U.S. Department of Justice
Law Enforcement Assistance Administration

Criminal Justice Planning and Management Series

Volume 2

Criminal Justice Analysis Course:

Text

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ACKNOWLEDGEMENTS

Good analysis is indispensable to the development and implementation of effective programs for improving criminal justice and reducing crime. Practitioners know that they must rely on analysis of crime and the criminal justice system problems they face to design programs and policies and that the chances for a rational allocation of the system's scarce resources are enhanced when the relevance of the data to the problem at hand is clearly apparent. A powerful tool at the practitioner's disposal is the data collected, analyzed and utilized throughout the decision-making process.

The expertise of analysts, planners, evaluators, statisticians, and of greatest importance, people who have had direct personal experience with state and local criminal justice analysis and planning processes have been tapped by the Law Enforcement Assistance Administration (LEAA) to develop and deliver a Criminal Justice Analysis Training Course.

LEAA has developed other training courses in Planning, Program Development, Evaluation and Management. The design of these programs of instruction is intended to form a comprehensive and complementary package for the assistance of state and local criminal justice agencies.

The purpose of this Text is to provide materials that complement and support the Analysis Course and that can be used as a reference by criminal justice students and professionals. The material presented is organized to parallel the sequence of the course modules.

The Criminal Justice Analysis curriculum is the product of over a four-year effort on the part of numerous practitioners, academicians, and professional organizations. This development process was divided into four phases. During the initial phase, the curriculum development effort was coordinated by Abt Associates. Five pilot offerings of the course were delivered by the State University of New York at Albany and were evaluated by the American Institutes of Research. Considerable assistance in the early planning stages of this project was provided by the National Conference of State Criminal Justice Planning Administrators, National Association of Criminal Justice Planning Directors, Criminal Justice Statistics Association, the National League of Cities/U.S. Conference of Mayors, and the National Association of Counties.

During this initial phase of course development, overall direction of the curriculum and delivery of the pilot offerings was a cooperative endeavor within LEAA. Primarily involved were the Office of Planning and Management, the National Criminal Justice Information and Statistics Service, and the Training Division of the Office of Operations Support. Leonard Oberlander of the Office of Planning and Management and Marianne Zawitz of the Statistics Division monitored the first phase of the project.

The second phase involved the course's revision and was directed by LEAA's Training Division, Office of Operations Support. Richard Ulrich, Director of the Training Division was project monitor during this revision phase with the support of John Moxley. The revision of the material was also assisted by the formation of an Advisory Group. This group of practitioners provided critical judgement in further developing and improving the curriculum. During this stage the revision was undertaken by Abt Associates with the assistance of the University of Southern California Criminal Justice Training Center under the supervision of Robert Carter who piloted the revised curriculum. Rebecca Wurzberger of the Criminal Justice Training Center at University of Southern California, coordinated its delivery. The preparation of the revised material was significantly aided by support and contributions made by the LEAA-sponsored Training Center system: in particular, Robert Stonek - University of Wisconsin at Milwaukee; H.G. Weisman, and Craig Fraser - Florida State University; Robert Galatti - Northeastern University; Robert Carter, Rebecca Wurzberger, and Tom Esensten - University of Southern California; and Theodore Heim, Lyle Newton, and Allen Beck of Washburn University.

The third phase of the project involved the assimilation and delivery of these materials by the five Criminal Justice Training Centers. The treatment of this material by additional faculties and repeated deliveries contributed significantly to the understanding of the course materials and the needs of the criminal justice community. This formed the basis for phase four of the project in which the final set of course revisions were made.

Phase four of the project proved to be a two and one half year effort under the leadership of the Washburn University Criminal Justice Training Center. The Project Director was Lyle Newton and the management and technical direction was provided by Allen Beck.

During this fourth phase, the "finalization" of what had then evolved into a major Criminal Justice research project, all five of the Criminal Justice Training Centers, their staffs, course participants, faculties, and a broad cross section of the nation's criminal justice analysts provided major contributions to the study. During this last phase LEAA monitorship was provided by Richard Waters at the Training Division, and major contributions to content and coordination were provided by Richard Ulrich.

From the beginning the person who conceived, labored and created the Criminal Justice Analysis Course was it's author, Seth Hirshorn.

INTRODUCTION

I. Purpose and Approach

The purpose of this text is to set forth the basic elements of criminal justice analysis in a manner useful to those who have direct responsibility for getting information to decision makers in a timely, accurate, and useful way. This text is an introduction to analysis. It presents, in a systematic framework, a set of skills, tools, and knowledge which has demonstrated application in criminal justice analysis.

The text does not focus on abstract statistical techniques or on theoretical nuances in the meaning and use of the concepts of criminal justice. It does focus on the use of anaylsis in criminal justice decision-making and covers the important technical and methodological problems which analysts face in practice. This text is designed so that the reader must consider, for each technique or method, how and at what point it fits into the larger analytic structure and process. Examples and graphics have been included to facilitate the reader in this task.

In this text the requirements of abstract analysis and those of real-world decision-making coalesce. "Doing" analysis that is useful to decision-makers involves decisions and compromise. One aim of this text is to clarify these decisions and issues that frequently arise in performing an analysis. Another aim is to promote an attitude of openness and candor about the strengths and weaknesses of the information products that result from analysis.

II. Audience

The text has been developed for staff of criminal justice agencies and students of criminal justice who are interested in or who are required to provide information in support of criminal justice decision-making. These are people at the state and local levels, in legislatures, executive agencies and courts who are responsible for developing and presenting data and information, reports and plans to criminal justice officials. Typical of this intended audience are:

- staff of criminal justice planning agencies preparing state and local plans and performing evaluations,
- police agency staff responsible for developing crime analyses,
- court planners who must analyze case flows and the costs of court operations, and
- research staff of correctional agencies who provide statistical studies of inmates, costs and facilities.

Such staff are clearly disparate in terms of their prior analytic education and criminal justice experience, and yet all share a need for a strong analytic foundation. This text has been designed to provide a reference to the basic analytic skills frequently used in criminal justice analysis for staff who do not have a strong methodological background. It also was designed to provide to experienced analysts, who are new to the field of criminal justice, an orientation and overview to some of the concepts and topics in criminal justice analysis.

III. Themes

The three themes which integrate the materials presented in this text are analysis as a process, analysis as a set of tools, and analysis as a set of skills. Theme one, analysis as process, involves four steps: 1) problem identification and specification; 2) data selection and collection; 3) extraction of information from data; and 4) persuasive presentation of information. This text emphasizes the generation of problem statements which are useful in the larger decision-making process. In this sense the process of analysis is neither abstract nor an academic exercise, but a significant influence on decision-making. The first step in the process of analysis, problem identification and specification, is critical to the achievement of this influence. Following are definitions of concepts which are central to this first step:

> Problem: Any present or future condition or situation which is unacceptable or which offers an opportunity for new achievement and is theoretically susceptible to planned intervention.
>
> Problem Specification: The identification of concerns; elaboration of concepts, variables, and measures; and postulation of hypotheses.
>
> Problem Statement: A written document or oral presentation which comprehensively describes the nature, magnitude, seriousness, rate of change, persons affected, and spatial and temporal aspects of a problem using qualitative and quantitative information. It identifies the nature, extent, and effect of system response; makes projections based on historical inferences; and rigorously attempts to establish the causes of the problem.

The process of moving from the identification of a problem to a well-reasoned and clearly presented problem statement is a major theme of this text and of importance to the criminal justice decision-maker. The quality, cost and timeliness of an analysis are among the factors that contribute to problem statements being perceived as valuable aids in decision-making. The process outlined in this text will, hopefully, be useful in their preparation.

The second theme of this text views analysis as a set of tools that a practitioner can use to collect and organize data and to interpret and present information. The text emphasizes the proper application and use of basic research and statistical tools.

The third theme focuses attention on analysis as a set of skills that are used by the practitioner to assist in meeting agency objectives within an organization's social, political and economic environment. These skills involve managing analyses in an efficient and effective manner. They include the ability to develop analysis plans and implement analyses that are timely, within resource constraints, and responsive to the needs of the decision-makers.

IV. Value of Analysis

Why do analysis? The ideal of an informed decision-making process is, in part, the rationale for the systematic application of analysis to criminal justice problems. Yet, decision-making involves more than the products of analysis--also involved are the subjective feelings of the decision-maker(s) and the political and ideological factors that weigh heavily in criminal justice decision-making. A premise of this text is that reducing the decision-maker's uncertainty and providing a strong, competing, alternative perspective to the subjective and political factors will improve the performance of the criminal justice system and contribute to the reduction of crime.

There are three components to the argument supporting the conduct of analysis:

- the unique tasks and procedures in criminal justice planning require analysis;
- analysis, and the role of the analyst, is a generic part of decision-making;
- federal and state statutes and guidelines require that analysis be performed.

A. Analysis and Planning

One definition of a "plan" is a detailed formulation of a program of action. As practiced across the U.S., criminal justice planning appears to have at least four major additional defining characteristics in that it is: 1) future oriented; 2) change oriented; 3) goal oriented; and 4) can be characterized as a process. Planning may be defined as the orderly, systematic, and continuing process of bringing anticipations of the future to bear on current decision-making.

Many times criminal justice planners receive a call or get a request for an immediate response to a question or problem. Such "crisis" planning often implies responding in an ad hoc manner to a natural or man-made disaster and, in criminal justice administration, usually involves dealing with the operational problems of line agencies.

More typically, however, planning is performed in a one-year time frame corresponding to the agency's or jurisdiction's budget cycle. One-year planning is usually closely tied to the on-going problems and projects of the jurisdiction and results in an Annual Report. Over time the process becomes increasingly repetitive and highly structured. In contrast, middle-range planning may involve a five to ten-year planning horizon while long-range planning may extend the planner's horizon beyond ten years and as far out in time as a specific problem, issue, or need may require.

A second characteristic of planning is that it is change oriented. There are two important dimensions of change appropriate to criminal justice: the size or magnitude of the planned change and the rate of change. Incremental changes, such as a shift in labor resource allocations, require a different type of planning effort than do more massive and fundamental changes, such as the decriminalization of certain statutes. Nonetheless, given an existing situation and a proposed change, large or small, a planner's responsibilities include:

- formulating an accurate statement of the problem(s) facing a community;
- identifying preferred alternative remedies; and
- considering what specific impacts such alternatives might have on these problem(s) and the community's environment.

The rate of proposed changes is an equally important consideration. For example, crime reduction objectives are usually qualified by the rate considerations of "by when" or "how soon."

A third major characteristic of planning is that it is goal-oriented. The development and prioritizing of goals and objectives are important planning activities. For example, the Urban High Crime Reduction Program funded by the Illinois Law Enforcement Commission established three major goals for local projects:

1) To reduce burglary and stranger-to-stranger crime through rational analysis and systematic goal-oriented planning, development and implementation;

2) To evaluate the various approaches undertaken by the program and the possible replications elsewhere in the state; and

3) To increase coordination between police, courts, and corrections officials in policy development and decision-making at the local level.

A review of local, regional, or state criminal justice planning documents would reveal similar sets of goals. Making such objectives operationally meaningful and establishing priorities among these goals, however, are equally important activities.

Finally, as illustrated in Exhibit i-1, planning may be conceptualized as a process consisting of a sequence of more or less discrete activities and tasks. At the center of this process is a rationalistic view of criminal justice decision-making which involves a planning-action-evaluation sequence. The initial seven steps of the general planning process model--from preparing for planning through identifying alternative courses of action--comprise the "planning" steps of this process. Selecting the preferred alternatives, planning for implementation, and actually implementing the plans comprise the "action" component. Finally, monitoring and evaluating progress is the "evaluation" step in the process.

The relationship between planning and analysis is revealed in the following ways: 1) in the types of decisions to be made and 2) in the completion of specific steps of the process model. The decisions which an agency has to make are decisions about which criminal justice problems merit attention, what the best approaches to treating these problems are, and who the appropriate agents are to carry out selected approaches. One contribution to structuring decisions which comes from analysis is the identification and statement of problems. Another contribution is the development of strategies for dealing with those problems. Indeed, analysis may play a role in virtually every step of the planning process because implicit in the formulation of strategies is some consideration of why--based on analysis of data--a strategy can reasonably be expected to work and what resources are needed to make it work.

B. Analysis and Decision-Making

Above all, analysis should be decision-oriented.[1] This link to criminal justice decision-making makes knowledge of analysis a basic job-related skill. Many students of government and public decision-making have commented on this fundamental relationship. John Dewey, for instance, perceived between "problem identification" and "solution," four successive steps decision-makers go through: 1) specification of difficulties and immediate pressures; 2) analysis of the problems and their basic dimensions; 3) a search for alternative solutions; and 4) consideration of the consequences of each alternative.[2] More recently, models of public decisions, while becoming more elaborate, have nevertheless continued to emphasize the central place of analysis in the decision-making process. Kepner and Tregoe defined the rational manager at least, in part, as a person who constantly screens his/her environment and assesses problems in terms of their perceived causes. Analysis is, again, central to the role of the rational manager.[3] Allan Easton has written that the first steps in decision-making are recognizing a need for change and diagnosing the problem. Diagnosis, according to Easton, is a ten step process requiring the analyst to:

1) Identify desired state and compare with actual,

2) Identify and enumerate symptoms and clues,

3) Diagram system - times and places of symptoms,

4) Review any recent changes in the system structure, process or environment,

5) Prepare state-of-affairs tables

   - What is happening?
   - Where?
   - When?
   - How much?
   - Are the symptoms stable or varying?

6) Prepare a list of tentative hypotheses,

7) Arrange hypotheses by simplicity and test them, simplest first,

8) Eliminate hypotheses, modify them with new evidence,

9) Continue until hypotheses fit all facts,

10) Test hypotheses for validity.[4]

Many other authors have similiarly placed analysis at the center of decision-making and considered scientific method the foundation of analysis.

Such an applied methodology requires:

1) Reliance upon "an open, explicit, verifiable, self-correcting system." It is important that analysis be replicable by other analysts.

2) Objectivity, personality and other irrationalities have no room in analysis. "The truth of a scientific proposition is established by logical and empirical methods common to the profession as a whole."

3) Proper testing of hypotheses. There is no one method applicable to problems of both the physical and social sciences.

4) Appropriate use of quantification.[5]

Over the past fifteen years the use of analysis in decision-making-management science, operations research, systems analysis, policy analysis and program evaluation--has drawn considerable attention and criticism. Churchman has identified the critics as the "humanists" and the "anti-planners." Analysts, according to the humanist's view, are too narrow in their definition of problems, rarely capturing humanistic values in their search through the data. If the humanists do not believe the procedures of analysis can capture the human dimension, they at least place some value in the concept of analysis.

> "Not so the anti-planners.... The most common variety is 'Mr. Experience." He/she believes that experience in the organization, combined with natural ability, native intelligence and personal leadership beats (analysis) everytime. This may be true occasionally but, it would be a difficult contention to "prove" either way.
>
> A somewhat more serious version of anti-planning is held by the "Skeptic." The Skeptic is a relativist who asks if anything is really 'true.' While skepticism suggests good questions, it does not provide good answers.
>
> Still another proponent of anti-planning is the "Determinist." The Determinist argues that any system is the result of various, often unidentifiable, social forces. (Determinists) basically argue that systematic decision-making is not a reality in public bureaucracies and attempt to describe the policy-making process as it really is: incremental, fragmented, unanalytic, limited and disjointed. From this viewpoint, however, determinism is a statement of fact, not an argument against (analysis).[6]

Analysis, it seems, is one of many factors than inform and influence criminal justice decision-making. These factors effect specific decisions in various ways and with varying impacts. Because most decision-making is inherently uncertain and public decisions require a careful balancing of technical, political, and other factors, the responsibility of the bureaucrat, and specifically, of the analyst, is to see that timely, relevant, and understandable information is available to the decision-maker. This is the place of analysis in decision-making: a salient and competing influence. The role of the analyst in this context is to maximize the impact information has on decisions.

C. Analysis and Federal/State Funding Requirements

The Justice Improvement Act of 1979 eliminated the comprehensive planning requirement for funding and replaced it with a significantly different "application." As part of an "application" for federal funds, each applicant is now required, among other things, to prepare a "crime analysis." This latter term is not explicitly defined in the 1979 Act; however, section 402(b) states that an analysis of the criminal justice problems within the State, to be based on input and data, is required; and, further, that a total and integrated analysis of the criminal justice problems is to be prepared. A review of the crime analysis provisions of the 1979 Act concluded that the preparation of a "crime analysis" is a central feature of state and local applications.[7]

The content of formula grant applications under the 1979 Act, and specifically, the meaning of "crime analysis" is partially addressed in the published (draft) rules of the Formula Grant Program which appeared in the Federal Register, January 14, 1980 (pp. 2808-2827). Following is the relevant excerpt from these rules appropriate to the new state council activities:

> "(b) Identification of priority problems, (1) Analysis. (i) State Councils shall conduct an analysis of crime and delinquency problems and criminal and juvenile justice needs within the State. The State's analysis must be based upon input and data from all eligible jurisdictions, State agencies, the judicial coordinating committee, and citizen and neighborhood and community groups. It must address the problems and needs of all components of the criminal and juvenile justice system, and provide a clear and logical basis for the priority problems and programs set forth in the comprehensive State application.
>
> (ii) Entitlement localities also shall conduct an analysis of the crime and delinquency problems and criminal and juvenile justice needs within their jurisdictions. This analysis must be based upon input from all participating local governments and citizen and neighborhood and community groups. The entitlement analysis must address, at a minimum, the problems and needs of those aspects of the criminal justice system for which it has responsibility, and provide a clear and logical basis for the priority

problems and programs set forth in the entitlement application.

(iii) The product of the analysis is a series of brief written problem statements set forth in the application for those problems that are priorities and for which programs are proposed.

(2) Priorities. Priorities are problems that have been identified by analysis and ranked in terms of their importance or emphasis. As part of the application process, they are used to indicate those problem areas of greatest concern and to provide guidance for the submission of applications from State agencies, local governments, and non-profit organizations.

A similar process is to be performed by each entitlement jurisdiction:

(ii) Entitlement area priorities. (A) Priorities established by entitlement jurisdictions are to be consistent with State priorities unless good cause for inconsistency can be shown by analysis of local needs (see § 31.401).

(B) Inconsistency is defined here as the inclusion of a priority not established and published by the State Council or the inclusion of a priority substantively in conflict with a priority established by the Council.

(3) Product. (i) The product of the analysis is a series of brief written statements set forth in the application that define and describe the priority problems. These statements are to be organized by the 23 eligible Section 401 purposes or by any other scheme and cross-referenced to these purposes.

(ii) A problem statement, as used herein, is defined as a written presentation which comprehensively describes the magnitude, seriousness, rate of change, persons affected, and spatial and temporal aspects of a problem using qualitative and quantitative information. It identifies the nature, extent, and effect of system response, makes projections based on historical inferences and rigorously attempts to establish the origins of the problem.

Finally, the proposed format of the state application is as follows:

<u>Standard format for Comprehensive State Application</u>

Area: Key to purposes set forth in Section 401(a)
Problem statement: Statement of problem, including an indication of its priority
Program: Description of program developed to deal with the problem stated above
1. Title
2. Description

a. Objectives
b. Activities Planned
c. Budget
d. Relationship to Similar Programs

3. Explanation of Adherence with Effectiveness Criteria
4. Performance Indicators

Note--there may be more than one problem statement for each area. Similarly, there may be more than one program for each priority problem.

In many respects the process and products just identified are derived from and/or are consistent with the materials contained in this text. The reader will find in the text a comprehensive reference on what a problem statement is, how it should be prepared, and most importantly, how data analysis may effectively be used in preparing such statements. The skills, tools and information presented will, hoepfully, be used by state and local practitioners in the development of federal, state, and local funding applications, thereby helping to assure the identification of significant problems and relating policies and program designs to these problem statements.

V. Roadmap

The definition of analysis as a process to inform criminal justice decision-making is used to organize the text. Exhibit i-2 is a display of this process emphasizing: 1) a focus on the problem formulation applications of analysis as distinct from strategy development or evaluation applications; 2) movement from ambigious concerns to well-documented problem statements which are a product of the process; 3) the focus of the process on informing and influencing decision-makers.

Exhibit i-3 outlines the text relating each of seven chapters to different components of the analysis process. There is an eighth chapter, which concludes the text, covering the management skills required in planning and conducting analyses. The exhibit is constructed in the form of a flowchart, and such flowcharts are used at the conclusion of each chapter to summarize and review material. A flowchart is a graphic representation in which symbols are used to represent operations, decision points, direction of movement, etc. In Exhibit i-3 rectangles are used to present an instruction or information; diamond-shaped figures indicate decision points--places where the user must make choices; and arrows are used to indicate the direction of the flow.

EXHIBIT i-2

PROBLEM ANALYSIS

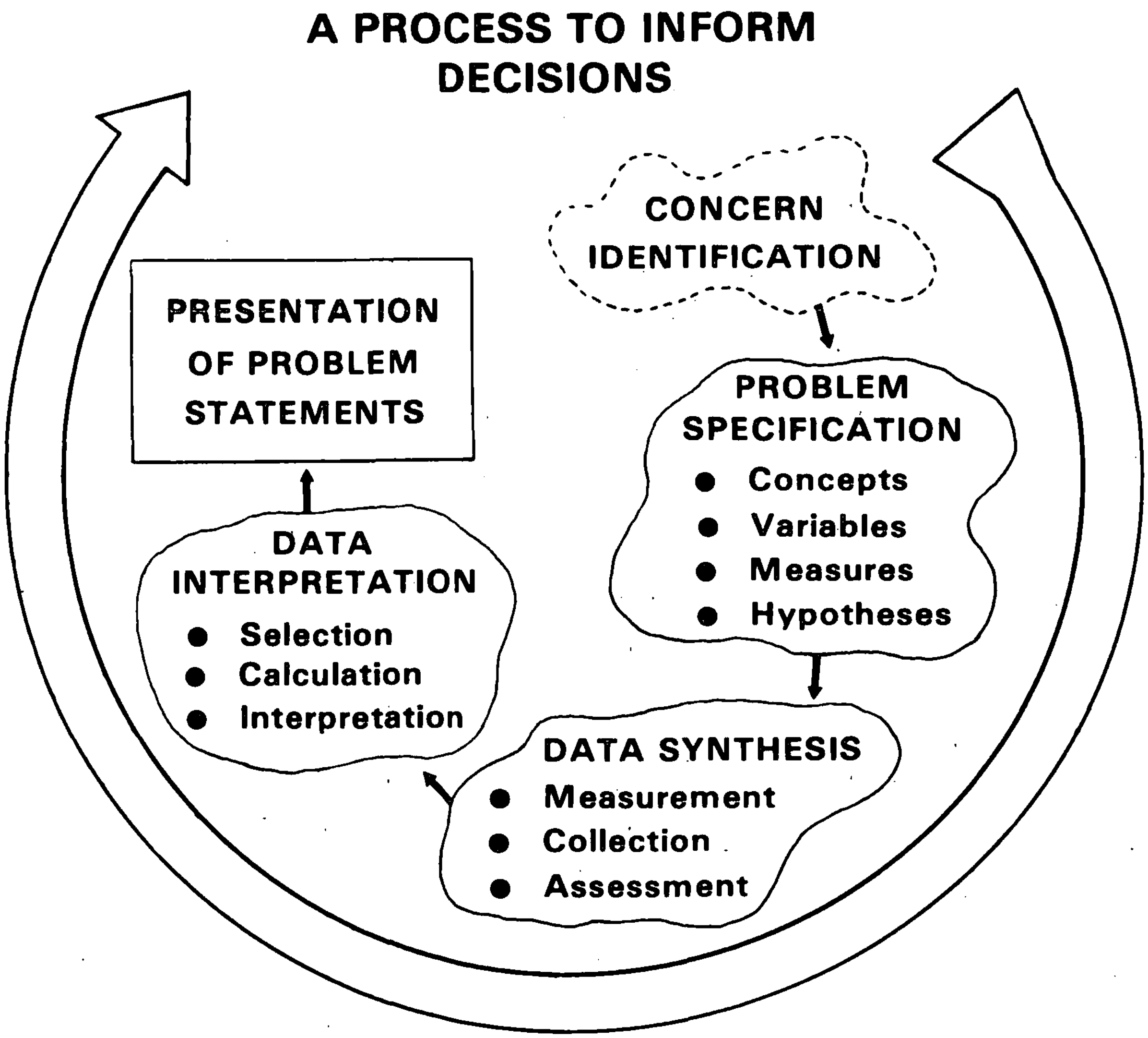
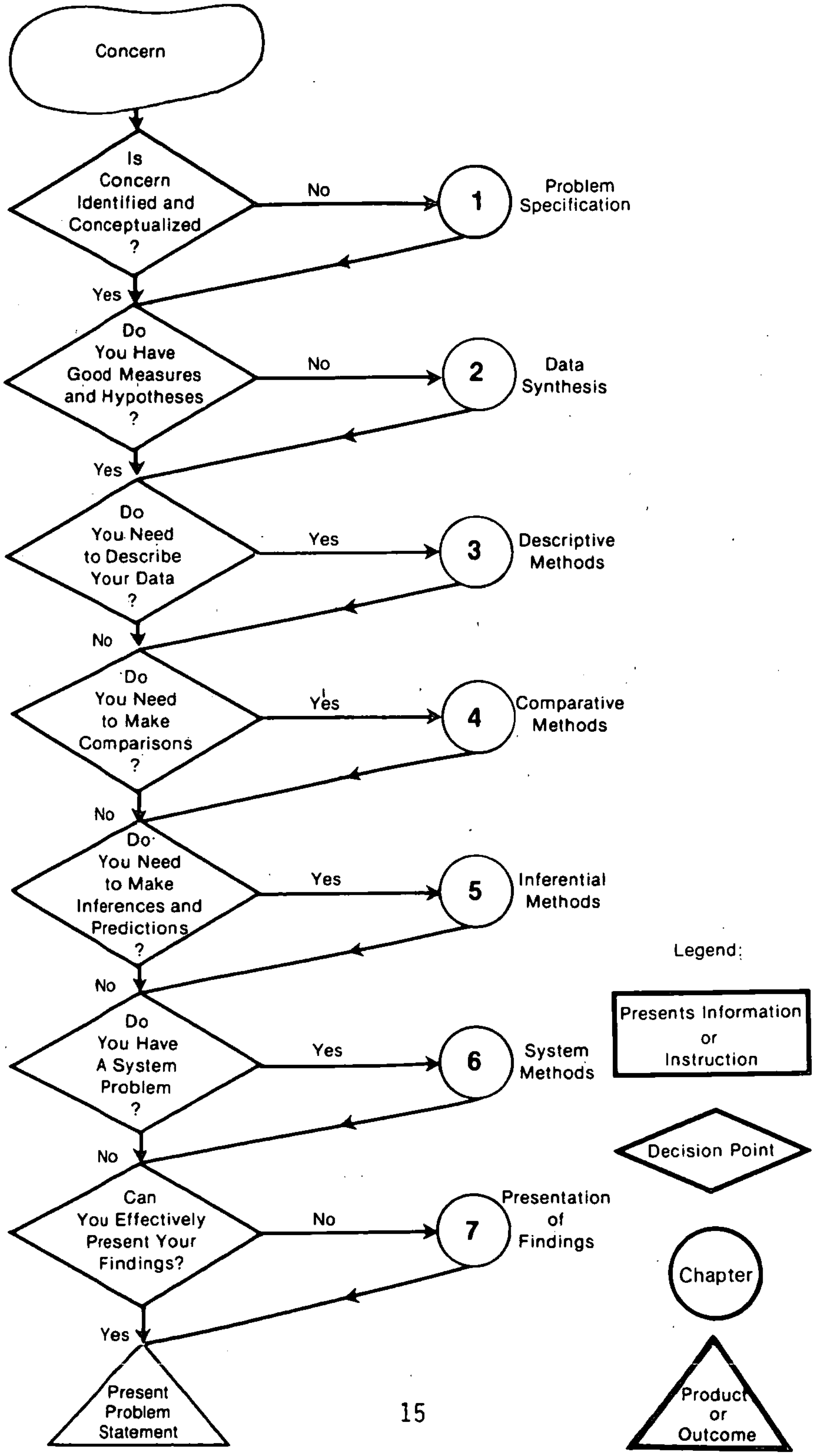


EXHIBIT i-3

ORGANIZATIONAL CHART: AN INDEXING OF CHAPTER CONTENT TO THE COMPONENT OF THE ANALYTIC PROCESS DISCUSSED



The Criminal Justice Analysis Text is divided into three parts. Throughout the text, the hypothetical community of Chaos City is used to provide examples of problems and to illustrate steps in the analysis process. Chaos City has a population of about 250,000 and though it is represented as a city which is typical of other cities of its size, there was no intention to depict precisely the conditions of any actual city.

Part One examines some of the basic considerations that are central to the conduct of analysis. Chapters 1 and 2 present an approach to analysis that has been developed out of the mainstream of our scientific traditions and the comparatively new field of study--the policy sciences. The reader will find in this material an organization, structure, and procedure for undertaking analyses and the systematic development of data sources in the criminal justice field.

Part Two presents, by example, descriptive, comparative, and inferential methods that have demonstrated wide applicability to criminal justice problems. Throughout this portion of the text the emphasis is on the selection of appropriate method(s) for a specified problem, the mathematics of the method(s), and the correct interpretation of results. In Chapter 3 a problem involving the analysis of robberies in the hypothetical community of Chaos City is introduced and used to illustrate the descriptive methods discussed in the chapter. Chapter 4 covers methods that are frequently used to compare two variables. These methods range from the construction of rates, indices and seriousness scales, to the development and interpretation of cross classification tables and scatter diagrams. Chapter 5 presents selected inferential statistics used to indicate association and relationship between variables. Also treated is the topic of least squares regression, a method frequently used for making point estimate predictions. Chapter 6 extends the discussion of methods to their application to system problems and system data: A number of techniques are examined for describing and comparing system data. A study of a hypothetical court backlog problem is used to focus the presentation.

Part Three of the Text treats the management and presentation skills that are essential if analyses are to make a difference. Chapter 7 explores the procedures and issues surrounding effective oral and written presentations. In the final chapter a management approach to planning and conducting analyses is discussed. This approach summarizes and draws upon the foundation provided in the preceeding chapters.

[1]Norman Beckman, "Policy Analysis in Government: "Alternatives to Muddling Through," Public Administration Review, (Vol. 37, No. 3) May-June, 1977 , pp. 221-22.

[2]Daniel Katz and Robert L. Kahn, The Social Psychology of Organizations 2nd Edition (New York: John Wiley and Sons, Inc., 1978), p.79.

[3]Charles H. Kepner and Benjamin B. Tregoe, The Rational Manager: A Systematic Approach to Problem Solving and Decision-Making, ed. Perrin Stayler (Princeton, New Jersey: Kepner-Tregoe, Inc., 1965).

[4]Allan Easton, Decision-Making: A Short Course for Professionals (New York: John Wiley and Sons, Inc., 1976).

[5]Alain Enthoven, U.S. Senate Subcommittee on National Security and International Operations, Planning Programming-Budgeting: Hearings, Washington GPO, 1967, in Robert D. Miewald, Public Administration: A Critical Perspective, (New York: McGraw-Hill, 1978) p. 172.

[6]Nicholas Henry, Public Administration and Public Affairs (Englewood Cliffs: Prentice Hall, 1975) pp. 132-133.

[7]Office of the General Counsel, LEAA, Reauthorization Meeting Issue Paper - Justice Improvement Act of 1979 (Louisville, Kentucky, Dec. 6-7, 1977), pp 12-13.

[8]Federal Register (Vol. 45, No. 9: Jan. 14, 1980), p. 2815.

[9]Ibid, p. 2816.

[10]Ibid, p. 2817.

[11]There are many useful references on flowcharting techniques mainly oriented to computer programming applications including: Thomas J. Schriber, Fundamentals of Flowcharting (New York: John Wiley and Sons, Inc., 1969) and Mario V. Farina, Flowcharting (Englewood Cliffs: Prentice-Hall, 1970). The development of flowcharts for this text was suggested by the application of flow charts developed by Thad R. Harshbarger in his book, Introductory Statistics: A Decision Map Approach, 2nd ed. (New York: Macmillan Publishing Co., 1977) and an excellent quick reference monograph developed at the Institute for Social Research, University of Michigan entitled A Guide for Selecting Statistical Techniques for Analyzing Social Science Data (Ann Arbor: ISR, 1975).

CHAPTER 1

PROBLEM SPECIFICATION

I. How Problems are Specified

A. Problem Specification Process

Analysis usually begins with a question or observation--yours or one that is given to you. These need to be challenged, explored and understood in terms of related issues and their probable consequences. While these may be raised by an inductive process, e.g., the observation of a dramatic change in the present situation or a significant shift in public opinion, the analyst uses deductive reasoning to develop an accurate and comprehensive explanation of the situation. The opening chapter presents a deductive approach to elaborating and refining such questions and observations into well specified problems.

Problem specification is the identification of related concerns; elaboration of relevant concepts, variables, and measures; and construction of hypotheses to help organize the analysis. In many respects these initial steps of analysis are the most confusing, time consuming, and important. They help to establish an understandable structure, to provide direction and to give meaning to subsequent analytic tasks. However, there is much wheel-spinning and many false starts during problem specification. After a great deal of consultation and deliberation, what initially appeared to be a critical problem may take on less importance and be replaced by a new set of issues. The problem specification approach described in the following pages is designed to make the analyst's initial encounter with a criminal justice problem as productive as possible, helping to reduce the inevitable frustrations of doing analysis, and hopefully resulting in products that get serious consideration in the decision-making process.

B. Identification of Concerns

How are decisions made about which issues are to be studied? What is an analyst's role in developing such an agenda for his/her agency? And why are some criminal justice problems not analyzed at all? Intuitive answers to such questions are usually of two types--the obvious and the complex. On the one hand, it seems obvious that most analysis agendas are established by the directives of an agency administrator or a political leader(s). On the other hand, decision-making processes in most criminal justice agencies are complex involving a variety of individual, organizational, and political influences. Consequently most criminal justice analysts tend to take a problem as given and are rarely involved in participating in setting their own agenda. In this section the process by which concerns are identified and the role of an analyst in developing his/her agency's analysis agenda are considered.

Statements of concern are the starting point in problem specification. A concern is the set of vague and frequently ambigious hunches and/or attitudes about aspects of crime and the criminal justice system. Typical of such hunches are statements such as:

- "It seems to me that there has been a substantial increase in crime in our city."
- "According to the newspaper, our senior citizens and handicapped residents are the most frequent victims of crime."
- "In my neighborhood people are scared to leave their homes at night."
- "The police in our city have done very little to combat the recent crime wave."

Such statements are usually undocumented, may be the result of a single incident or experience, and involve beliefs and intuition as much if not more than facts. These expressed concerns need to be elaborated by the analyst into a series of related questions. For example, the first statement about a rise in crime could be elaborated into the following questions:

- What are the trends in crimes in the city and in each neighborhood?
- How do these crime trends compare to other cities in the state and nationwide among comparable size cities?

The second statement concerning the victims of crime might be addressed by asking the following questions:

- Which groups in the population are most likely to be victimized?
- What is the relation between victimization and education, age, marital status, home ownership, and residential stability of the victims? Do these relationships vary by type of crime?
- Are people who are victimized by one type of crime more likely to be victimized by another type of crime?

The fear of crime hunch might be developed into these questions:

- How safe do residents believe their neighborhood and city are during the day and at night?
- Do residents believe their neighborhood and city are safer or more dangerous than other places?
- Have residents limited or changed their activities because they are afraid of crime?

- What types of individuals or groups are more likely to express fear of crime? Are the differences in fear large or small?

- Is fear of crime higher or lower among persons who own their homes rather than rent, or who have more or less education? Are these differences, if any, due to income differences?

The final statement concerning police performance could be elaborated into the following questions:

- How do residents of the city rate the performance of the local police?

- Do people who think that crime is getting worse seem to blame the police?

- Are victims more likely than non-victims to dislike the police? Does this vary by race and income?[1]

As a second example consider the following concerns identified during the Kansas City Preventive Patrol Experiment which "was designed to measure the impact routine patrol had on the incidence of crime and the public's fear of crime:"[2]

- The ability of police departments to conduct social experiments which address current and projected issues of concern.

- The ways in which existing resources (time, manpower, finances, etc.) can be identified and used in developing new police strategies and, specifically, ways in which manpower can be developed and employed to the best advantage.

- The ways of accurately assessing what police officers do in the field and of measuring the impact of their activities upon the community.

- The development, at the line level, of criteria by which police officers can measure work performance.

- The ability of police departments to define their roles in both the criminal justice system and the communities of which they are a part, and to communicate these roles accurately to the various publics the department serve.

- The relationship of police effectiveness to these issues.

In contrast to the previous set of concerns, these are expressed in a more objectified manner--as statements of need. In this case, needs for various types of information. Still these concerns lack specificity and are implicitly based on attitudes or hunches about police work.

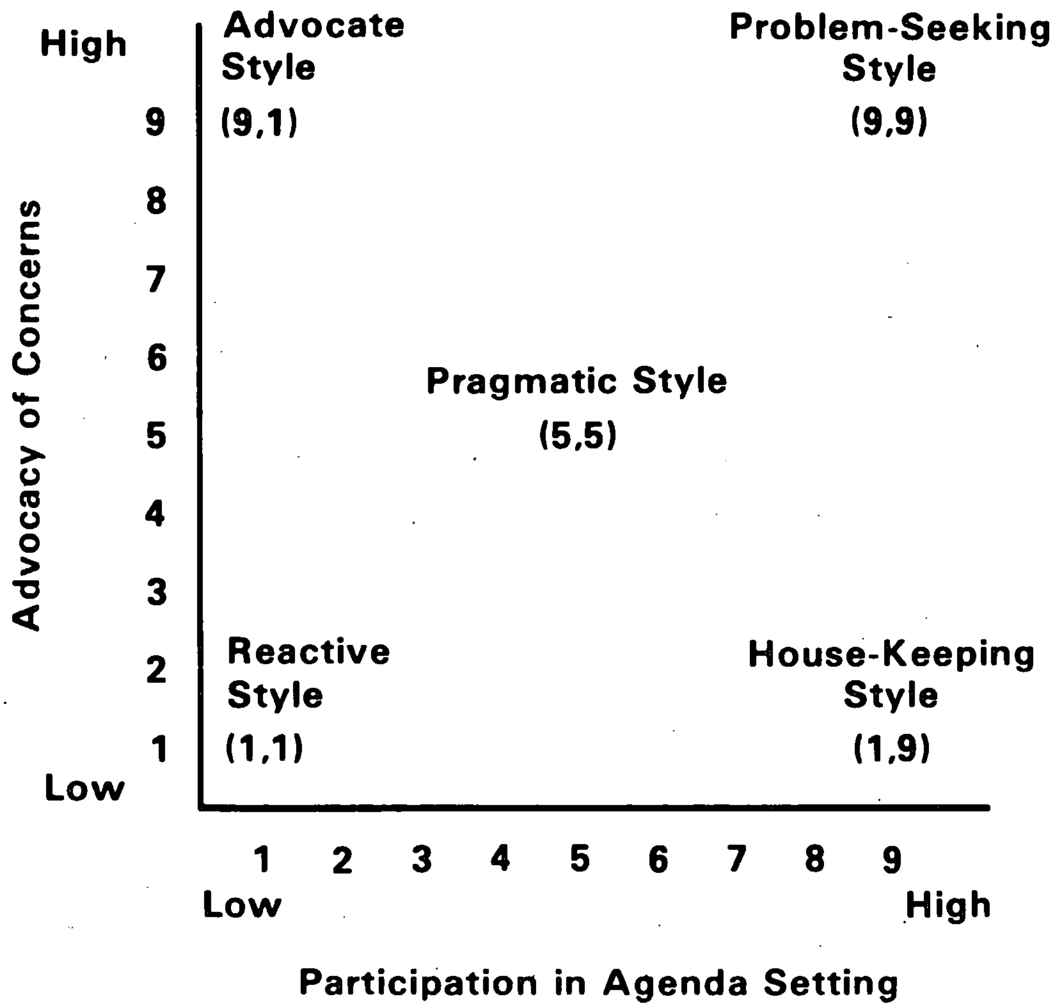
There is a second important characteristic of most concerns in criminal justice. The process of generating such concerns usually results in differing conclusions, points of view and even political conflict. Such conflict means that if analysis of concerns is to occur, they must be placed on an "analysis agenda." This agenda consists of "the (concerns) receiving active and serious consideration by (the analyst)."[3] The source of new concerns and the process by which the analysis agenda is developed are major issues, since all concerns cannot be analyzed and prioritizing of concerns must occur.

At any particular point in time the analysis agenda will consist of mostly "old" concerns, perhaps one or two new issues, and is usually more in the minds of the analyst and agency administrator than in a formal document. The "old" concerns are those topics which, because of some process such as budgeting or planning, routinely become the focus of attention. Old concerns may arise also from the periodic swing of the crime statistics or of the criminal justice pendulum. New concerns must fight for a place on the agenda and consequently are more often the result of unanticipated events which have the appearance of requiring immediate attention.

Within the context of new and old concerns and the setting of the analyst's agenda, style takes on importance. Analytic styles may be identified by behavior of the analyst in regard to (1) advocacy of concerns and (2) participation in agenda setting.[4] A variety of styles may be described by the interaction of these two factors. (See Exhibit 1-1). One type of analyst avoids controversy and the advocacy of issues. Reactors (1,1 style), when confronted with a high risk issue expressed by a superior in the organization, generally indicate the problematic aspects of doing an analysis, preferring to focus on the softer issues. They are consequently inoffensively unresponsive. A Reactor would prefer to have no analysis agenda at all. Problem-seeking (9,9 style) analysts assume that because of their specialized and technical skills they are more knowledgable about the criminal justice concerns facing the community. They also have a great deal of autonomy in their work. Consequently Problem Seekers are heavily involved in setting their own agendas and in advocacy of concerns. Advocates (9,1 style), in contrast, may be avoided or blocked from participation in agenda setting either informally due to personal conflicts or formally by the rules and regulations of the organization. Advocates emphasize the elaboration and expansion of the administration's statements of concern. They tend to view themselves as agents of these decision-makers and their primary responsibility as implementation and not the development of new analytic topics. Housekeeping Analysts (1,9 style) are setters of their own agendas; however they avoid controversial issues and advocacy. Housekeepers tend to be removed from the major decision-making process and organizationally isolated from the leadership of an agency, focusing on the routine and required "housekeeping" tasks, such as preparing the <u>Annual Report</u>.

EXHIBIT 1-1

A SUMMARY OF ANALYTIC STYLES



Source: Adapted from Robert R. Blake and Jane S. Mouton, The Managerial Grid (Houston: Gulf Publishing Company, 1964) p. 10.

In the middle is a pragmatic style (5,5 style) in which the analyst has a major part in setting the agenda and does not avoid advocating new concerns. However, the extent and type of participation and advocacy is heavily influenced by other participants and by the pragmatist's assessment of each situation.

These styles are not suggested in a prescriptive manner. Most analysts exhibit characteristics of more than one type, but the analytic style may play a significant part in identifying concerns and establishing the agency's analytic agenda. Once such an agenda exits, the next step is to elaborate each statement of concern into its component concepts, variables, and measures.

C. Generation of Concepts

A concept is defined as a distinguishable component found or expressed within a statement of concern. Exhibit 1-2 is a statement about crime trends in Chaos City. The concern expressed in this statement is that violent crimes are increasing in the community at an alarming rate. Within this concern and expressed in the statement are several concepts, including (1) "incidence of violent crimes" and (2) "rate of change in the incidence of violent crimes." This statement also illustrates an alternative definition of the term concept, i.e. "a concept expresses an abstraction formed by generalizations from particulars."[5] The concept "incidence of violent crimes" is developed by generalizing from the specific homicide, assault, and robbery rates. (See Chart in Exhibit 1-2)

These two definitions are examples of the difference between an inductive and deductive approach to analysis. Inductive reasoning is initiated by examination of the data and the particulars and from these developing a sense of patterns, trends, and relationships. In contrast deductive reasoning begins with an understanding of a concern and involves examining presumed patterns, trends, and relationships against data.[6]

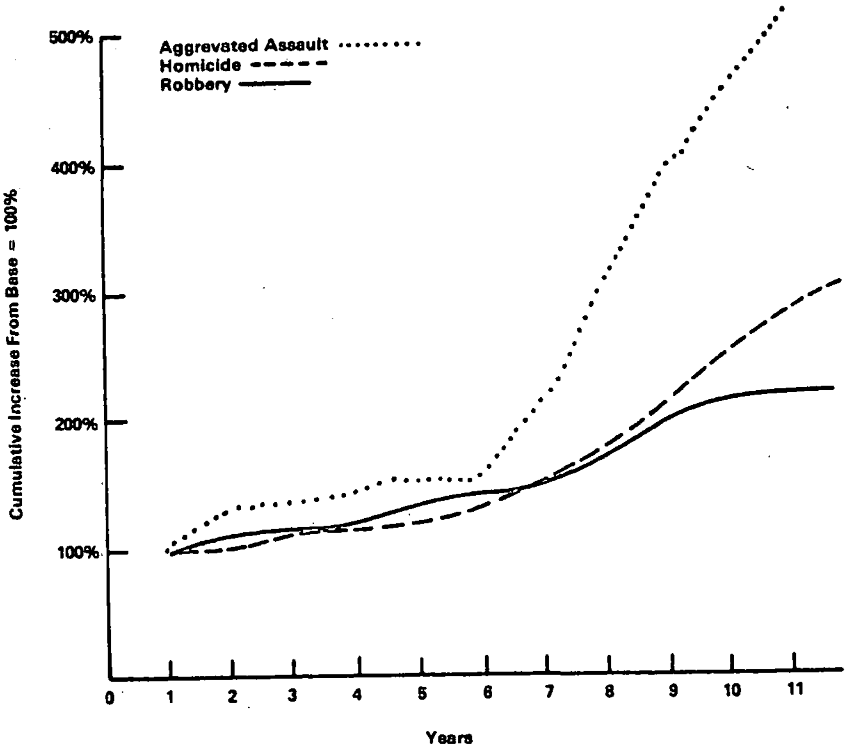
Additional examples of concepts are implied in the questions pertaining to the fear of crime presented in section B above. Specifically, the questions about the police involve the concept of police operations and perceptions of police operations. The questions about residents' fear of crime pertain to the concepts of (1) "perceptions of neighborhood safety," (2) "groups that are affected by fear of crime," and (3) "the consequences of fear of crime."

EXHIBIT 1-2.

CONCERNS AND CONCEPTS: STATEMENT OF CRIME TRENDS IN CHAOS CITY

Historically, aggravated assault and homicide rates in this area have been relatively low, and these crimes have not been considered serious problems. By contrast, the rate of robbery has always been quite high; more observers have consistently identified robbery as the jurisdiction's most serious crime problem. Analysis of recent trend data, however, indicates that the city's assault rate has shown dramatic increases over the last several years. The significance of this trend is exacerbated by recent signs that the homicide rate is now responding to the increase in assaults. Fortunately, the assault increase has, according to police statistics, come primarily in assaults which involve knives and blunt instruments. Since these are less often fatal than firearm assaults, the homicide rate has not yet risen as rapidly as the assault rate. Should firearm assaults resume their traditional proportional role, however, the city is likely to suffer a very substantial increase in homicides.

PROPORTIONAL INCREASES IN ASSAULT, HOMICIDE AND ROBBERY IN CHAOS CITY BY YEAR



Year One = 100%

The following list of concepts have broad applicability in development of many criminal justice concerns:

- Magnitude: Size, extent and/or importance of a problem.
- Rate of Change: Comparison of a problem in an earlier period of time to a later period.
- Temporal Aspects: Cyclical nature or seasonality of the problem.
- Seriousness: Amount of harm a problem inflicts on a community or person.
- Persons Affected: Considerations of the Victim, Offender and/or Public related to the problem.
- Spatial Aspects: The geography of the problem.
- Administration: The organization, policies, goals and standards of the relevant criminal justice agencies.
- System Operations: The inputs, performance and outputs of the relevant criminal justice agencies.

Consider the statement in Exhibit 1-3. Identified in the margins are some of the concepts from the above list. The concern expressed by the statement is that there is a need to address the rape problem in Chaos City.

EXHIBIT 1-3.

CONCERNS AND CONCEPTS: RAPE IN CHAOS CITY

Social agencies have always given too little attention -- and too little understanding -- to the victims of rape. The results have been both that many, perhaps most, rapes are never reported to law enforcement agencies and that victims, scared by the callousness of the system, are unwilling to testify in court, thereby minimizing the possibilities of convicting the offender. Chaos City recently witnessed a series of grotesque and highly publicized rapes. Although the overall rate of reported rapes does not seem high for the city, these specific incidents have galvanized citizen interest and have led to the formation of a citizen law enforcement task force; already this group has raised sufficient funds with the community to give it some stability and to allow it to formulate a series of pilot proposals. Thus, the city presents an excellent environment for testing innovative approaches for improving the treatment of rape victims and increasing the conviction rate in the prosecution of rape offenders.

______ Persons Affected

______ Current System Operations

______ Magnitude

______ Administration

______ System Response

The difficulty in moving from concerns to concepts is a major barrier in the conduct of analysis. The field of criminal justice has not yet reached a point in development where there are well-defined and standardized concepts. The debates over the meaning of recidivism, delinquency, deterrence, and performance are indicators of this problem. Nevertheless, the careful development and use of concepts is an important objective. Precision in the use of concepts greatly enhances communication and the transmission of knowledge. (In Chapter 6 a set of system-related concepts are defined and used in conducting an analysis of court backlog problems.)

Concerns and their related concepts are familiar to the criminal justice administrator and to politicians with an interest in criminal justice. Most legislation and administrative regulations are written at this level of problem specification. Most political debates over criminal justice issues occur at the conceptual level. It is the analyst's responsibility, in addition to elaborating and bringing some precision to these terms, to operationalize concepts into their respective variables and measures. This topic is the subject of the next section.

D. Elaboration of Variables

Analysts do not study concepts directly; what analysts essentially study are variables. A variable is a characteristic, trait, attribute, or event having more than one possible value. For example, type of weapon can take on three possible values -- knife, gun, or none; sex offender may take on two possible values; -- male or female; while age of offender may take on a large number of different values. Variables are often directly observable while concepts are not. Presented in Exhibits 1-4 and 1-5 are data that have been collected as a result of a concern over robberies in Chaos City. In Exhibit 1-4, three concepts related to this concern are identified: characteristics of the offender; characteristics of the crime; and characteristics of the victim. Fifteen robberies are displayed, ten that occurred in August and 5 in September. In Exhibit 1-5, the first column presents a list of 15 variables -- six related to offender characteristics, five related to crime characteristics, and three related to victim characteristics.

EXHIBIT 1-4.

CONCEPTS AND VARIABLES: ROBBERY DATA SET

<u>Concept</u>: Characteristics of Offenders

Variables:
- Age
- Sex
- Race
- Education
- Employment Status
- Prior Record

<u>Concept</u>: Characteristics of the Crime

Variables:
- Type of Weapon
- Time of Day
- Place of Arrest
- Type of Robbery
- Place of Occurrence

<u>Concept</u>: Characteristics of the Victim

Variables:
- Age
- Sex
- Value of Stolen Property

EXHIBIT 1-5.

VARIABLES AND MEASURES: ROBBERY DATA SET

Variable	Measure -- Description and Codes
Age	Age of Offender at Arrest
Sex	Sex of Offender M. Male F. Female
Race	Race of Offender W. White B. Black I. Indian
Education	Last year of school completed by Offender
Employment Status	Employment Status of Offender U. Unemployed at time of arrest E. Employed at time of arrest
Prior Record	Offender has prior criminal record Y. Yes N. No
Type of Weapon	Type of Weapon K. Knife G. Gun N. None
Time of Day	Time of day robbery occurred (A=A.M., P=P.M.)
Place of Arrest	Part of metropolitan area Offender was arrested S. Suburban area C. Central City
Type of Robbery	Type of Robbery 1. Robbery and attempted robbery with injury 2. Robbery without injury 3. Attempted robbery without injury
Place of Occurrence	Type of place where robbery occurred 1. Highway 2. Commercial House 3. Gas or Service Station 4. Chain Store 5. Residence 6. Bank 7. Miscellaneous
Age of Victim	Age of Victim
Sex of Victim	Sex of Victim M. Male F. Female
Value of Stolen Property	Dollar Value of Stolen Property

These examples illustrate an important distinction between variables that is useful in specifying a problem. Variables may simply categorize behavior or traits; they may rank categories in the order of their seriousness or desirability; or they may quantify the trait or behavior. The first type of variable simply divides behaviors or traits into categories which are exhaustive and mutually exclusive. This type of variable is called a categorical variable or a nominal measure of the trait or behavior.[7] (The relationship of measures to variables is elaborated in section 5, below.) In Exhibit 1-5, each offender is classified as either male or female, and a single offender cannot be both sexes. Other categorical variables in Exhibit 1-5 include race of offender, employment status, prior record, type of weapon, place of arrest, place of occurrence, sex of victim, and time of day. The second type of variable simply rank orders the categories of nominal measure. Type of robbery, in Exhibit 1-5, is a variable in which categories of robbery are ranked from the most serious type of robbery, with a value of 1, to least serious type, with a value of 3. A third type of variable is a continuous variable which "orders values over a specified range"[8], but in this case the values are quantifiably comparable to each other. In the rank ordered variable, for example, though robbery of type 1 is more serious than robbery of types 2 and 3, the numbers are used only to differentiate one category from another. In a continuous variable, however, like age of the victim, a category with a value of 36 is twice that of a category with a value of 18. Other examples of continuous variables in Exhibit 1-5 are age of the offender and the dollar value of stolen property.

Problems of basic interest in criminal justice analysis are those indicated by the following variables: type of crime, unacceptable rates of crime, fluctuations in crime rates, etc. Frequently, an analyst is concerned with the ways in which certain crime variables fluctuate from time to time or from place to place in his/her city. It may be noted that over the period of several years, some crimes have higher rates during certain months of the year--such crimes as auto theft--while other crimes, such as commercial robberies, appear constant throughout the year. Why do these crimes either vary or remain constant?

In criminal justice analysis, variables relating to the types and rates of crime are typically considered dependent variables; that is, the value which a (dependent) crime variable assumes is thought to be influenced by the values assumed by other kinds of variables--such as season of year, climate, unemployment rate, population growth, or the changing age composition of the population.[9] The other variables which seem to influence the types and rates of crime are called independent variables. Independent variables help to explain or to predict the values which are likely to be assumed by dependent variables.[10]

To summarize: A single concept may be made observable through one or more variables. A single variable may have a level of measurement which is categorical, rank-ordered, or continuous. That same variable may also be either independent or dependent. (And as will be noted in greater detail in section F, below, a variable which is independent may also be classed in a third way--as descriptive <u>or</u> causal.)

E. Elaboration of Measures

A measure is defined as an observable qualitative or quantitative indicator used as a standard for description or comparison. Measures of the variables in the Robbery Data Set were presented in Exhibit 1-5. Measurement is the procedure of classifying "cases" (the unit being analyzed, be it "robberies" as in Exhibits 1-4 and 1-5, or "respondents" as in a victimization survey) into well defined categories of a variable. Exhibit 1-6 presents the specific values of each variable identified in Exhibit 1-5.

There are, generally, two types of problems associated with measurement: the accuracy of the measures used in an analysis and the meaning of the classifications selected. Measurement accuracy is considered in Chapter 2. Assigning meaning to the classifications used requires the adoption of a rule by the analyst. "A rule is a guide, a method, a command that tells us what to do." An example of a measurement rule which rank orders is: "Assign the numerals 1 through 5 to individuals according to how nice they are. If an individual is very, very nice, let the number 5 be assigned. If an individual is not nice at all, let the number 1 be assigned. Assign to individuals between these limits numbers between these limits."[11] In Exhibit 1-5 the rule used to measure the variable "employment status" was: "Assign a 'U' to all offenders who are unemployed at the time of their arrest and an 'E' if they are employed." The validity of the measure U or E, of course, depends upon how employment or unemployment are defined. Just as there are "good" and "bad" definitions of employment, for example, there are good and bad measurement rules and good and bad measures. Validity will be discussed in greater detail in Chapter 2.

EXHIBIT 1-6.
VARIABLES AND VALUES: DATA SET OF 15 ROBBERY INCIDENTS
OCCURRING IN AUGUST AND SEPTEMBER

	August										September				
Robbery Incidents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Selected Offender Variables															
Age	25	26	32	41	24	16	21	19	31	27	27	30	17	19	20
Sex	M	M	F	M	M	M	M	M	M	M	M	F	M	M	M
Race	W	W	W	W	B	B	B	B	I	W	W	W	B	B	W
Education	8	10	12	12	6	10	7	6	6	0	12	12	10	12	12
Employment Status	U	U	E	E	U	E	E	U	U	E	E	E	U	U	E
Prior Record	Y	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	N	N
Selected Crime Variables															
Type of Weapon	K	G	N	G	K	K	G	G	N	G	G	N	G	K	K
Time of Day	7p	8p	5p	5p	1a	10p	2a	2a	1a	3a	3p	1a	2p	1a	8a
Place of Arrest	S	S	S	C	C	C	C	C	C	C	C	S	C	C	S
Type of Robbery	2	2	3	1	1	1	1	2	2	2	2	2	2	1	3
Place of Occurrence	3	2	3	4	4	3	2	3	6	2	3	5	2	1	1
Selected Victim Characteristics															
Age	30	41	45	22	61	72	49	81	25	35	62	65	35	72	60
Sex	M	F	F	M	M	M	F	F	M	M	M	F	M	M	F
Value of Stolen Property	100	350	0	100	na	0	75	25	4000	150	75	600	1500	65	0

*For explanation of variables and values see Exhibit 1-5
Source: Hypothetical data.

In specifying a problem the analyst should be aware of these issues and work toward developing measurement procedures that are based on sound measurement rules, that are consistently applied, and that have measures which are fully defined. A central element of problem specification is that for a single concept there will usually be several variables to select from and that for each variable there are many possible measures. The analyst's work is to identify these alternatives and to make choices most appropriate to the nature of the problem.

F. Postulating Hypotheses

Hypotheses are statements asserting a relationship between two or more concepts, variables, or measures. A major distinction between a concern and a hypothesis is that hypotheses are testable and consequently, may be an effective tool of the analyst. Questions (concerns) such as "are older people more likely to be robbed than young people?" and "do burglars strike at the homes of the wealthy more often than at the homes of the poor?" are not directly testable. The analyst must develop and test one or more hypotheses implied by such questions. For example, the analyst might test to see if the robbery rate is higher among the elderly than among younger residents, and if burglary rates are higher in wealthier areas of the city than in poor areas.

One way of describing the relationship between the variables in a hypothesis is by indicating which are independent and which are dependent, as noted briefly in section D above. The relationship is more precisely defined if one can further categorize the independent variables as descriptive or causal. Thus, if burglary rates (the dependent variable) vary in association with the wealth or poverty of areas of the city (the independent variable), it is important to know that the independent variable, in this hypothesis, is considered descriptive rather than causal.

Many hypotheses in criminal justice analysis are of a descriptive type in which no causal relationship is implied. Such statements as "crime has increased in Chaos City between 1975 and 1979" and "the crime rate in Chaos City is higher than in Gotham City" are descriptive hypotheses. The former is a statement relating crime and time, while the latter relates crime and areas. They are subject to empirical verification, i.e., they are testable. However, it is a severe stretch of the imagination to suggest that either the passage of time or geography produces crime; rather a change in time and place (the independent variables) may be merely associated with a change in the pattern of crime.

Causal hypotheses, in contrast, do assert that a change in one variable produces or results in a change in another variable. Consider the following conclusions of three evaluation studies:

- A study of intensive police patrol in the evening indicated that the crimes inhibited by the patrol were displaced to the afternoon.

- A study of the installation of burglar alarms in the commercial area of one city indicated that the installation led to a decrease in commercial burglary but a simultaneous increase in residential burglary.

- A study of the effect of improved street lighting showed that night robberies decreased as a result of improved lighting, but the data suggested that street crime moved to new geographic locations and into residences and commercial establishments.[12]

Implied in the first statement is the causal hypothesis that intensive police patroling reduces the incidence of crime. In the second statement the implied causal hypothesis is that the installation of burglary alarms in commercial facilities reduces commercial burglary. The last statement implied the causal hypothesis that improved street lighting reduces crime in an area. All three studies imply another causal hypothesis: localized and targeted crime prevention efforts displace rather than prevent crime.

Causal thinking is a complex but an important aspect of analysis. As Robert Dahl puts it, "policy-thinking is and must be causality thinking."[13] Formal conditions under which causality may be considered have been identified by Mario Bunge. These standards have been developed to address the question as to when it is reasonable to apply causal hypotheses. That is, when is the use of causal relations valid? These conditions include:

(1) That the process in question can be regarded as isolated.
(2) Reciprocal actions do not exist.
(3) That the antecedents and the consequents be uniquely connected to each other, i.e. when each effect can be considered as following (not necessarily in time) uniquely from a fixed cause.[14]

Such conditions are viewed more as ideals; in practice, causal hypotheses often deviate from these standards without great harm.

> "Strict and pure causation works nowhere and never. Causation works approximately in certain processes limited both in space and time -- and, even so, only in particular respects. Causal hypotheses are no more (and no less) than rough, approximate, one-sided reconstructions of determination; they are often entirely dispensable, but they are sometimes adequate and indispensable.
>
> To put it otherwise: in the external world there is always a wide class of processes the causal aspect of which is so important in certain respects and within limited contexts that they can be described as causal--although they are never exactly and exclusively causal."[15]

Blalock presents an interesting summary of the major objections to such causal thinking. These objections include:

(1) Causal relations are essentially working assumptions or tools of the (analyst) rather than verifiable statements about reality.
(2) Causal relations are really only applicable to completely isolated systems.
(3) There seems to be no systematic way of knowing for sure whether one has located all the relevant variables. Nor do we have any foolproof procedures for deciding which variables to use.
(4) And that no two events are ever exactly the same.16

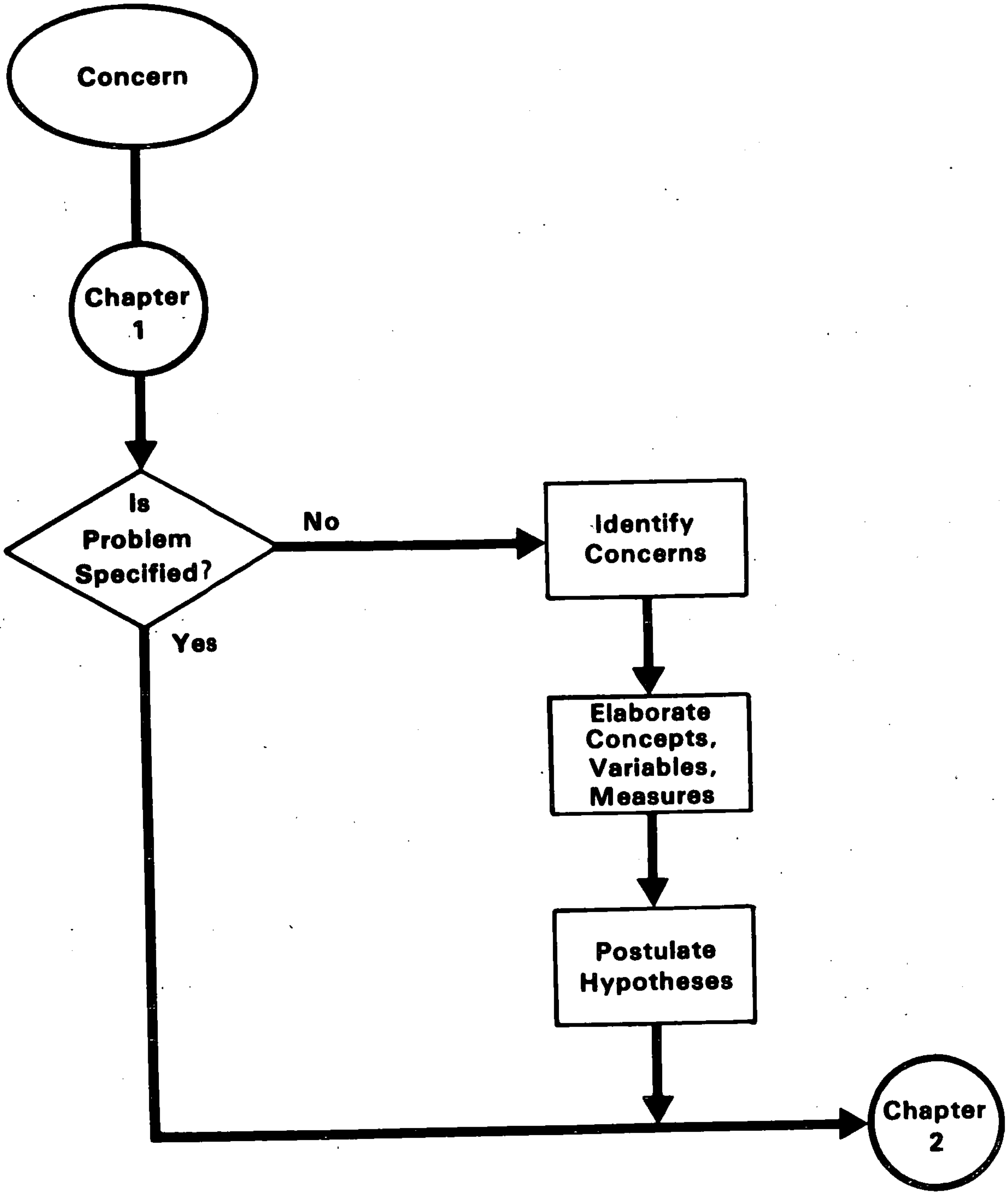
Each of these objections, and indeed many others, to causal thinking indicate the importance of the analyst -- his or her own views of reasonableness and completeness. The rules and procedures identified in this chapter for specifying a problem are an aid in causal thinking, as are many of the statistical procedures which follow. However these "techniques do not solve any of the common-sense difficulties about making causal inferences. Such techniques may help organize or arrange the data so that the numbers speak more clearly to the question of causality -- but that is all (these) techniques can do. All the logical, theoretical, and empirical difficulties attendant to establishing a causal relationship persist no matter what (technique) is applied. 'There is,' as Thurber moralized, 'no safety in numbers, or in anything else'."17

II. Summary

In this opening chapter the logical foundations and central concept of analysis have been presented. Problem specification has been defined as essentially a deductive process involving (1) identification of major concerns, (2) elaboration of related concepts, variables, and measures, and (3) the generation of hypotheses. Exhibit 1-7 summarizes this process.

EXHIBIT 1-7

CHAPTER 1 SUMMARY: PROBLEM SPECIFICATION



Problem specification depends on an analyst's style and his/her ability to develop hypotheses pertinent to real concerns. Hypotheses are a powerful tool that provide direction and focus to our analyses and, through observation and measurement, are directly testable. Other approaches to knowledge such as beliefs, intuition or the use of authority inform analyses but are not testable directly. The purpose of hypothesizing is not to stifle creativity, nor are hypotheses suggested as an alternative to beliefs, intuition and authoritative pronouncements. These compliment each other and interact in the conduct of analysis.

The differences between and uses of inductive and deductive reasoning are rarely obvious to the analyst. Let a model be defined as a simplified representation of the real world. Consider the following description of the model-building process:

Step 1: Observe some facts.
Step 2: Look at the facts as though they were the end result of some unknown process (model). Then speculate about the processes that might have produced such a result.
Step 3: Then deduce other results (implications or consequences or predictions) from the model.
Step 4: Then ask yourself whether these other implications are true and produce new models if necessary.[18]

The first three steps exemplify inductive reasoning. Step 4 applies deductive logic to validate the model. Discovery in this instance, and good analysis generally, involves both inductive and deductive reasoning. A criminal justice analyst might begin an analysis with a set of questions posed by a decision-making group, generate the implied hypotheses, and elaborate the concepts, variables, and measures. After collecting and examining data and testing his/her hypotheses, some of the hypotheses may be rejected, a few accepted and most reformulated for testing. In reformulating and subsequently retesting the hypotheses based on observations and data, the analyst has shifted from deduction to inductive reasoning.

An analyst's ability to measure and to obtain data to be used in testing hypotheses is essential to the conduct of an analysis. The process for elaborating concerns into concepts, variables, and measures is difficult. In practice, it is the quality of the measures used that is of greatest importance. Good measures are relevant and adequate expressions of the concerns which initiate the process of problem specification. In the next chapter, the issue of what constitutes an accurate measure is considered, as are the sources of data typically used in criminal justice analyses and methods of collecting data.

[1]These statements and research questions are adapted from Wesley O. Skogan and William R. Klecka, The Fear of Crime (Washington D.C.: The American Political Science Association, 1977).

[2]The Police Foundation, Kansas City Preventive Patrol Experiment: A Technical Report (Washington D.C.: The Police Foundation, 1974), pp. v, xiii-iv.

[3]George C. Edwards and Ira Sharkansky, The Policy Predicament: Making and Implementing Public Policy (San Francisco: W.H. Freeman and Company, 1978), pp 87-117.

[4]The discussion of analytic styles was strongly influenced by two sources: Robert R. Blake and Jane Srygley Mouton, The Managerial Grid (Houston: Gulf Publishing Company, 1964), p. 10, and Michael Mont Harmon, "Administrative Policy Formulation and the Public Interest," Public Administration Review (Sept./Oct., 1969): 486.

[5]Fred N. Kerlinger, Foundations of Behavioral Research, 2nd ed. (New York: Holt, Rhinehart and Winston, 1973), p. 9.

[6]Earl R. Babbie, The Practice of Social Research (Belmont, Calif: Wadsworth Publishing Company, 1975), pp. 30-35.

[7]Babbie, The Practice of Social Research, p. 89.

[8]Kerlinger, Foundations, p. 39.

[9]Herman J. Loether and Donald G. McTavish, Descriptive and Inferential Statistics: An Introduction (Boston: Allyn and Bacon, 1976), p. 26.

[10]Ibid. The issue of causality is more fully discussed in the section (If) on hypotheses. See also Hubert M. Blalock, Jr., Causal Inference in Non-experimental Research (Chapel Hill: University of North Carolina Press, 1964), pp 27-30.

[11]Kerlinger, Foundations, p. 428.

[12]National Advisory Committee on Criminal Justice Standards and Goals, Criminal Justice Research and Development Report on the Task Force on Criminal Justice Research and Development (Washington D.C.: Law Enforcement Assistance Administration, 1976), p. 104.

[13]Robert Dahl, "Cause and Effect in the Study of Politics" in Cause and Effect, ed. Daniel Lerner (New York: Free Press, 1965), p. 88.

[14]Mario Bunge, Causality (Cambridge: Harvard University Press, 1959), pp 335-338.

[15]Ibid.

[16] Blalock, Causal Inference, pp 11-14.

[17] Edward R. Tufte, Data Analysis in Politics and Policy (Englewood Cliffs: Prentice-Hall, 1974), p. 5.

[18] Charles A. Lave and James G. March, An Introduction to Models in the Social Sciences (New York: Harper and Row, 1975), pp. 19-20.

CHAPTER 2

DATA SYNTHESIS

Review of Problem Specification

The results of specifying a problem are the identification of concerns, the elaboration of concepts, variables, and measures, and a list of tentative hypotheses. In Exhibit 2-1 a preliminary specification is presented involving a concern raised about the rehabilitative effects of a vocational counseling program for ex-offenders. Part A identifies the concern; Part B elaborates some of the concepts, variables, and measures related to it; and Part C is a list of the initial hypotheses. As discussed in Chapter One, the logical relationships between concepts, variables, and measures involve important decisions made by the analyst. To organize the decision process, the charts presented in Exhibits 2-1 and 2-2 help make these choices explicit and facilitate a comprehensive assessment of the work product. In Chapter Two, several factors useful in refining and assessing the process of problem specification are discussed. These factors include: (1) the accuracy of the measures selected; (2) the adequacy of the selected hypotheses; and (3) the availability of data needed to test the hypotheses.

Criteria to consider in assessing the quality or accuracy of the proposed measures are presented in section I of the chapter. This involves a consideration of validity and reliability. Validity is the extent to which a measure is an adequate reflection of the concept being considered. The validity of crime statistics has been questioned because these statistics may not be one-to-one reflections of events.[1] Some of the factors that influence the validity of crime and criminal justice system measures are discussed, and methods of testing validity are noted. Reliability refers to the stability of a measure resulting from the use of the same measuring procedure at two different points in time or among groups of similar items at the same time. For example, in the problem specified in Exhibit 2-1, assume that a program participant is interviewed by several intake clerks on the first day of his/her participation and that "employment status" is ascertained by more than one clerk, though the same measure and procedures are used by the clerks to determine this information. There may be considerable variation in the participant's responses to the clerks, if his/her memory fails from one interview to the next or if he/she does not interpret the term unemployed in the same way each time asked about his/her status. The greater the variability in responses due to such factors, the less reliable the measure. Some of the factors that influence the reliability of a measurement process and practices to follow in measuring crime and the criminal justice system that will help reduce reliability problems are presented.

Exhibit 2 - 1
Problem Specification

Part A: Concern

Is vocational counseling contributing to ex-offenders' rehabilitation?

Part B: Elaboration of Concepts, Variables and Measures.

CONCEPTS	**VARIABLES**	**MEASURES**
Recidivism	Rearrests	Number of days between release and rearrest clearances on rearrests by crime type.
	Reconvictions	(To be developed)
	Reincarcerations	(To be developed)
Economic Security	Employment Status	No. of days unemployed since release. No. of jobs held since release.
	Income	(To be developed)

RELATING CONCEPTS	RELATING VARIABLES	RELATING MEASURES
1) Improved economic security reduces the risk of recidivism.	a) Improvement in employment status reduces the risk of rearrest	1) The more days unemployed since release the greater the frequency of rearrests among exconvicts
		2) The fewer jobs held since release reduces the frequency of rearrests among exconvicts.
	b) Improvement in income reduces the risk of reincarceration.	1) (To be Developed)
		2)

A second consideration in improving a problem specification is the overall assessment of the hypotheses. Part C of Exhibit 2-1 identifies some hypotheses for the concern about vocational counseling. An assessment of these hypotheses should consider: (1) the accuracy of the measures selected; (2) the importance of each hypothesis to decision-makers; (3) the testability of each hypothesis; and (4) how comprehensive the set of hypotheses is in terms of the stated concern. These topics are covered in section II of the chapter.

A third consideration in revising and improving a problem specification is the availability of the required data. The feasibility of an analysis is, in large part, a determination that the required data exist and are accessible or they can be collected with available resources and in sufficient time to be useful to decision-makers. In most analyses, the data collection effort consumes more resources and time than any other component of the process. Consequently, the concluding sections (III and IV) of the chapter present: (1) an inventory of existing crime and criminal justice system data sources; (2) a discussion of data collection methods; and (3) guidelines for planning a data collection effort.

The outcomes of assessing measures, assessing hypotheses, and determining the feasibility of data collection may be substitute measures, reformulated hypotheses and, perhaps, a redefinition of the concern. These considerations are preceded in the analysis process by the development of a preliminary problem specification; they result in a detailed problem specification and the development of a related data base. These are the basic foundations for the conduct of analysis.

I. Measurement Accuracy

A. Validity

Assuming that a concept can be measured, the analyst needs to be able to assess the quality of the selected indicator. Such an assessment should consider the extent to which a measure is an accurate reflection of reality. For example, to what extent do the questions on a community survey questionnaire actually measure "fear of crime"? Does a supervisor's rating of an employee adequately measure job performance? Are official crime statistics good measures of its incidence? Many factors influence the validity of a measure; two that are particularly common in criminal justice studies are (1) the lack of agreement on operational definitions of concepts and (2) inadequate research designs.

Developing an operational definition requires agreement on the measurement rules and the method of observation. Such agreement may be confined to your office or involve the use of a state or national standard such as Uniform Crime Reports (UCR) definitions or those developed by LEAA for national data collection.[2] If the analyst and colleagues agree that "fear of crime" is to be defined as "the percentage of residents who believe their neighborhood is very unsafe," this is an operational definition. Many of the key concepts used in criminal justice analysis lack such definition and much work has been done and arguments entered into over definitions of recidivism, deterrence, incapacitation, performance, and productivity. An effort at defining performance, productivity, and other concepts used in system analysis is presented in Chapter 7. The ability to agree on operational meaning for key measures influences perceived validity. "Without agreement, the analyst would be lost in a sea of conflicting value judgments populated by creatures of various uncoordinated private worlds."[3]

The selection of a research design also effects the validity of a study's findings. Perhaps one of the most provocative criminal justice studies in recent years was the work of Robert Martinson.[4] He assessed evaluations of many offender rehabilitation programs conducted prior to 1966. One criterion of his assessment was how valid the findings of each study were. Validity in the evaluation context is the degree of confidence an analyst has that it was the program that caused the observed impact on the offender population and that the value of this impact can be explained.[5] Martinson argues that the choice of research design directly affects a study's validity. Specifically, "true" experiments, in which the analyst has most control over the observation and measurement of behavior, and over the types and levels of treatment received, produce most valid measures. Ex Post Facto designs, in which observation and measurement occur only after exposure to the program, are the weakest design yielding the least valid measures. A simulated research design consisting of pre-tests on one group of subjects who have not participated in the program and post-tests on a second group of subjects who have not participated represents a middle ground. The lack of equivalence in the pre- and post-test groups and the lack of control exerted by the analyst cause simulated designs to produce less valid findings than "true" experiments according to Martinson. A high proportion of the evaluation studies reviewed by Martinson were not "true" experiments.[6]

There are many ways of testing the validity of a measure. Some tests are based on comparing an observed indicator to some standard of its "real" value. For example, face validation involves a subjective appraisal by the analyst of a measure's apparent consistency with the analyst's view of its "real" value. Does the measure make sense? Face validity can be enhanced by using multiple judges such as others in the office or a panel of experts.

A second test of validity involves comparing a measure with some other measure known to be valid. For example, in one study the analysts tested the validity of self-reported deviant behavior by comparing interview responses to polygraph findings.[7] In the following paragraph, a study is described in which self-reported narcotic addiction was validated using chemical analysis of a urine specimen for each respondent:

> In this investigation, noninstitutionalized addicts' responses to questions regarding a number of topics were obtained in a situation where, according to Ball (1967), interviews were conducted by a highly competent and experienced interviewer with considerable knowledge of the addicts' subculture and of lower-class slum neighborhoods, who made it clear to the addicts that nothing was to be reported to the police. These data (which Ball implies

were collected under maximally positive conditions) were then validated against such outside criteria as FBI records and urine specimens. The validation procedures revealed that about 20 per cent of the addicts reported their first arrests incorrectly and 30 per cent gave invalid reports of their criminal histories. Both of these reports were validated by FBI data, which may, of course, in themselves be inaccurate. However, the use of a chemical analysis of a urine specimen, which is regarded as the most valid physical means of ascertaining current opiate use, revealed that 29 per cent of those using heroin denied such to the interviewer.[8]

Such external criteria are frequently not available or are too costly to be used and alternative tests of validity are necessary.

A third test of validity is to compare the observed measure to measures of the same concept developed in other studies by different methods. Sellin and Wolfgang compared their index of crime seriousness to similar indexes reported in previous studies. By demonstrating the similarity of their index to these other measures of crime seriousness, they concluded that the index was a reasonably valid indicator of the concept.[9] A similar validation test involved a comparison of UCR data and victimization survey estimates of crime. The purpose of this study was to assess "the extent to which the Wes-Skogan Uniform Crime Report's 'crimes known' figures reflect the underlying distribution of victim-defined crime in local communities."[10] The validation test was, in part, to compare the UCR data in several cities to victimization data for the same cities on two crimes -- robbery and auto theft.

A fourth validity test is to compare intuitive, a priori assumptions about the measure to the observed values of the measure. For example, Sellin and Wolfgang assumed that crimes involving harm, loss, or damage would have higher seriousness scores than crimes involving no harm, loss, or damage. This assumption was confirmed by their survey findings.

A final test of validity is based on a perspective that the measure represents to a greater or lesser extent the concept being studied. Sellin wrote in 1931 that "the value of a crime for index purposes decreases as the distance from the crime in terms of procedure increases."[11] At that time the police furnished the most valid measures of crime according to this criterion.[12] Today, however, some researchers suggest that victimization surveys provide a more valid magnitude estimate of crime. Exhibit 2-2 presents victim-reported estimates and police-reported measures for selected offenses in eight cities of the U.S. The victim reported measure appears to be twice the magnitude of the UCR data.[13]

EXHIBIT 2-2

POLICE-REPORTED VERSUS VICTIM-REPORTED
CRIME IN EIGHT CITIES

By Offense	Police-Reported[a]	Victim-Reported[b]
Rape	3,090	6,600
Aggravated assault	24,095	37,600
Robbery	34,274	78,100
Burglary	119,984	325,600
Larceny $50+	60,714	140,700
Larceny $50	101,085	259,500
Auto theft	65,966	65,700
Total, all offenses	409,208	913,800

[a]FBI Uniform Crime Reports
[b]LEAA National Crime Panel Survey
Source: LEAA Newsletter, U.S. Department of Justice, 3 (March, 1974), p.1.

However, similar comparisons presented in the National Academy of Science's assessment of the National Crime Surveys (NCS) concluded, in part, that even victim-reported crime measures such as those in Exhibit 2-2 only represent a portion of serious crime, for five reasons:

1. Certain serious crimes are not covered by the NCS, e.g. white collar crimes such as shoplifting and vandalism and violent crimes such as homicide and child molestation.
2. The different jurisdictional bases of the UCR and NCS data make inter-city comparisons difficult. (See the discussion of reliability.)
3. NCS estimates are affected by the exclusion of "series" offenses for certain crimes such as assault and personal thefts.
4. Sampling error and response bias limit the accuracy of the NCS. For example, young, black males are underrepresented in the NCS sample. (See the discussion of reliability.)
5. Certain crimes are significantly under-reported in the NCS, e.g. personal thefts and assaults.[14]

Consequently, it would appear that only a portion of all serious crimes are represented in either police-reported or victim-reported crime data. This type of validation, in which a measure represents only a portion of the underlying concept suggests that multiple indicators should be used to describe a particular concept.[15]

B. Reliability

The assessment of a measure's quality must consider reliability as well as validity. A particular measurement procedure or indicator is reliable to the extent it yields results which are consistent from one time to another or from one group to another. Bathroom scales and yardsticks are traditional measurement devices used to illustrate this issue:

> An ordinary wooden yardstick will give approximately the same length each time if the same object is measured with it a number of times. If the yardstick were made of an elastic material, its results would not be so reliable. It might say that a chair was twenty inches high one day, sixteen the next. Similarly, if it were made of a material that expanded or contracted greatly with changes of temperature, its results would not be reliable. On hot days it would say that the chair was shorter than on cold days. In fact, the choice of wood as a material for yardsticks is in part a response to the problem of reliability in measurement, a problem certainly not confined to the social sciences. Wood is cheap, rigid, and relatively unresponsive to changes in temperature.[16]

If an analyst wants to collect data on court backlog, a major problem that needs to be dealt with is incomparability; court backlog is determined in different ways in different jurisdictions. The data on court backlogs may be of dubious reliability since they are compiled in different ways, unless a statewide convention has been developed to report backlog. Typically, no such conventions have been developed.

A second source of incomparability may be the instability of the measure itself. For example, certain measures, such as a judge's workload, are not likely to vary much over time. Shifts of 30% or more in a single month would more likely indicate a change in measurement procedures than in workload. However, the seriousness of criminal cases before the court is likely to fluctuate considerably and rapidly, so that comparisons of case seriousness separated by a significant passage of time are not likely to be reliable.

A third source of incomparability may be substantial changes in reporting practices overtime. For example, the Uniform Crime Reports which have been published since 1933, have been affected by changes in police agency participation, by the way in which crime is recorded by local police departments, and by the manner in which crime is categorized and aggregated.[17]

Another type of reliability problem is the error that is inherent in any measurement process. Suchman identifies five major sources of reliability error in evaluation studies that are due to random or chance factors:

1. Subject reliability - the subject's mood, motivation, fatigue, and so on - may momentarily affect his physical and mental health and his attitudes and behavior in relation to

public service programs. When such factors are of a transient nature, they may produce unsystematic changes in his responses.

2. Observer reliability - the same personal factors will also affect the way in which an observer makes his measurements. These observer factors will not only tend to affect the subject's reactions, but also the observer's interpretation of the subject's responses.

3. Situational reliability - the conditions under which the measurement is made - may produce changes in results which do not reflect "true" changes in the population being studied. If the variation in the evaluation situation is systematic, one could then, of course, make valid deductions about the effect of the evaluation situation upon one's measure. However, if such variation is random, then these situational factors will not generate any constant bias--which perhaps could be corrected to produce valid results, but rather will generate unsystematic responses which produce unreliable results.

4. Instrument reliability - all of the aforementioned factors will combine to produce an evaluative instrument of low reliability. However, certain specific aspects of the instrument itself may affect its reliability. Poorly worded questions in an interview, for example, especially those which are ambiguous or double-barreled (i.e., having two meanings), may lead to a random variation in responses.

5. Processing reliability - simple coding or mechanical errors when they occur at random or in an unsystematic manner also may lead to a lack of reliability.[18]

There are two tests often used to assess a measure's reliability. The "Test-Retest" procedure is based on the fact that a measurement procedure repeated under similar circumstances should yield similar results if the procedure and indicator are reliable. For example, the initial administration of a performance evaluation instrument in a police department results in a rank ordering of patrolmen. If the second, third and subsequent ratings tend to result in similar rank orders, then the instrument may be considered reliable. A second test of reliability is based on the assumed equivalence of two different sets of indicators used to measure the same concept. The "Split-Half" technique assumes, for example, that if the 20 traits identified on the performance evaluation instrument, can be divided into two groups of ten, each group would yield comparable results in terms of measuring performance. If the two groups of ten traits are equivalent, the measurement procedure is considered to be reliable.[19]

II. Assessing Hypotheses

After evaluating the accuracy of selected measures, a second step in reviewing an initial problem specification is to assess the list of hypotheses that were developed. Each hypothesis should be examined in terms of the following:

- Can the variables be measured?
- Are the measures accurate?
- Is there data to support the measures?
- Is the hypothesis testable?
- Is the hypothesis important?
- Is the set of hypotheses comprehensive?

Following is a brief discussion of each of these issues.

A. Can the variables be measured?

A common problem in generating hypotheses is the inclusion of value statements in the initial problem specification. Such value statements are not measureable and should either be reformulated or eliminated from the list of hypotheses. Words to be on guard for include "should," "ought," "worse," and "better." For example,

- Juvenile felons are no better than adult felons.
- The county and city should consolidate their police departments.

These are value judgments and need to be rewritten into measurable hypotheses such as:

- Juvenile felons tend to be as dangerous as adult felons.
- A consolidated police department is less costly than the combined costs of the independent city and county departments.

While it may be difficult operationally to define "dangerous" and "costs," at least they lend themselves to measurement, and are therefore better hypotheses.

B. Are the measures accurate?

Each measure should be assessed in terms of its validity and reliability. If there is a choice, use indicators from standard sources which are comparable. Check the definitions being used for each measure against standard definitions from national sources or previous studies. Measures that have apparent reliability or validity problems should be tested, if possible, and substitute measures or multiple indicators developed from other sources should be used.

C. Are there data to support the measures?

There are two aspects to this issue: first, are there existing measures that are readily available which support the hypotheses; secondly, can data be collected with available resources and in sufficient time to be useful to decision-makers. The last two sections of this chapter cover these topics in depth. Clearly, hypotheses for which data do not exist, or for which data cannot be obtained should be eliminated or revised.

D. Is the hypothesis testable?

A hypothesis should be related to available techniques useful for testing the acceptability of the statement. Exhibit 2-3 illustrates some of the relationships between types of hypotheses, characteristics of the population being studied, and the appropriate types of statistical methods.[20]

EXHIBIT 2-3

TYPES OF TECHNIQUES FOR TESTING VARIOUS HYPOTHESES

	Single Case	Population or Census	Sample
One Variable Hypotheses	1. Measurement of one variable on one case.	2. Measurement of one variable and description only.	3. Measurement and inference concerning one variable.
Multi-Variable Hypotheses	4. Measurement and listing of two or more variables taken on a single case.	5. Comparison and inference about relationships among two or more variables.	6. Comparison and inference of relationships among two or more variables.

Source: Adapted from Philip J. Runkel and Joseph E. McGrath <u>Research on Human Behavior</u>. (New York: Holt, Rinehart and Winston, Inc., 1972) p. 29.

The first cell of Exhibit 2-3 requires only measurement and comparison. For example, hypotheses may be asserted as questions or statements:

(1) How much money was spent for law enforcement in Chaos City in 1978?
(2) What does the mayor feel is the most important criminal justice problem?
(3) Law enforcement expenditures increased in Chaos City between 1977 and 1978.

The first and second questions require only a single observation for one case. The measure in the first hypothesis is the law enforcement expenditure in 1978 and the single case is Chaos City. In the second hypothesis the measure is the perceived most important criminal justice problem and the mayor is the single case. The third hypothesis illustrates the change in a single case (Chaos City) on a single variable (law enforcement expenditure) over time (1977-1978). Hypotheses 1 and 2 simply require measurement, while the 3rd requires comparing two or more observations. Techniques for performing such comparisons are presented in Chapter 4.

The second cell represents hypotheses involving the measurement of all cases in a finite population on a single variable. A finite population could be counties in the state, states in the country, months in the years, offenders arraigned during the month of July or downtown businessmen in Chaos City. The "case" for each population would be counties, states, months, offenders, and downtown businessmen, respectively. While the number of cases may vary dramatically, e.g. 12 months, 50 states, 250 downtown businessmen, only one variable is measured for all the cases.
For example,

(4) How many narcotic addicts were arraigned in Chaos City Court during the month of July?
(5) Downtown businessmen in Chaos City feel that shoplifting is a major crime problem.
(6) What was the average total criminal justice expenditure for all states in 1978?
(7) What was the average monthly workload of the Chaos City court during 1978?
(8) The average total criminal justice expenditure for all states increased between 1977 and 1978?

In hypothesis #4 the <u>variable</u> of interest is the presence or absense of narcotic addiction among arraigned offenders. The <u>case</u> is the arraigned offender and the <u>population</u> is all arraigned offenders during the month of July in Chaos City. In hypothesis #5 the <u>variable</u> to be measured is the perceived magnitude of the shoplifting problem; the <u>case</u> is the downtown businessman; and the <u>population</u> is all downtown businessmen. The variables, cases, and populations are similarly defined for hypotheses #6 and #7. In each of these hypotheses the appropriate treatment of the data is with the descriptive methods presented in Chapter 3, e.g. measures of central tendency and variation. Hypothesis #8 requires the use of descriptive and comparative techniques presented in Chapter 4. The variable in hypothesis #8 is total criminal justice expenditure between 1977 and 1978; the case is each state; and the population is all states.

Sampling and statistical inference are required to test the type of hypothesis entered in the third cell of Exhibit 2-3. These hypotheses involve making generalizations about a population based on a sample of cases rather than on all of the cases of the population. For example, one may want to know:

(9) What percentage of Chaos City residents indicate that they are very afraid of street crime?
(10) What is the average annual income of adult felons arrested in Chaos City?
(11) The percentage of Chaos City residents who were very afraid of street crime decreased between 1977 and 1978.

Obtaining a measure of each of the variables in these three hypotheses for every resident of Chaos City or for every adult felon arrested in Chaos City, would be too expensive and impractical. One way of obtaining the necessary information at lower cost is to select a sample of cases and use them to represent findings for the entire population of residents or of adult felons. In order for this approach to generate the quality of information needed, it is necessary to select the sample so that each case in the population sampled has known chance (probability) of being included in the sample and so that the procedures for deciding which case to include are unbiased procedures (such as flipping a coin). (Sampling is discussed in greater detail in section III, D of this chapter.) The information obtained from the cases included in the sample provide a basis for making inferences about what the findings would be for the entire population. If the sample is appropriately selected, it also will be possible to estimate the degree to which sample results are likely to differ from the results which would have been obtained if all the cases in the population had been included.

In hypotheses #9 the population to be sampled from is all Chaos City residents; a case is each resident respondent; the variable to be measured is the fear of street crime; and the sampling procedure might be to randomly select 500 residents from the city's telephone directory for a telephone interview. In hypothesis #10 the population is all adult felony arrestees in Chaos City; a case is each adult felony arrestee; the variable to be measured is their annual income; and the sampling procedure might be to select for measurement 1 in every 10 adult felony arrestees for the first week in each month for one year.

Chapter Five covers selected topics in statistical inference. However, it does not cover the estimation of a population parameter given a sample value of the parameter. (A parameter is, for example, an average or proportion).[21] Hypothesis #11 involves comparing an estimated population parameter at two points in time. Such a test of difference is not treated in Chapter 5 and usually requires the application of analysis of variance techniques.[22]

Multi-variate hypotheses are treated in the second row of Exhibit 2-3. In the fourth cell, there is only one case being examined for values of two variables. For example,

(12) The age of the Mayor of Chaos City is related to his or her perception of the most important criminal justice problem.

(13) Did the amount of total city expenditures and law enforcement expenditures in Chaos City increase between 1977 and 1978?

These, like hypotheses #1-#3 (cell 1), simply require measurement and comparison of two or more variables.

Hypotheses in the fifth cell involve assessing the nature and strength of relationships between variables. For example,

(14) What is the relationship between sentence length and crime seriousness for all convicted juvenile felons in Chaos City during July and August?

(15) There is a relationship between the total crime index and total law enforcement expenditures for all states in 1970 and 1978.

These hypotheses are similar to those in cell 2, except that it is necessary to develop information about the relationship between the measures. Comparative and inferential techniques for assessing such relationships are presented in Chapters 4 and 5.

The last cell of Exhibit 2-3 is similar to the 3rd cell with the exception that these hypotheses involve implied causal relationships between two or more variables. For example,

(16) The age of residents affects their fear of street crime.

(17) The average annual income of adult felons arrested in Chaos City seems to influence the seriousness of the crimes committed.

(18) Did prosecution expenditures have a declining or increasing effect on the incidence of serious crimes for all states change between 1971-1976?

Some techniques useful in assessing such relationships are introduced in Chapters 4 and 5. However, population estimation, analysis of variance and other multivariate methods go beyond the scope of this text.[23]

In judging the testability of a hypothesis, an analyst will have to determine whether a statement should be accepted or rejected on the basis of the information gained from the sample. The previous discussion is a partial guide for considering methods useful in aiding such decisions.[24] If a hypothesis does not relate clearly to any known testing technique, it should be revised or eliminated. If a hypothesis involves testing procedures that are unfamiliar to the analyst, expert assistance should be sought. If such assistance is not available, the hypothesis should be revised or eliminated.

E. Is the hypothesis important?

A final consideration in assessing a hypothesis is its importance. Importance here is used in reference to the decision-makers -- what will they be interested in? How central is the hypothesis to their concerns? Assuming that a finding should be accepted, what value has it for the decision-maker? Though the analyst may make subjective judgements about the interests of key decision-makers the key factor in determining the value of a finding is the analyst's ability to isolate and define variables which can be manipulated through programs and policies. It is of little use to demonstrate the relationship of a variable to the crime rate, if the independent variable cannot be manipulated through programs and policies. It is of little use to demonstrate a relationship to the crime rate, if the independent variable is not subject to planned change. Studies of the relationship between crime and either police discretion or sentencing policy, both of which may be influenced by decision-makers, are likely to be more effective than studies relating the crime rate to population density. Orienting hypotheses to be more tractable requires both a theoretical understanding of the concern and a knowledge of the decision-making process.

F. Is the set of hypotheses comprehensive?

Once each hypothesis has been scrutinized as just discussed and a revised list of hypotheses has been prepared, a final assessment should be performed. This means to review the list comprehensively, (not each hypothesis one at a time) and consider the scope and coverage provided. In conducting this review the seven concepts introduced in Chapter One (p. 6) should be considered. If an area such as system operations has been ignored, fill in the list with an additional hypothesis(es) involving this concept. If the list is unbalanced, i.e., has too many hypotheses in a specific area, eliminate duplicates and fill in with additional hypotheses in the other areas, if necessary. It should be emphasized that throughout the analysis process, a problem specification is subject to modification. For example, if data proves unavailable, or test results are ambiguous, the analyst should adapt the specification to this new information.

III. Data Sources

A. Alternative Data Sources

A wealth of data is available in the criminal justice field. However, the major problems facing the analyst are (1) how to select appropriate data from existing sources, (2) identifying what new data are needed, (3) designing an efficient and effective data collection procedure, and (4) assessing the quality of the obtained data. A useful way of organizing the mass of data available in criminal justice is to think of data needs in six major categories:

- Victim-Reported Crime Data
- Police-Reported Crime Data
- Public Opinion Data

- Demographic Data
- System Data
- Juvenile Data

Victim-Reported Crime Data, the first category, provides data to answer one of the questions most often asked, "How much crime is there in this community (or state)?" Such data are usually obtained from victimization surveys which ask citizens about recent situations in which they have been victims. Data on some crimes such as kidnapping (which occur too rarely to be effectively picked up by surveys) must come from official (i.e., Police-Reported) data sources such as the Uniform Crime Reports (UCR). Clearly, while such information is frequently referred to as "actual" crime data, the term is misleading since victimization surveys usually utilize samples rather than a complete census of the population of victims.

Police-Reported Crime Data provide measures of the volume and type of crime reported to law enforcement agencies. UCR crime data do not reflect all crimes which have been commited. For example, "in a 1973 national survey of crime victims, the reporting rate for simple larceny was only about 18 per cent."[25]

Public opinion data obtained from surveys and interviews are useful in answering questions such as "What crimes concern residents and businessmen most?" and "How well do citizens feel the criminal justice system is working?"

Demographic data help answer the question, "How many people or businesses of various types are victims of crimes and what are the characteristics of these victims?" Demographic data are used in calculation of crime rates and to analyze the correlates of crime.

Data on the criminal justice system are needed to answer questions such as, "How does the criminal justice system respond to reported crime?" and "Are system facilities and resources adequate to deal with the current level of offenses?"

Juvenile data are found in all the other data categories, but are treated in this text as a separate category because of laws requiring special handling of such data to ensure confidentiality. In addition, the juvenile justice system is normally separated from adult facilities, as is the data collection apparatus.

Data from each category also can be used in many different types of combinations to answer a broad range of general and specific questions. When combining different data sources, it is important to ask if the data sources are compatible. For example, do the data cover the same time period? Are the discrepancies between data sources so great as to make any findings questionable? The problem of compatibility is always troublesome when using different data sources, particularly in a field such as criminal justice where many different data bases are available.

These six types of data may be considered secondary data. Secondary data are data that have been collected in conjunction with other analyses and are currently available in easily usable form. For example, published U.S. Census reports containing population data are secondary data. So is a report on a victimization survey for a locality, or an annual police department report summarizing crimes committed during the past year. Primary data are data which are not currently available in easily usable form. These data must be obtained through observation and collection by such methods as surveying or interviewing or by developing a new data set from administrative records.

B. Information Systems as a Data Resource

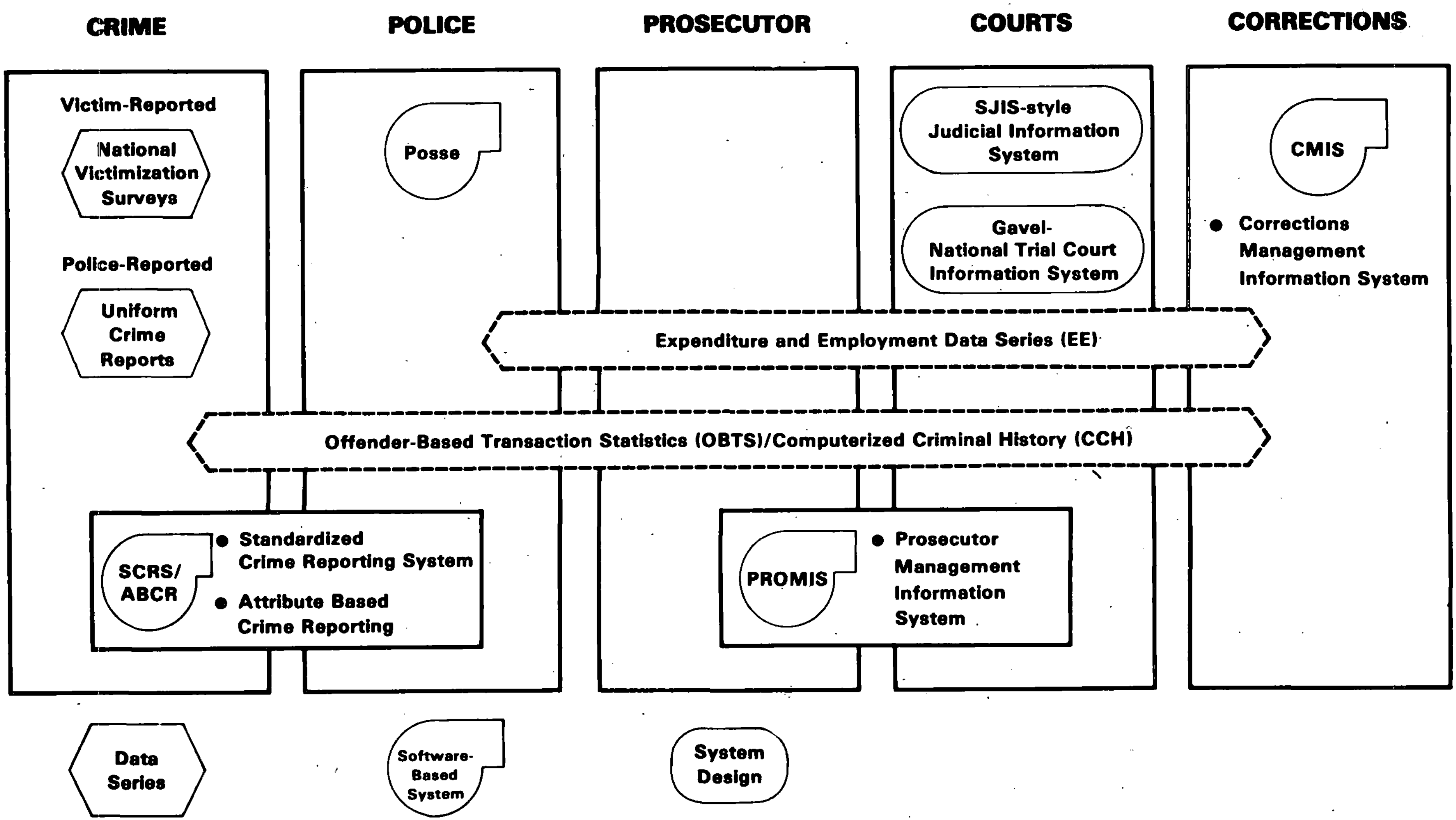
A major data resource in many jurisdictions is the existence of a criminal justice information system. An information system as used in this chapter refers to either (1) system designs which include specification of data elements (variables) which are not automated or (2) a system design that includes data elements and a series of computer programs, fully documented and available on request. An example of the former is the "State Judicial Information System" (SJIS) which represents a committee decision not to attempt to write a set of computer programs applicable to many states with varying information needs. Each of the participating states has arrived at its own solution, using as much of the SJIS system design as it desires. The National Trial Court Information System (GAVEL), like SJIS, is a system design which represents the ideas of a national committee of court administrators about which records are to be kept, about definitions of key variables, and about report formats. Various aspects of GAVEL have been incorporated into the Prosecutor Resource Management Information System (PROMIS) but there is no GAVEL software package. SJIS and GAVEL represent individualized system designs which are not suitable for transfer to other jurisdictions, nor are they necessarily a ready source of data.

In jurisdictions which have PROMIS, an excellent data source exists. PROMIS is a series of computer programs that serves a variety of functions in different organizational settings. It was developed specifically as a tool to (1) assist in allocating resources based on the importance of a criminal case, (2) to control scheduling and logistical problems, and (3) as a mechanism for monitoring the even-handness of discretion. It also is useful as a research and analysis tool, providing data and data manipulation capabilities where little or none existed prior to its implementation. PROMIS functions within the Court System in Tallahassee, Florida; it is the nucleus of the Rhode Island SJIS state Judicial Information System; the (JUSTIS) system of Milwaukee was built around PROMIS and serves the Court, the Prosecutor, the Sheriff, and the County Clerk. PROMIS is an operational system in over twenty cities and it is in various stages of transfer to over 100 other cities and states.[26]

Exhibit 2-4 illustrates these information systems. Also included are five nationally-sponsored data series that provide different types of data used in criminal justice analysis: the national victimization surveys, the Uniform Crime Reports, Offender-Based Transaction Statistics, Computerized Criminal History, and the Expenditure and Employment data series. The two systems identified that are operational are PROMIS and CMIS (formally known as OBSCIS-offender-based state correctional information system).

EXHIBIT 2-4

SUMMARY OF NATIONALLY SPONSORED CRIMINAL JUSTICE DATA SERIES AND INFORMATION SYSTEMS



POSSE, a police information system for small size cities, and the Standardized Crime Reporting System (SCRS) are currently under development. SCRS indentifies specific data elements police need to collect. ABCR is a software program which classifies crime characteristics into UCR, state statute, (NCIC), or any other classification. These secondary data sources and information systems are discussed in greater detail in section 5d below.

C. Secondary Data Sources

(At the end of the chapter Appendix A is a comprehensive list of LEAA Statistics Division Publications (FY's 1971-1980). These are a substantial source of secondary data used in criminal justice analysis as discussed in this section.)

1. Victim Reported Data

The first national victimization survey was conducted in 1966. In 1972 the National Crime Surveys were initiated by LEAA and the U.S. Bureau of the Census. These surveys were designed to measure the extent to which persons age 12 and over, households, and businesses have been victims of certain types of crime, and to describe the nature of the criminal incident and the victims.[27] The National Crime Surveys consisted of four survey efforts:

(1) National Household Survey -- A sample of 60,000 households from throughout the U.S., each interviewed at 6-month intervals. This survey has been conducted continuously since July 1972.
(2) City Household Survey -- A sample of 10,000 households in each of 26 central cities was surveyed. In 1972-1973, surveys were conducted in the five largest cities -- New York, Los Angeles, Detroit, Chicago, and Philadephia -- and the eight impact cities -- Baltimore, Cleveland, Dallas, Denver, Newark, Portland, and St. Louis. In 1974, 13 different cities were surveyed -- Buffalo, Cincinnati, Houston, Miami, Milwaukee, Minneapolis, New Orleans, Oakland, Pittsburgh, San Diego, San Francisco, and Washington, D.C. The initial 13 cities were resurveyed in 1975. After that date the City Household Survey was discontinued.
(3) National Commercial Survey -- A sample of 39,000 establishments from throughout the U.S. which were interviewed at six month intervals beginning in July 1972. This survey was discontinued in 1978.
(4) City Commercial Survey -- A sample survey of establishments located in the same cities used for the City Household Survey varied from 1,000 to 5,000 establishments. This survey was also discontinued in 1976.

These victimization surveys were designed to achieve two principal objectives: (1) provide in-depth and dynamic descriptive measures of criminal victimizations and (2) provide measures that are useful for problem and policy-oriented analysis. The type of information contained in these surveys includes:

- characteristics of victims failing to report crimes to police;
- risk of victimization related to demographic characteristics of victims such as race, sex, age, occupation, geographic location, and income;
- consequences of victimization -- injury, medical costs, financial losses due to property loss, extent of property recovery, days lost from work;
- characteristics of offenders such as age, sex, and race, number of offenders involved in the victimization, and the offender's relationship to the victim; and
- attitudes of respondents toward aspects of the criminal justice system and crime.

The uses of victim reported data in crime and criminal justice analyses are numerous. For example:

- Victim reported data provide a clearer picture of the magnitude of the crime problem and factors related to it, with subsequent implications for changes needed in the criminal justice system to control or reduce crime;
- Place and time of occurrence can suggest police operations strategies. For example, some geographic areas (e.g., downtowns) may have substantially more night-time crime and need additional police protection or street lighting.
- Reasons for not reporting can suggest special efforts to get victims to report, and can suggest areas in which increased system response may be necessary.
- The cost of crime can be more accurately calculated, permitting more accurate studies to be made of the true benefits and costs of existing or proposed programs and system responses.
- Victimization survey data can suggest additional elements of offenses that should be recorded in police offense reports.
- Victimization survey data can provide an important perspective on changes in rate of crime over time.

There has been much substantive and methodological criticism of the victimization surveys. Some of the limitations are that: (1) due to the time frame involved, recall of victims interviewed may not be accurate; (2) certain crimes are not covered; (3) small area analysis has not been practical due to both privacy restrictions and the nature of the samples used; and (4) sampling bias resulting in reliability and validity problems.

A major difficulty in obtaining accurate crime data based on victim reports is the need for recall. The recall problem was a focus of a study conducted in San Jose, California, where reverse record checks were conducted. In reverse record checks, persons who have reported crimes to the police are selected from police files and then are interviewed -- without being told how they have been selected -- to determine the accuracy of reported victimizations. The San Jose study indicated that victimization data significantly underrepresent the actual amount of crime because of non-recall.[28]

The other three limitations described above are related to the survey procedure. Usually the number of respondents is too small to permit small-area (e.g., neighborhood level) analysis. Crimes which occur rarely such as kidnapping and skyjacking are not picked up accurately through sample surveys, and official reports must be used for this type of data.[29] (See Exhibit 2-5 for a summary of information on Victim Reported Crime Data.)

EXHIBIT 2-5

VICTIM REPORTED DATA, SUMMARY

TYPE	DEFINITION	SOURCES	USES	LIMITATIONS
Victim Reported Data	Indicators of types & magnitude of crime	• National crime surveys • Local victimization surveys	• True picture • Magnitude • Correlates • Implications for change • Place and time of occurrance • Operational strategies • Reasons for reporting • Costs of crime • Perspectives on data changes	• Forgetting • Sampling errors • Small Area limitations • No data on some rare crimes (e.g. kidnapping homicide) • Population at risks rates are difficult to obtain • Unreliable data on infrequent crimes (e.g. rape)

2. Police Reported Data

The data which are most readily available are based on police reported crime, or "crime statistics" as these data are sometimes called. Crime statistics are the official records of reported offenses and arrests. The sources for such crime data include:

- local police department reports;
- reports by Criminal Justice Planning Agencies or Statisical Analysis Centers;
- State Uniform Crime Reporting Programs;
- national data collected by the FBI available in the Uniform Crime Statistics (UCR) reports; and
- crime-orientated information systems -- SCRS and ABCR.

a. Local Police Department Reports

Reports summarizing local data may be the richest source of data on reported offenses and arrests. Many localities have developed their own reporting systems which record crimes of particular interest locally.

b. State/Regional Criminal Justice Planning Agency Data

The majority of states in the United States have one or more of the following state criminal justice-related agencies which collect statewide crime statistics: a state Criminal Justice Coordinating Council, a Statistical Analysis Center, or a UCR data collection program. These agencies will have the most complete crime data on a statewide basis.

c. State Uniform Crime Reporting Programs

In 1979 forty-five states had a State UCR program and three state programs were under development. UCR state programs serve particularly valuable functions including:

- assistance in enacting laws requiring local UCR participation;
- collecting more information than required by the national program;
- production of annual and some semi-annual publications; and
- responding to local requests for data.

Such programs have greatly increased reporting, through technical assistance and training from contributing agencies and through the enforcement of mandatory reporting laws. The outreach and audit capabilities of such programs have greatly improved the quality of UCR data. Such programs have produced more timely, frequent, and detailed analyses of the UCR data in their states than that available from the FBI. Many state programs capture much more than basic UCR data (i.e., the incident based systems of Oregon and South Carolina) which they feed back in analyzed form to contributors for use in management, planning, and evaluation.

d. National Uniform Crime Reports (UCR)

The only reasonably comparative and consistent national data on crime is collected by the FBI and published as the Uniform Crime Reports. This system was developed in 1930 under the auspices of the International Association of Chiefs of Police (IACP). The purpose of the UCR system is to obtain data on a national basis for comparing the incidence of serious crimes -- mainly those involving physical violence. Prior to the development of the UCR system in 1930, no comprehensive system or crime information on a national scale existed. This was primarily due to the fact that the criminal statutes varied so greatly from state to state in terminology used to define criminal behavior.

To overcome this problem, a set of definitions for specific criminal acts was devised, following a thorough examination of all the current state criminal statutes. To reduce the potential volume of reporting, only "serious" crimes were included. The crimes which meet the FBI definition of "serious" include:

- Criminal Homicide: (a) Murder and non-negligent manslaughter -- all willful felonious homicides as distinguished from deaths caused by negligence (excludes attempts to kill, assaults to kill, suicides, accidental deaths, or justifiable homicides). Justifiable homicides are limited to: 1) the killing of a person by a law enforcement officer in the line of duty; and 2) the killing of a person in the act of committing a felony by a private citizen. (b) Manslaughter by negligence -- any death which the police investigation established was primarily attributable to gross negligence of some individual other than the victim.
- Forcible Rape: The carnal knowledge of a female, forcibly and against her will in the categories of rape by force, assault to rape, and attempted rape (excludes statutory offenses where no force was used and the victim was under age of consent).
- Robbery: Stealing or taking anything of value from the care, custody, or control of a person by force or violence or by putting in fear, such as a strong-arm robbery, stickups, armed robbery, assaults to rob, and attempts to rob.
- Aggravated Assault: Assault with intent to kill or for the purpose of inflicting severe bodily injury by shooting, cutting, stabbing, maiming, poisoning, scalding, or by the use of acids, explosives, or other means (excludes simple assaults).
- Burglary -- Breaking or Entering: Burglary, housebreaking, safe-cracking, or any other unlawful entry of a structure with the intent to commit a felony or a theft (includes attempted forcible entry). The UCR definition does not include auto burglaries, burglary of moveables, or a wide variety of such incidents as included in some state statutes.
- Larceny -- Theft (Except Motor Vehicle Theft): The unlawful taking, carrying, leading, or riding away of property from the possession or constructive possession of another. Thefts of bicycles or of automobile accessories, shoplifting, pocket-picking, or any stealing of property or article which

is not taken by force and violence or by fraud (excludes embezzlement, "con" games, forgery, or worthless checks).

- Motor Vehicle Theft: Unlawful taking or stealing or attempted theft of a motor vehicle. A motor vehicle is a self-propelled vehicle that travels on the surface but not on rails. Specifically excluded from this category are motor boats, construction equipment, airplanes, and farming equipment.

In January 1979, Congress required that the UCR add Arson to this list of serious offenses. A second recent change in the UCR was the decision no longer to report dispositional data.

The UCR data have certain limitations. These include:

- incomplete reporting (not all jurisdictions participate in the reporting system, and not all participating jurisdictions supply all requested data);
- limited number of crimes reported;
- possible bias in individual locality data due to differing interpretations of reporting procedures or to changes in the local data collection system; and
- variable scoring practices and the lack of a clear relationship between arrest and offense data.

The major publications summarizing national UCR data are:

- a "quarterly report" giving trend information on the Crime Index offenses (comparison of percent change between current time period and same period of the prior year and a five-year trend);
- an annual report entitled Crime in the United States summarizing crime on a national basis by a number of different breakdowns; and
- Standarized Crime Reporting System (SCRS).

Crime reporting systems were initially developed by police agencies simply as investigative and prosecutorial aids. Use of police records and statistics has significantly expanded in recent years. Such data are used, for example, for management decisions concerning the distribution of law enforcement resources. On the other hand, utilization of crime/event report information by non-police criminal justice analysts has been minimal. This under-utilization of police reporting systems is largely the consequence of unfamiliarity with the range of data available and inadequate conceptualization and hypothesizing about relationships between crime/event report data and important current issues. The lack of analytic interest also was partly due, in the past, to concerns over the validity and reliability of data produced by police agencies. The data integrity problem, however, has been substantially reduced with the development of Standardized Crime Reporting System (SCRS).

SCRS is still in an early stage of development as a national system. A computer-aided SCRS system has been pilot-tested in a number of jurisdictions including the Durango, Colorado Police Department and the city of North Las Vegas. It has a significant potential for establishing a basic data base on criminal occurrences, particularly when coupled with the concept of Attribute-Based Crime Reporting discussed below. The SCRS model is undergoing testing in five jurisdictions, four local police departments, and one state agency. The SCRS model includes these features:

- geocoding;
- alphanumeric identifiers for events and recording officers;
- easy-to-use forms;
- simplified paper flow;
- trained collectors, processors, and users of data;
- clearly-defined responsibilities for report review, approval, and audit;
- uniform criteria for report taking, property valuation, and offense classification;
- thoroughly tested standardized data elements; and
- case or event-oriented recordkeeping.

SCRS is in the process of establishing four basic report forms:

- complaint/dispatch report;
- crime/event report;
- follow-up investigation report; and
- arrest report.

Each form will contain data elements that allow it to be linked to other forms associated with the same crime or event. Such linkage is a critical component of SCRS, in that it allows ready access to all related records surrounding a criminal event. Furthermore, it supports the development of statistical information describing agency processing of cases.

A variety of output reports can be created from an SCRS data base. Most are intended to provide direct support to department management, but they also can be an important source of information for analysts. Included are offense, arrest, court disposition, property loss, and activity summaries.

f. Attribute-Based Crime Reporting (ABCR)

ABCR is a computerized methodology for categorizing crime based upon the unique characteristics of the criminal event. Using this methodology, the specific attributes of each event are recorded and become the basis for producing the crime classification required not only by the individual agency but also by others in the criminal justice community. Originally, ABCR was seen as a means to use a computer to assign events to the variety of crime classifications in use today (e.g., those of Uniform Crime Reporting, of the uniform offense classification used for NCIC/CCH, and of the appropriate state statutes). ABCR would allow for automatic translation from basic attributes to any of these crime classifications. In 1980, tests of ABCR are being conducted by the Oregon State Police and the local Police Departments in Sacremento and Davis, California. (See Exhibit 2-6 for a summarization of information on Police Reported Crime Data.)

EXHIBIT 2-6

ASSESSMENT OF POLICE REPORTED CRIME DATA

TYPE	DEFINITION	SOURCES	USES	LIMITATIONS
Police Reported Crime Data	Official "Crime Statistics" on reported offenses and arrests	• Local police department reports • State UCR programs reports • Data tapes state/regional planning agencies • Special study reports • Federal UCR program • SCRS • ABCR • CCH	• Detailed analyses of particular interest locally • Trend analysis • Workload analysis	• Local variations in citizen reporting • Incomplete reporting by agency • Scoring of offenses hierarchy • Comparisons of offenses with arrests or clearances

3. Public Opinion Data

The third major data category relates to public opinion or attitudes. Secondary sources containing this type of data are usually victimization surveys or public opinion polls which may include data on:

- the importance of crime relative to other problems;
- fear of crime and actions people take to protect themselves;
- ratings of criminal justice services; and
- ratings of possible solutions to crime problems.

Existing sources of public opinion data include:

- surveys from the major companies which specialize in public opinion polling;
- local studies financed through the Community Development Block Grant funds from the U.S. Department of Housing and Urban Development or through other agencies;
- local newspapers which may run surveys as part of an article or series;
- victimization surveys which often contain questions on public opinion;
- local business associations for business-related crime; and
- annual nationwide social surveys from university research centers such as the National Opinion Research Center (University of Chicago) and the Institute for Social Research (University of Michigan).

The use of a public opinion poll to "test" a new program or policy alternative is illustrated in the Michigan Speaks Out surveys.[30] A controversial issue in many states is the sentencing discretion given to criminal court judges by state statutes. Exhibit 2-7 presents the results of three surveys of Michigan residents who were asked their opinions on this topic. The data indicate a developing public sentiment in favor of mandatory sentences and reducing judicial discretion in sentencing. Exhibit 2-8 presents summary information on public opinion data.

EXHIBIT 2-7

RESIDENT ATTITUDES ON SENTENCING LAW ALTERNATIVES, STATE OF MICHIGAN, 1974-1976

Question: THERE ARE VARIOUS WAYS OF SENTENCING CONVICTED CRIMINALS. WHICH ONE OF THESE WAYS COMES CLOSEST TO YOUR THOUGHTS ON SENTENCING?

	Total 1974	Total 1975	Total 1976	Change 1974-76
Basis 1*	45%	46%	52%	+7
Basis 2*	38	36	32	-6
Basis 3*	14	14	9	-5
Don't Know	3	5	7	+4
	100%	100%**	100%	
*BASES	(400)	(800)	(800)	

1 = The law should specify one single mandatory sentence, for each offense (crime or law breaking). This should get more severe for each offense after the first one. The judge would not be free to vary the sentence for different cases.

2 = The law should continue to specify minimum and maximum ranges of sentences for each crime.

3 = The judge should be free to impose any sentence he feels warranted (indeterminant sentencing).

** Does not total to 100% due to rounding.

Source: The Michigan Public Speaks Out on Crime (4th Edition) Office of Criminal Justice Programs, State of Michigan, 1976.

EXHIBIT 2-8

ASSESSMENT OF CRIME-RELATED PUBLIC OPINION DATA

TYPE	DEFINITION	SOURCES	USES	LIMITATIONS
Public Opinion Data	Perceptual or subjective indicators of crime or criminal justice services	• National polling companies • University research centers • Victimization surveys • Local newspapers • Political polls	• Measure opinions on relative importance of crime • Fear of crime • Ratings of criminal justice services • Possible solutions to crime problems • Comparisons of citizen vs. official priorities • Comparisons of actual vs. perceived crime problems	• Sampling errors • Instrument bias • Interviewer bias • Interpretation of results • Accuracy of data • Content

4. Demographic Data

The fourth major category of secondary data is demographic data. Demographic data refers to data on population, especially with reference to size, density, distribution, and vital statistics. Typical demographic measures used in criminal justice analysis include such population characteristics as age, sex, race, income, education, and place of residence. In addition, demographic data include social, economic, and political indicators of communities, neighborhoods, cities, states, and other geographical areas.

Demographic data are available from a wide variety of sources at the national, state, and local levels. Generally, the U.S. Census provides data of good quality and of sufficient detail to be useful to the analyst. However, Census data are limited because most specialized data are collected only every five years or more and rapidly become inaccurate, particularly in areas experiencing rapid population change. Recently it was decided that the population census will be taken every five years to solve some of these currency problems. On the state and local level, demographic data are useful in developing specific indicators (e.g., school vandalism rates per 1,000 school-aged children where the number of school-aged chidren is obtained from the local school system).

Demographic data are used for two major purposes in the analysis of crime: to calculate crime or population-at-risk rates and to examine the correlates of crime and system performance. Crime rates are normally calculated by dividing the number of reported offenses occurring over a one-year period by the number of people living within the jurisdiction. Thus, if 500 commercial burglaries are reported in a locality of 100,000 population, the commercial burglary rate is 0.5% or 500 per 100,000. Population-at-risk rates are a more refined measure which take into account the population most likely to be affected by a crime. For example, if the locality with 500 commercial robberies had 1,000 commercial enterprises in operation during that year, the population-at-risk rate would be 50% or 50,000 per 100,000. (See Chapter 3 for a more complete discussion of population-at-risk. See Exhibit 2-9 for summary of information on demographic data.)

EXHIBIT 2-9

DEMOGRAPHIC DATA, SUMMARY

TYPE	DEFINITION	SOURCES	USES	LIMITATIONS
Demographic Data	Population statistics which refer to size, density distribution and vital events	o U. S. Census Bureau o Reports o Data tapes o Special surveys o State census agencies o University population research centers o Local surveys o Local school systems o Local planning agencies	o Population-at-risk rates o Examination of correlaters of crime and system performance o Geographic comparisons o Offender/victim comparisons	o Currency o Small area limitations o Category breakdowns inadequate o Differing geographic boundaries for data

5. System* Data

Criminal Justice system data are obtained from several quite different sources. The expenditure and employment data series provides resource data that are national in scope. A second source of system data are offender-based transaction statistics (OBTS) and computerized criminal histories (CCH). OBTS provides an indication of workload and offender flows, while CCH records provide indepth qualitative indicators of a criminal career. There are, in addition, a number of quite different criminal justice information systems which, if available, are a rich source of system data. A wide variety of Management and Administrative Statistics (MAS) are a major data source of many system-oriented studies. These are data obtained from official or unofficial agency records and reports. Finally, the Uniform Parole Report and National Prisoner Survey provide information on corrections. Following is a discussion of these system data sources.

a. Expenditure and Employment Data

The national survey of expenditures and employment in criminal justice agencies dates back to FY 1967 in which a special study was conducted by the Bureau of the Census to identify police, judicial, and corrections data for large governments in the U.S. Between 1969 and 1971 several major changes in survey design and procedures were made, thus making pre-1971 data unreliable for most time-series analyses. In 1971 a new, enlarged sample of governments was identified for the survey. This panel includes the federal government, all state governments, and a representative sample of local governments in each state. For example, in 1976:

> "Data were collected for all county governments, for all municipalities having a 1970 population of 10,000 or more, and a sample of the remaining municipalities and townships with less than 10,000 population . . . The survey panel therefore included the Federal government, the 50 state governments, and 9,045 local governments (the 3,042 county governments, 4,305 municipalities and 1,698 townships). Two sets of reports have been produced: Annual Reports for FY 1967 - to the present, and Trends in Expenditure and Employment Data reports covering FYs 1971 - 1973, FYs 1971 - 1974, FYs 1971-1975 and FYs 1971 - 1976.[31]

b. Computerized Criminal Histories (CCH)

The criminal history chronicles each major contact that an individual has with the criminal justice process by documenting such events as arrests, dispositions, sentences, correctional commitments, and release status. This record is the information thread that weaves together the functions performed by law enforcement, prosecutors, defense, courts, corrections, probation, and parole. What is significant about a criminal

*System, as this term is customarily used in criminal justice analysis, is defined in Chapter 6.

history record is that it is relied upon by a wide variety of users, all performing different functions at different points in the overall criminal justice process. Among these are pre-arrest investigations by law enforcement officers and prosecutors; information for arrest and bail release decisions; plea bargaining, court case preparation, and witness verifications; juror qualification, and sentencing; post-trial corrections and probation/parole activities such as estimating the likelihood of escape and violence. If a CCH is complete, it is particularly valuable for looking at career criminal and recidivism issues.

Hence, computerized criminal history systems are, today, the most comprehensive source of data about the criminal justice process itself. Each of the major components of the system (law enforcement, courts, and corrections) relies upon specific reporting systems which collect data and provide information on the particular operations of that component. The UCR supports law enforcement; SJIS and OBSCIS application are designed to meet the respective informational needs of state judiciaries and correctional agencies. A computerized criminal history system coordinates them all.

Since criminal history records collectively can be manipulated in numerous ways, managerial uses of the data become spinoffs from normal operating systems. New state-level systems to collect, manipulate, and report this type of information are not necessary. Managerial needs can be met by manipulating existing data, available from operational computerized criminal history systems.

CCH provides only limited qualitative data for the analyst. However, with the inclusion of additional data elements and the support of an OBTS report generator program, good quantitative data may be obtained.

Typically criminal history records contain:

- o personal descriptors (fingerprint classification, date of birth, sex, height/weight, aliases/nicknames, and residence locations and dates);
- o arrest data (arrest charges, places, and dates);
- o court/prosecution/probation data (charges: pleaded to, reduced and/or sentences; dispositions: charges, outcomes, probation terms); and
- o corrections (where and how long incarcerated, parole/release, local/state/federal).

In 1979 30 states were developing CCH systems, 12 states were providing CCH records to NCIC, and three others were designing CCH systems.

c. Offender Based Transaction Statistics (OBTS)

One way of examining the rate and speed with which offenders are handled by the criminal justice system and the consequences of certain dispositions is to track individual offenders. This method is called offender based transaction statistics (OBTS). The data are "transactional" since the individual offender is the unit of count and thus links each segment of the criminal justice system to the others.

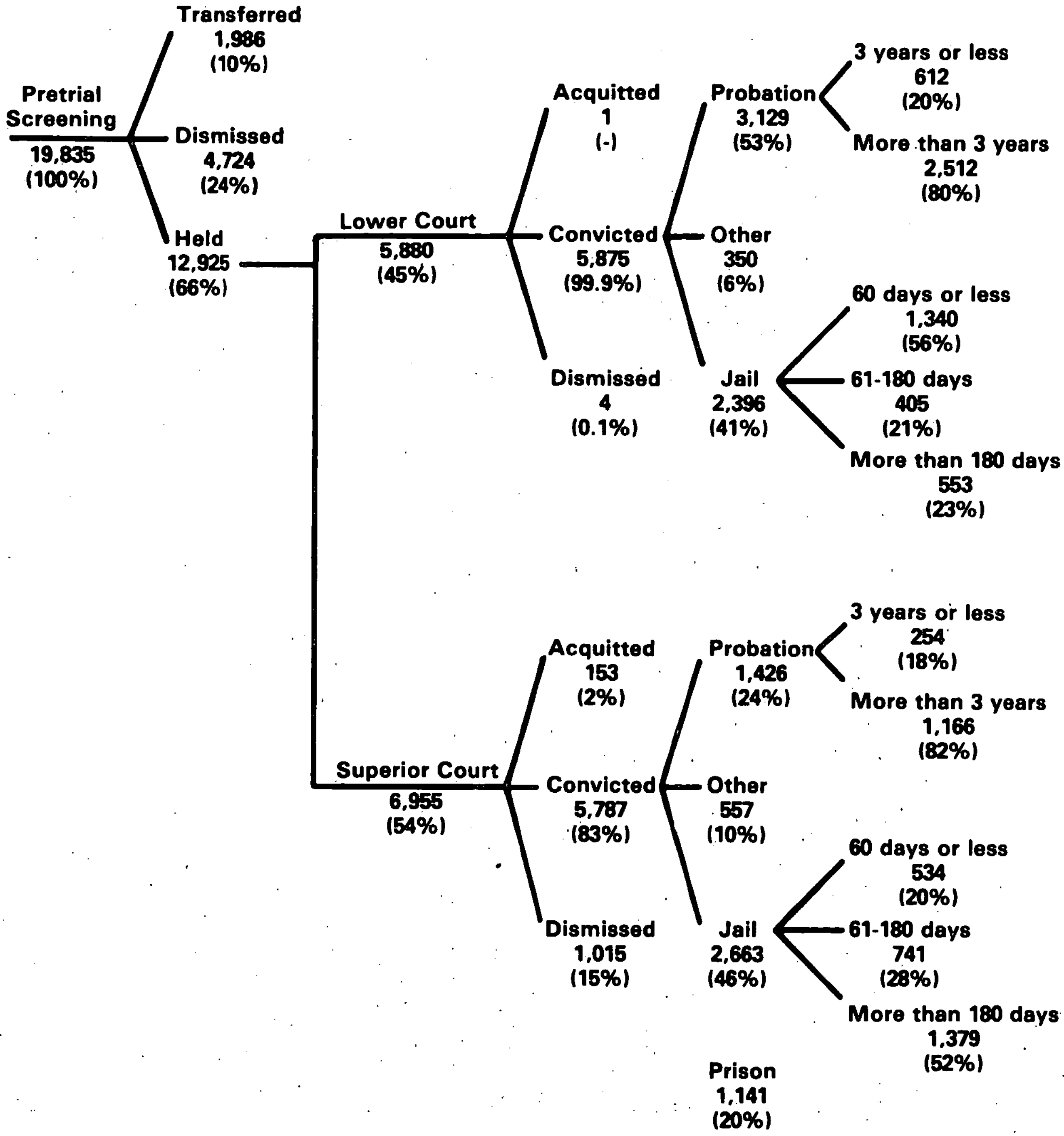
An example of an offender-based transaction data system at the state level is found in California.

Exhibit 2-10 is based upon a transaction data set and depicts the flow of adult felony offenders through various decision-making stages for urban counties. While the decision points depicted in this flowchart are limited due to the lack of correctional data and other pieces of information such as bail determination, they nonetheless give a fairly good approximation of a working OBTS model. It is interesting to note, for example, that approximately one fifth of both urban and rural arrestees have their cases dismissed prior to trial. What may account for these pre-trial case dismissals? Are such a high proportion of initial arrest decisions based upon evidence that cannot later support a conviction? Of those convicted at the superior court level, approximately one-fifth of all urban offenders receive a prison disposition. If one were to consider all convictions (at either the lower or superior court level) the percentage receiving a prison disposition is considerably lower -- around 10%. This is especially interesting when one considers that all original arrest offenses provided for a prison term of some kind.

Although the data used in this example are preliminary in that many stages in the processing of offenders are omitted, they nonetheless demonstrate the type of information that can be obtained when criminal data are recorded in a transactional format. It is possible to see at a glance the path along which offenders are traveling and the type of dispositions that are occurring. Decisions made at one stage can be related to those occurring at a later stage, a possibility that is precluded with agency-specific summary tables, such as those generated in the UCR.

EXHIBIT 2-10

SAMPLE OBTS FLOW CHART, FLOW OF CALIFORNIA FELONY OFFENDERS, URBAN AREAS, 1969-1971



Source: Carl Pope. Offender-Based Transaction Statistics: New Directions in Data Collection and Reporting. (Washington D.C.: LEAA, NCJISS) 1975, p. 20.

d. Information Systems

National Trial Court Information System (GAVEL)

In 1979 GAVEL was a project intended to:

- determine the information required to operate and manage a trial court,
- develop functional specifications for the GAVEL model, and
- identify existing automated trial court information systems, which may contain elements appropriate for inclusion in the model.

Determination of the information requirements of any system is normally based upon an analysis of the information needs of those who are expected to receive system outputs. In the case of GAVEL, trial court operational personnel and administrators are the most obvious users of system information, and they were being consulted during the system development process.

Prosecutive Management Information System (PROMIS)

PROMIS was originally developed by the Office of the U.S. Attorney for the District of Columbia. Subsequently, PROMIS was declared an Exemplary Project by LEAA, and it is currently being adopted by prosecutors and courts throughout the country. PROMIS was developed with four major goals:

- to allow expenditure of resources on the preparation of cases in a manner proportionate to their relative importance;
- to monitor and insure consistency in the exercise of prosecutorial discretion;
- to alleviate scheduling and logistical impediments to the adjudication of cases on their merits; and
- to analyze problems in the prosecution of criminal cases.

Exhibit 2-11 lists system functions in relation to the above goals. For this discussion, one particularly interesting feature of the model is providing a basis for ranking cases by "importance."

EXHIBIT 2-11

PROMIS GOALS AND CAPABILITIES

Goal	Capabilities
1. Allocate resources based on	• Uniform rating of crime gravity • Importance of Cases • Uniform rating of defendants prior record gravity • Calendar listings of pending cases in descending order of gravity
2. Monitor even-handedness	• Automation of reasons for discretionary decisions • Tracking of relationship between police charges and prosecution charges • Ability to conduct special studies relating disposition patterns not only to legal charges but also to gravity ratings
3. Control Scheduling	• Automated subpoena generation • Logistical problems • Display of reasons for prior postponements in each case • Automated alert when defendant has more than one case pending • Listings of fugitives from pending cases • Case aging lists • Case listings by assistant prosecutor
4. Research and Analysis Capability	• Periodic statistical reports on: - intake and screening - preliminary hearings and grand jury cases - misdemeanor and felony trials - disposition types - delay problems • Ability to perform special studies, e.g.: - geo-based studies of crimes and arrests - patterns of criminality - plea bargaining

PROMIS provides comparability among cases by rating each case according to two standard sets of criteria. One set measures the amount of harm done to society by the alleged offense, and the other set measures the gravity of the prior criminal record of the accused. Since these ratings are numerical, it is possible to compare one defendent to another, irrespective of the current charges against each, and to compare one crime to another whether or not both involve the same statutory offense. Based on these ratings, prosecution management can apportion its limited staff time to the intensive preparation of those cases on the day's calendar which involve relatively more important crimes and offenders. PROMIS prints out a copy of the court calendar for each date, but instead of listing the cases in the order the court will call them, e.g., oldest case first, alphabetically, or in ascending order by docket number, it lists them in descending order of importance according to the seriousness of the crime and the gravity of the prior record of the accused.

Crime gravity or "seriousness" is measured by a set of criteria developed by criminologists Marvin Wolfgang and Thorsten Sellin of the University of Pennsylvania (see Chapter 4). These criteria, which are applied to the case by the assistant prosecutor and the arresting police officer during intake and screening, assess the amount of harm done to society through a measurement of the amount of personal injury, property damage or loss, and intimidation.

The case's gravity is measured by a variation on a set of criteria developed originally for the California Department of Corrections to predict recidivism among parole candidates. These criteria pertain to the density of prior arrests and convictions, particularly for crimes against persons, and to the use of aliases.

State Judicial Information System (SJIS)

The SJIS program is the first multi-state effort to bring management information systems to state-level judicial administration. The model supports eight functions seen as being common to state court administration throughout the country:

- monitoring and supervision,
- resource allocation,
- planning,
- research and development,
- budgeting,
- legislative liaison,
- training and education, and
- state and local government liaison.

Note that planning has been specifically included and that several of the listed functions are closely related to analytical activities. A major responsibility of state-level court administration is analysis.

The SJIS data base is structured to allow flexibility in adapting the model to individual state needs while still supporting comparative studies. Each state has built its own system, yet there is a high degree of commonality.

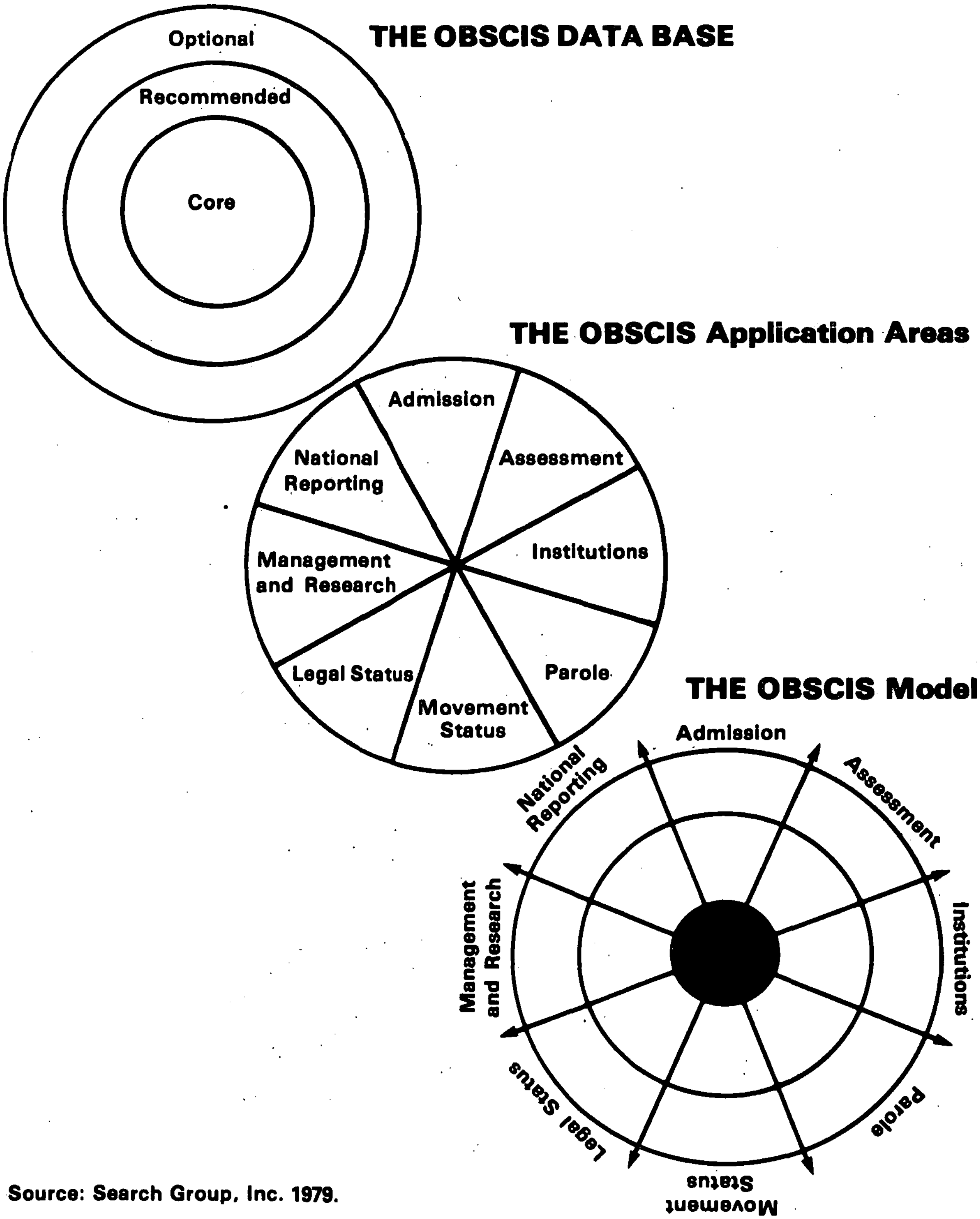
Corrections Management Information System (CMIS)

In 1974, SEARCH Group, Inc. launched the Offender-Based State Corrections Information System (OBSCIS) project. The goal of this project has been to identify practicial guidelines and uniform standards for the development of correctional information and statistical systems for use as a research and planning tool. OBSCIS involvement has grown from 10 states, initially, to 35 states as of 1979.

During phase I, the project produced a model (Exhibit 2-12) that attempted to satisfy the basic informational needs of correctional administrators while supporting the requirements of other criminal justice system designs such as Offender-Based Transaction Statistics/Computerized Criminal Histories (OBTS/CCH) and National Prisoner Statistics (NPS).

EXHIBIT 2-12

THE OBSCIS DATA BASE, APPLICATION AREAS AND MODEL



Source: Search Group, Inc. 1979.

The OBSCIS data base is structured into three strata of data elements. A minimum necessary to support all national corrections information programs is known as the Core level. Elements found in the Core level include basic offender items such as sex, birthdate, offenses, and sentence. Where applicable, a uniform coding structure has been developed to standarize the data among all states.

Extending beyond the Core is a recommended group of data elements which form the basis for a correctional information system at the state level. Some Core level elements are expanded and other elements not found at the Core level are added. Examples of added Core level elements include birthplace, alias, and parole board decisions.

At the outer perimeter of the data base are optional data elements for those states developing additional capabilities and features. This level encompasses those data elements found at the Core and Recommended levels but may include expanded definitions or more detailed coding. For example, in the standard list an offender's alias is specified with a yes/no indicator while in the Optional category, a list of all known aliases can be developed and collected. Thus, the OBSCIS data base can be expanded to meet the needs of a particular corrections environment.

In 1979 the OBSCIS system was renamed CMIS (Corrections Management Information System) to reflect the increased sophistication and comprehensiveness of application areas of this information system. Work is currently underway to develop application programs in the areas of personnel management, budget control, prison industries, food management, inventory control, transportation, and physical plant maintenance. In addition, inmate banking and visitor control applications also are under development.

e. Management and Administrative Statistics (MAS)

Much fragmented MAS information is available; however, because of varying formats, insufficient currency, and questionable accuracy, they are difficult to use. However, there are many sources of MAS data and depending on the analytic need, they may be quite useful. Some of these MAS sources are:

- budgets of units of state and local government;
- expenditure reports of units of state and local government;
- UCR reports on personnel;
- reports of agencies with licensing responsibilities (such as agencies which license residential facilities);
- mental health agency client reports (by source of reference and type of service provided);
- individual institution statistics, usually maintained in conjunction with whatever agency pays the costs;
- court statistics on arraignments, indictments, trials, dispositions, verdicts, sentencing, and referrals;
- agency or institution annual reports;
- Equal Employment Opportunity Commission EEO-4 forms (filed by all units of local government);
- information and management systems such as PROMIS;

- o applications for funds made by units of state and local government (such as CETA, HUD, Title XX of the Social Security Act, etc.)
- o State Statistical Analysis Centers; and
- o state and local certification agencies.

The preceding system data sources are summarized in Exhibit 2-13.

EXHIBIT 2-13

ASSESSMENT OF SYSTEM DATA

TYPE	DEFINITION	SOURCES	USES	LIMITATIONS
System Data	Measures of the manner & rates of processing offenders	• Offender-based transaction • SAC • Agencies • Information Systems	• Dynamic System picture • Identify bottlenecks • Highlight interrelatships • Assess the "what," "where" and "when" of decisions • Suggest "why" questions	• Fragmentation • Interpretation • Arrests/dispositions • Disposition coding • Low frequency • Historical bias • Incomplete reporting
	Measures of resources include: • Budgets • Personnel • Equipment of both system agencies and community resources	Management & Administrative Statistics (MAS) • SAC • Agencies • Information systems • Expenditure and employment data • CJIS	• Develop more efficient & effective operations • Resources implications of proposed system changes • Cross jurisdictional comparisons	• Fragmentation • Incomplete reporting • Currency • Variable reliability

6. Juvenile Data

Juvenile data are treated separately in this text because the juvenile justice system (and the offense categories it involves) are not simply a junior version of adult crimes and systems. Juvenile and adult records are generally recorded differently and kept separately. Most juvenile record-keeping agencies are much more reluctant than agencies keeping adult criminal records to make juvenile information available to "outsiders," even to criminal justice personnel. (In some jurisdictions, in fact, juvenile records are completely destroyed once a juvenile reaches "adult" status.)

Juveniles are generally persons who have not yet reached their 18th birthday. They may come under the jurisdiction of the justice system for a rather wide range of behaviors which do not provide a basis for such jurisdiction in the case of adults. These are generally called "status offenses" (although the term "offense" is often inappropriate) because it is the age status of the individual which permits the claim of jurisdiction. Traditionally, such offenses have fallen into two major categories -- "dependency" and "neglect" -- although traditional terminology is changing. One recent survey identified 34 different status offense categories used in various states.

Most of these categories have to do with the relationship between parents and children, particularly authority relationships. Most common are runaways and "incorrigibles." Truancy is another common status offense. Laws mandate attendance at school up to age 16 in most jurisdictions. A 16-year-old can be arrested and subject to legal penalties if repeatedly absent from school; 17-year-olds cannot. (A basic legal distinction exists between "status" offense and "delinquency": a delinquent act would be a crime if committed by an adult; a status offense would not be.) The implications of status offenses for data analysis are that a large number of behavioral forms recorded in juvenile records would not be "criminal" if engaged in by an adult and therefore grossly inflate juvenile offense statistics. The implications for jurisdictional claims are that there is greater discretion by authorities as to whether or not to take legal action than in the case of adult crimes, and a larger percentage of juvenile "caseload" is under jurisdiction for quasi- or non-criminal behavior. (Technically, "juveniles" cannot commit "crimes," they can only be arrested/adjudicated for achieving a state of "delinquency.") A large part of the juvenile system is focused on preventing juveniles from subsequently committing "crimes" as adults. A measure of that concentration of effort is the fact that $41 billion or 98% of all Federal expenditures for youth in 1976 were for prevention programs while only $1 billion or 2% were for Federal enforcement/adjudication/corrections/diversion programs (Office of Juvenile Justice and Delinquency Prevention, 1979).

UCR juvenile arrest statistics may be obtained by a locality by asking the FBI or State UCR (preferably) directly for the data. However, a shortcoming in "official" data is that a very large proportion of juvenile offenses never find their way into official records, due to the reluctance of police to arrest, the difficulty in detecting perpetrators, and other factors. In Boston, for example, in over one-half of the cases in which juveniles are contacted by the police and a record made, the juvenile is warned by the police and released, and in a far larger proportion of police contacts, no record of any kind is made. Neither "warnings" or unrecorded contacts figure in UCR statistics.

A second major source of juvenile data is the "Child in Custody" series which reports on a nationwide census of juvenile detention and a correctional facility census. This series reports on public residential facilities (in 1971 and 1973) and was expanded to cover private facilities, as well.

It is therefore useful for local and state-level personnel to have access to other juvenile data which provide a more accurate and comprehensive picture of the actual volume and forms of juvenile crime in their jurisdictions. The following list includes nine "populations" of offenders and/or offenses which can be used:

- offenses recorded through direct field observation in the community;
- complaints to police, including those where no official action is recorded;
- tabulations of total contacts and arrests recorded by police;
- tabulations of all juvenile arrests by crime, by police juvenile division, other police divisions, and as a result of referrals;
- recorded court arraignments (appearances, charges);
- court case records;
- probation caseloads, by offense-types;
- populations of institutions and other placement facilities (by basis of commitment); and
- parole/aftercare caseloads (by offense types).

Not all of these data sources will be available in all jurisdictions, but some or most are collected in many. Because these bodies of data are based on different selection criteria, each gives a different picture of the "shape" of juvenile offender population and offense patterns for the same jurisdiction. Comparisons among the several bodies of data provide a variety of useful kinds of information. An example of one kind of information included is the volume and kinds of unacted-on delinquency. Another example is the selection and attrition processes within the "flow" through the juvenile justice system.

There are, however, limitations to these data bases. For instance, court records provide detailed accounting of case processing and are computerized in some jurisdictions, making them easily accessible for analysis. In the case of juvenile case statistics, however, access may be severely limited due to the desire to protect the identity of a juvenile. Concern with the stigmatizing characteristics of contact with the juvenile justice system has recently reinforced the strong concern for confidentially in releasing juvenile records. Reseachers will need clearance from proper authorities in many jurisdictions to use juvenile justice case data. Comparable concern appears in the use of juvenile correctional system data.

When obtaining these types of data from sources, the analyst should bear in mind that:

- the quality varies greatly from state to state and from community to community;
- the validity and reliability of the data must be assessed before a decision is made to use them; and
- the major limitations of the data can be traced to the fact that they were usually collected for purposes different from those of juvenile justice analysis.

The following section describes some of these data sources and identifies selected strategies for utilizing them.

a. Federally Required Reporting Data

Title XX of the Social Security Act
The Title XX state plans can be a useful source of data for assessing needs and resources for the juvenile justice system.

Comprehensive Employment and Training Act (CETA)
This locally planned and implemented program is a source of youth employment and training information.

Housing and Urban Development Grant Applications
These grant applications require detailed community and state profile data which can be used to avoid a duplicate effort.

b. Large National Sample Surveys

There are many national sample surveys that are sufficiently large so that the state and large city sub-samples could be analyzed with confidence. However, the sub-samples should contain at least 350 to 400 interviews or subjects. Following is a selection of available and relevant national surveys.

Class of '72 Longitudinal Youth Survey
Sponsored by the Office of Education, DHEW, this study involved 22,000 youth who were interviewed during their senior year and reinterviewed two years later. The study is particularly valuable in analyzing the problems that youth experience in the transition from school to work. The state sub-samples would be usable by all but the smallest states. Any political unit with two or more percent of the U.S. population can use the study.

U.S. Census Current Population Reports
These interdecennial reports based on very large samples of the populations contain a number of subject areas of interest to juvenile justice planners -- SES, minority populations, employment, and health are illustrated. While some are focused on youth, many

contain only very gross data on youth. LEAA has made special arrangements with DUALabs to make these data available to state and local planners.

National Alcohol and Drug Abuse Data
This national survey contains a wealth of information on alcohol and drug abuse in the population. It contains profiles of the population most at risk. Strategies for obtaining these data include utilizing the DUALabs service or purchasing the tapes and documentation of these data bases.

Child in Custody Series
A data source containing statistics on youth receiving federal and state institutional care.

c. Specialized Juvenile Data Sources

School Vandalism and Dropout/Pushout Data
Many school districts, state education agencies, and national associations gather these types of data. However, some are reluctant to share data because the data might reflect badly on their performance.

The relatively high volume of offenses, the relatively low number of serious offenses, and the special confidential characteristics of juvenile data qualify these data for special and separate treatment. Other special characteristics of juvenile data include:

- o the collective (gang) nature of many crimes which cannot easily be detected from official data;
- o the peaking of crime rates for different crimes at different ages indicates preventive programs can be aimed at specific "high-risk" age groups; and
- o the special and complex nature of the juvenile criminal justice system with many "passes," "diversions," and "failures to impose sanctions" results in a high attrition rate within the system; it also may make offender-based tracking and the collection of useful MAS more difficult.

Juvenile Data Sources are summarized in Exhibit 2-14.

EXHIBIT 2-14

ASSESSMENT OF JUVENILE DATA

TYPE	DEFINITION	SOURCES	USES	LIMITATIONS
Juvenile Data	Data on forms of juvenile behavior including: • Criminal • Quasi-criminal • Non-criminal & associated system responses	• Juvenile department reports • Local police department reports • State child service agencies • Federal data • Schools • Juvenile court	• Assess kinds and volume of unacted upon delinquency • Assess selection & attrition processes • Define program target population groups • Assess "careers in crime"	• Definitions i.e. delinquent behavior • Confidentiality • Stigma • Age peaks by offense • Diversion • Failure to impose sanctions

D. Primary Data Collection

Primary data are data which must be collected for a particular analysis. There are several different methods of collecting such data and these modes of observation are the subject of this section. Specifically, six methods of collecting criminal justice data will be discussed. These are field research, content analysis, experiments, simulation/modeling, historical research, and surveys.[32]

Field research involves the direct observation of an agency, process, or procedure. In conducting field observations it is important to consider:

- your relation to the subject (should you be observable?);
- what to look at; and
- how to record your observation.

Keeping a journal, recording observations as they occur, and emphasizing unexpected or deviant cases are steps which are fundamental to this data collection procedure. Peter Manning's study of police work is based on field research.[33]

Content analysis involves the systematic sampling of some type of document or other communications medium (e.g., T.V. tapes). It is typically used in historical studies as well as in developing background material relating to an issue or problem. In performing a content analysis, the unit of study is usually a word, a phrase, a report, or some other form of communication.

A third data gathering procedure is the use of experiments. An experiment involves: (1) taking some action by changing a process, activity, or organization and (2) observing the consequences of such changes. An example of a major experiment in the criminal justice field is the Kansas City Preventive Patrol Experiment. In this experiment three controlled levels of preventive patrol were used. Reactive patrol areas received no preventive patrol and only calls for assistance brought patrols to the area. Proactive patrols resulted in police visibility being increased two to three times its usual level. The third strategy maintained normal levels in the area during the experiment. Five specific hypotheses were tested:

(1) crime as reflected by victimization survey and reported crime data would not vary by type of patrol;
(2) citizen perception of police service would not vary by type of patrol;
(3) citizen fear and behavior as a result of fear would not vary by type of patrol;
(4) police response time and citizen satisfaction with response time would vary by experimental area; and
(5) traffic accidents would increase in the reactive beats.[34]

Historical research, a fourth procedure, involves the reconstruction of prior events to explain specific consequences or outcomes. There are many examples of this type of research in the criminal justice literature. One of the more provocative historical studies is Roger Lane's investigation of 19th century homicides in Boston.35

Simulation/modeling procedures may be useful in generating data. These techniques are based on knowledge of the criminal justice system and/or criminal justice behavior, the construction of a computerized version of the processes, and observation and modification of the model to analyze possible changes and their consequences. The JUSSIM model developed at Carnegie-Mellon University simulates the processing of defendants from arrest to release, by crime type groupings, through the criminal justice system. Using the model, various changes in policy and program can be considered and their consequences examined.36

The last data collection method to be considered is survey research. This is, perhaps, the most common data collection procedure used in criminal justice. The survey process consists of: (1) designing the survey; (2) preparing a sampling plan; (3) selecting a survey procedure and drafting questions; (4) conducting the survey; and (5) coding the results.

Design Consideration

The decision to use a survey to collect data is based on several factors. These include the nature of the hypotheses to be tested, the resources and time available to collect the data, the need for accurate measures, the feasibility of a survey design, and the acceptability of a survey to decision-makers and staff.

In assessing alternative primary data collection efforts, it is important to be familiar with the variety of methods available. Even if the jurisdiction uses a consultant to do all the data collection work, a decision must still be made by the jurisdiction or jointly with a consultant of what data to collect, how large and what type of sample is required, and how the data should be collected.

In answering these basic questions it is important to have the problems clearly stated. Selection of data collection and analysis methods is heavily dependent on problem specifications, and analytic efficiency is directly related to an effective data collection plan. Once the questions and uses to which the findings will be put are known, a review of methods should be undertaken.

Despite the availability of National Victimization data, a number of local (e.g., city, state) criminal justice agencies have conducted, or are planning to conduct, sample surveys of their own. These locally initiated efforts are scattered, and they vary tremendously in focus and quality. Although most of the local surveys have been concerned with the study of victimization, other information -- particularly in the realm of public attitudes -- is being generated.

NCJISS has undertaken several studies emphasizing the application of local as well as the national victimization data. For example, James Garofalo's study focuses on local victimization survey applications ("Local Victim Surveys: A Review of the Issues," Analytic Report SD-NAD-2).

There are a number of reasons why local agencies have chosen to devote resources to conducting local sample surveys. First, some local agencies find it desirable to develop sources of information that are independent of official processing. Even among local personnel who use the NCS and police-reported data, there is concern with the amount of "lag time" that occurs between data collection and dissemination. The results of locally sponsored surveys can be put to use as soon as the data are collected and analyzed. Secondly, many practitioners believe that it is easier to gain acceptance for programs developed on the basis of locally collected data rather than on the basis of results generalized from surveys that were conducted elsewhere. Finally, when trying to address issues with information generated by a survey that was not explicitly designed to address those issues, one often finds that questions were not asked in exactly the way one would have wished. This problem can be overcome when local personnel design their own surveys of problems and issues that are relevant to them.

Regardless of whether a sample survey is being conducted on a national or local level, it is imperative that the people planning the survey explicitly consider what information they wish to generate and how they intend to use the survey results. Survey methods are less applicable to some information needs than to others. For example, it would be wasteful to use a survey to gather data on which to base decisions about the allocation of police manpower within a city; actual calls to the police for service and reported crimes already provide good indicators of the need for police personnel in various areas of the city. On the other hand, if police officials are concerned with potential public response to a planned change in police practices (e.g., the abandonment of some existing service functions), then a sample survey could prove useful in estimating public attitudes.

Even when it is decided that a sample survey will be helpful in generating needed information, the particular goals set for the survey will determine what specific methods must be used and how much the effort will cost. Suppose, for example, that a goal is to estimate, from a sample, the number of robberies occurring in a city. Such a task requires a very large sample because robberies are relatively rare events. In addition, the goal requires that the sample used be representative of the population of the city.

Surveys of known victims can provide valuable information about citizen contacts and satisfaction with the criminal justice system, pointing to ways for system improvement. Because the target population can be defined to include only people who have been in contact with the criminal justice system, it is easier to construct a sampling frame, that is, identify respondents. Official records can be used for this purpose. Since all of the people in the sampling frame are known to have had contact with the system, the sample drawn for interviewing would not have to be anywhere near as large as in the usual victimization survey which tries to uncover victimizations in the general population.

There are several ways in which the NCS experiences can be useful to local agencies planning to conduct their own surveys. If the local agency wants to locate and interview victims in the general population, the NCS findings can provide a rough idea of how many victims of various types of crime will be located in a sample of a given size in a certain type of area (e.g., urban, suburban, rural). With this estimate, the agency can decide on the approximate sample size it will need. Secondly, the interview schedules used in the NCS have been extensively pretested and refined. They can be quite useful as guidance for the agency in constructing its own instruments. Thirdly, the NCS pretests also have generated some very important findings about effective interviewing procedures in victimization surveys. Familiarity with these findings can help avoid needless errors and improve data collection quality. The Census Bureau has produced interviewer training and instruction manuals for the NCS program. These documents cover a variety of procedural points. For example, one section describes how each question of the interview schedule should be asked and when and how the interviewer should probe for answers. Finally, the Census Bureau's NCS documentation contains technical information on sampling, weighting factors, and estimation procedures useful for those involved in a local effort.

Sampling Procedures

It is generally not practical to collect data from an entire population because of time and cost considerations. In the usual case, it is more efficient to collect and study data from a sample of the population being considered. An analysis of the sample data should provide useful information about the population being studied. Two questions are usually addressed in considering a sample: how large a sample should be selected and how should the sample be drawn. Sampling procedures are discussed below, followed by a brief discussion of the problems in estimating sample size.

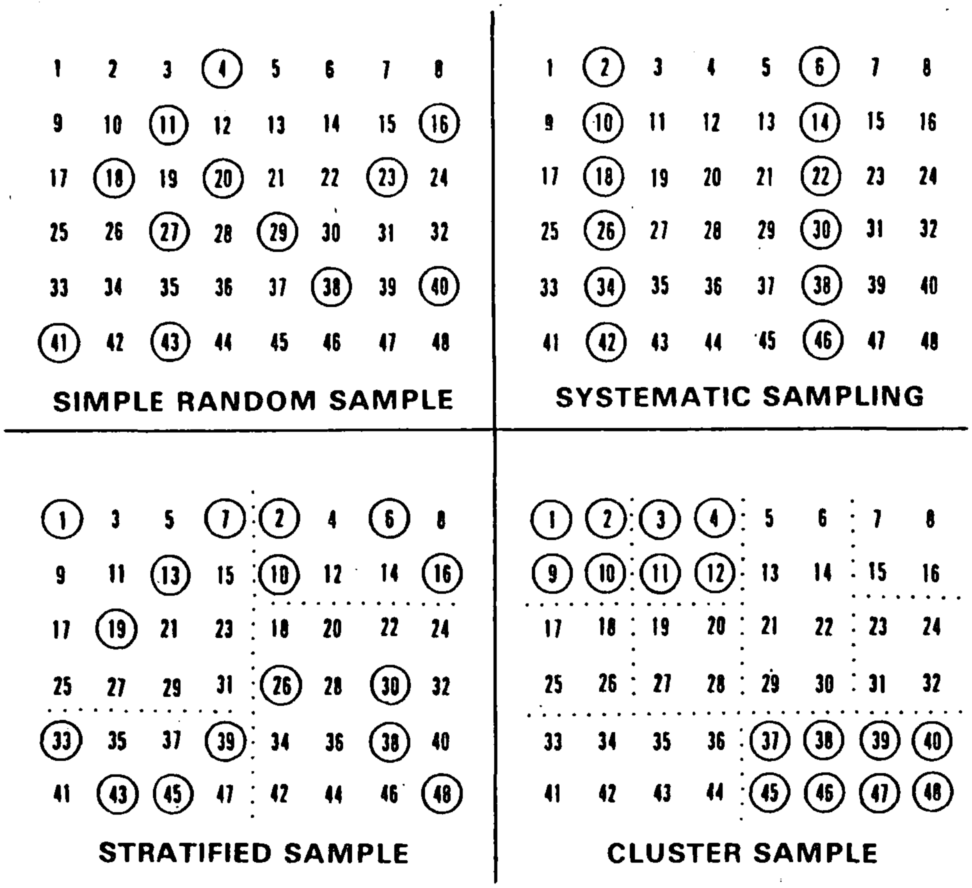
In order for the results obtained from the analysis of sample data to be applicable to the population from which they were drawn, it is necessary that the sample be representative. A representative sample is one which reflects the characteristics of the population being sampled in its true proportions. In actual practice, a representative sample can never be attained unless there is perfectly accurate and complete knowledge about the population being studied.

A representative sample is most likely to be obtained if the sample is drawn using a random selection procedure. Such a sample is called a random sample. A random sample is extremely important: methods of statistical inference used to generalize from the sample to the population of interest depend upon the representativeness of the sample. A random sample can be drawn only from a population if every item or person in the population has an equal chance of being drawn on each successive draw.

There are a variety of types of random samples that can be drawn from populations. Four types of random samples will be briefly discussed here: 1) simple random samples, 2) systematic samples, 3) stratified samples, and 4) cluster samples. (See Exhibit 2-15.)

EXHIBIT 2-15

FOUR TYPES OF SAMPLES



A simple random sample can be drawn from a list of all members of a population using any of a variety of simple devices (for example, drawing numbers from a hat or using a table of random numbers). In most practical research problems, a total list of all items or people in a population is rarely available. For example, there are no lists of all people living in New York City. Using a telephone book would include only those members of the population who had a telephone and who chose to be listed, for many purposes excluding important elements, e.g., low income groups, from the population of interest. The more the list from which the sample is drawn is not representative of the total population, the more the results of inference to the total population will be biased.

Systematic sampling is similar to random sampling. For systematic sampling, beginning with a randomly chosen person on the list, one can simply choose every <u>k</u>th person.

In a stratified random sample design, the total population is divided into relatively homogenous subpopulations. Random samples are then drawn from within each of these subpopulations. One reason it is often useful to stratify a sample is that different sources or lists may have to be used for each subpopulation. Another reason for stratifying a sample is that a smaller number of cases can be drawn to achieve the same level of accuracy. Selecting and sampling from strata reduces variability in the population. This reduced variability allows a smaller sample size to be used. This is an important consideration because the reduced sample size required by stratifying can result in substantially reduced costs. Examples of strata are: sex (male or female); age (20-29, 30-39, etc.); marital status (married, widowed, divorced, separated, never married).

In stratified sampling the population is divided into groups, and then a random sample is drawn from each group. In contrast, in cluster sampling, the population is divided into a large number of groups, and then samples are drawn from among the groups. For example, if all the census tracts in a city were considered to be organized in clusters, a certain number of census tracts would be selected for study. The objective of such a cluster analysis is to select clusters which exhibit great variation, but which at the same time are small in size, or located in such a manner as to minimize data collection costs, such as those involved in interviewers' traveling time.

Sample Size

A basic dilemma facing an analyst who must select a sample, is how large a sample should be chosen. It is a dilemma in the sense that various tradeoffs must be made in arriving at a reasonable decision. Backstrom and Hursh describe these tradeoffs as involving: (1) how homogeneous the population is; (2) the sampling procedure selected; (3) the number of categories to be analyzed; (4) time, money, and personnel available to collect the data; (5) the amount of error between sample estimates and population values that can be tolerated (tolerated error); and (6) the need for measurement accuracy (especially reliability)[37]. In general, if a population from which observations are to be collected is more varied -- heterogeneous -- a larger sample will be required to achieve a specified level of precision. Populations with more homogeneity -- less variation -- require relatively smaller sample sizes.

According to Backstrom and Hursh, in general, "Stratified samples require the least number of cases, the simple random samples somewhat more - for the same level of precision."[38] Similarly, in certain sampling problems, cluster sampling may be a most efficient procedure, reducing sample size in comparison to other procedures, simplifying the selection of respondents, and reducing the cost of data collection.

The sample size selected must be feasible given the resources available to collect the data. It is impractical to interview 2000 city residents if you have to prepare a report within a one week period and have a staff of one -- yourself -- to do the interviews. The larger the number of analytic categories required of the data, generally, the larger the sample size required. Many inferential procedures assume a certain minimum count in each category; violations of these assumptions make their interpretation doubtful.

The concept of tolerated error may, perhaps, be best understood with an example. Suppose your sampling problem was to estimate the average number of victimizations in your city for the past year. Let's assume that the amount of allowed sampling error is 5%. If our sample of interviews (n = 300, N = 250,000) indicates an 8% victimization rate, we would estimate that the population rearrest rate is between 3% and 13%. If we need a more reliable estimate -- a smaller tolerated error, say 2% -- a smaller bound would be estimated, requiring a larger sample size, say n = 1000.

The last tradeoff in estimating a sample size is based on the occurrence of our sample estimate within the estimated range of tolerated error. Confidence that this will occur 95 samples in 100 requires a smaller sample size, than if 99 samples in 100 is required. The interrelationships between tolerated error, confidence units and sample sizes are illustrated in Exhibit 2-16. This exhibit is based on a city population of approximately 250,000 and lists sample size estimates for a simple random sample. For example, to obtain a 95% confidence limit and a tolerated error of 4%, a sample of 600 residents is required.

EXHIBIT 2-16

SIMPLE RANDOM SAMPLE SIZE FOR SEVERAL DEGREES OF PRECISION*

Tolerated Error	Confidence Limits	
	95 Samples	90 Samples
1%	9,604	18,587
2%	2,401	4,147
3%	1,067	1,843
4%	600	1,037
5%	384	683
6%	267	481
7%	198	339

*N≅250,000

Source: Backstrom and Hursh Survey Research (Evenston: Northwestern University Press, 1963) p. 33

Survey Procedures

There are two basic types of instruments in survey research: interview schedules and self-administered questionnaires. Interview schedules are forms from which interviewers read questions to respondents and on which replies are recorded. The major advantage of this kind of data collection procedure is that skilled interviewers can probe the respondents by asking a series of questions in order to clarify issues. In situations where a skilled interviewer can create a non-threatening situation for the respondent, increased cooperation on the part of the respondent may lead to more valuable results. Conversely, in a situation where interviewers are poorly matched with respondents, tension between the interviewer and respondent can seriously affect the quality of the data collected. An additional advantage of the interviewer method is that observational data or other kinds of data, e.g., environmental conditions, can be collected during the same session. In some instances, interviewers also may produce a higher response rate than would be attained using self-administered questionnaires.

The major disadvantage associated with interview schedules is the sharply increased costs as compared with using self-administered questionnaires. A second disadvantage is that the presence of an interviewer may result in potential response bias in some situations. For example, in situations where interviewers are not highly skilled, where respondents are suspicious; where there is a poor demographic match between interviewer and respondent, or where the material covered in the interview is personal or fraught with socially desirable answers -- responses recorded by the interviewers may be biased. In Exhibit 2-17 these three different survey procedures are compared: the personal interview; the telephone interview; and the mailed questionnaire.

Self-administered questionnaires are designed so that respondents can provide answers to the questions without any assistance. Clarity and appearance of the questionnaire are particularly important in designing self-administered survey questionnaires. A major advantage in using a self-administered questionnaire is cost. Self-administered questionnaires are much less expensive to administer than are interviews. They can be administered to people assembled in groups, can be distributed to people on location to be returned upon completion, or can be administered through the mails. For some topics, particularly when questionnaire responses are anonymous, respondents may be willing to answer questions concerning socially undesirable or illegal behavior. Measures can be included in questionnaires to account for socially desirable response bias as well as for random checking of responses, consequently reducing these two common sources of error.

The major problem with self-administered questionnaires is response rate. Although response rates can usually be increased substantially with follow-up reminders to respondents, the number of respondents not completing the questionnaire may be higher for self-administered questionnaires than the refusal rates in an interview situation. A lower response rate can have a serious limiting effect on conclusions drawn from a particular study because of the sampling bias introduced by non-respondents.

EXHIBIT 2-17

A COMPARISON OF ALTERNATIVE SURVEY PROCEDURES

CRITERIA	PERSONAL INTERVIEW	SELF-ADMINISTERED QUESTIONNAIRE	TELEPHONE INTERVIEW
Inexepensive	no	sometimes	yes
Random sampling generally	no	sometimes	with RDD*
Entire spectrum of the population potentially contactable	yes	no	no
Sampling of special populations	yes	with list	sometimes
Easy to cover large geographic area	no	yes	yes
Control over who is actual respondent	yes	no	yes
High response rate	sometimes	no	yes
Easy call-backs and follow-ups	no	no	yes
Long interview generally possible	yes	sometimes	sometimes
Explanations and probings possible	yes	no	yes
Visual materials may be presented	yes	yes	no
Nonthreatening to respondent	no	yes	yes
Interviewer can present credentials	yes	yes	no
Safe for interviewers	no	N.A.	yes
Easy Supervision of interviewers	no	N.A.	yes

*RDD - random digit dialing
Source: Tachfarber, Alfred J.; Klecka, William R.; Random Digit Dialing: Lowering the cost of Vicitimization Surveys; Police Foundation, 1976

Finally, it is important to consider the basic measurement issues discussed at the beginning of this module when designing a survey, as well as the necessity of pretesting your procedures and instruments to help assure useful and accurate data.

IV. Planning the Data Collection Effort

A Data Collection Plan is a valuable tool for organizing and outlining the sources and procedures to be used in obtaining data for an analysis. Such a plan is based on a Problem Specification and includes consideration of the following topics:

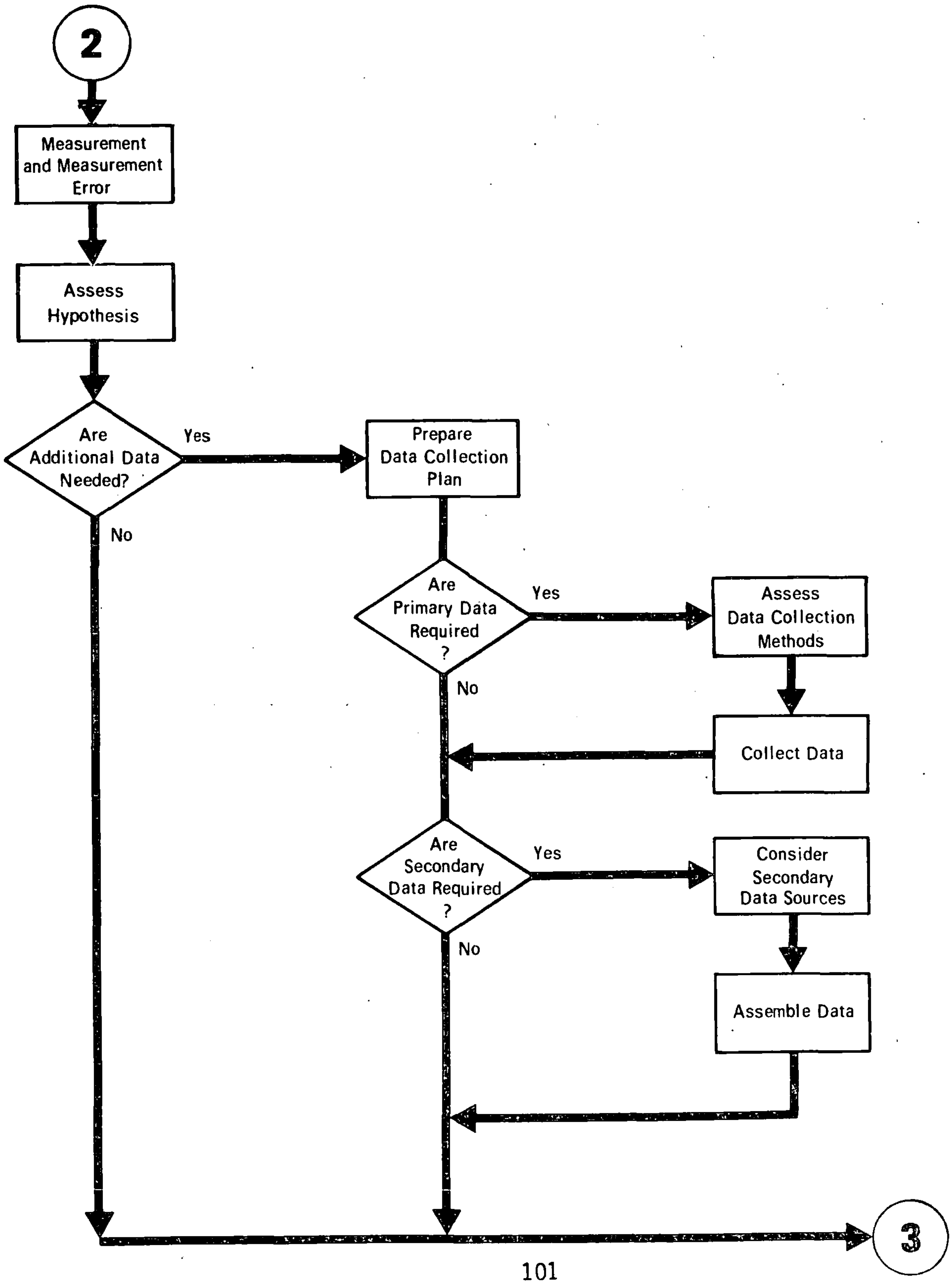
1. Determine measures to be used. (Review Problem Specification.)
2. Identify secondary data sources for each measure.
   a. Is appropriate data available? (If not, go to 3.)
   b. Will data permit adequate testing of hypotheses? (If not, go to 3.)
   c. Are the data sufficiently reliable and valid? (If not, go to 3.)
3. Identify primary data collection procedures.
   a. What type of data are required?
   b. Can the data be collected in time?
   c. What are the strengths and weaknesses of alternative data collection procedures?
4. Consider additional requirements.
   a. Identify authorization requirements.
   b. Identify coding requirements process.
   c. Develop sampling requirements.
   d. Develop instrument requirements.
   e. Develop data conversion requirements.

The process of deciding the appropriate data sources and collection procedures for a given set of hypotheses involves making difficult tradeoffs between measurement accuracy, time, and cost. Planning a data collection report is an important part of an overall plan for managing an analysis. Planning and managing the analysis effort is covered in detail in Chapter Eight.

The art and craft of using data effectively in analysis is learned through practice, error, and improvement. Data synthesis requires knowledge of the topics of this chapter, as well as an understanding of the initial Problem Specification and the statistical tests and methods to which the data will be applied. These descriptive, comparative, and inferential methods are the subject of Chapter 3 to 6. Exhibit 2-18 illustrates in a flow chart the major decisions and activities associated with Data Synthesis.

EXHIBIT 2-18

CHAPTER 2 SUMMARY CHART: DATA SYNTHESIS



[1]Wesley G. Skogan, "The Validity of Official Crime Statistics," Social Science Quarterly 55 (Jan., 1974): 25.

[2]U.S. Department of Justice, Federal Bureau of Investigation, Crime in the United States-1978: Uniform Crime Reports, 1974 and U.S. Department of Justice, Law Enforcement Assistance Administration, National Criminal Justice Information and Statistics Service, Dictionary of Criminal Justice Data Terminology, First Edition, 1976.

[3]R.L.D. Wright, Understanding Statistics: An Informal Introduction for the Behavioral Sciences (New York: Harcourt, Brace, Janovich Inc., 1976), p. 46.

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[5]National Advisory Committee on Criminal Justice Standards and Goals, Criminal Justice Research and Development, A Report on the Task Force on Criminal Justice Research and Development (Dec., 1976), p. 122.

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[7]John P. Clark and Larry L. Tifft, "Polygraph and Interview Validation of Self-Reported Deviant Behavior," American Sociological Review 31 (1966): 516-523.

[8]John Ball, "The Reliability and Validity of Interview Data Obtained From 59 Narcotic Drug Addicts," American Journal of Sociology 72 (1967): 650-654, as reported in Derek K. Phillips, Knowledge From What: Theories and Methods of Social Research (Chicago: Rand McNally and Company, 1972), pp. 26-27.

[9]Thorseten Sellin and Marvin E. Wolfgang, The Measurement of Delinquency (New York: John Wiley & Sons, 1964), pp. 323-333.

[10]Skogan, The Validity of Official Crime Statistics, p. 29.

[11]Sellin and Wolfgang, The Measurement of Delinquency, p. 324.

[12]Michael D. Maltz, "Crime Statistics: A Historical Perspective," Crime & Delinquency No. 1, 23 (Jan., 1977), p. 34.

[13]For a similar validation study of UCR data see Michael J. Hendelang, "The Uniform Crime Reports Revisited," Journal of Criminal Justice 2 (1974): 1-17.

[14]National Academy of Science, Panel for the Evaluation of Crime Surveys, Surveying Crime (Washington D.C.: 1976), pp. 134-140.

[15]Dickenson McGraw and George Watson, Political and Social Inquiry (New York: John Wiley and Sons, 1976), p. 212.

[16]W. Phillips Snively, The Craft of Political Research: A Primer (Englewood Cliffs: Prentice-Hall, 1972), p. 51.

[17]Ted Robert Gurr, Politimetrics: An Introduction to Quantitative Macro Politics (Englewood Cliffs: Prentice-Hall, 1972), p. 51.

[18]Suchman, Evaluative Research, p. 118.

[19]Runkel and McGrath, Research on Human Behavior, pp. 152-158.

[20]This section is developed from a similar presentation in Runkel and McGrath, Research on Human Behavior, pp. 24-31.

[21]There are many excellent statistics texts that cover this problem of estimation quite well, particularly Hyman Ott, William Mendenhall and Richard Larson, Statistics a Tool for the Social Sciences, 2nd ed. (Belmont, Calif.: Wadsworth Publishing, 1978), pp. 187-213.

[22]These techniques are usually presented in intermediate and advanced statistics texts. One of the most thorough discussions of analysis of variance is in Thomas H. Wonnacott and Ronald J. Wonacott, Introductory Statistics, 3rd. ed. (New York: John Wiley & Sons, 1977), pp. 277-312.

[23]Two good sources covering multivariate regression and correlation are Fred N. Kerlinger and Elazar J. Pedhazur, Multiple Regression in Behavioral Research (New York: Holt, Rinehart and Winston, Inc., 1973) and N.R. Draper and H. Smith, Applied Regression Analysis (New York: John Wiley & Sons, Inc., 1968).

[24]A very handy guide to statistical methods based on the level of measurement (See Chapter 4) of the variables being considered and the number of variables in the hypothesis -- one, two or more than two -- is Frank M. Andrews et. al., A Guide for Selecting Statistical Techniques for Analyzing Social Science Data (Ann Arbor: Institute for Social Research, 1975).

[25]Wesley G. Skogan, "Dimensions of the Dark Figure of Unreported Crime," Crime and Delinquency No. 1, 73 (January, 1970): 49.

[26]Letter from Alvin Ash, Systems Specialist, Law Enforcement Assistance Administration, August 1979.

[27]U.S. Department of Justice, Law Enforcement Assistance Administration, Dictionary of Criminal Justice Data Terminology (1976): 64.

[28]American Justice Institute, Burglary in San Jose (Springfield, Va.: NTIS, PB# 211 789), 1974.

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[30]Michigan Office of Criminal Justice Programs, Michigan Commission on Criminal Justice, The Michigan Public Speaks Out on Crime, 4th ed. (Lansing: April, 1976).

[31]U.S. Department of Justice, Law Enforcement Assistance Administration and U.S. Bureau of the Census, Expenditure and Employment Data for the Criminal Justice System: 1976 (1978): 16.

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[37]Charles H. Backstrom and Gerald D. Hursh, Survey Research (Evanston, Ill.: Northwestern University Press, 1963), pp. 25-35.

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FY 1971:

February 1971	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1968-69.
May 1971	NATIONAL JAIL CENSUS

FY 1972:

July 1971	CRIMINAL JUSTICE AGENCIES IN THE U.S., 1970 (Summary)
February 1972	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1960-70
May 1972	CRIMINAL JUSTICE AGENCIES IN ... (51 volumes)

FY 1973:

September 1972	SAN JOSE METHODS TEST OF KNOWN CRIME VICTIMS
February 1973	EXPENDITURES AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1970-71
March 1973	LOCAL JAILS: DATA FOR INDIVIDUAL COUNTY AND CITY JAILS

FY 1974:

February 1974	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1971-72
February 1974	NATIONAL SURVEY OF COURT ORGANIZATION, 1971
April 1974	CRIME IN THE NATION'S FIVE LARGEST CITIES: National Crime Panel Surveys in Chicago, Detroit, Los Angeles, New York, and Philadelphia--Advance Report
May 1974	CHILDREN IN CUSTODY: A Report on the Juvenile Detention and Correctional Facility Census of 1971
June 1974	CRIMES AND VICTIMS: A Report on the Dayton-San Jose Pilot Survey of Victimization
July 1974	SOURCEBOOK OF CRIMINAL JUSTICE STATISTICS 1973 (1st edition)

FY 1975 continued:

July 1974	CRIME IN EIGHT AMERICAN CITIES: National Crime Panel Surveys in Atlanta, Baltimore, Cleveland, Dallas, Denver, Newark, Portland, and St. Louis--Advance Report.
September 1974	SURVEY OF INMATES OF LOCAL JAILS 1972: Advance Report
November 1974	CRIMINAL VICTIMIZATION IN THE U.S.: January-June 1973
February 1975	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1972-73
February 1975	CRIMINAL JUSTICE AGENCIES IN REGION 9
May 1975	CRIMINAL JUSTICE AGENCIES IN REGION 7
June 1975	CRIMINAL JUSTICE AGENCIES IN REGIONS 1-6, 8, and 10
June 1975	CRIMINAL VICTIMIZATION SURVEYS IN THE NATION'S FIVE LARGEST CITIES: National Crime Panel Surveys in Chicago, Detroit, Los Angeles, New York, and Philadelphia (final report)
June 1975	CAPITAL PUNISHMENT 1973: National Prisoner Statistics Bulletin
June 1975	CRIMINAL VICTIMIZATION IN THE U.S.: 1973 Advance Report

FY 1976:

July 1975	PRISONERS IN STATE AND FEDERAL INSTITUTIONS ON DECEMBER 31, 1971, 1972, and 1973
July 1975	CRIMINAL VICTIMIZATION SURVEYS IN 13 AMERICAN CITIES: National Crime Panel Surveys in Boston, Buffalo, Cincinnati, Houston, Miami, Milwaukee, Minneapolis, New Orleans, Oakland, Pittsburgh, San Diego, San Francisco, and Washington, D.C.
August 1975	HISTORICAL STATISTICS ON EXPENDITURE AND EMPLOYMENT FOR THE CRIMINAL JUSTICE SYSTEM, 1971 to 1973
August 1975	THE NATION'S JAILS: A report on the Census of Jails from 1972 Survey of Inmates of Local Jails
September 1975	SOURCEBOOK OF CRIMINAL JUSTICE STATISTICS 1974 (2nd edition)
September 1975	CHILDREN IN CUSTODY: Advance Report on the Juvenile Detention and Correctional Facility Census of 1972-73

FY 1976 continued:

September 1975	CENSUS OF STATE CORRECTIONAL FACILITIES, 1974, ADVANCE REPORT: National Prisoner Statistics Special Report
November 1975	NATIONAL SURVEY OF COURT ORGANIZATION: 1975 Supplement to State Judicial Systems
November 1975	CAPITAL PUNISHMENT 1974: National Prisoner Statistics Bulletin
March 1976	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM: 1974
March 1976	ANALYTIC MONOGRAPHS:
	Public Opinion Regarding Crime, Criminal Justice, Related Topics
	New Directions in Processing Juvenile Offenders: The Denver Model
	Who Gets Detained? An Empirical Analysis of the Pre-Adjudicatory Detention of Juveniles in Denver
	Juvenile Dispositions: Social and Legal Factors Related to the Processing of Denver Delinquency Cases
	Offender-Based Transaction Statistics: New Directions in Data Collection and Reporting
	Sentencing of California Felony Offenders
	The Judicial Processing of Assault and Burglary Offenders in Selected California Counties
April 1976	SURVEY OF INMATES OF STATE CORRECTIONAL FACILITIES, 1974
	ADVANCE REPORT: National Prisoner Statistics Special Report
June 1976	AN ANALYSIS OF VICTIMIZATION SURVEY RESULTS FROM THE EIGHT IMPACT CITIES: Summary Report
June 1976	TRENDS IN EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1971-74
June 1976	CRIMINAL VICTIMIZATION IN THE U.S.: A Comparison of 1973 and 1974 Findings
September 1976	PRISONERS IN STATE AND FEDERAL INSTITUTIONS ON DECEMBER 31, 1974: National Prisoner Statistics Bulletin
November 1976	CAPITAL PUNISHMENT 1975

FY 1977:

December 1976	CRIMINAL VICTIMIZATION SURVEYS IN EIGHT AMERICAN CITIES: A Comparison of 1971/72 and 1974/75 Findings
December 1976	CRIMINAL VICTIMIZATION SURVEYS IN CHICAGO, DETROIT, LOS ANGELES, NEW YORK, AND PHILADELPHIA: A Comparison of 1972 and 1974 Findings
January 1977	SOURCEBOOK OF CRIMINAL JUSTICE STATISTICS 1975
January 1977	PRE-ADJUDICATORY DETENTION IN THREE JUVENILE COURTS
January 1977	DELINQUENCY DISPOSITIONS: An Empirical Analysis of Processing Decisions in Three Juvenile Courts
January 1977	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1975: Advance Report
March 1977	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1975
March 1977	CRIMINAL VICTIMIZATION IN THE UNITED STATES: 1973
March 1977	CENSUS OF PRISONERS IN STATE CORRECTIONAL FACILITIES, 1973
April 1977	PRISONERS IN STATE AND FEDERAL INSTITUTIONS ON DECEMBER 31, 1976: Advance Report
April 1977	CHILDREN IN CUSTODY: Advance Report on Juvenile Detention and Correctional Facility Census of 1974
April 1977	PRISONERS IN STATE AND FEDERAL INSTITUTIONS ON DECEMBER 31, 1975
May 1977	CRIMINAL VICTIMIZATION IN THE UNITED STATES: A Comparison of 1974 and 1975 Findings
May 1977	DICTIONARY OF CRIMINAL JUSTICE DATA TERMINOLOGY: Terms and Definitions Proposed for Interstate and National Data Collection and Exchange
May 1977	CAPITAL PUNISHMENT 1976: Advance Report
June 1977	THE PATTERNS AND DISTRIBUTION OF ASSAULT INCIDENT CHARACTERISTICS AMONG SOCIAL AREAS
June 1977	PATTERNS OF ROBBERY CHARACTERISTICS AND THEIR OCCURRENCE AMONG SOCIAL AREAS
June 1977	SOURCEBOOK OF CRIMINAL JUSTICE STATISTICS 1976
July 1977	TRENDS IN EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM: 1971-75

FY 1977 continued:

July 1977	NATIONAL SURVEY OF COURT ORGANIZATION: 1977 Supplement to State Judicial Systems
August 1977	LOCAL VICTIM SURVEYS: A Review of the Issues

FY 1978:

October 1977	CRIMINAL VICTIMIZATION SURVEYS IN WASHINGTON, D.C.
October 1977	CRIME-SPECIFIC ANALYSIS: The Characteristics of Burglary Incidents
October 1977	CRIME-SPECIFIC ANALYSIS: An Empirical Examination of Burglary Offender Characteristics
November 1977	CRIMINAL VICTIMIZATION SURVEYS IN PITTSBURGH
November 1977	CRIMINAL VICTIMIZATION SURVEYS IN SAN FRANCISCO
November 1977	PUBLIC OPINION ABOUT CRIME: THe Attitudes of Victims and Non-victims in Selected Cities
November 1977	THE POLICE AND PUBLIC OPINION: An Analysis of Victimization and Attitude Data from 13 American Cities
November 1977	CHILDREN IN CUSTODY: Advance Report on the Juvenile Detention and Correctional Facility Census of 1975
December 1977	CRIMINAL VICTIMIZATION SURVEYS IN BOSTON
December 1977	CAPITAL PUNISHMENT 1976
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN BUFFALO
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN CINCINNATI
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN HOUSTON
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN MIAMI
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN MILWAUKEE
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN MINNEAPOLIS
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN NEW ORLEANS
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN OAKLAND
January 1978	CRIMINAL VICTIMIZATION SURVEYS IN SAN DIEGO

FY 1978 continued:

February 1978	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1976 Advance Report
February 1978	CRIMINAL VICTIMIZATION SURVEYS IN THE UNITED STATES: A Comparison of 1975 and 1976 Findings
March 1978	CHILDREN IN CUSTODY: A Report on the Juvenile Detention and Correctional Faciltity Census of 1973
April 1978	PRISONERS IN STATE AND FEDERAL INSTITUTIONS ON DECEMBER 31, 1976
April 1978	SOURCEBOOK OF CRIMINAL JUSTICE STATISTICS 1977
April 1978	STATE AND LOCAL PROBATION AND PAROLE SYSTEMS
April 1978	AN INTRODUCTION TO THE NATIONAL CRIME SURVEY
May 1978	CRIMINAL VICTIMIZATION IN THE UNITED STATES: 1974
May 1978	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1976
May 1978	CRIME-SPECIFIC ANALYSIS: An Empirical Examination of Burglary Offenses and Offender Characteristics
May 1978	PRISONERS IN STATE AND FEDERAL INSTITUTIONS on December 31, 1977: Advance Report
June 1978	CRIMINAL VICTIMIZATION IN THE UNITED STATES: 1975
June 1978	CAPITAL PUNISHMENT 1977: Advance Report
June 1978	SOURCES OF NATIONAL CRIMINAL JUSTICE STATISTICS: An Annotated Bibliography
July 1978	COMPENSATING VICTIMS OF VIOLENT CRIME: Potential costs and Coverage of a National Program
July 1978	STATE AND LOCAL PROSECUTION AND CIVIL ATTORNEY SYSTEMS
August 1978	TRENDS IN EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1971-1976
September 1978	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM: 1977 Advance Report
September 1978	FEDERAL CRIMINAL SENTENCING: Perspectives of Analysis and a Design for Research

FY 1978 continued:

September 1978	VARIATIONS IN FEDERAL CRIMINAL SENTENCES: A Statistical Assessment at the National Level
September 1978	FEDERAL SENTENCING PATTERNS: A Study of Geographical Variations
September 1978	PREDICTING SENTENCES IN FEDERAL COURTS: The Feasibility of a National Sentencing Policy

FY 1979:

October 1978	WASHINGTON, D.C.: Public Attitudes About Crime
October 1978	HOUSTON: Public Attitudes About Crime
October 1978	MYTHS AND REALITIES ABOUT CRIME: A Non-technical Presentation of Selected Information from the National Prisoner Statistics Program and the National Crime Survey
November 1978	OAKLAND: Public Attitudes About Crime
November 1978	PAROLE IN THE UNITED STATES: 1976 and 1977 Uniform Parole Reports
December 1978	SAN FRANCISCO: Public Attitudes About Crime
December 1978	STATE COURT CASELOAD STATISTICS: Advance Report, 1975
January 1979	CAPITAL PUNISHMENT 1977: National Prisoner Statistics Bulletin
January 1979	CRIMINAL VICTIMIZATION IN THE U.S.: A Comparision of 1976 and 1977 Findings, Advance Report
February 1979	MILWAUKEE: Public Attitudes About Crime
February 1979	MINNEAPOLIS: Public Attitudes About Crime
February 1979	STATE COURT CASELOAD STATISTICS: The State of the Art
April 1979	PITTSBURGH: Public Attitudes About Crime
May 1979	CENSUS OF JAILS AND SURVEY OF JAIL INMATES, 1978: Preliminary Report
May 1979	PRISONERS IN STATE AND FEDERAL INSTITUTIONS on December 31, 1977: National Prisoner Statistics Bulletin
May 1979	CINCINNATI: Public Opinion About Crime
May 1979	A CROSS-CITY COMPARISON OF FELONY CASE PROCESSING

FY 1979 continued:

June 1979	BOSTON: Public Opinion About Crime
June 1979	BUFFALO: Public Opinion About Crime
June 1979	TECHNICAL STANDARDS FOR MACHINE-READABLE DATA SUPPLIED TO LEAA
June 1979	PRISONERS IN STATE AND FEDERAL INSTITUTIONS on December 31, 1978: Advance Report
June 1979	CAPITAL PUNISHMENT 1978: Advance Report
July 1979	EXPENDITURE AND EMPLOYMENT DATA FOR THE CRIMINAL JUSTICE SYSTEM, 1977
July 1979	STATE COURT CASELOAD STATISTICS: Annual Report, 1975
August 1979	RAPE VICTIMIZATION IN 26 AMERICAN CITIES
August 1979	SOURCEBOOK OF CRIMINAL JUSTICE STATISTICS 1978
September 1979	CRIMINAL VICTIMIZATION IN THE U.S.: 1976
September 1979	CHILDREN IN CUSTODY: Advance Report on the 1977 Census of Public Juvenile Facilities
September 1979	STATE COURT CASELOAD STATISTICS: Advance Report, 1978

FY 1980:

October 1979	PROFILE OF STATE PRISON INMATES: Socio-demographic Findings from the 1974 Survey of Inmates of State Correctional Facilities
October 1979	PAROLE IN THE U.S.: 1978 Uniform Parole Reports
November 1979	CRIMINAL VICTIMIZATION IN URBAN SCHOOLS
November 1979	CRIME AGAINST PERSONS IN URBAN, SUBURBAN, AND RURAL AREAS: A Comparative Analysis of Victimization Rates
November 1979	CHILDREN IN CUSTODY: Advance Report on the 1977 Census of Private Juvenile Facilities
November 1979	CRIMINAL VICTIMIZATION IN THE U.S.: Summary Findings of 1977-78 Changes in Crime and of Trends Since 1973
November 1979	THE COST OF NEGLIGENCE: Lossess from Preventable Household Burglaries

CHAPTER 3

DESCRIPTIVE METHODS

Introduction

What is "data interpretation" as used in this text? Essentially it is the application of a set of tools used for converting data about crime and the criminal justice system into information valuable for decision-making. These tools include both quantitative techniques as well as qualitative methods.

The types of methods that are used to interpret data range from the application of graphs, charts, and maps to multi-variate modeling methods useful for understanding and predicting trends. This chapter concentrates on building skills involving basic quantitative tools -- descriptive statistics.

What are/is statistics? The question implies the answer, for statistics is a collection of numerical facts about ourselves and our environment as well as a set of tools used to deal with such numerical facts. It is this latter definition which is used as one of this text's themes, emphasizing the view that statistics is concerned with the collection, organization and interpretation of numerical facts or observations about crime and the criminal justice system.[1]

Descriptive statistics are used for two purposes. They are used to characterize what is "typical" about a set of data (e.g., how a crime is typically performed, where and when in the community it most frequently occurs, and who the average offender is). For instance, of the 975,630 estimated robberies in 1974, less than half involved the use of a weapon (47%). Of the robberies involving a weapon, the knife was the most frequently used weapon (43%). Sixty percent of all robberies took place on the streets or in parks; forty-six percent took place between the hours of 6:00 a.m. and 6:00 p.m. Finally, the "typical" suburban robber in 1974 was a white male between 25 and 29 years of age. It is assumed that the analyst has data on each crime, each offender, and each victim and wants to describe the principal characteristics of the crime, criminal activity in the jurisdiction, or the types of offenders and victims involved in specific crimes. The statistical measures used for such descriptions are the mean, mode, and median, known collectively as measures of central tendency.

A second purpose of descriptive statistics is to measure the variation in data. Variation refers to the differences among the various measured observations. Measures of variability are used to indicate how widely individual measurements vary from the central tendency in the data. Using the example of robbery again, the state with the lowest robbery rate per 100,000 inhabitants in 1977 was Iowa (10.1) while the state with the highest rate was New York (476.3). The minimum (10.1) and maximum (476.3) values of a distribution as well as the range for a distribution (476.3 - 10.1 = 466.2) are three statistical measures of variation. Such statistical measures of variation are discussed in this chapter.

In addition to these descriptive statistics, this chapter presents and illustrates various graphic techniques for describing data for a single variable. Sets of statistical measures by themselves do not convey the complete profile or description of a trend. They are enhanced and supported by carefully conceptualized graphics. In this chapter two categories of graphics are presented using crime data examples: those used to describe quantitative data -- frequency histograms and polygons; and those appropriate for describing qualitative variables -- charts and graphs. While most of the illustrations and examples used in this chapter involved crime data, system data may be treated in a similar fashion.

I. Measurement Levels

Exhibit 3-1 summarizes information and provides examples of the four measurement scales or levels that are used to classify data. Such a classification scheme is essential for the selection of methods appropriate for use with particular variables.

EXHIBIT 3-1.

MEASUREMENT LEVELS

COMMONLY USED NAMES	LEVEL	DESCRIPTION	EXAMPLES	STATISTICS FREQUENTLY USED
Discrete, Qualitative, Categorical	Nominal	Data are placed in mutually exclusive and exhaustive categories	Sex, Race, Type of Crime, Type of Weapon	Tables of Frequencies & (Rates, Mode, Pie Charts, Bar Graphs, Cross Tabulation tables Chi Square Seriousness Scales)
Discrete, Rank-ordered	Ordinal	Data are placed in mutually exclusive and exhaustive categories, ordered along according to a hierarchy	Socio-economic status Ranks in law enforcement agency	
Quantitative	Interval	Data are distributed along a continuum with established distances between points with no reference to an absolute zero	Temperature Intelligence	Mean Median Range Standard Deviation Statistical Maps Histograms Time Charts Rates Pearson's r Regression Scattergrams Grouped data: All statistics for nominal & ordinal level variables
Quantitative, Continuous	Ratios	Data Are distributed along a continuum with established distances between points with an absolute zero	Age, Years of Education, Expenditures, Manpower	

Every variable categorizes data, but the set of categories used for a given variable can itself be classed on the basis of the level of measurement it expresses. The four possible levels are nominal, ordinal, interval, and ratio. Both nominal and ordinal level variables are commonly called discrete variables, qualitative variables, or categorical variables. The nominal level variable classes cases (or observations) into exhaustive and mutually exclusive categories. For example, sex is a nominal variable which classes cases as either male or female but never as both male and female. The ordinal level variables both class cases into categories and rate the categories from the most to the least amount of some underlying characteristic. For example, type of robbery is a variable which has categories with the underlying dimension of the seriousness of the offense, where the "label" 4 is assigned to the most serious type of robbery and the "label" 1 is assigned to the least serious. However, the numbers used to rank the seriousness of robberies do not provide any information on how much more serious a robbery of category 2 is than a robbery of category 1. Nor is it clear that the difference in seriousness between robberies of category 1 and those of category 2 is the same as the difference in seriousness between robberies of category 2 and robberies of category 3. The numbers assigned to categories are used only to identify categories; any differences are qualitative rather than quantitative.

Both the interval and ratio levels of measurement imply quantification of the observations categorized by a variable. For example, temperature is an interval measure because it permits not only differentiation between 32 degrees and 33 degrees, the precision of measurement is such that it can be assumed that the difference between 32 degrees and 33 degrees is the same as that between 98 degrees and 99 degrees. However, it cannot be assumed that 99 degrees is three times as hot as 33 degrees. (Few examples of this level of variable are used in criminal justice analysis.) Dollar value of stolen property is a continuous variable because no matter what the labels assigned to categories, it is always possible to find a meaningful category between any two labelled categories. For example, between dollar values of $1,000 and $1,001 a value of $1,000.50 can be found and has qualitative (or substantive) meaning as well as quantitative meaning. Between the values of $1,000 and $1,000.50, a value of $1,000.33 can be found and has qualitative meaning as well as quantitative meaning.

Variables commonly used in criminal justice analysis are listed in column 4 of Exhibit 3-1, by level of measurement (in the third column). The last column indicates appropriate methods from Chapter 3-5 for treating variables of a given measurement level.

Many variables can be measured on more than one scale. For example, a ratio level measure such as age, may be grouped into categories and treated as an ordinal level variable. To explain the term "grouped data" it is necessary to discuss first the concept of a distribution.[2] Step one in creating a distribution is to count the number of observations or cases which fall in each category of a variable. This number denotes the frequency with which a category of observations occurs. In Exhibit 3-2, such counts are presented for two different types of variables, place of occurrence, a nominal level variable, offender's age, and a ratio level variable. The term "real limits" is a concept used to bound observations in a manner so that values can be readily categorized. In the example, these bounds or limits extend one-half unit on either side of the apparent interval limits. Interval and ratio scale variables are generally referred to by their mid-points. In the case of "Offender's Age" the category mid-points are: 16.0, 17.0, 19.0, 20.0, etc. Grouping observations is done to focus attention on certain specific categories as illustrated by the grouped frequency distribution for place of occurrence; or grouping into fewer categories facilitates a presentation as with offender's age. Grouping data is a useful technique, however there are two potential problems: (1) the fewer the categories the greater the loss of detailed information; and (2) the potential measurement error caused by grouping the data. While the same descriptive statistics are used for grouped data, different formulas are applied to ungrouped and grouped variables.

EXHIBIT 3-2.

FREQUENCY DISTRIBUTIONS AND GROUPED DATA

1. Frequency Distributions

a. Place of Occurence

Place of Occurence	Frequency of Cases in Each Category (f)
Highway	2
Commercial House	4
Gas or Service Station	5
Chain Store	2
Residence	1
Bank	1
Miscellaneous	0
	15

b. Offender's Age

Offender's Age	Real Limits	f
16	15.5 - 16.5	1
17	16.5 - 17.5	1
19	18.5 - 19.5	2
20	19.5 - 20.5	1
21	20.5 - 21.5	1
24	23.5 - 24.5	1
25	24.5 - 25.5	1
26	25.5 - 26.5	1
27	26.5 - 27.5	2
30	29.5 - 30.5	1
31	30.5 - 31.5	1
32	31.5 - 32.5	1
41	40.5 - 41.5	1
		15

2. Grouped Frequency Distributions

a. Place of Occurrence

Place of Occurrence	f
Commercial House	4
Gas or Service Station	5
Other	6
	15

b. Offender's Age

Offender's Age (Expressed Limits)	Class Mid-Point	f
15-22	18.5	6
23-30	26.5	6
31-38	34.5	2
39-46	42.5	1
		15

Source: hypothetical data

II. Statistical Methods

A. Measures of Central Tendency

A number of easily calculated measures are available to summarize numerical data for a single variable, and to facilitate comparison and interpretation of data. Central tendency is used here to describe the representativeness, typicality or centrality of a distribution. The idea is that data for a single variable, such as the age of offenders, tends to cluster around a central value which is between two extreme values of the variable being studied.

Locating a central value can be very useful in reducing a mass of data to easily understood quantitative values which in turn can be readily communicated to decision-makers, particularly when coupled with a description of the distribution of the data about the central point -- a subject covered in the following material. In addition to reducing masses of data, measures of central tendency simplify the task of drawing conclusions and making generalizations about the concerns. Following are definitions and examples of three common measures of central tendency: the mean, the median, and the mode.

1. Mean

The mean is the sum of all cases or observations for an interval or ratio scale variable divided by the number of cases or observations. Consider the distribution for the variable "dollar value of stolen property" from Chapter 1's Exhibit 1-4. First note that it is a continuous, ratio level variable. Second, there is one missing case, reducing the total number of cases to 14. In order to describe the "typical case," the distribution is summed (Σ , sigma, means to sum the distribution) and divided by the number of cases in the distribution (N). The resulting value, \$502.86, is the mean, average or typical case. This calculation is presented in Exhibit 3-3.

EXHIBIT 3-3.

MEAN: DEFINITION AND EXAMPLE

1. Definition

$\overline{X}$ = mean

N = number of cases

Σ = $X_1 + X_2 + 111 + X_n = \frac{\Sigma X}{N}$

2. Example

a.

	Case	Dollar Value of Stolen Property
	1	100
	2	350
	3	0
	4	100
	5	missing
	6	0
	7	75
	8	25
N = 14	9	4000
	10	150
	11	75
	12	600
	13	1500
	14	65
	15	0
		ΣX = 7040

b. $\overline{X} + \frac{\Sigma X}{N} = \frac{7040}{14} = \$502.86$

Source: hypothetical data

Extreme values in a distribution, such as case #9 the $4,000 bank robbery significantly affects the value of the mean. If case #9 had been excluded from the calculation:

$$N = 13$$

$$\Sigma X = 3040$$

and $$\overline{X} = \$233.85$$

This is a substantial change in the "typical case." If a distribution has such extreme values, use of the mean may be misleading. Other central tendency measures, such as the median, would be preferrable.

The definition of the mean just provided is for the most frequently used mean -- the arithmetic mean. In criminal justice analysis the harmonic mean is particularly important. It is used to average ratios in which the numerator is held constant. Consider the robbery rates presented in Exhibit 3-4. These are robbery rates per 100,000 population for all cities in 1975 which had a population of between 250,000 and 400,000 including the hypothetical metropolis of Chaos City. These rates are calculated by first dividing the number of offenses by the total population and then multiplying the result by 100,000. The product is the number of robberies per 100,000 population. Using a rate instead of the number of offenses permits accurate intercity comparisons on the incidence of robbery standardized for population size.

EXHIBIT 3-4.

CHAOS CITY AND TWENTY-SEVEN
U.S. CITY ROBBERY RATES, 1977

CITY	ROBBERY RATE (Per 100,000) 1977
Akron	243.50
Albuquerque	269.86
Austin	170.02
Baton Rouge	131.12
Birmingham	357.98
Chaos City	450.91
Charlotte	218.18
El Paso	213.64
Fort Worth	315.88
Long Beach	594.75
Louisville	406.90
Miami	670.26
Minneapolis	436.91
Newark	943.26
Norfolk	220.44
Oakland	918.49
Oklahoma City	211.80
Omaha	217.79
Portland	477.39
Rochester (N.Y.)	411.34
Sacramento	489.22
St. Paul	316.95
Tampa	378.83
Toledo	494.76
Tulsa	147.41
Tucson	185.52
Wichita	481.69

Source: UCR, 1977 and City and County Data Book, 1977, and hypothetical data for Chaos City.

The mean robbery rate for these cities is 384 robberies per 100,000 population. The harmonic mean is 296. The formula for calculating the harmonic mean is:

$$\overline{X}_H = \frac{N}{\Sigma\ 1/x} \quad \text{or} \quad \frac{1}{N} \quad \Sigma\frac{1}{X}$$

$$\overline{X}_H = \frac{1}{243.5} + \frac{1}{269.86} + \ldots + \frac{1}{481.69} = \frac{27}{.0913}$$

$$\overline{X}_H = 296$$

Note that the harmonic mean in this example is smaller than the arithmetic mean. It may be a preferred measure of central tendency when discussing crime rates or system flows, e.g. offenders per week. Using an arithmetic mean may introduce bias in the estimate of central tendency for an index number.

2. Median

The median is a special case of percentile ranks. That is, by definition, the median is the score at the 50th percentile, thus requiring that the categories of a measure be ordered. The median is determined so that half the observations are equal to or greater than the middle observation and half of the observations are equal to or less than the middle observation.

Exhibit 3-5 defines and provides an example of determining the median. In the example, $100 is the median dollar value of stolen property. If case #9 -- $4000 -- was excluded, N = 13 and the value of the median would be the average of the two middle values, $100 and $75, or $87.50.

EXHIBIT 3-5.

MEDIAN: DEFINITION AND EXAMPLE

1. Definition

The median of a set of numbers arranged in order of magnitude is the middle value or the arithmetic mean of the two middle values. (Data From Exhibit 1-4)

2. Example. (Data from Exhibit 3-3)

Case #	Rank	Value of Stolen Property	
9	1	4000	
13	2	1500	
12	3	600	
2	4	350	
10	5	150	(6 Scores Above)
4	6	100	
1	7	100	-Median
11	8	75	
7	9	75	(6 Scores Below)
14	10	65	
8	11	25	
15	12	25	
6	13	0	
3	14	0	

Source: hypothetical data

The average of the two middle cases is used if a distribution has an even-number of cases. The rank-ordering of cases is time consuming especially for samples or populations with large numbers of cases; however, it is an appropriate statistic for all variables that are ordinal, interval, or ratio level.

3. Mode

The last measure of central tendency considered here is the mode. The mode is a descriptive statistic used primarily for nominal and ordinal variables. It is the easiest of the measures to determine, yet it is not frequently used in criminal justice analysis. There are two explanations for the mode's lack of use:

a. It is not stable; adding a few additional observations can significantly change the modal value; and
b. a distribution may possess more than one mode, thus making it an ambiguous measure (i.e., a bimodal or multi-modal distribution).

Nevertheless, the mode is almost always found by simply inspecting a distribution for the value(s) which most frequently occur.

In Exhibit 3-6, the example uses the distribution of robberies by place of occurence, a nominal level variable. In this distribution, gas stations is the category which occurs most frequently and therefore it is the modal category.

EXHIBIT 3-6.

THE MODE: DEFINITION AND EXAMPLE

1. Definition

The mode for a set of measurements is the value(s) that occurs with the greatest frequency.

2. Example

Place of Occurrence	Frequency (f)	
Highway	2	
Commercial	4	
Gas or Service Station	5	Mode
Chain Store	2	
Residence	1	
Bank	1	
Miscellaneous	0	

Source: hypothetical data

B. Measures of Variation

The purpose of numerical description is to obtain a set of measures (one or more) that are useful in communicating a simple mental impression of one or more complex data distribution(s). Measures of central tendency only portray part of this impression; equally important is the relative distribution or spread of the measurements.

Measures of variation are companions to central tendency measures; that is, while measures of central tendency describe what is "typical," measures of variation can be used to describe how adequate the typical case is in representing a distribution. Specifically, measures of variation have two primary purposes: 1) to describe how well the central tendency measure represents the central tendency in the data distribution, and 2) to summarize the spread of observations throughout categories in a distribution.

1. Frequency Tables

Frequency tables present the percentage distribution and cumulative distribution of discrete variables and are an effective descriptive method. A frequency table includes the count of cases or frequency in each category and may include the percent or relative frequency and the cumulative percent. Exhibit 3-7 presents an example of a complete frequency table. In the example, 40% of the robbery victims in Chaos City during August and September were between the ages of 58-73. The value below which a percentage of cases falls is called a percentile. In the example, the 53.3 percentile is 57.5 (using the real interval limits), this means that 53.3% of the victims are under 57.5 years old. If the categories were rank-ordered from highest to lowest, the 46.7 percentile would be 57.5 yrs. -- 46.7% of all robbery victims were over 57 years of age. While it is traditional to construct frequency tables with categories ordered from lowest to highest, in certain circumstances reversing the order may better emphasize the point to be made in this example.

EXHIBIT 3-7.

FREQUENCY TABLES: DEFINITION AND EXAMPLE

1. Definition

A frequency table is appropriate for discrete variables only, and is used to organize data into either a frequency distribution or a percentage distribution.

2. Example (Data From Exhibit 1-4)

Victim's Age	Frequency f	Relative Frequency*	Percent**	Cumulative Frequency	Cumulative Percent***
1-15	0	0	0.0%	0	0.0%
16-31	3	.20	20%	3	20%
32-57	5	.333	33.3%	8	53.3%
58-73	6	.40	40.0%	14	93.3%
73	1	.067	6.7%	15	100%

*Relative Frequency = $\frac{\text{Frequency (in a category)}}{\text{N (total number of cases)}}$

Relative Frequency for "16-31" category = $\frac{3}{15}$ = .20 or 20%

**Percent = Relative Frequency X 100

***a. Rank-order categories from lowest to highest.
b. The percentage distribution are summed starting with lowest category and working to highest.
c. The highest category should total to 100%.

Source: hypothetical data

2. Range

In describing the variation in the distribution of a continuous variable, a different measure of association must be used than those just presented. The range is the difference between the largest and smallest values in a distribution. It is a measure of the span or spread of possible values within which observed values for a variable actually occur. Because only the maximum and minimum values are considered, the range provides no indication of the form of the distribution -- whether they are all clustered or evenly spread across the distribution.

Of the 27 cities included in Exhibit 3-4, Newark, N.J. had the highest robbery rate in 1977 -- 943.26 -- and Baton Rouge, La. had the lowest -- 131.12. This range of over 800 robberies per 100,000 population indicates substantial variation. Note that Chaos City is near the middle of this range.

EXHIBIT 3-8.

RANGE: DEFINITION AND EXAMPLES

1. Definition: Range = Maximum - minimum.

2. Examples:

a. (From Exhibit 1-4)

		Max	-	Min	=	Range
Offender's Age	R =	41	-	16	=	25 yrs.
Offender's Education	R =	12	-	0	=	12 yrs.
Victim's Age	R =	81	-	22	=	59 yrs.
Dollar/Value Stolen Prop.	R =	$4000	-	0	=	$4000

b. From Exhibit 3-4

Maximum Robbery Rate	=	943.26	(Newark)
- Minimum Robbery Rate	=	131.12	(Baton Rouge)
Range	=	812.14	robberies per 100,000 population

Source: hypothetical data

The range is most frequently used in summarizing data to be made available to the public, in highlighting data by emphasizing extremes, and for describing the variation in small samples. Like the mode, the range is an unstable statistic; change in either the maximum or minimum results in changes in the range. The range's dependence on extreme values in a distribution also creates problems of interpretation.

3. Standard Deviation

One of the most commonly used measures of variation for continuous variables is the standard deviation. This statistic describes how far individual items in a distribution depart from the mean. In Exhibit 3-9, the formula for calculating the standard deviation is presented (various formulas exist, the one used in the exhibit is for ungrouped data with a small N).

Notice that in Exhibit 3-9 the sum of the deviations from the mean equals zero. This should always be true. Like the mean, the standard deviation is sensitive to extreme values in a distribution. Recall that the mean for the dollar value of stolen property (excluding the $4000 bank robbery) is $233.85. The standard deviation for this distribution with the bank robbery excluded is $482.06.

EXHIBIT 3-9.

STANDARD DEVIATION: DEFINITION AND EXAMPLE

a. Definition

$$S = \sqrt{\frac{\Sigma(X-\overline{X})^2}{N}}$$

Where:

S = Standard Deviation
X = Mean
N = Total number of cases

b. Example:

1. Dollar Value of Stolen Property (From Exhibit I-4)

(X)	$X-\overline{X}$	$(X-\overline{X})^2$
100	-402.86	162296.18
350	-152.86	23366.18
0	-502.86	252868.18
100	-402.86	162296.18
0	-502.86	252868.18
75	-427.86	183064.18
25	-477.86	228350.18
4000	3497.14	12229988.18
150	-352.86	124510.18
75	-427.86	813064.18
600	97.14	9436.18
1500	997.14	994288.18
65	-437.86	191721.38
0	-502.86	252868.18
7040	Σ = 0.0	Σ = 15250985.72

2. $\overline{X} = \frac{\Sigma X}{N} = \frac{7040}{14} = \$502.86$

3. $S = \sqrt{\frac{15250985.72}{14}} = \$1043.72$

Source: hypothetical data

Many calculators, such as the TI-55, and software packages, such as SPSS, calculate the standard deviation using the formula:

$$S = \sqrt{\frac{\Sigma(X - \overline{X})2}{N - 1}}$$

The N-1 is preferred for sample data while the N is used on data for entire populations. Using the N-1 formula, the standard deviation for the value of the stolen property is $1117.24; for the robbery data in Exhibit 3-4, the standard deviation is $211.52 robberies per 100,000.

Several techniques are appropriate for interpreting the standard deviation. The following discussion focuses on how it may be used in examining the shape of a distribution and, by transformation into a standard score, used to assess differences between an individual case and a sample or population.

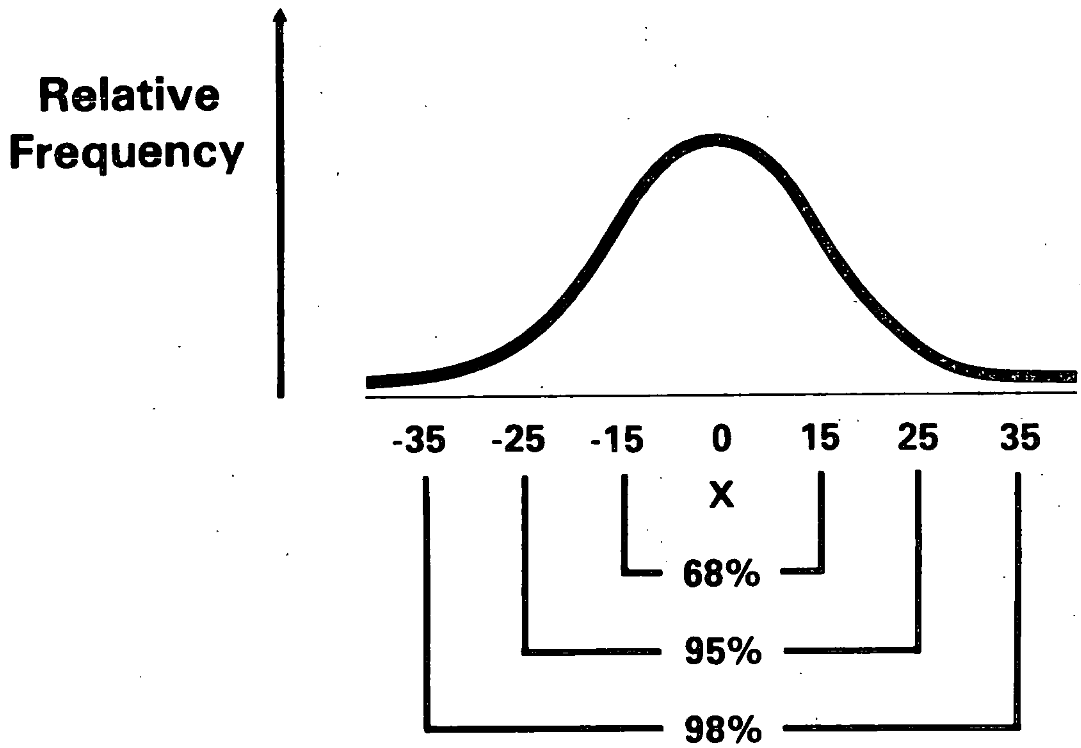
a. The Empirical Rule

A significant application of the standard deviation is to use it in describing the expected percentage of cases that fall within a specified distance from the mean. This use is only appropriate for continuous variables that have a "bell-shaped" distribution as illustrated in Exhibit 3-10. According to the Empirical Rule a "bell-shaped" distribution should have 68% of all observations falling within one standard deviation of the mean, 95% within two and nearly all within three standard deviations. In Exhibit 1-6 the mean and standard deviation of victim's age are, respectively, 50.3 and 18.7. According to the Empirical Rule, if the distribution is bell-shaped, about 68% of the cases will fall within the interval 50.3 years, plus or minus 18.7 years (from 31.6 years to 69 years). In fact 9 victims or 60% of the observations are less than 15 years of age and there are 15 or 100% of the observations less than 25 years of age (50.3 + 37.6 or 12.7 to 87.9).

The bell-shaped distribution (sometimes referred to as a normal or Gaussian curve) together with the Empirical Rule are powerful tools for describing the variation or shape of a distribution for a continuous variable.

EXHIBIT 3-10

PERCENTAGES UNDER A BELL-SHAPED DISTRIBUTION



b. Standard Score

The standard deviation is a useful statistic for describing how far a particular case departs from the mean of a sample or population. Consider the cross-sectional data presented in Exhibit 3-11. These are the same cities used in Exhibit 3-4. Summary statistics for each variable are presented in Exhibit 3-12 (including the robbery rate data from Exhibit 3-4):

EXHIBIT 3-11.

SELECTED CHARACTERISTICS FOR TWENTY-SEVEN CITIES

CITY	City Population 1977 CITY POP	Population Density* 1975 POP DEN	Per Capita Income($) 1974 PCI 74	Law Enforcement Employees 1977 POL 77	Crime Index 1977 CRI 77	Robberies 1977 ROB 77
AKRON	251,750	4645	4614	511	17689	613
ALBUQUERQUE	279,400	3150	4544	705	23955	754
AUSTIN	301,150	3147	4379	678	23536	512
BATON ROUGE	294,390	6146	4187	651	21402	386
BIRMINGHAM	276,270	3345	4023	834	24975	989
CHAOS CITY	330,000	4714	5120	566	33011	1488
CHARLOTTE	281,420	2596	4926	713	22296	614
EL PASO	385,690	2418	3479	830	24621	824
FORT WORTH	358,360	1569	3479	876	36743	1132
LONG BEACH	335,600	6699	5652	940	26669	1996
LOUISVILLE	335,950	5599	4302	938	20312	1367
MIAMI	365,080	10644	4416	1033	34099	2447
MINNEAPOLIS	378,110	6813	5161	909	32298	1652
NEWARK	339,570	14450	3348	1741	30313	3202
NORFOLK	286,690	5450	4233	734	19443	632
OAKLAND	330,650	6192	5034	1031	39713	3037
OKLAHOMA CITY	365,920	576	4731	862	27970	775
OMAHA	371,450	4586	4887	661	22020	809
PORTLAND	356,730	3815	5192	878	36821	1703
ROCHESTER (N.Y.)	267,170	7280	4335	783	26510	1099
SACRAMENTO	260,820	2778	4765	660	26998	1276
ST. PAUL	279,530	5355	4931	699	21403	886
TAMPA	280,340	3318	4362	788	25606	1062
TOLEDO	367,650	4528	4571	835	30965	1819
TULSA	331,730	1871	5173	751	24449	489
TUCSON	296,460	3236	4385	694	29645	550
WICHITA	264,900	2778	4765	660	26998	1276

*people per square mile

Source: UCR, 1977 and City and County Data Book, 1977 and hypothetical data for Chaos City.

EXHIBIT 3-12.

DESCRIPTIVE MEASURES, TWENTY-SEVEN CITY DATA SET

VARIABLE	N	MINIMUM	MAXIMUM	MEAN	STD DEV
City Pop 77	27	251,750.00	385,690.00	317,510.00	41,860.00
Pop Den 75	27	560.00	14,450.00	4,729.60	2,875.40
Per Cap Income PCI 74	27	3,348.00	5,652.00	4,555.30	552.71
Law Enf Employ Pol 77	27	511.00	1,741.00	813.37	226.76
Crime Index CRI 77	27	17,689.00	39,713.00	27,054.00	5,684.30
Robberies ROB 77	27	386.00	3,203.00	1,236.70	744.91
Robberies Per 100,000 pop ROB Rate	27	131.12	943.00	384.25	211.52

Source: UCR, 1977 and City and County Data Book, 1977.

The typical city in this group had about 1236 robberies, a total crime index of 27054, employed 813 people in law enforcement and had an average annual per capita income of $4555.

Focusing attention on Chaos City reveals that it is below the mean on population density, per capita income, and law enforcement personnel, but above the mean on the crime index, on number of robberies, and on the robbery rate. Another method for making such comparisons, based on the standard deviation, involves calculating standard scores. A standard score is the number of standard deviations above or below the mean a case happens to be. Exhibit 3-13 defines and gives an example of calculating a standard score. The standard scores for all 27 cities for the variables per capita income, law enforcement personnel, and number of robberies are presented in Exhibit 3-14. A Z-score is not expressed in the original units, i.e. dollars, personnel, and robberies, but in "standard" units. This facilitates accurate comparison of one city across all variables. For example, while Chaos City is about 1 standard unit above the mean on per capita income, it is 1 standard unit above on police and .3 standard units below on robberies. Akron, like Chaos City is more than 1 unit below on police. Note that Newark is 4 standard units above the mean on police and more than 2 units below on per capita income.

EXHIBIT 3-13.

STANDARD SCORE, DEFINITION AND EXAMPLE

a. Definition:

$$Z = \frac{(X_i - \bar{X})}{S}$$

Where:

Z = Standard Score or Z-Score
X_i = A particular case
S = Standard deviation of a discrete or continuous variable

b. Example: Z for Chaos City number of robberies

$$Z = \frac{(1488 - 1236.7)}{744.91}$$

$$Z = .3374$$

Source: hypothetical data

EXHIBIT 3-14.

STANDARD SCORES, PER CAPITA INCOME,
LAW ENFORCEMENT PERSONNEL, AND NUMBER OF ROBBERIES, TWENTY-SEVEN CITIES.

Standard Scores

CITY	PER CAPITA INCOME (1974)	LAW ENFORCEMENT EMPLOYEES (1977)	NUMBER OF ROBBERIES (1977)
AKRON	.106140	-1.333400	- .83724
ALBUQUERQUE	- .020505	- .477910	- .64795
AUSTIN	- .319030	- .596980	- .97283
BATON ROUGE	- .666410	- .716050	-1.14200
BIRMINGHAM	- .963140	.090976	- .33248
CHAOS CITY	1.021600	-1.090900	.33740
CHARLOTTE	.670640	- .442630	- .83590
EL PASO	-1.947400	.073336	- .55398
FORT WORTH	-1.947400	.276190	- .14051
LONG BEACH	1.984200	.558430	1.01940
LOUISVILLE	- .458350	.549610	.17497
MIAMI	- .252090	.968560	1.62480
MINNEAPOLIS	1.095800	.421720	.55756
NEWARK	-2.184400	4.090800	2.63970
NORFOLK	- .583190	- .350020	- .81173
OAKLAND	.866040	.959740	2.41690
OKLAHOMA CITY	.317830	.214450	- .61976
OMAHA	.600070	- .671950	- .57412
PORTLAND	1.151900	.285010	.62603
ROCHESTER (N.Y.)	- .398640	- .133930	- .18481
SACRAMENTO	.379340	- .676360	.05280
ST. PAUL	.679680	- .504370	- .47075
TAMPA	- .349790	- .111880	- .23448
TOLEDO	.028345	.095386	.78175
TULSA	1.117500	- .275050	-1.00370
TUCSON	- .308180	- .526420	- .92181
WICHITA	.378340	- .676360	.05280

Source: UCR, 1977 and City and County Data Book, 1977 and hypothetical data for Chaos City.

In summary, measures of variation, like the standard deviation and range are powerful descriptive methods for summarizing the variation in a distribution. Analyzing the shape or form of a distribution requires consideration of the Empirical Rule, while comparing an individual case across several variables to a sample or population is facilitated by calculation of standard scores. Central tendency and variation are two related properties of distributions of data. The specific method(s) used depends on the type of variables being considered and the kinds of questions being asked. In general, when reporting on the description of a distribution, both central tendency and variation should be covered.

C. Selecting A Sample Size

In Chapter 2, several factors were discussed that influence the size of a sample for a particular problem. Following are two problems illustrating basic statistical approaches to selecting a sample size; both assume a simple random sampling procedure is used.

The Chief of the Chaos City Police Department wants an estimate of the average amount of money stolen in robberies during 1979. No statistic on all robberies is within a $1000 range. If there were 8,000 robberies (N = 8,000) in 1979 and the tolerated error for our estimate is $50, the following procedure could be used to estimate sample size required.[3]

1. Since the population variance, σ^2, is unknown, we may estimate it by assuming the range is equal to 4 standard deviations:

$$\sigma = \frac{\text{range}}{4} = \frac{\$1000}{4} = \$250$$

2. $\sigma^2 \simeq \$250^2 = \$62,500$

3. The formula for estimating, n, the sample size for this type of problem is:

$$n = \frac{N\sigma^2}{(N-1)0+\sigma^2}$$

$$\text{where } D = \frac{B^2}{4} = \frac{\$50^2}{4} = \frac{\$2500}{4} = \$625$$

(B is the error which can be tolerated in the calculations.)

4. By substitution

$$n = \frac{8000(62,500)}{(8000-1)625 + 62,500}$$

$$n = 99$$

5. Approximately 99 random observations of the dollar value of stolen property are necessary to estimate the population mean (μ), with a bound on error of estimation of $50.

As a second example consider a survey of city residents (N = 250,000) designed to estimate the percentage of residents that perceive crime as the community's number one problem. The tolerated error (B) on this survey is only 0.01, and, since no prior survey has been conducted, no good estimate of the proportion is available.

1. The Chief of Police assumes that, p, the proportion of residents who believe that crime is the city's number one problem is 20% (p = 0.2).

2. $D = \frac{B^2}{4} = \frac{0.01^2}{4} = \frac{0.0001}{4} = 0.000025$

3. Substituting

$$n = \frac{Npq}{(N-1)D + pq}$$

Where p is the estimated proportion of the community who perceive crime to be the number one problem and q is the proportion that does not.

$$n = \frac{250,000(0.3)\ (0.7)}{(250,000-1)0.000025 + (0.3)(0.7)}$$

$$n = \frac{52500}{6.46}$$

$$n = 8127$$

4. The cost and time required to survey 8127 residents is, for the Police Department, prohibitive. Therefore, the Chief agrees to a tolerated error (B) of 0.05. Consequently, the reestimated sample size is:

$$D = \frac{B^2}{4} = \frac{0.05^2}{4} = \frac{0.0025}{4} = 0.000625$$

and

$$n = \frac{Npq}{(N-1)D + pq}$$

$$n = \frac{250,000(0.3)(0.7)}{(250,000-1)0.000625 + (0.3)(0.7)}$$

$$n = \frac{52500}{156.45} \simeq 336$$

5. Three hundred thirty-six residents would be needed in a sample random sample, if the acceptable tolerated error is 5%, a substantial saving in resources compared to a 1% tolerated error sample size of 8127.

III. Graphical Methods

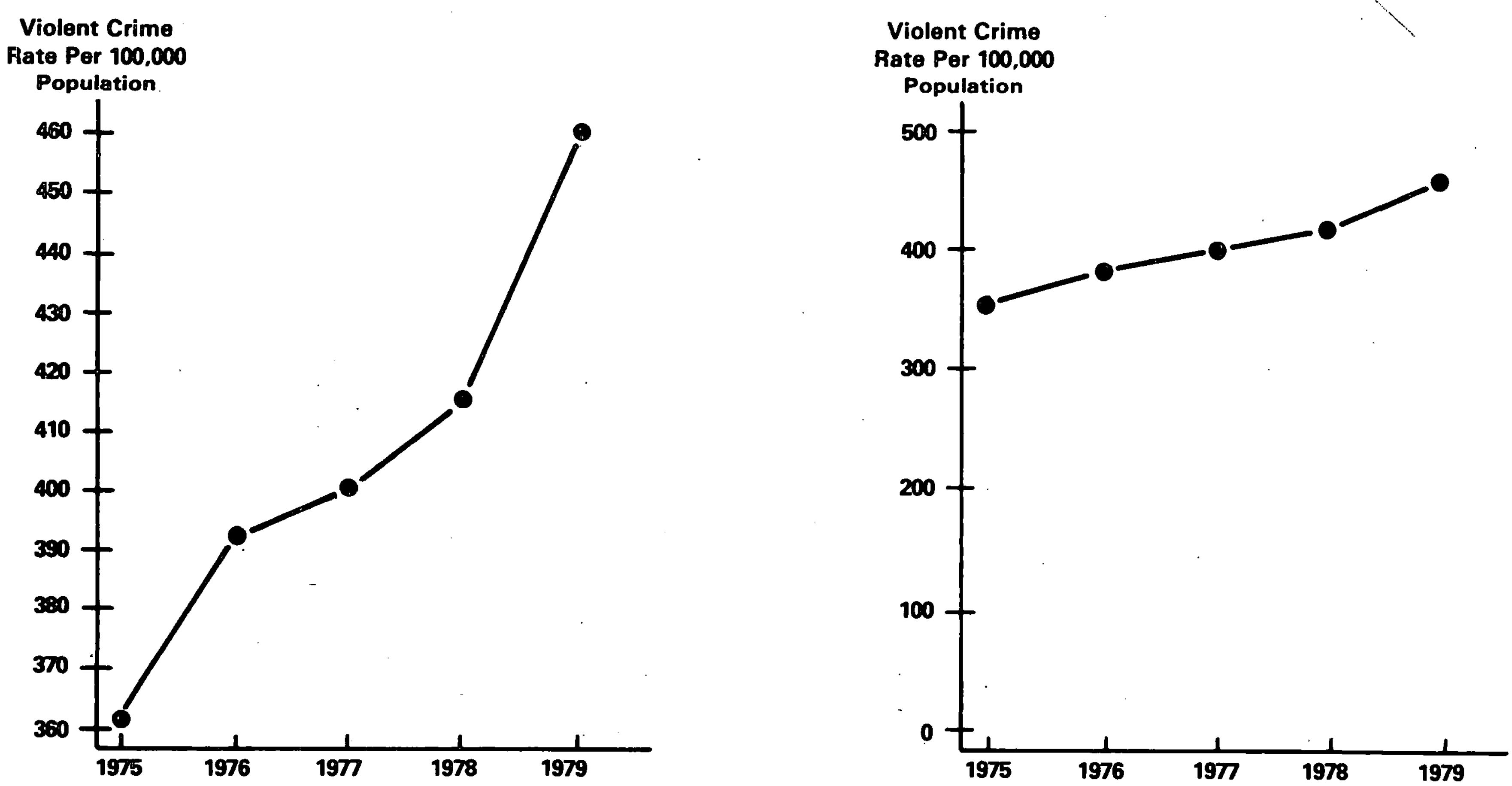
Crime and criminal justice system problems may be described using the statistical methods presented in the previous section as well as by applying graphical techniques to data. In this section various graphical tools, including Pie Charts, Bar Graphs, and Frequency Polygons are presented.

Graphical methods complement statistical treatment of data. They are used to facilitate description of problems by 1) clarifying the informational content of the data; 2) highlighting certain aspects of the information; and 3) making contrasts and comparisons more vivid. Graphics also help to focus questions about the causes of problems and the consequences of planned actions.

Graphs are snapshots of reality, framed by the picture-taker. Varying interpretations of the data will depend, in part, on how the data is portrayed. Exhibit 3-15 illustrates two different graphical presentations of the same data. Clearly, the application of graphical tools involves not just a knowledge of the tools, but also the associated skills necessary for developing a presentation style that minimizes distortions, deceptions, or misrepresentations.

EXHIBIT 3-15

USE OF THE "OH, BOY" CHART TO EXAGGERATE DIFFERENCES



Source: Adapted from Darrell Hulf. How to Lie with Statistics. (New York: N.W. Norton, 1954)

A. Pie Charts

Pie Charts are illustrated in Exhibit 3-16. Each circle represents the total of some characteristic, such as the total number of persons arrested and victims of robbery in August and September in Chaos City. These charts depict two demographic characteristics: gender and age. Note the problem in fully interpreting these images: for instance, how comparable are these percentages to the characteristics of all robberies in Chaos City.

Note how in Exhibit 3-16 each "pie" is divided into "slices" with each slice representing a portion of the whole. Thus, for victims, 60% were males and its "slice of the pie" is represented by 216 degrees (1% = 3.6 degrees).

In Exhibit 3-17, reasons stated by the District Attorney of Chaos City for not prosecuting felony cases are listed. Evidence problems -- such as inadmissable evidence, unavailable physical evidence, and insufficient physical evidence -- clearly are the most significant. Notice that both the shifts in reasons over the two time periods and the total magnitude of DA refusals is represented in the two pie charts.

An interesting variation of the pie chart is the coin chart which is frequently used to present expenditure data graphically. Exhibit 3-18 presents fiscal year 1974 expenditures by jurisdiction -- federal, state, and local -- for the three components of the criminal justice system -- police, courts, and corrections -- using the coin chart method.

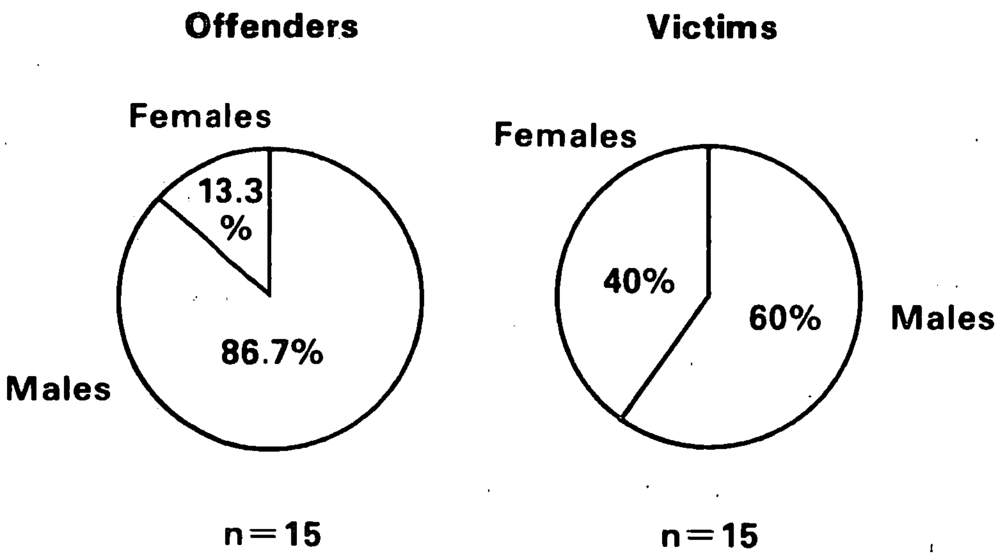
Some studies have indicated that of the many different graphical techniques available, the pie chart is read more accurately and as rapidly as the other types of graphics. In addition, pie charts may be used for all measurement scales. In constructing a pie chart follow these rules:[4]

- Minimize the number of categories (slices). Too many categories make the chart difficult to interpret.
- When possible display the categories (slices) in ascending/descending order.
- Avoid displaying the data or numbers in each category; use instead percentage figures whenever possible since these are easier to interpret.
- Always indicate the size of total sample or population used.

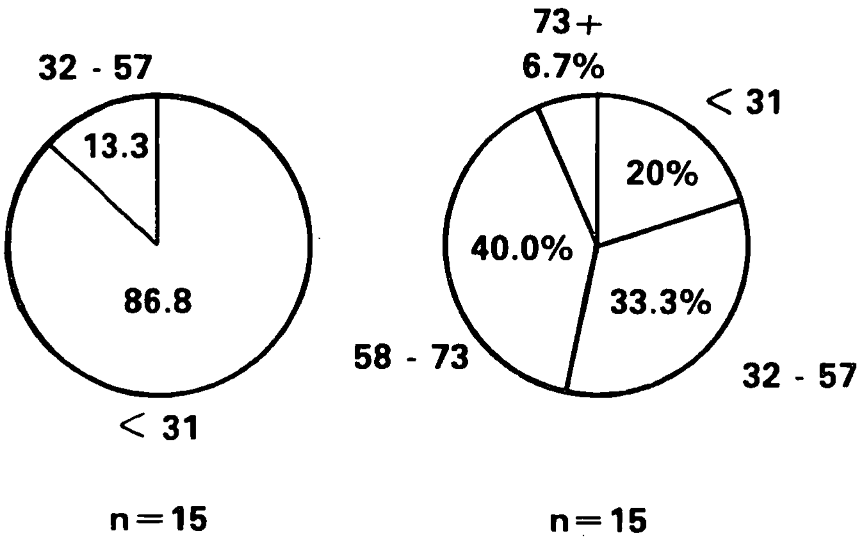
EXHIBIT 3-16

PIE CHART EXAMPLES OF CHARACTERISTICS OF OFFENDERS AND VICTIMS OF ROBBERIES, CHAOS CITY, AUGUST AND SEPTEMBER

GENDER



AGE



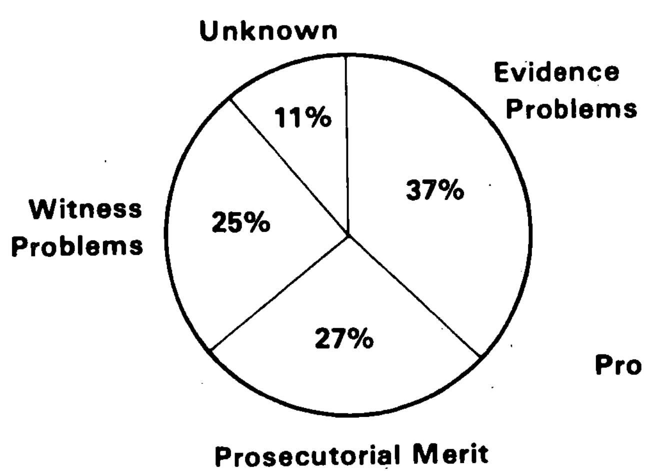
Source: Hypothetical Data

EXHIBIT 3-17

PIE CHART EXAMPLES, REASONS FOR DA CASE REFUSALS, CHAOS CITY, 1973 AND 1977

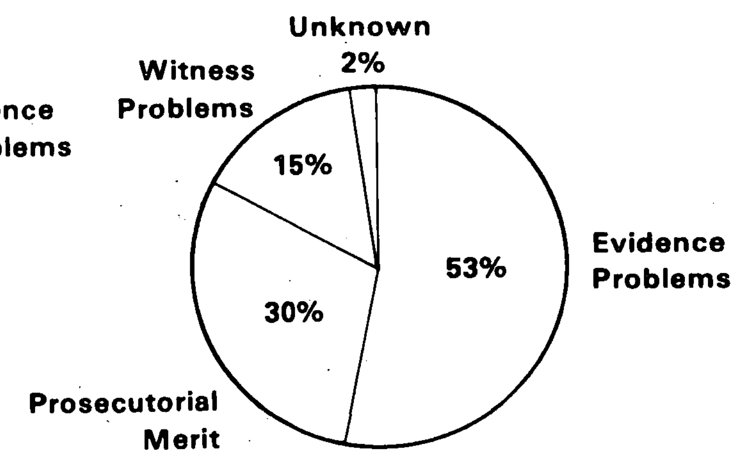
Reason for Refusals	1973	%	1977	%
Evidence Problems	764	37%	2,397	53%
Witness Problems	516	25%	680	15%
Prosecutorial Merit	558	27%	1,356	30%
Unknown	227	11%	91	2%
TOTAL	2,065	100%	4,524	100%

1973



n=2,065

1977



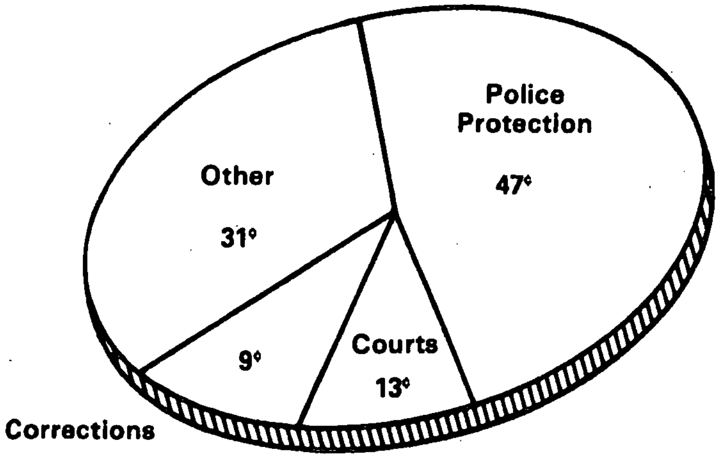
n=4,524

Source: Hypothetical Data

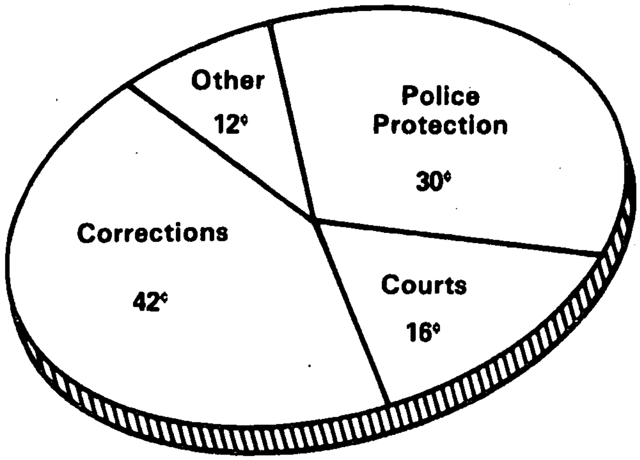
EXHIBIT 3-18

CRIMINAL JUSTICE EXPENDITURES, BY JURISDICTION AND FUNCTION, FY 1974 COIN CHART EXAMPLE

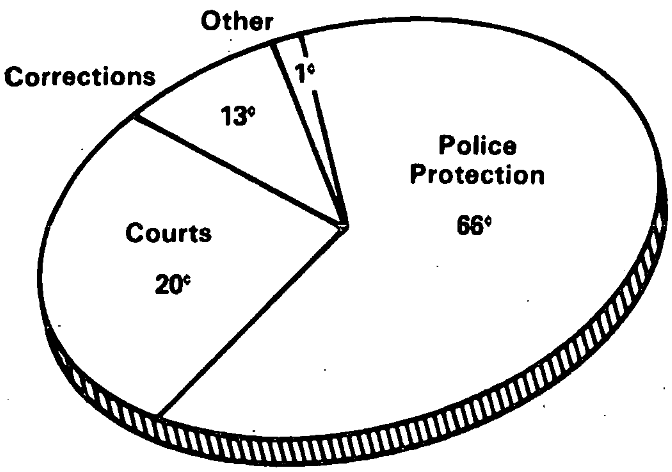
FEDERAL



STATE



LOCAL



Source: Sourcebook, 1976

B. Bar Graphs

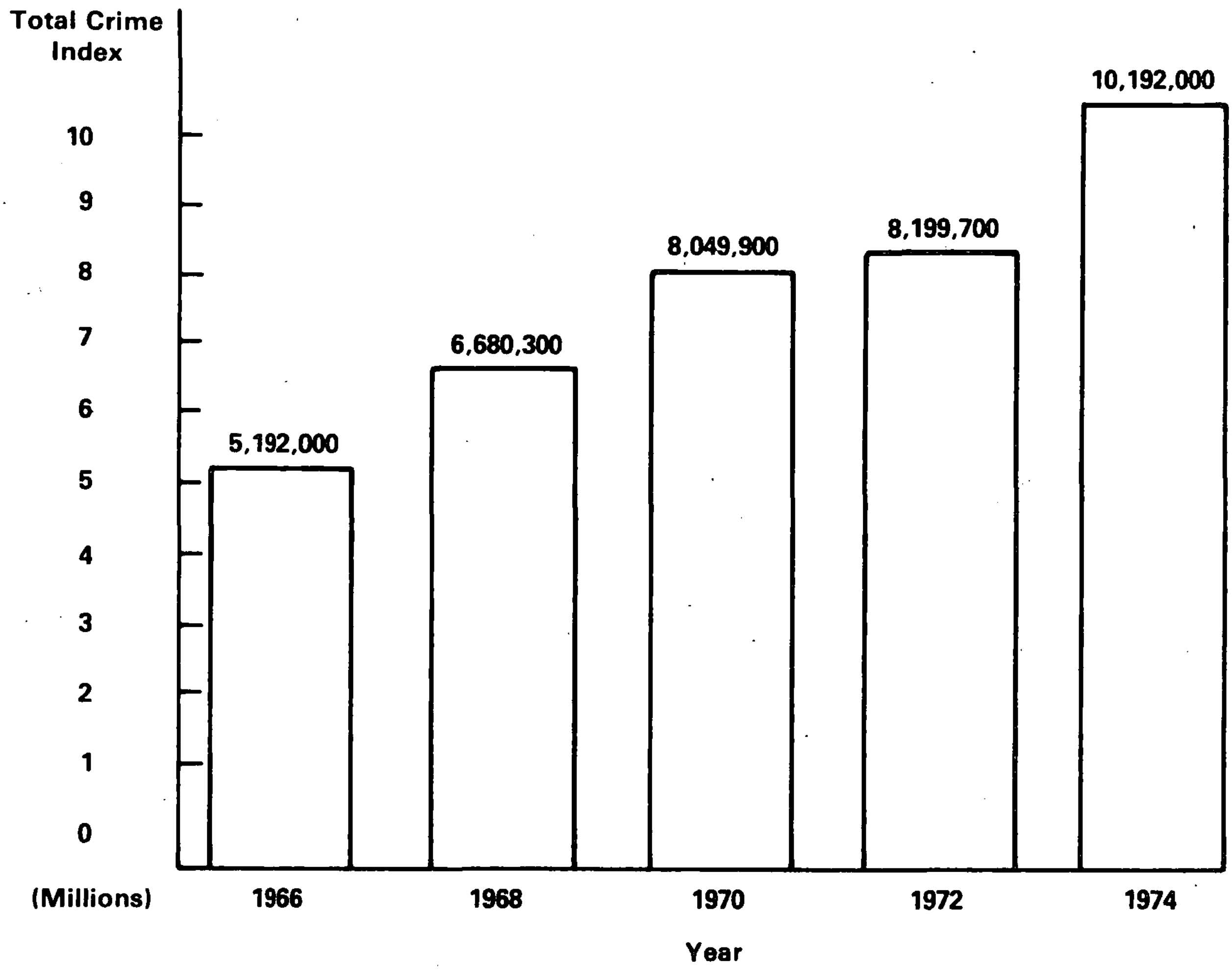
A bar graph, illustrated in Exhibit 3-19, is used to display qualitative data. A vertical or horizontal bar represents the number of observations or values in a particular category. The bar graph emphasizes the categories of a variable; as in Exhibit 3-19, the emphasis is on year. In this application each bar represents the total crime index nationwide. Note the steady increase in the index over this eight-year interval illustrated by the graph.

A second application of the bar graph is presented in Exhibit 3-20. In this bar graph, each bar is the same length, representing 100% of the cases in each crime category. The unshaded portion of the bar indicates the percentage of a specific crime that had been cleared, the shared portion indicating those crimes for which no arrest had been made. It is obvious from this graph that violent crimes are much more likely to be cleared than are property crimes. Following are some rules to follow in constructing bar graphs:[5]

- Place categories along the horizontal axis; frequencies on the vertical axis.
- For clarity of presentation, leave a space between each category bar.
- Keep bars uniform in width and avoid an excessive number of categories.

EXHIBIT 3-19

BAR GRAPH EXAMPLE
TOTAL CRIME INDEX, U.S., 1966-1974

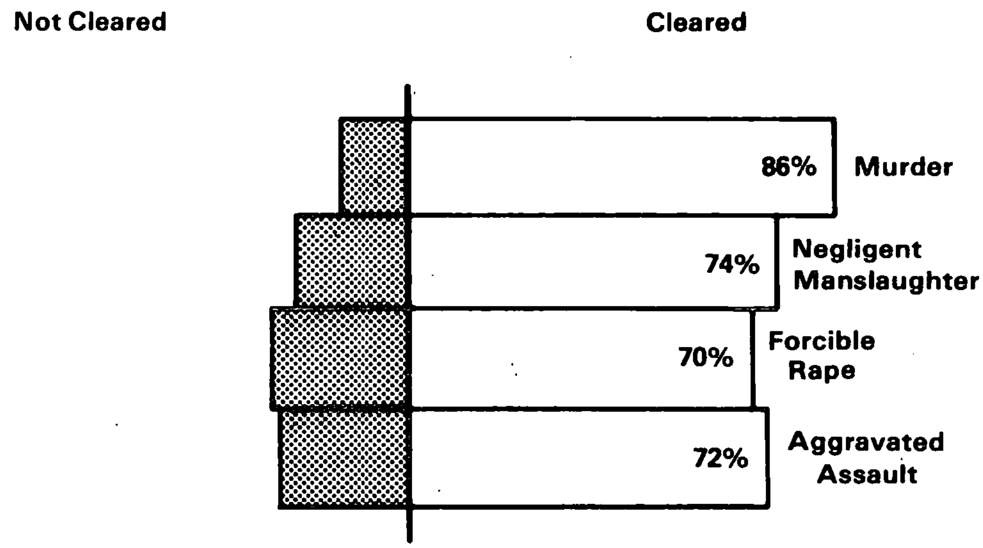


Source: Uniform Crime Report for the United States, 1974.

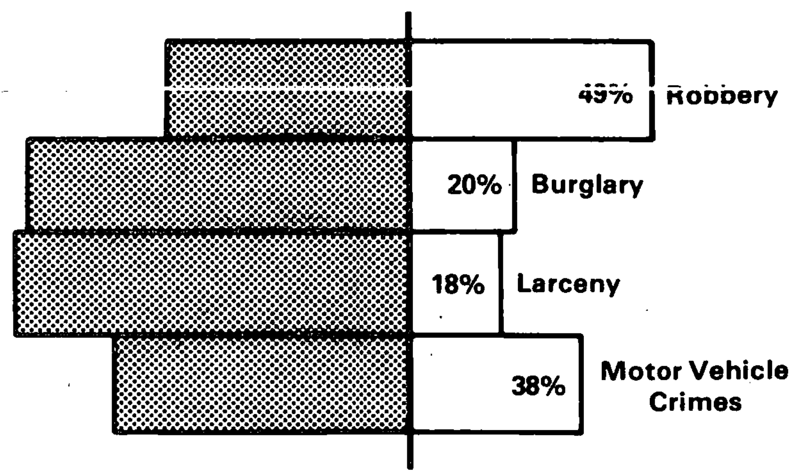
EXHIBIT 3-20

BAR GRAPH EXAMPLE
CRIMES CLEARED BY ARREST, UNITED STATES, 1974

VIOLENT CRIMES



PROPERTY CRIMES



ce: Sourcebook, 1976, p. 555 and adapted from Loether and McTavish, Descriptive and Inferential Statistics, Boston, Allyn & Bacon, 1977.

C. Histograms

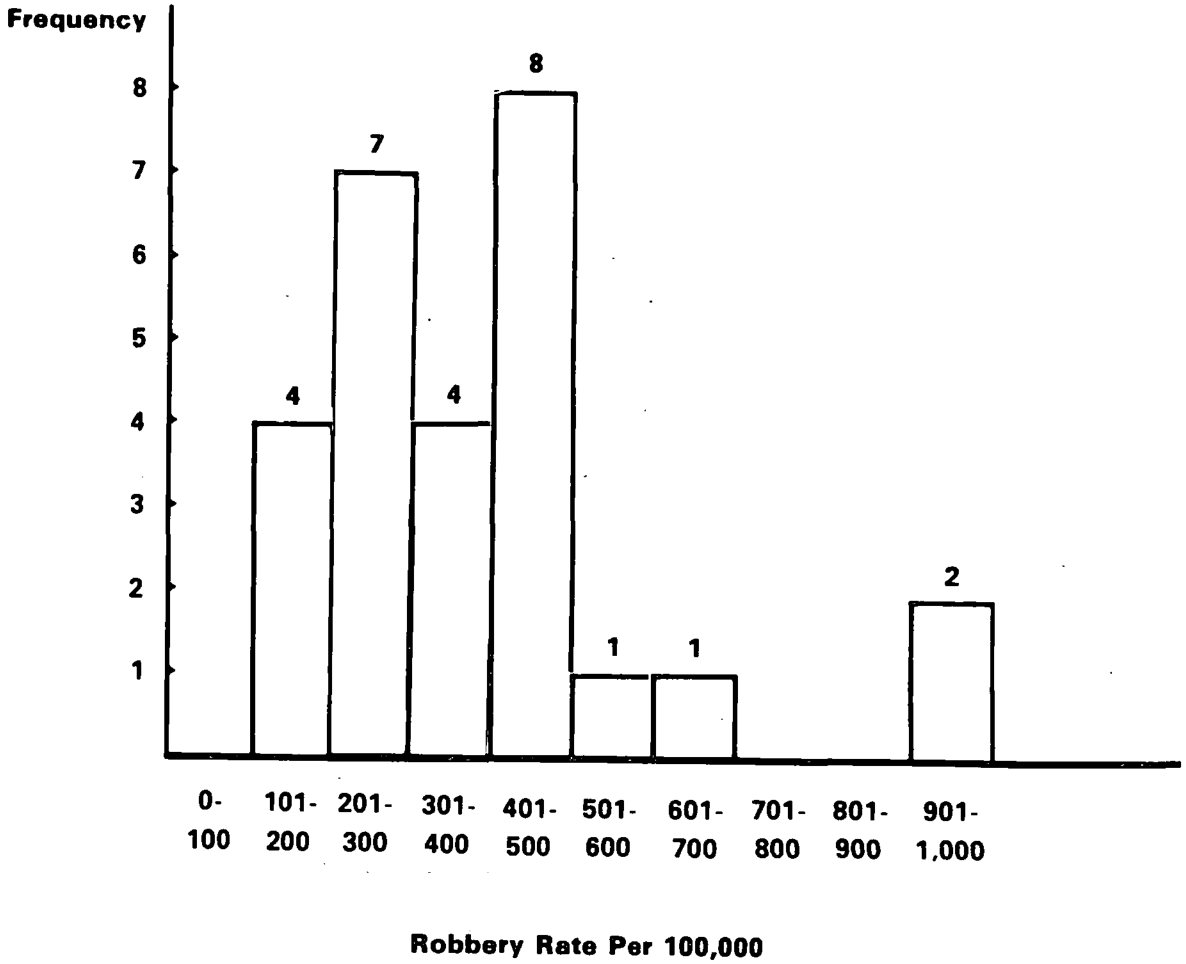
Perhaps the most useful graphic techniques are employed to interpret frequency distributions. Two tools are used to visualize frequency distributions: histograms and polygons. A frequency histogram is the quantitative variable counterpart to the bar graph just described. Exhibit 3-21 illustrates the use of the histogram on the robbery rate data for the twenty-seven cities (Exhibit 3-4). A second technique used to visualize frequency distributions is the frequency polygon. These are constructed by simply connecting with straight lines the mid-points of the histogram bars. A frequency polygon using the same data as in Exhibit 3-21 is presented in Exhibit 3-22.

EXHIBIT 3-21

FREQUENCY HISTOGRAM EXAMPLE, ROBBERY RATES, TWENTY-SEVEN CITY DATA

Robbery Rates

Rate	F
0-100	0
101-200	4
201-300	7
301-400	4
401-500	8
501-600	1
601-700	1
701-800	0
801-900	0
901-1,000	2



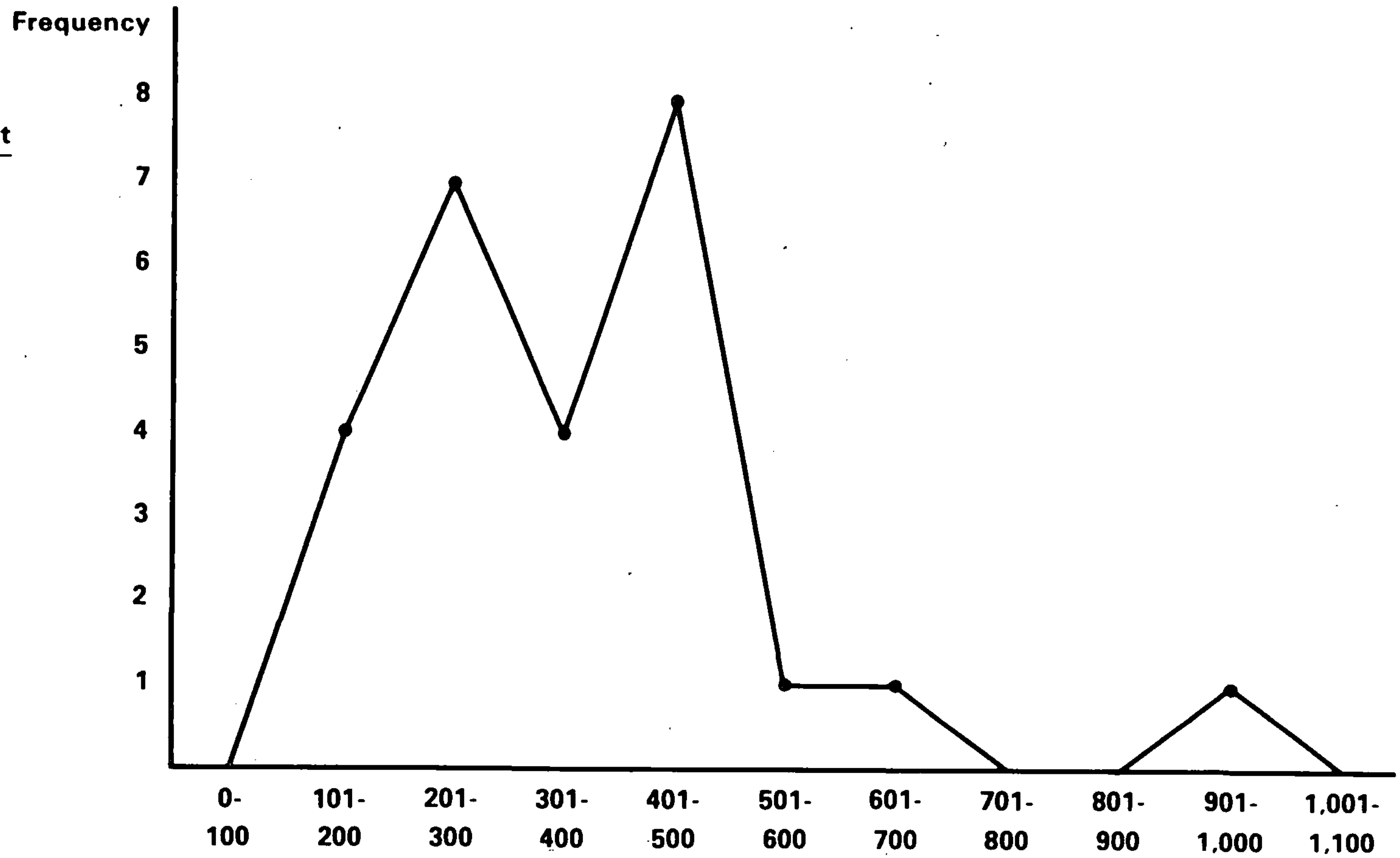
Source: See Exhibit 3-5

EXHIBIT 3-22

FREQUENCY POLYGON EXAMPLE, ROBBERY RATES, TWENTY-SEVEN CITY DATA

Robbery Rates

Rate	F	Med Point
0-100	0	50
101-200	4	150
201-300	7	250
301-400	4	350
401-500	8	450
501-600	1	550
601-700	1	650
701-800	0	750
801-900	0	850
901-1,000	1	950
1,001-1,100	0	1,050



Source: See Exhibit 3-5

Both techniques are particularly effective in reducing a large number of data points into easily understood and communicated information. The examples in Exhibits 3-21 and 3-22 utilize only 27 data points (one data point for each city) yet still are useful in clarifying the central tendency and dispersion of the robbery rates for these cities.

These graphical methods may be used to provide a clear comparison between two or more distributions. The emphasis in interpreting a frequency polygon or histogram is on the shape of the distribution. Notice that grouping the data is usually required in developing these graphics.

The characteristics of such frequency distributions are of particular importance in interpreting data. Explanation of the factors that influence the shape of the distributions (where they are high or low) is a major purpose of statistical inference. A number of statistical measures have been developed to describe the shape of frequency distributions. Readers interested in such measures should consult the footnote references at the end of this chapter for additional information on this subject.

IV. Time Charts and Percentage Change

Time is an important dimension in analyzing most problems. As was indicated in chapter one, the temporal aspects of a concern should be carefully considered in developing a problem specification. Exhibit 3-23 presents time series data from Chaos City for eight offense categories covering the period 1971-1977.

EXHIBIT 3-23.

CHAOS CITY, REPORTED CRIME DATA, 1971-1977

CRIME CATEGORY	1971	1972	1973	1974	1975	1976	1977
Residential Burglary	4100	4000	4900	6000	5800	6800	7000
Commercial Burglary	540	600	650	700	1000	1500	1800
Commercial Robbery	250	300	360	500	550	600	700
Street Robbery	300	350	450	600	850	1000	1200
Assault (Incl. Rape)	2600 (101)	2800 (98)	3100 (97)	3500 (110)	3500 (92)	3400 (120)	3600 (150)
Auto Theft	3800	3700	4000	4100	3900	3800	4000
Total	11,590	11,750	13,460	15,100	15,600	17,100	18,300

Source: Chaos City Police Department, 1978, hypothetical data.

One method for treating such data in Exhibit 3-23 is to calculate percent change (Δ). A formula for percent change is:

$$\frac{\text{Value in Later Period} - \text{Value in Earlier Period}}{\text{Value in Earlier Period}} \times 100 = \%\Delta$$

For example, the percent change in residential burglaries between 1971 and 1977 was:

$$\%\,\Delta = \frac{7000 - 4100}{4100} \times 100 = 70.7\%$$

Exhibit 3-24 lists the percent change for each offense category. During this period street robberies increased by 300% while auto thefts increased by only 5.3%.

EXHIBIT 3-24.

PERCENT CHANGE IN REPORTED CRIME, CHAOS CITY, 1971-1977

Reported Crime	Percent Change 1971-1977	Average Annual Percent Change 1971-1977
Residential Burglary	70.7%	8.89%
Commercial Burglary	233.30%	23.30%
Commercial Robbery	180.00%	19.10%
Street Robbery	300.00%	26.30%
Assaults	38.50%	5.70%
Rapes	48.50%	8.10%
Auto Theft	5.30%	1.00%
TOTAL	57.90%	8.00%

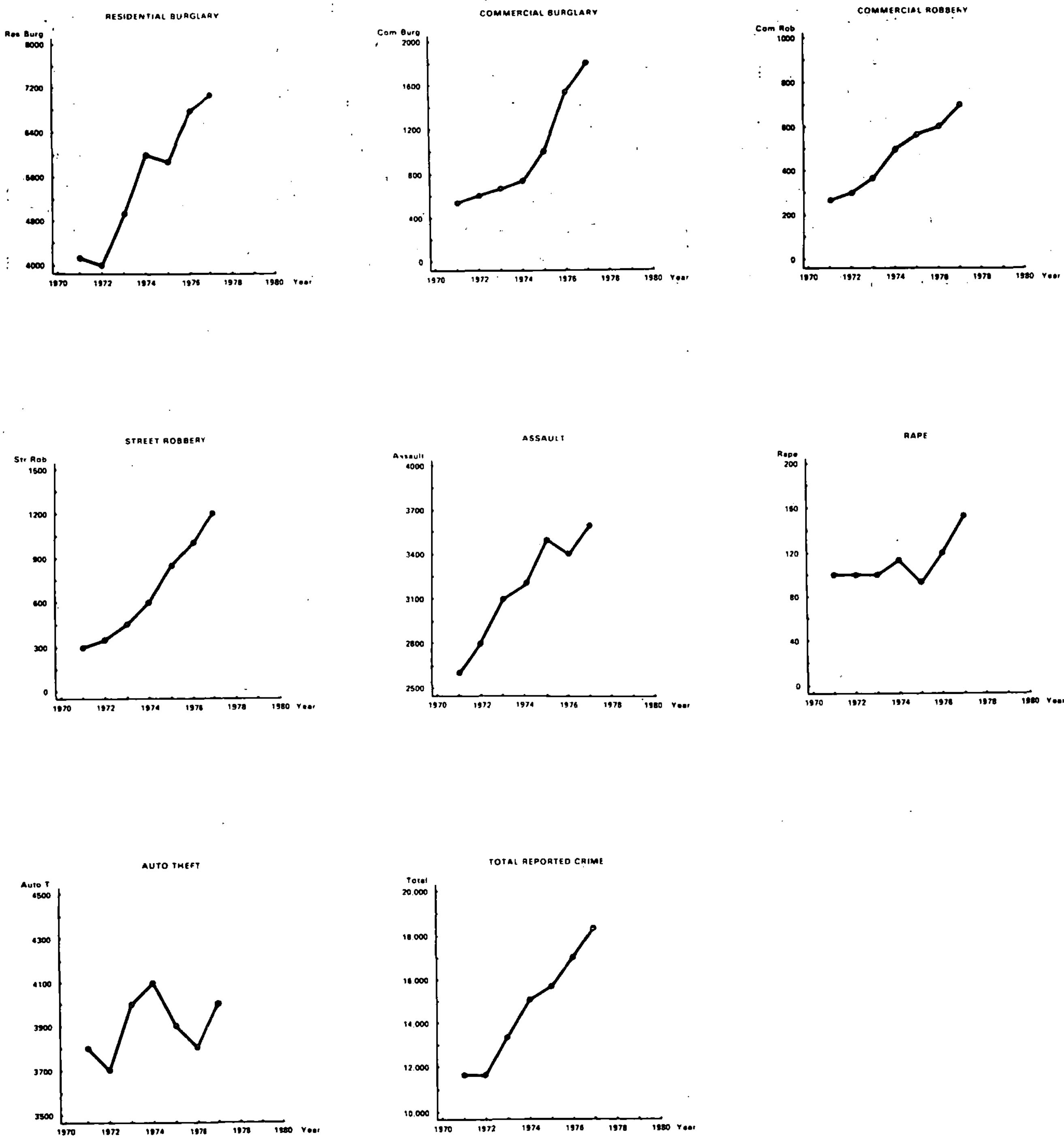
Source: hypothetical data

Time series data also may be presented graphically to facilitate the visual examination of the data. Exhibit 3-25 contains time charts for each of the variables of Exhibit 3-21. Displays such as these are particularly useful for identifying unexpected fluctuations in a trend as evidenced for auto thefts and assaults.

Such time charts focus attention on the pattern of increase or decrease in a variable over a period of hours, days, months or, as in this data set, years. In constructing a time chart, developing a suitable scale for the variable being examined is an important step. Notice the different scales used in the time charts of Exhibit 3-25. Direct comparisons of these charts, particularly in terms of the magnitude of certain offense categories could be misleading. To facilitate comparisons between offense categories, a single scale may be developed and two or more variables plotted on a single time chart. Exhibit 3-26 illustrates this technique for residential and commercial burglary, commercial and street robbery, and auto thefts. The single scale used is between 0 and 10,000 offenses; notice how readily this chart permits comparison between offense categories.

EXHIBIT 3-25

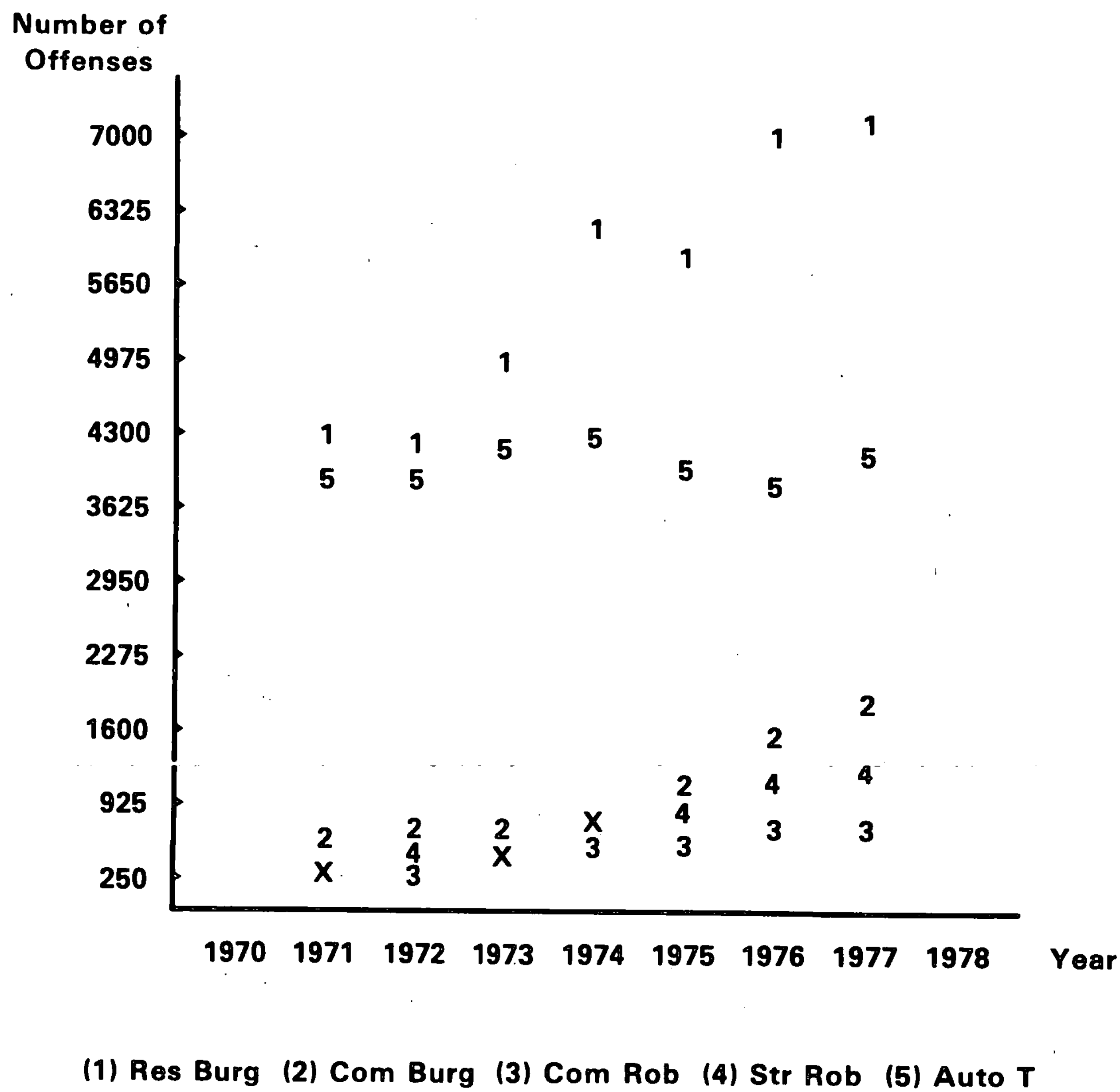
TIME CHARTS, REPORTED CRIME, CHAOS CITY, 1971-1977



Source: Hypothetical Data

EXHIBIT 3-26

TIME CHART, COMPARISON OF FIVE OFFENSES, CHAOS CITY, 1971 - 1977



Source: Hypothetical Data

Time charts and percent change provide a method for adding an important historical perspective to an analysis. Cross-sectional data sets (such as Exhibit 1-4, the robbery data set and Exhibit 3-10, and the twenty-seven city data set) provide a snapshot impression of a problem (the two months in the robbery data set are not here considered as a time series). Such snapshots are useful, but since most problems are dynamic and not static, time series analysis is a most powerful complement to the descriptive methods previously covered in this chapter.

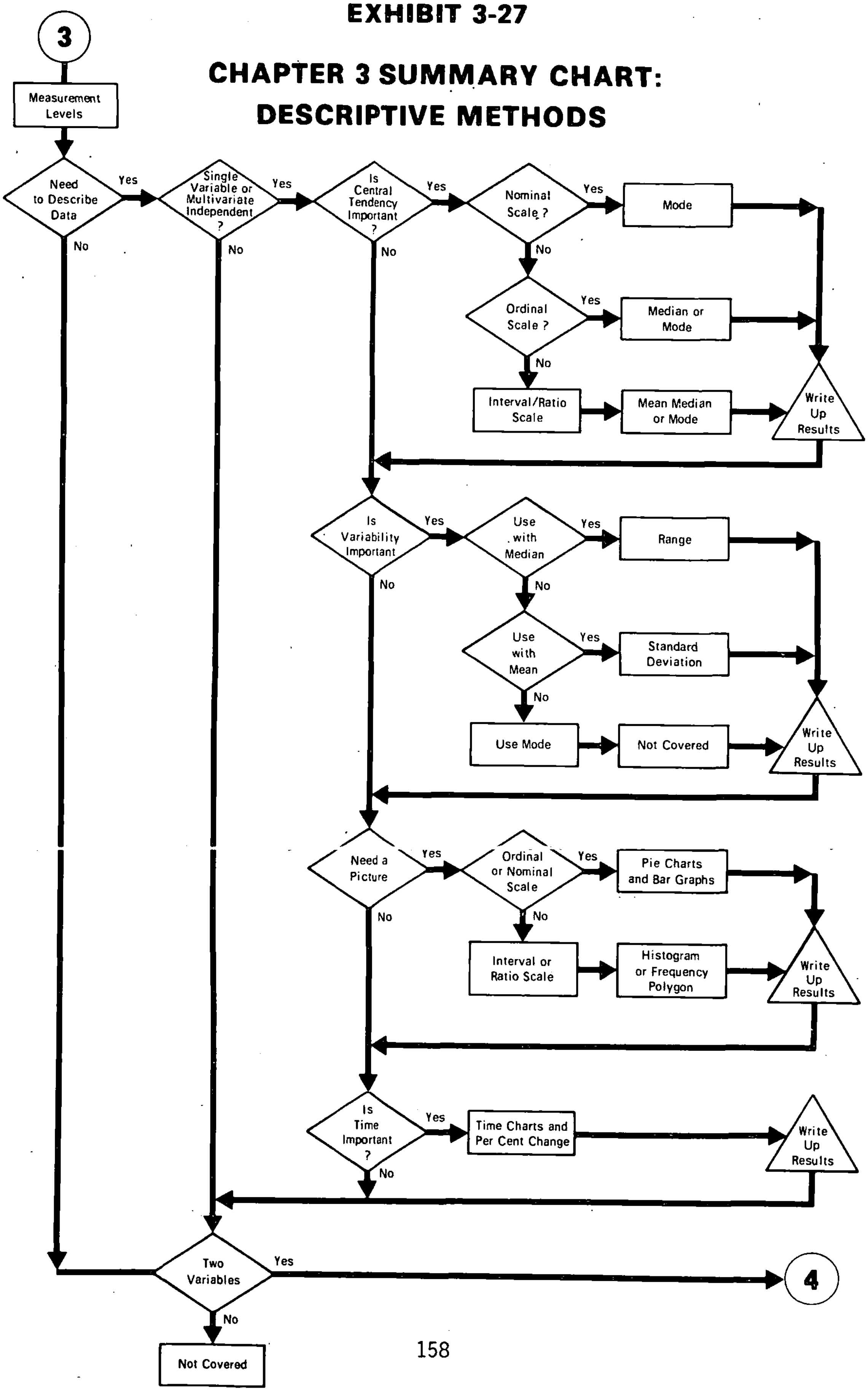
Interpretation of trend data presents particularly difficult issues. Consider the apparent random fluctuation in the number of reported auto thefts over a seven year period. If an analyst only considered the period 1976 to 1977, one would conclude that with a 5% increase, auto thefts should be a major concern in Chaos City. However, placed in perspective of the seven year time series, it would appear that the increase in 1976-1977 is not part of a long term trend, and that the variation is quite small (range is only 400 offenses) considering the amount of auto theft in 1971. Consequently auto theft would not be an offense to be particularly alarmed about. Contrast this trend to the time series for commercial burglary which appears to have significantly increased during the period 1974-1977 (a 157% change). These examples should reinforce the importance of developing a time series data set long enough for identifying significant trends, thus avoiding misinterpretation of short term fluctuations.

V. Conclusion

Descriptive methods are used to summarize and display data. The choice of method is both a measurement scale issue and an issue of obtaining maximum emphasis relevant to the hypothesis under consideration. Exhibit 3-27 illustrates the logic of such selection. In the next chapter various techniques for comparing two or more variables are presented. Descriptive methods should, however, be first applied to any data set before moving on to higher-order techniques.

EXHIBIT 3-27

CHAPTER 3 SUMMARY CHART: DESCRIPTIVE METHODS



[1] Audrey Haber and Richard P. Runyon, General Statistics, 3rd ed. (Reading: Addison-Wesley), p. 6.

[2] Herman J. Loether and Donald G. McTavish, Descriptive and Inferential Statistics (Boston: Allyn and Bacon, 1976), pp. 54-64.

[3] Problems and approach adapted from Richard H. Scheaffer, William Mendenhall, and Lyman Ott, Elementary Survey Sampling (North Scituate: Duxbury Press, 1979) pp. 42-50.

[4] William Mendenhall, Lyman Ott and Richard F. Larson, Statistics: A Tool for the Social Sciences, 2nd ed. (North Scituate: Duxbury Press, 1978), pp. 42-92.

[5] Ibid.

CHAPTER 4

COMPARATIVE METHODS

Introduction

A number of statistical tools are available to describe the relationships between two or more variables. In this chapter five such methods are presented: the use of rates and index numbers, a crime seriousness weighting system, cross-classification tables, scattergrams, and statistical maps.

Comparative analysis is a powerful approach for three reasons. First, comparison of "similar" jurisdictions can give the analyst a clearer idea of the significance of particular data and trends and a better perspective in interpreting shifts in these measures. Second, attention should be given to the ways in which roughly similar jurisdictions differ from each other in terms of their demographic characteristics and their respective systems of justice. Relating these differences to differences in the levels and intensity of crime may result in clearer insights into the sources of crime and possible prevention strategies; insights which should be at the heart of program design. Third, comparisons of jurisdictions, census tracts or other units of analysis, may give criminal justice decision-makers moderately objective standards for allocating limited resources. While the severity of a problem may be an "absolute measure" in the eyes of a local resident, decision-makers with limited resources must compare different problems and assess different levels of severity in determining the allocation of resources.

I. Rates and Index Numbers

The concept of rates is familiar to most criminal justice practitioners and has been discussed briefly in this text: crime rate, arrest rate, clearance rate, conviction rate, recidivism rate, and so forth. In fact most of these notions are so familiar that analysts often fail to question the way that a particular rate is constructed, or to examine carefully what a rate or index really measures and how they should be interpreted.

For example, crime rate is commonly distinguished from crime incidence in that the former represents a standardized version of the latter. That is, crime counts within a geographic unit are divided by the population of the unit (thus arriving at a rate per capita), and the result is multiplied by 100,000 or some other scaling factor to make the interpretation of the result somewhat easier. In this way, geographic units of different population size are made more comparable through a standardizing process.

Deriving crime rates as described above represents one way of achieving comparability. When this method is used for specific crimes, however, the meaning of rate varies. If a rate is to be interpreted as a "risk" of victimization, then greater care must be taken in choosing the denominator which is used to calculate the rate. For example, in calculating the rate of forcible rape as a risk of being the victim of such a crime, the number of rapes reported should be divided by the number of females (in the age group where the event would be legally defined as rape) residing in the geographic unit of interest, rather than by the total population. Similarly, the risk of auto theft should be estimated by dividing the number of autos stolen by the number of autos that could be stolen (e.g., the number of registered autos). Thus while there is nothing inherently "wrong" in dividing the incidence of different types of crime by population (or area) to arrive at a rate, analysts should always be cognizant of what the result really means and how it is to be interpreted.

Exhibit 4-1 presents selected characteristics of Chaos City for each year between 1971 and 1977. These may be combined with the incidence data presented in Exhibit 3-23 to produce appropriate rates for each of these offense categories. For example, dividing the incidence of residential burglary in 1971 by the number of dwelling units (the population-at-risk) in 1971 and multiplying by 10,000 produces a residential burglary rate expressed as the number of offenses per 10,000 dwelling units, i.e., (4100/90000)10000 = 455.6 residential burglaries per 10,000 dwelling units.

In Exhibit 4-2 the percent change between 1971 and 1977 in incidence and rate is compared for the seven crime categories. Not only is the percent change in rate substantially less than the percent change in incidence, controlling for the populations-at-risk reveals that assaults and auto thefts declined during this period. Exhibit 4-3 is a time chart of the incidence data, while Exhibit 4-4 is a chart of the rate data. The sharp increase in incidence of residential burglary is not evident in the rate chart, while the rate chart clearly indicates the decline in auto thefts. Different patterns emerge by examining the rates and comparing them to the incidence data, suggesting different relationships and problem areas.

EXHIBIT 4-1.

CENSUS DATA FOR CHAOS CITY, 1971-1977

CATEGORY	1971	1972	1973	1974	1975	1976	1977
Population	250,000	270,000	300,000	310,000	330,000	340,000	350,000
Housing Units	90,000	100,000	115,000	120,000	135,000	140,000	150,000
Commercial Establishments	5,300	5,800	6,300	7,300	8,000	8,600	9,000

Source: See Exhibits 4-1 and 3-23.

EXHIBIT 4-2

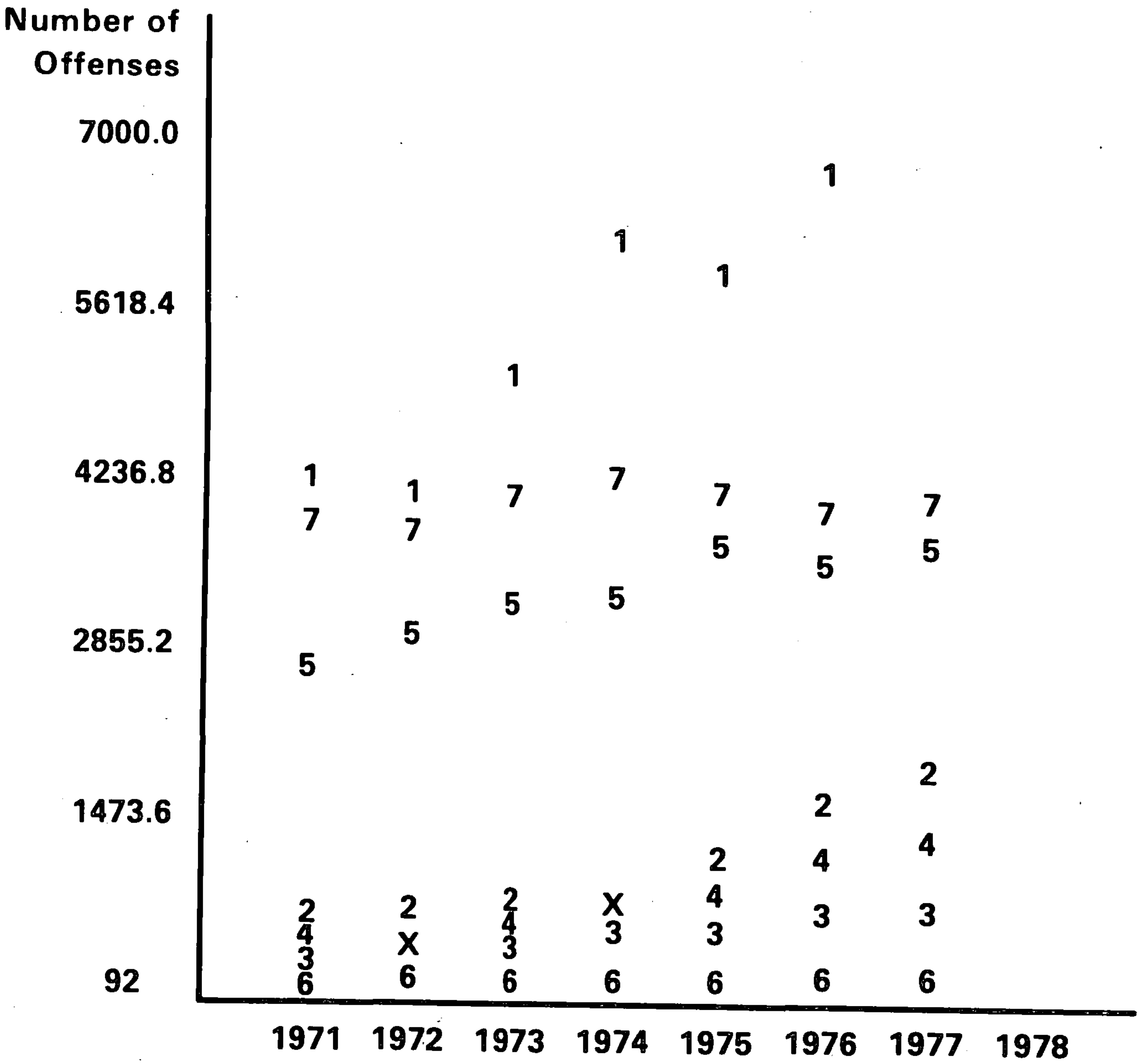
PERCENT CHANGE IN INCIDENCE AND RATES,
SEVEN CRIME CATEGORIES, CHAOS CITY, 1971-1977

	Percent Change, 1971-1977	
	in Incidence	in Rate
Residential Burglary	70.7%	2.4%
Commercial Burglary	233.3%	96.3%
Commercial Robbery	180.0%	64.9%
Street Robbery	300.0%	185.7%
Assault	38.5%	-1.1%
Rape	48.5%	6.1%
Auto Theft	5.3%	-24.8%

Source: See Exhibits 4-1 and 3-23. Percent change was calculated using 1977 and 1971 data only. (hypothetical data)

EXHIBIT 4-3

INCIDENCE OF CRIME CHART, SEVEN CRIME CATEGORIES, CHAOS CITY 1971 - 1977



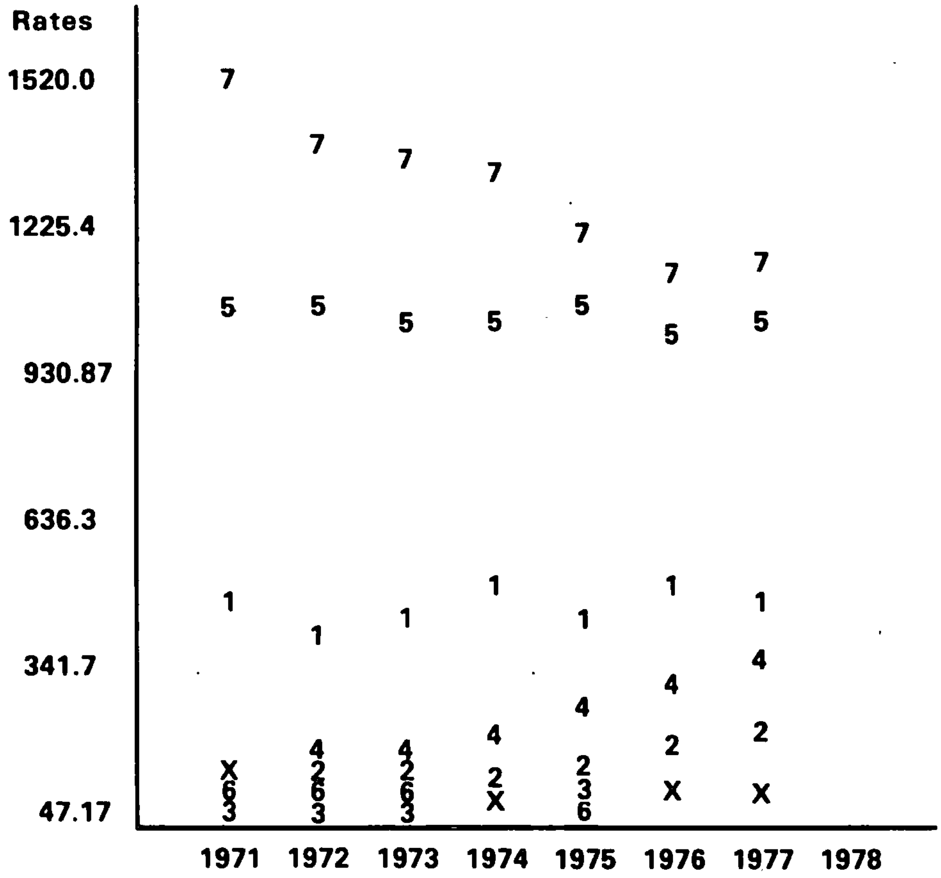
(1) Res Burg (2) Com Burg (3) Com Rob (4) Str Rob

(5) Assault (6) Rape (7) Auto T

Source: Hypothetical Data

EXHIBIT 4-4

CRIME RATES CHART, SEVEN CRIME CATEGORIES, CHAOS CITY, 1971 -1977



(1)	Res BR	=	Residential Burglaries Per 10,000 Dwelling Units.
(2)	Com BR	=	Commercial Burglaries Per 1,000 Commercial Establishments.
(3)	Com RR	=	Commercial Robberies Per 1,000 Commercial Establishments.
(4)	St RR	=	Street Robberies Per 100,000 Population.
(5)	As Rate	=	Assaults Per 100,000 Population.
(6)	Rape R	=	Rapes Per 100,000 Females.

$$= \frac{\text{Rapes}}{\text{City Population/2}} \times 100{,}000$$

(7) Auto R = Auto Thefts Per 100,000 Population.

$$= \frac{\text{Auto Thefts}}{\text{City Population/2}} \times 100{,}000$$

Source: hypothetical data

It is particularly useful to standardize size in the comparative analysis of crime trends because changes in population size are generally thought to be part of broader social trends and not susceptible to local control. Crime rate allows the analyst to characterize crime in ways that may be more suggestive of local remedial action.

Frequently, an analyst wants an annual crime rate per 100,000 population but has crime incidence data for only part of the year. An annualized figure can be estimated using this formula:

$$\frac{\text{\# of incidents reported to date}}{\text{population of jurisdiction}} \times 100{,}000 \times \frac{12}{\text{\# of months for which data are reported}}$$

Such a formula does not, of course, account for possible seasonal variations or for trends in crime which might alter or change the crime level within a given year. Multiplying the part-year crime rate by the reciprocal of the proportion of months studied will provide an annualized figure which can more readily be used in comparisons across jurisdictions.

Following are two qualifications to be aware of in using crime rates to analyze time trends:

a. Certain data, e.g., population size, are normally collected only every ten years by the Bureau of the Census. Estimation methods are used to determine population size between decennials.
b. Population size is not the at-risk factor for all crime categories. There are more meaningful rates for certain crimes. In the previous examples, the population-at-risks selected were, commercial units, dwelling units, and females (population/2). Since the number of registered vehicles was not available, population size was used as the at-risk population in calculating an auto theft rate.
c. Monthly adjustments.

The following section expands the discussion of rates to include four different types of index numbers applicable to criminal justice analysis. These four are: (1) density index; (2) concentration index; (3) distribution index; and (4) index of unit share. Exhibit 4-5 presents selected characteristics for the five neighborhoods of Chaos City as of 1977. This data will be used to illustrate these index numbers.

EXHIBIT 4-5.

NEIGHBORHOOD CHARACTERISTICS, CHAOS CITY, 1977

CHARACTERISTICS	CITY TOTAL	NEIGHBORHOOD				
		CENTRAL	WESTSIDE	UNIVERSITY	PARK	WASHINGTON
Population	350,000	65,000	90,000	50,000	80,000	65,000
Geog. Size	70 sq. mi.	5	22	10	18	15
Housing Units	150,000	25,000	40,000	25,000	36,000	24,000
Commercial Establishments	9,000	3,000	2,000	1,000	2,500	500
Median Income Households	11,400	9,000	12,900	14,200	6,800	21,500
% Minority	30%	54%	1%	2%	86%	1%
% Under 18	22%	10%	19%	21%	24%	18%
Residential Burglary	7,000	800	2,400	700	2,100	1,000
Commercial Burglary	1,800	500	500	200	400	200
Commercial Robbery	700	200	100	50	300	50
Street Robbery	1,200	500	200	100	300	100
Assault (Rape)	3,600 (150)	600 (20)	900 (18)	400 (75)	900 (18)	800 (19)
Auto Theft	4,000	2,000	400	400	1000	200
Juvenile Offenders*	1,060	300	250	200	200	110

*For these offense categories, neighborhood denotes place of arrest.
Source: hypothetical data

A. Four Types of Index Numbers

1. Density Index

A density index reflects population counts per unit area. For example, the visualizing of cities versus rural areas represents an intuitive perception of density. Density is particularly important for aggregate statistics because it standardizes for size of area. Thus, political or administrative areas (e.g., states, counties, cities, police districts, and census tracts), which rarely exhibit uniformity of size, can be converted to comparable units by means of a density index.

The density for a particular offense is calculated by dividing the number of arrests for that offense by the size of the jurisdiction. (See Exhibit 4-5 for data.) For example, the density of residential burglaries (RB) in Central and Westside, respectively, in 1977, is:

$$\text{RB Density (Central)} = \frac{\text{800 Residential Burglaries}}{\text{5 Square Miles}} = \frac{\text{160 Residential Burglaries}}{\text{Per Square Mi.}}$$

$$\text{RB Density (Westside)} = \frac{\text{2400 Residential Burglaries}}{\text{22 Sq. Miles}} = \frac{\text{109 Residential Burglaries}}{\text{Per Square Mi.}}$$

Exhibit 4-6 compares the incidence, rate, and density of residential burglary for each neighborhood in Chaos City. While Westside is ranked highest in incidence and rate, it is third highest in density. The Central area, fourth highest in incidence and rate, is first in residential burglary density.

EXHIBIT 4-6.

DENSITY, INCIDENCE AND RATE COMPARED FOR RESIDENTIAL BURGLARY, BY NEIGHBORHOOD, CHAOS CITY, 1977

	Residential Burglary		
Neighborhoods	Incidence	Rate**	Density***
Central	800.00(4)*	320.00(4)	160.000(1)
Westside	2400.00(1)	600.00(1)	109.090(3)
University	700.00(5)	280.00(5)	70.000(4)
Park	2100.00(2)	583.33(2)	116.670(2)
Washington	1000.00(3)	416.67(3)	66.667(5)

* Rank
** Residential Burglaries Per 10,000 dwelling units
*** Residential Burglaries Per sq. mile

Source: hypothetical data

Density indices are particularly useful since they control for the size of a jurisdiction when conducting a comparative analysis. The analysis of the problems related to criminal justice require such spatial "standardization." As an extreme example, in a sample of juvenile delinquent males, a different action would certainly be taken if the number of juveniles involved, say 200, reside in an area of one square mile, than if they resided in a hundred square miles. It also is possible that the nature of police operations would depend on the density of target groups (e.g., juveniles or male juveniles).

2. Concentration Index

Concentration indices are most appropriately described as the ratio of two measures related to the same phenomenon, where a particular attribute of the phenomenon is captured in the numerator or denominator, but not in both. It is perhaps, the easiest type of index to construct because all the elements usually come from the same data source. For example, one might need to know about the residence of male juveniles in developing a special diversion program for male delinquents in a metropolitan area. Using Probation Department files, the concentration index for each census tract can be computed by dividing the number of male juveniles against whom delinquency petitions have been filed and whose residence is within that tract, by the total number of juveniles residing in that tract against whom such action has been taken.

As another example of a concentration index consider the question: in the central neighborhood what is the percent of all offenses that are committed by juveniles? In order to answer this question data on the total number of offenses in 1977 and the number of juvenile offenders is required. These are available in Exhibit 4-7. By using the following formula, a concentration index, reflecting the concentration of juvenile offenders in each neighborhood, may be calculated:

$$\text{Concentration Index (Central)} = \frac{\text{Number Juvenile Offenders in Central}}{\text{Number of Offenders in Central}} \times 100$$

$$\text{CI (Central)} = \frac{300}{4600} \times 100$$

$$\text{CI (Central)} = 6.5\%$$

In Exhibit 4-7 the first column presents this concentration of juvenile offenders for each neighborhood. University has the highest concentration of juvenile offenders with 10.8% of all offenders in 1977 and Washington had the lowest concentration.

EXHIBIT 4-7.

CONCENTRATION INDEX, DISTRIBUTION INDEX, AND
INDEX OF UNIT SHARE, JUVENILE OFFENDERS
BY NEIGHBORHOOD, CHAOS CITY, 1977

Neighborhoods	Concentration Index*	Distribution Index**	Index of Unit Share***
Central	6.5%	4.6%	28.3%
Westside	5.4%	1.5%	23.6%
University	10.8%	1.9%	18.9%
Park	4.0%	1.0%	18.9%
Washington	4.7%	.9%	10.4%

* Number of juvenile offenders/number of offenders.
** Number of juvenile offenders/number of juveniles.
*** Number of juvenile offenders in each neighborhood/ number of juvenile offenders in Chaos City.

Source: hypothetical data

3. Distribution Index

A "distribution index" is useful for assessing the degree of a problem within the context of a larger population that could be involved with the problem. The numerator would be some aspect of interest to criminal justice as compared to a "population-at-risk." The risk population can be persons (e.g., juveniles), places (e.g., liquor stores), or things (e.g., autos). This kind of measure is often useful for resource allocation and/or long-range planning. Consider another example concerning male juveniles. A distribution index would not be based on a comparison of male delinquents to all delinquents. Rather, the denominator of the index would be the total numer of male juveniles, and the numerator would be the number of delinquent male juveniles. Note that two data sources may have to be consulted to construct this index; one from which male juvenile delinquency data can be obtained, and one from which the male juvenile population can be estimated.

An example of a distribution index is presented in Exhibit 4-7. This index was calculated using the following formula:

$$\text{Distribution Index (Central)} = \frac{\text{Number Juvenile Offenders}}{\text{Number of Juveniles}} \times 100$$

$$\text{DI (Central)} = \frac{300}{(65{,}000 - .10)} \times 100$$

$$\text{DI (Central)} = 4.6\%$$

In the Washington neighborhood less than 1% of all juveniles were arrested, while in Central over 4.6% of the juvenile population was arrested.

4. Index of Unit Share

This index refers to the proportion of a phenomenon which occurs in a large area. It is frequently used by analysts to contrast the share of crime in an area to that area's share of the population. For example, in the previous discussion, the number of juvenile offenders was used as the greatest share of juvenile delinquency, within Chaos City. This can be calculated by dividing the count of juveniles who were arrested in each neighborhood by the total number of juvenile offenders in the city.

An index of unit share is calculated as follows:

$$\text{Index of Unit Share (Central)} = \frac{\text{\# juvenile offenders in Central}}{\text{\# juvenile offenders in Chaos City}} \times 100$$

$$\text{IUS (Central)} = \frac{300}{1060} \times 100$$

$$\text{IUS (Central)} = 28.3\%$$

The third column of Exhibit 4-7 is an Index of Unit Share of delinquency for each neighborhood. Note that these percentages should add to 100% (but may not due to rounding error). The greatest proportion of juvenile offenders is in Central followed by Westside. Only 10% of all juvenile offenders lived in Washington during 1977.

B. Comparative Analysis Using Index Numbers

Comparative analysis is typically used to assess many variables for many different jurisdictions. It can be done for jurisdictions within a state or, as in the previous examples, neighborhoods within a local jurisdiction. It can be extended by comparisons with figures for regional groupings of states or with nationally aggregated data of similar-sized jurisdictions, such as cities 250,000-400,000 in population or suburban counties.

Comparative analysis of crime indices often is extended in three directions. First, victimization data may be introduced. These data allow the analyst to factor in a rough city-to-city adjustment for levels of crime reporting. Second, comparative measures can be combined with time series data, a very powerful combination which remedies several of the weaknesses of each individual technique. Third, maps displaying the values of each different indices with various degrees and kinds of shading provide an excellent visual comparative framework and clearly demonstrate the differences in the meanings of the index numbers. This mode of presentation of index numbers is excellent for managers and decision-makers whose time constraints preclude their examining extensive statistical tables.

The strengths of comparative analysis of index numbers are: 1) its emphasis on describing levels and changes of a phenomenon and, 2) the use of indices to establish patterns or trends. The weaknesses of the technique, at least in its basic forms, include: 1) a failure to account for differences in measurement among jurisdictions which might influence the reliability of comparisons, 2) a lack of historical perspective which may encourage misleading interpretations of trends, relative rankings, and other comparisons, and 3) the development of a conceptually ambiguous analysis based on multiple indices using complex measures.

II. Seriousness Weighting

Weighting offenses according to their relative seriousness is basically an effort to identify those offenses that inflict a greater harm on the community. Many concerns about crime and the criminal justice system are linked to serious offenses; these are what decision-makers would like to do something about. Therefore, these crimes must be identified. A seriousness scale is an attempt at such identification.

A. Need for a Seriousness Scale

Identification of crime by category, e.g., robberies, burglaries, and assaults, conveys some information about the seriousness of the offense. However, crime types, by themselves, are not sufficient indicators of seriousness for three reasons:

a. Crime types are nominal scale data. Seriousness measures should be, at least, ordinal scale data.
b. Crime types do not sufficiently provide information which the community can use to determine the level of seriousness.
c. The UCR program relies on a scoring system in which multiple offenses and, with some types of crime, multiple victims are not recorded. Therefore, a great deal of detail is lost when classifying crime according to UCR rules.

A scale is needed that places all offenses on one continuum of seriousness, regardless of crime type -- violent or property. All the elements of the offense should be considered in a seriousness scale. A ranking method is needed to indicate how much more serious incident X is than Y. Such a method requires the development of seriousness weights for each offense. Intuitively, homicides are more serious than auto theft, and auto theft more serious than loitering. However, is a robbery of $1000 more serious than assault resulting in hospitalization; or is the burglary of $250 more serious than the theft of a '68 Volkswagen beetle? To answer such questions requires knowledge of the degree of seriousness; a ranking of seriousness is required so that such distinctions may be made. These ranks must be consistent with intuition (face validity) and must be uniform so that the degree of difference between offenses may be noted.

B. An Example Of A Seriousness Scale: The Sellin-Wolfgang Index

Several seriousness scales have been developed; one of the new widely used scales involves a weighting system for crime that can be used to measure changes in the seriousness of crime over time or among jurisdictions created by Thorsten Sellin and Marvin E. Wolfgang.[1] This scale may be used to determine where in a city the rates of serious crime are increasing and where they are decreasing. It may be used as an aid in determining budget allocations, assessing manpower requirements, and identifying the need for special programs such as block patrols or security programs.

The Sellin-Wolfgang index has three important characteristics:

a. It can be disaggregated down to the smallest geographical and temporal unit.
b. It is based on data normally collected by local police departments; thus costs in establishing the system are minimized; also, there is likely to exist a sufficiently long time series for trend analysis.
c. It is a measure of the amount of harm inflicted on the community.

A survey was used by Selling and Wolfgang, requesting respondents to describe the seriousness of specific crimes. These responses were aggregated to estimate the magnitude of seriousness for specific crimes. Scaling techniques were then used to convert responses to scale values (scores) for the components of a crime. These components and scale values, the Sellin-Wolfgang Index, are presented in Exhibit 4-8.

EXHIBIT 4-8.

SELLIN-WOLFGANG SERIOUSNESS COMPONENTS AND SCORES

I.	Number of victims of bodily harm	
	(a) Receiving minor injuries	1
	(b) Treated and discharged	4
	(c) Hospitalized	7
	(d) Killed	26
II.	Number of victims of forcible sexual intercourse	10
	(a) Number of such victims intimidated by weapon	2
III.	Intimidation (except II above)	
	(a) Physical or verbal only	2
	(b) By weapon	4
IV.	Number of premises forcibly entered	1
V.	Number of motor vehicles stolen	2
VI.	Values of property stolen, damaged, or destroyed (in dollars)	
	(a) Under $10	1
	(b) $10 - $250	2
	(c) $251 - $2,000	3
	(d) $2,001 - $9,000	4
	(e) $9,001 - $30,000	5
	(f) $30,001 - $80,000	6
	(g) Over $80,000	10

Source: Sellin, Thorsten, and Marvin E. Wolfgang. The Measurement of Delinquency. New York: Wiley, 1964.

To apply this index (1) a crime must be divided into its specific components; (2) each component must be given a score; and (3) the scores must be totaled and an aggregate estimate of the crime's seriousness determined. For example, if an offender breaks into a retail store while no one is there, without a weapon, and steals $500, the seriousness of this offense would be assessed as follows:

Store entered	=	1	
Dollar Value of Stolen Property	=	3	
		4	Total

If the same offender had entered the store with a shotgun and had shot the proprietor and his wife who were subsequently hospitalized, the seriousness of the crime would be assessed as follows:

Store entered	=	1	
Two Hospitalized Victims	=	14	
Intimidation	=	4	
Dollar Value of Stolen Property	=	3	
		22	Total

Both of these examples would equal "1" in the Uniform Crime Reports.

In Exhibit 4-9 seriousness scores have been applied to drug arrest data for Chaos City by neighborhood. There is a significant variation in the seriousness score and the incidence of these crimes in two of the neighborhoods. In Westside the crimes are more serious than reflected by the incidence, while in Park it is less serious than the frequency of drug crimes would initially indicate.

EXHIBIT 4-9.

APPLICATION OF SERIOUSNESS SCALE, DRUG ARRESTS BY NEIGHBORHOOD, CHAOS CITY, 1977

Neighborhood	Drug Arrests[1]	Percent of Incidents	Total Seriousness[2]	Percent of Seriousness
Central	30	6.1%	60	6.6%
Westside	42	8.6%	142	15.7%
University	125	25.6%	250	27.7%
Park	240	49.1%	300	33.1%
Washington	52	10.6%	152	16.8%
Total	489	100%	904	100%

[1]In a one year period, 1977
[2]Sum of all Seriousness Scores for each neighborhood.

Source: hypothetical data

C. Uses of Seriousness Scale

One application of the seriousness scale was in the Watts Model City Area, using Los Angeles Police Department data. The project demonstrated that seriousness per 100,000 population and the crime rate are related and may even be negatively correlated.[2]

Heller and McEwen in reporting on the application of the Sellin-Wolfgang Index to crime data provided by the St. Louis Metropolitan Police Department concluded:

- The average seriousness of a crime against the person was four times as great as the average seriousness for a crime against poverty.
- Crimes against the person in St. Louis accounted for 12.5% of the incidents but 37.5% of the seriousness.
- Two-thirds of the harm from crime may be attributed to property loss, and one-sixth each to physical injury and mutilization.
- The injury and property loss occurring in the average traffic accident is over fifty percent more serious than that occurring in the average Part 1 offense.[3]

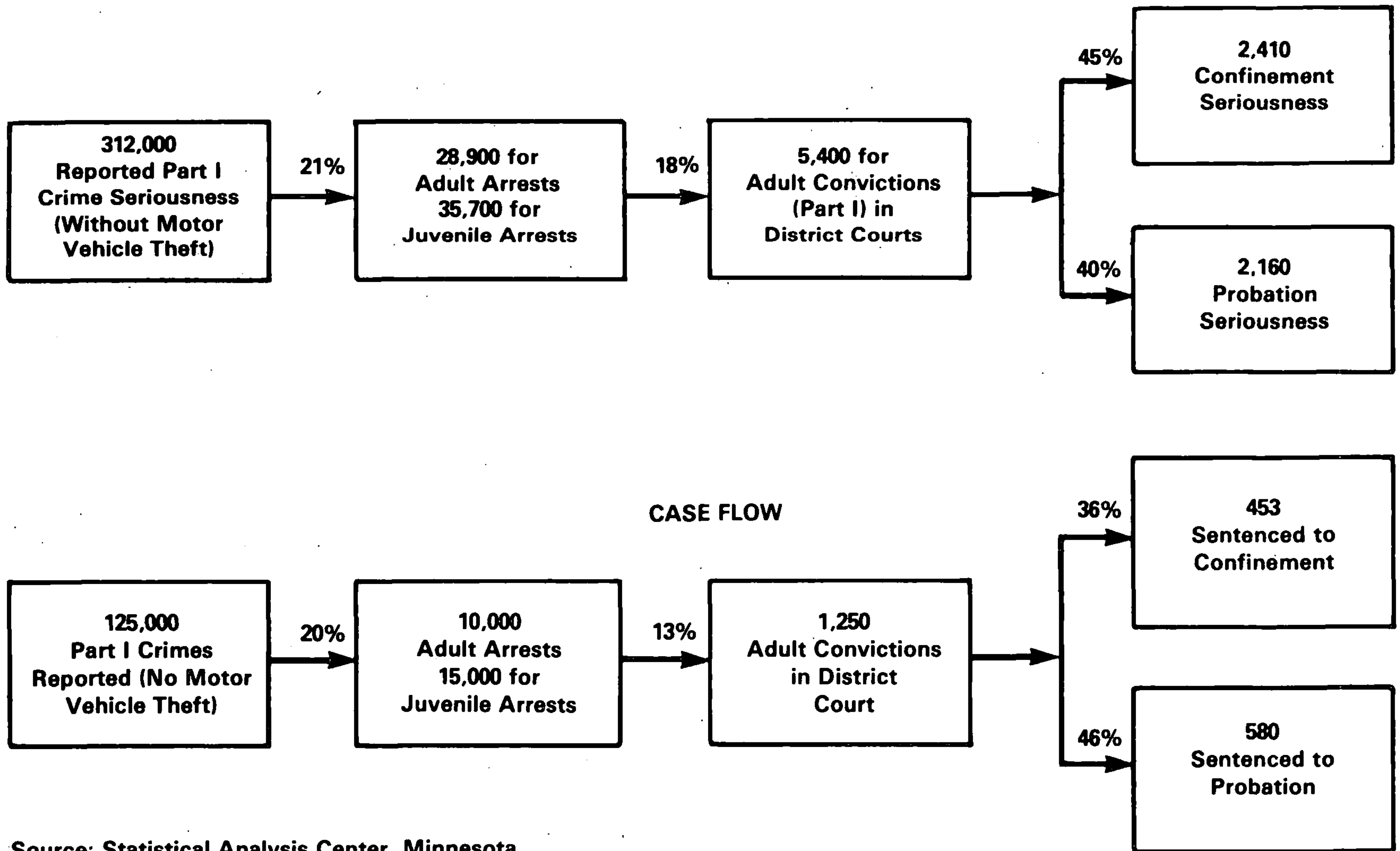
Another application of the seriousness concept is illustrated in the following quotation from a report prepared by the Minnesota Statistical Analysis Center and Research Unit. This application involves using a seriousness score to describe and assess criminal justice system operations.

> One problem in analyzing or evaluating the criminal justice system is that knowing the number of crimes, the crime rate, or the number of people arrested does not give us much information about the seriousness of crimes. If the criminal justice system had sufficient resources to give equal attention to all types of crime, the seriousness of crime would not be a particular issue. But we know that the system exercises great discretion in who will be arrested, prosecuted, and sentenced to prison; this is shown by the funneling down of the numbers of people at successive stages of the system. We might expect that if the system must choose between prosecuting crimes of varying seriousness, those most serious will get the most attention. On the other hand, we do not expect less serious crimes to be totally disregarded, so that they might be committed with impunity. Thus, how the system handles crimes, as measured by their seriousness, can be one measure of how the system is working. We can, specifically, compare the funneling by quantitative numbers of people to the funneling by seriousness of the associated crimes.
>
> Comparing the seriousness flowchart with the strictly numerical flowchart in (Exhibit 4-10) we

make these observations. The two flowcharts are most alike when arrests are compared as fractions of reported Part I crime. Adult arrests account for 8 percent of reported Part I crimes (excluding motor vehicle theft); the percentage is 20 percent if juvenile arrests are included. For seriousness the comparable percentages are 9 percent and 21 percent. So we find only a slight predisposition in the system toward the arrest of the more serious offenders. At the district court level the margin of seriousness increases over the numerical: 13 percent of the adults arrested are convicted, and this accounts for 18 percent of the seriousness of the crimes of arrest. For district courts 46 percent of those convicted are placed on probation and 16 percent confined. In terms of seriousness of convictions those percentages are 40 percent and 45 percent. Thus, seriousness becomes a more decisive factor as one moves through the system, although the margin is not especially great. Note also that one effect of plea negotiation is to reduce the observed level of crime seriousness processed by the court subsystem.[4]

EXHIBIT 4-10

COMPARISON OF SERIOUSNESS AND CASEFLOW FOR PART I OFFENSES (EXCLUDING MOTOR VEHICLE THEFT) STATE OF MINNESOTA, 1973



Source: Statistical Analysis Center, Minnesota.

III. Cross-Classification Tables

The procedure for grouping data into classes for descriptive purposes was discussed in chapter three. In this section percentage comparison of such classes or categories is presented as a technique for describing one variable and for examining the relationship between two or more nominal or ordinal scale variables.

A. One-Way and Two-Way Tables

A one-way table consists of categories, cell counts, and percentages for a single variable. In Exhibit 4-11 the one-way table displays both in absolute and relative terms the significance of different crimes in Chaos City for 1977. Residential burglaries accounted for 7,000 of the 18,300 crimes or 38.2% of the total. Auto thefts represent 21.9% of the total crimes.

In developing a two-way table, the two variables should be part of a hypothesis with an independent and dependent variable*. The dependent variable should be the column or vertical variable and the independent variable should be the row or horizontal variable. In Part B of Exhibit 4-11, "neighborhood" has been added as an independent variable. From the percentages it is apparent there is a major difference in the distribution of crimes by neighborhood. For example, 43.5% of the crimes in Central were auto thefts in 1977 while auto thefts accounted for only a small percentage of the crimes in Westside (8.7%), Park (2%), and Washington (8.5%). Some of this variation may be explained by neighborhoods and other factors. Uses of rates and indices as a companion to such a two-way table would help to identify some of these other factors.

The analysis of such cross-classification tables involves both the description of the individual variables involved (i.e., in Exhibit 4-11, crime and neighborhood) as well as making a determination concerning the relationship between the variables (i.e., does the incidence of crime vary significantly across geographical areas of the city).

* These were terms defined and discussed in Chapter One and are included in the glossary.

EXHIBIT 4-11.

ONE-WAY AND TWO-WAY TABLES ILLUSTRATIONS,
NEIGHBORHOOD CRIME DATA SET,
CHAOS CITY, 1977

A. One-way Table: Incidence of Crime, Crime Type, Chaos City, 1977

	Total	Residential Burglary	Commercial Burglary	Commercial Robbery	Street Robbery	Assault	Rape	Auto Theft
Total	18300	7000	1800	700	1200	3450	150	4000
Percent	100%	38.2%	9.8%	3.8%	6.6%	18.9%	.8%	21.9%

B. Two-way Table: Incidence of Crime, Crime Type by Neighborhood, Chaos City, 1977

	Central	%	Westside	%	University	%	Park	%	Washington	%
Residential Burglary	800	17.4%	2400	52.2%	700	37.8%	2100	4.2%	1000	42.6%
Commercial Burglary	500	10.9%	500	10.9%	200	10.8%	400	8.0%	200	8.5%
Commercial Robbery	200	4.35	100	2.2%	50	2.7%	300	6.0%	50	2.1%
Street Robbery	500	10.9%	200	4.3%	100	5.4%	300	6.0%	100	4.3%
Assault	580	12.6%	882	19.2%	325	17.65	882	17.6%	781	33.2%
Rape	20	.4%	18	.4%	75	4.1%	18	.4%	19	.8%
Auto Thefts	2000	43.5%	400	8.7%	400	21.6%	100	2.0%	200	8.5%
TOTAL	4600		4600		1850		5000		2350	

Source: hypothetical data

B. Percentaging A Two-Way Table

The assessment of relationship between two nominal or ordinal scale variables (or grouped interval or ratio scale variables) should begin with a percentage comparison. Percentaging a two-way table means dividing and percentaging the observations according to the independent variable. Exhibit 4-12 presents a four-step procedure for conducting a percentage comparison.

EXHIBIT 4-12.

FOUR STEP PERCENTAGE COMPARISON OF
A TWO-WAY TABLE,
EFFECT OF INCOME ON RECIDIVISM

Step 1: Identify Hypothesis and Dependent and Independent Variables.

Hypothesis: Recidivism is related to income.

(Dependent Variable)	(Independent Variable)			
	Average Annual Income During Follow-up Period			
Recidivism Status	Less Than $4000	$4001 - $8000	More Than $8000	TOTAL
Rearrested	68	43	9	120
Not Rearrested	68	47	15	130
TOTAL	136	90	24	250

Step 2: Percentage the Dependent Variable

(Dependent Variable)	(Independent Variable)			
	Average Annual Income During Follow-up Period			
Recidivism Status	Less Than $4000	$4001 - $8000	More Than $8000	TOTAL %
Rearrested				48.0%
Not Rearrested				52.0%
TOTAL				100.0%

Step 3: Percentage the Dependent Variable For One of the Independent Categories

(Dependent Variable) (Independent Variable)

Recidivism Status	Average Annual Income During Follow-up Period			
	Less Than $4000	$4001 - $8000	More Than $8000	TOTAL
Rearrested	50%			48%
Not Rearrested	50%			52%
TOTAL	100%			100%

Step 4: Percentage the Dependent Variable for the Remaining Independent Categories

(Dependent Variable) (Independent Variable)

Recidivism Status	Average Annual Income During Follow-up Period			
	Less Than $4000	$4001 - $8000	More Than $8000	TOTAL
Rearrested	50%	47.8%	37.5%	48%
Not Rearrested	50%	52.5%	62.5%	52%
TOTAL	100%	100.0%	100.0%	100%

The first step consists of identifying the hypothesis in terms of an independent variable (columns) and the dependent variable (rows). The data are then appropriately distributed into each cell of the table. In the example, the hypothesis being examined is that an ex-offender's recidivism status is positively related to his/her annual income. The greater the income, the less the probability of being rearrested. The data presented in the table consist of a title, headings for the row and column variables, category labels for the two variables, cell counts, and row and column totals. The latter are sometimes referred to as the "marginals."

Step two requires percentaging the marginals for the dependent variable. Forty-eight percent of the ex-offenders were rearrested, while 52% were not. Step three involves percentaging the dependent variable for one of the independent categories. Fifty percent of the ex-offenders who earned less than $4000 were rearrested; not 50% of those rearrested earned less than $4000. The fourth step completes the percentaging for the remaining independent categories. Note that there appears to be some evidence of a positive relationship between the independent and dependent variables: income appears to be related to recidivism.

Exhibit 4-13 presents the same table as in Exhibit 4-12, with the addition of column and total percentages. The row percentages are interpreted: 56.7% of the recidivists earned less than $4000 and only 7.5% earned more than $8000. The column percentages are interpreted: 62.5% of those who earned more than $8000 did not recidivate. The total percentages are interpreted: 27.2% of the sample earned less than $4000 and were recidivists. There is some evidence in the column percentages to suggest a positive relationship between income and recidivism.

EXHIBIT 4-13.

ROW, COLUMN AND TOTAL PERCENTAGES FOR A TWO-WAY TABLE,
EFFECT OF INCOME ON RECIDIVISM

(Dependent Variable)	(Independent Variable)			
	Average Annual Income During Follow-up Period			
Recidivism Status	Less Than $4000	$4001 - $8000	More Than $8000	ROW TOTAL %
Rearrested	68.0* 56.7%** 50.0%*** 27.2%****	43.0 35.8% 48.3% 17.2%	9.0 7.5% 37.5 3.6%	120 48%
Not Rearrested	68.0 52.3% 50.0% 27.2%	47.0 36.2% 52.2% 18.8%	15.0 11.5 62.5 6.0%	130 52% 52%
Column	136.0	90.0	24.0	250
TOTAL	54.4%	36.0%	9.6%	100%

Source: hypothetical data

*N
**Row %
***Column %
****Total %

A second example of a two-way table is presented in Exhibit 4-14. Using the twenty-seven-city data set (Exhibit 3-4) the mean values for the variables "total crime rate" and "population density" were used to create two categories for each variable: cities below the mean -- low density and low crime rate -- and cities above the mean -- high density and high crime rate. The twenty-seven-city data was then distributed and percentaged into the two-way table of Exhibit 4-14. The percentages are interpreted: 57.1% of the low crime rate cities have low population densities and 30.8% of the high crime rate cities have high population densities while only 40.0% of the high density cities had high crime rates. This latter finding suggests that lower density cities have higher crime rates for cities with populations between 250,000 and 400,000 population.

EXHIBIT 4-14.

TWO-WAY TABLE, EFFECT OF POPULATION DENSITY ON CRIME RATE*
TWENTY-SEVEN CITIES, 1977

Dependent Variable	Independent Variable: Low Density (Min - 4729)	Independent Variable: High Density (4730 - Max)	TOTALS
Low Crime Rate (Min - 1527)	8** 57.1% 47.1% 29.6%	6 42.9% 60.0% 22.2%	14 51.9%
High Crime Rate (1528 - Max)	9 69.2% 52.9% 33.3%	4 30.8% 40.0% 14.8%	13 48.1%
TOTALS	17 63.0%	10 37.0%	27 100.0%

Source: Exhibit 3-4

* Total Crime Index per 100,000 population
** The four numbers in this cell represent:
N
Row %
Column %
Total %

IV. Scattergrams

A. Definition

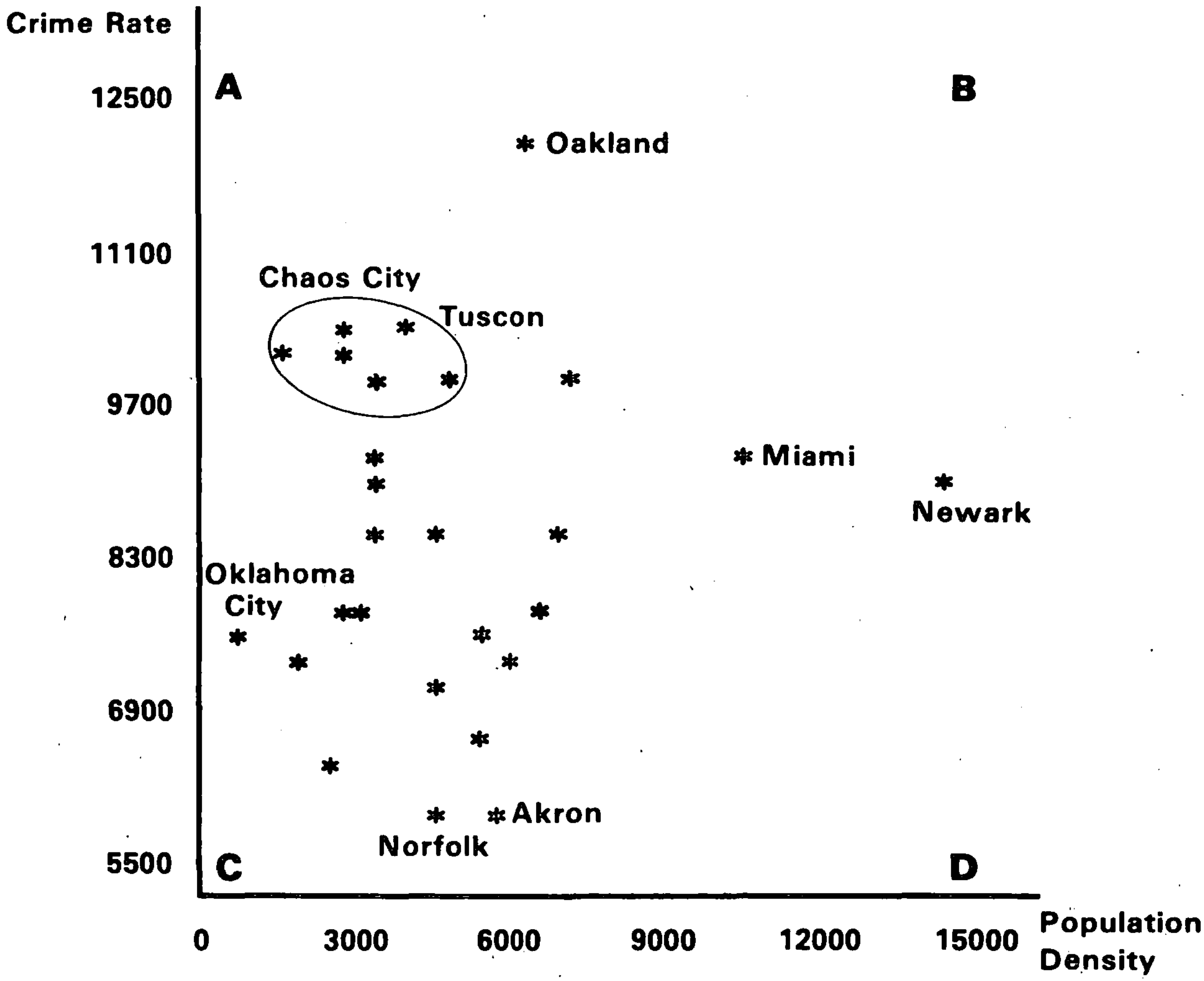
A scattergram (scatter diagram or scatter plot) is a graphical method used to examine the relationship between two or more interval scale variables. In a bivariate (two variable) scattergram the vertical axis is the dependent variable and the horizontal axis is the independent variable. Each point represents the value of both variables for a single case. The pattern of points is then interpreted.

B. Construction and Interpretation of Scattergrams

In the previous section, a two-way table was used to examine the relationship between the grouped total crime rate (crimes per 100,000 population) and population density data. In this section a scattergram is used to examine the same relationship using the original, ratio scale variables. This scattergram is presented in Exhibit 4-15. It is constructed so that each dot represents one city. Selected cities have been highlighted with labels and the horizontal and vertical axes have been proportionately scaled and labeled.

EXHIBIT 4-15

SCATTERGRAM, EFFECT OF POPULATION DENSITY★★ ON THE CRIME RATE★, TWENTY-SEVEN CITIES, 1977



★ Total Crime Index per 100,000 Population

★★ Population Per Square Mile

Source: Exhibit 3-4

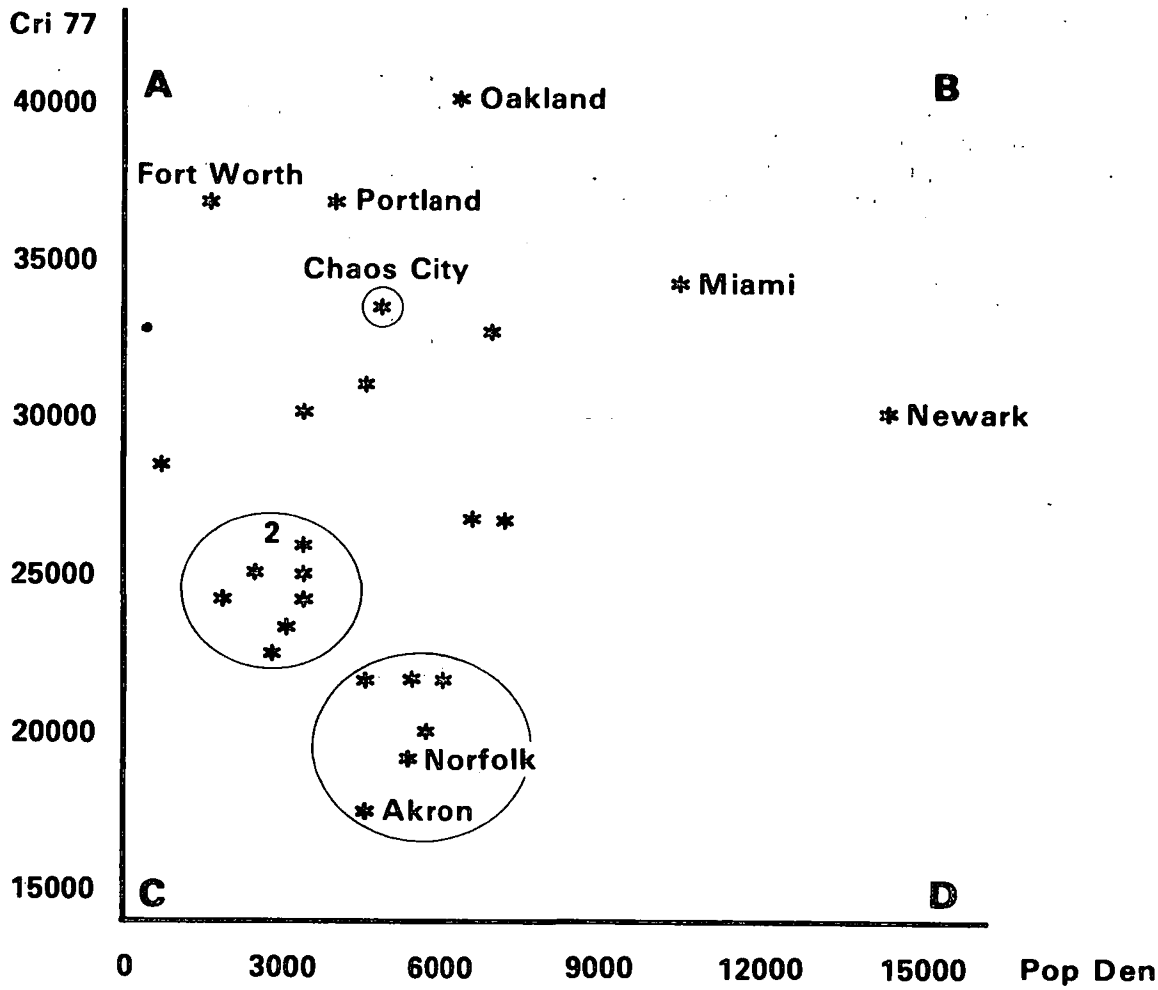
There are three general approaches used to interpret a scattergram. First, the plot should be examined for any clear pattern or trend in the relationship. In this set of data no such pattern emerges. Second, clusters and outliers should be identified and described. One such cluster of lower density, higher crime cities has been circled on the scattergram. Cities in this cluster include Tucson, Fort Worth, Portland, Sacramento, Wichita, and Chaos City. Further analysis of these cities may lead to identifying a descriptive label for the group and an understanding of the reasons for their clustering. Outliers in this scattergram are cities with extreme values such as Oklahoma City (lowest density), Oakland (highest crime rate), Newark (highest density), and Norfolk and Akron (lowest crime rates). An interpretation may be enhanced by discussing and speculating on the reasons for such extreme values.

A third approach involves dividing the scattergram into four or more quadrants as indicated. Each quadrant may then be described. For example, more cities are plotted in quadrant C than in the others. Quadrant C contains cities generally having lower population density and a lower crime rate. Only Miami and Newark are in B Quadrant -- high crime rate and high density, and no cities in this sample had high population densities and low crime rates in 1977.

Exhibit 4-16 presents a scattergram of the total crime index (frequency not rate) and population density for the same cities. A very similar pattern can be observed: again Newark, Akron, Oakland, and Oklahoma City are the outliers. Two clusters, however, appear to emerge -- both in the low density-low index quadrant (C). Most of the cities are in quadrant C, none of the sampled cities have higher densities and a lower index (quadrant D). Both scattergrams suggest that lower density and higher crime incidence and rates may be related for cities of this size (250,000-400,000 population).

EXHIBIT 4-16

SCATTERGRAM, EFFECT OF POPULATION DENSITY ON CRIME INCIDENCE, TWENTY-SEVEN CITIES, 1977



Source: Exhibit 3-4

As a last example consider the hypothesis that cities with higher crime rates have to employ more law enforcement personnel. Two variables that may be used to assess this relationship are: (1) crime rate (total crime index per 100,000 population) and (2) police rate (law enforcement personnel per 100,000 population). Data for these two variables for the 27 cities are presented in Exhibit 4-17. A scattergram of this relationship (Exhibit 4-18) indicates that most cities in the sample have lower police rates and lower crime rates. However, the clustering of cities and the presence of outliers such as Oakland and Newark make the plot difficult to interpret. Two approaches to solving these problems are (1) removing the outliers from the sample and rescaling the axes; and (2) logarithmic transformations of the variables. Exhibit 4-19 is identical to Exhibit 4-18 except the outliers of Newark and Oakland have been removed and the axes have been rescaled. A slight bottom-left to top-right trend is visible suggesting that higher police rates may be associated with higher crime rates.

EXHIBIT 4-17.

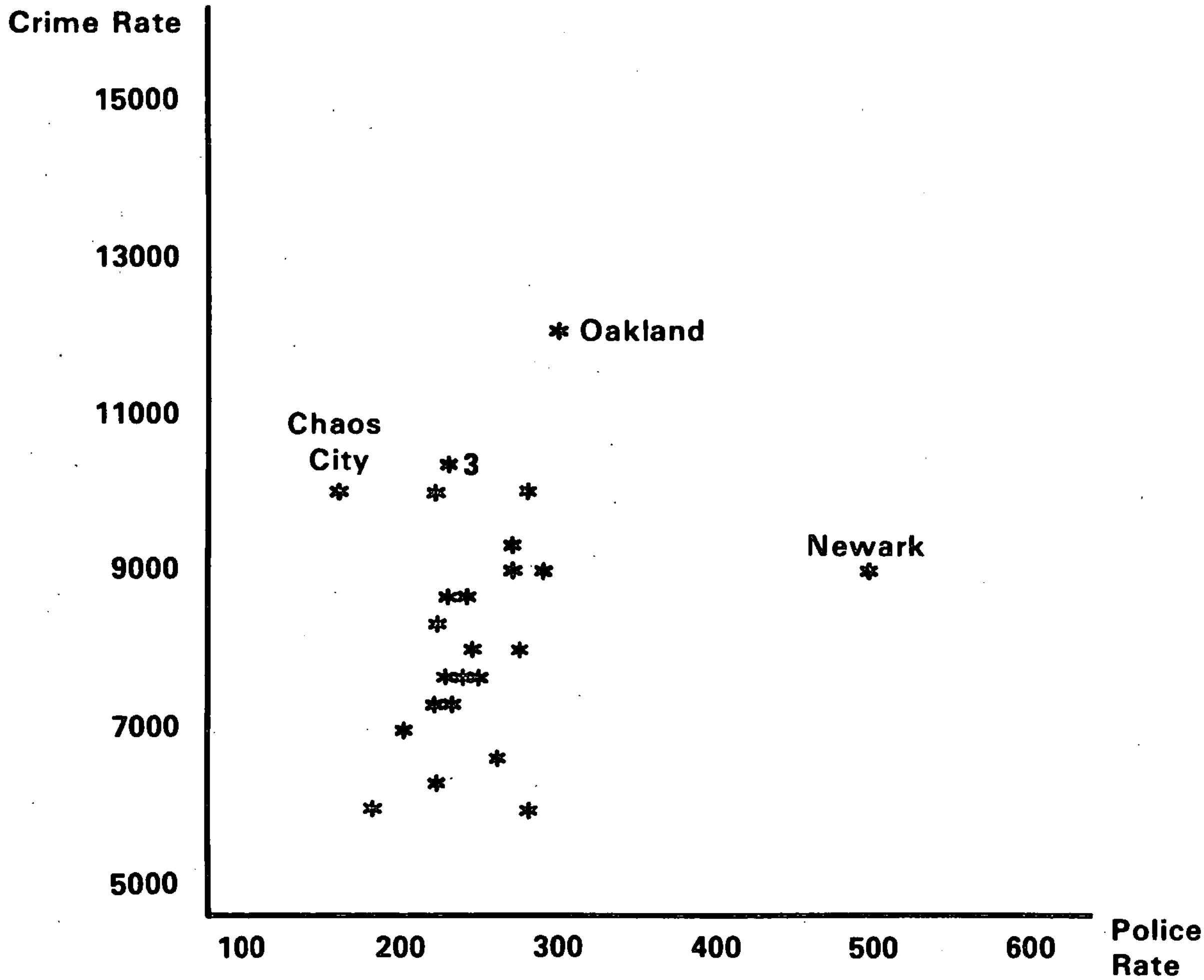
TOTAL CRIME INDEX PER 100,000 POPULATION, LAW ENFORCEMENT PERSONNEL PER 100,000 POPULATION AND THEIR LOGARITHMICS, TWENTY-SEVEN CITIES, 1977

CITY	A Law Enforcement Personnel Per 100,000 Pop	B Total Crime Index Per 100,000 Pop	Log 10 A	Log 10 B
AKRON	202.98	7026.5	5.3131	8.8574
ALBUQ	252.33	8573.7	5.5307	9.0565
AUSTIN	225.14	7815.5	5.4167	8.9639
B ROUG	221.13	7269.8	5.3988	8.8915
BIRMIN	301.88	9040.0	5.7100	9.1094
CHAOS	171.52	10003.0	5.1447	9.2107
CHARLO	253.36	7922.8	5.5348	8.9775
EL PASO	215.20	6383.6	5.3716	8.7615
F WORTH	244.44	10253.0	5.4990	9.2353
L BEAC	280.09	7946.0	5.6351	8.9805
LOUISV	279.20	6046.1	5.6319	8.7072
MIAMI	282.95	9340.1	5.6453	9.1421
MINNEA	240.40	8541.9	5.4823	9.0527
NEWARK	512.71	8926.9	6.2397	9.0968
NORFOL	256.02	6781.8	5.5453	8.8220
OAKLA	311.81	12011.0	5.7424	9.3935
OKLA C	235.57	7643.8	5.4620	8.9417
OMAHA	177.95	5928.0	5.1815	8.6874
PORTLA	246.12	10322.0	5.5058	9.2420
ROCH N	293.07	9922.4	5.6804	9.2026
SACRAM	253.05	10351.0	5.5336	9.2449
ST PAU	250.06	7656.6	5.5217	8.9433
TAMPA	281.09	9133.9	5.6387	9.1197
TOLEDO	227.12	8422.4	5.4255	9.0387
TULSA	226.39	7370.2	5.4223	8.9052
TUCSON	234.10	9999.8	5.4557	9.2103
WICHIT	249.15	10192.0	5.5181	9.2293

Source: U.S. Department of Justice, Federal Bureau of Investigation. Uniform Crime Reports, 1977.

EXHIBIT 4-18

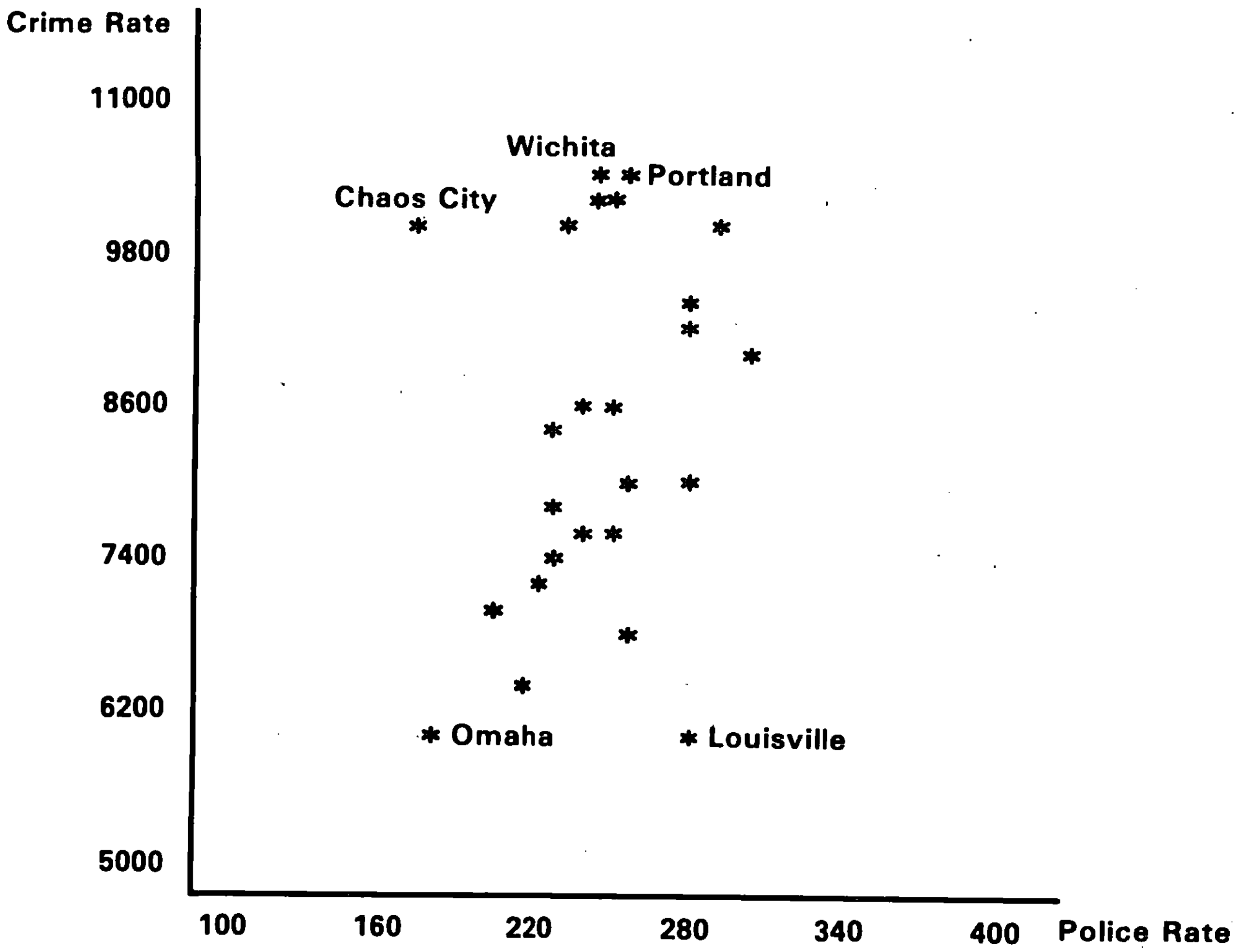
SCATTERGRAM, EFFECT OF POLICE RATE★ ON CRIME RATE★ ★, TWENTY-SEVEN CITIES, 1977



Source: Exhibit 3-4

EXHIBIT 4-19

SCATTERGRAM, EFFECT OF POLICE RATE ON THE CRIME RATE (OUTLIERS REMOVED), TWENTY-SEVEN CITIES, 1977

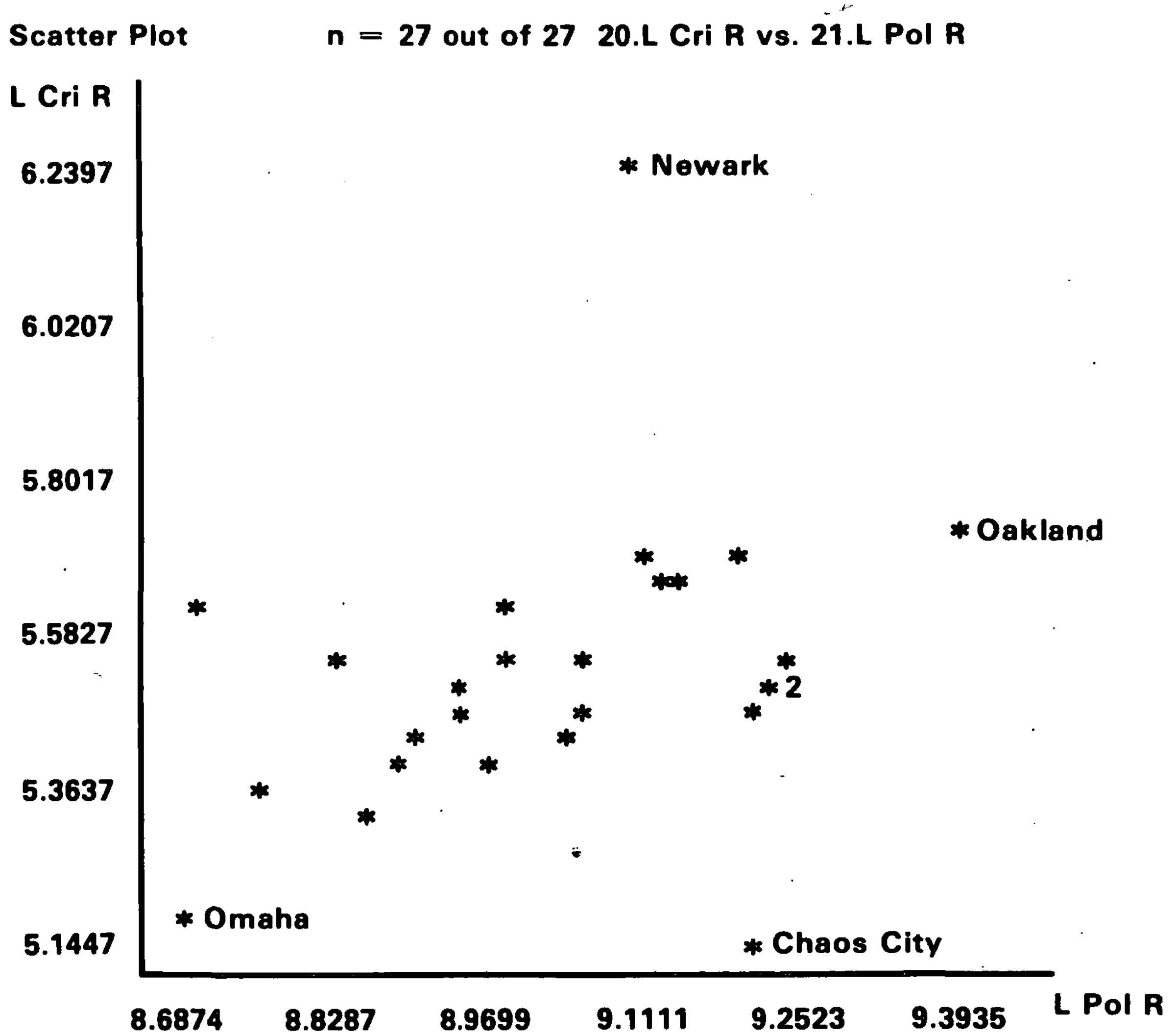


Source: Exhibit 3-4

Logging the variables has the effect of pulling outliers toward the middle of the distribution and spreading the clustered values out. In Exhibit 4-20 the $\log_{10}$ of both the police rate and the crime rate are both plotted. The logarithim for Akron to the base_{10} is $\log_{10} 7065.5 = 8.8575$ because $10^{8.8575} = 7065.5$. The logged scattergram provides clearer evidence in support of the hypothesis that crime rate and police rate are positively related.[5]

EXHIBIT 4-20

SCATTERGRAM, EFFECT OF POLICE RATE ON CRIME RATE (BOTH VARIABLES LOGGED), TWENTY-SEVEN CITIES, 1977



Source: Exhibit 3-4

V. Statistical Maps

Spatial analysis is important in criminal justice analysis because it fits many of the operational problems, such as deployment of police, jury selection in courts, and isolation of crime and/or victimization and related social problems. Furthermore, program funding is rarely applied to individuals. Rather, funds are applied to problem areas, such as neighborhoods and communities. Therefore, it is important to be able to utilize tools that provide ways of aggregating individual cases or transaction statistics into spatial summaries.

Two different approaches to development of statistical maps are presented in this section. Exhibit 4-21 illustrates the product of a hand-drafted statistical map while Exhibits 4-22 and 4-23 are computer-made statistical maps. Regardless of the approach taken there are two basic rules-of-thumb to use in preparing such maps:

- Minimize the number of categories and shades to facilitate reading of the map.
- Select appropriate geographical units to present.

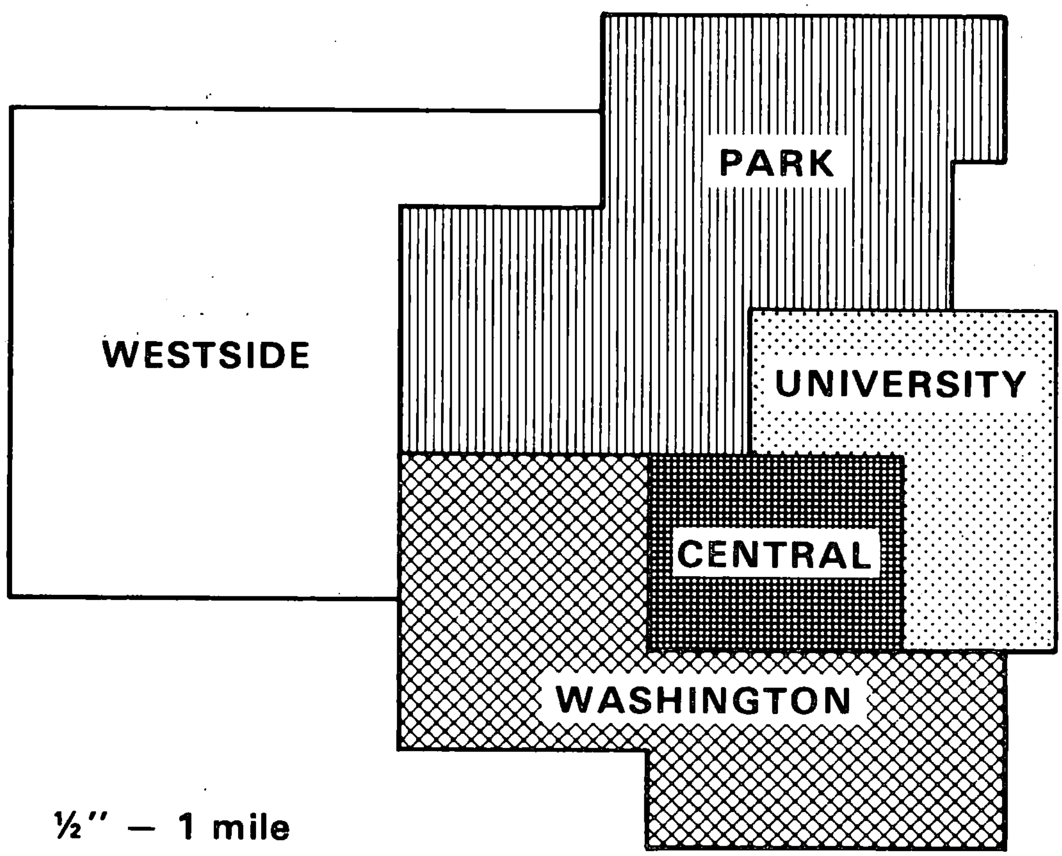
In general, statistical maps are prepared by selecting appropriate shading for different classifications of a variable and a proper unit to analyze. In Exhibit 4-21 the unit of analysis is the neighborhood and the darker shading indicates a higher number of assaults per 100,000 population. Note two deficiencies of such a map; shading does not adequately reflect the differences between neighborhoods in terms of the assault rate; and specific sites of assault incidence are not identified.

Computer-made maps can overcome these problems.[6] For example, the Pin Map of assaults in the central neighborhood distinguishes between four types of assaults and locates, by street, major sites with higher incidence. (See Exhibit 4-22).

A Grid Map is displayed in Exhibit 4-23 using the same data as presented in Exhibit 4-22. Shading is used to indicate the relative intensity of assaults in a specified area. Note the corridor visibly present along the main avenue of Chaos City. This corridor phenomenon is also evident in Exhibit 4-24 which is a contour map of the assault data.

EXHIBIT 4-21

HAND DRAFTED STATISTICAL MAP, ASSAULTS PER 100,000 POPULATION, BY NEIGHBORHOOOD, CHAOS CITY, 1977



	Assaults Per 100,000	Rank	Shade
Central	10154.0	1	
Westside	1000.0	4	
University	800.0	5	
Park	1125.0	3	
Washington	1230.8	2	

Source: Hypothetical Data

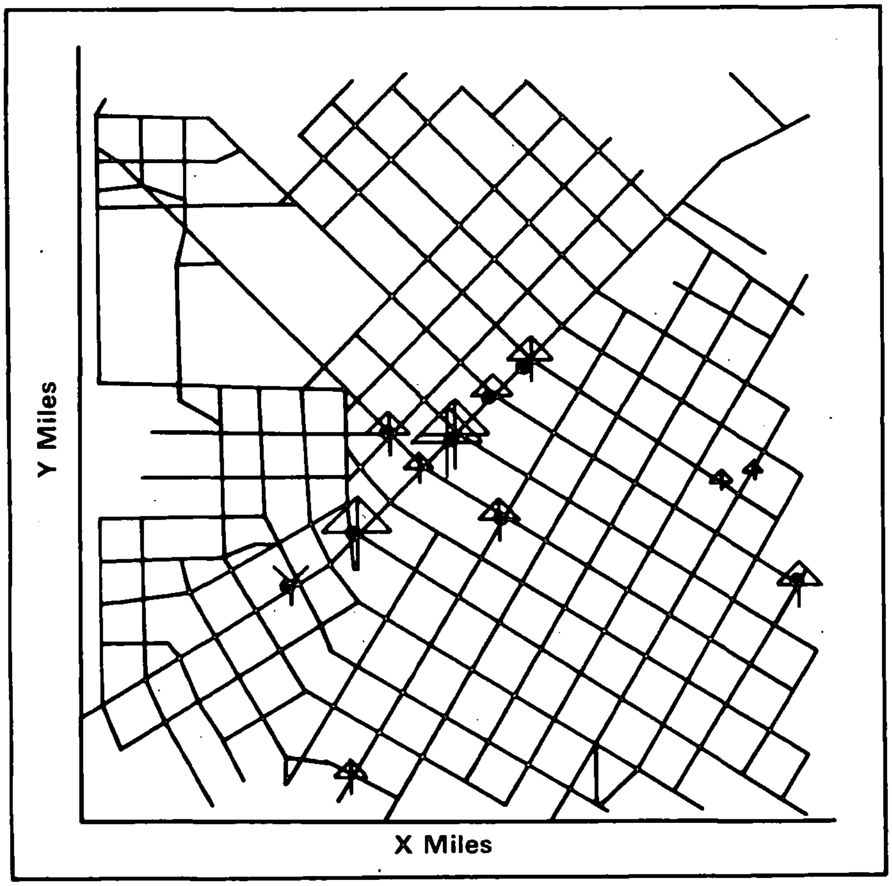
EXHIBIT 4-22

COMPUTER MADE PIN MAP, ASSAULTS IN CENTRAL NEIGHBORHOOD, CHAOS CITY, 1977

Crime Symbol Key

Size Increases With Number of Crimes

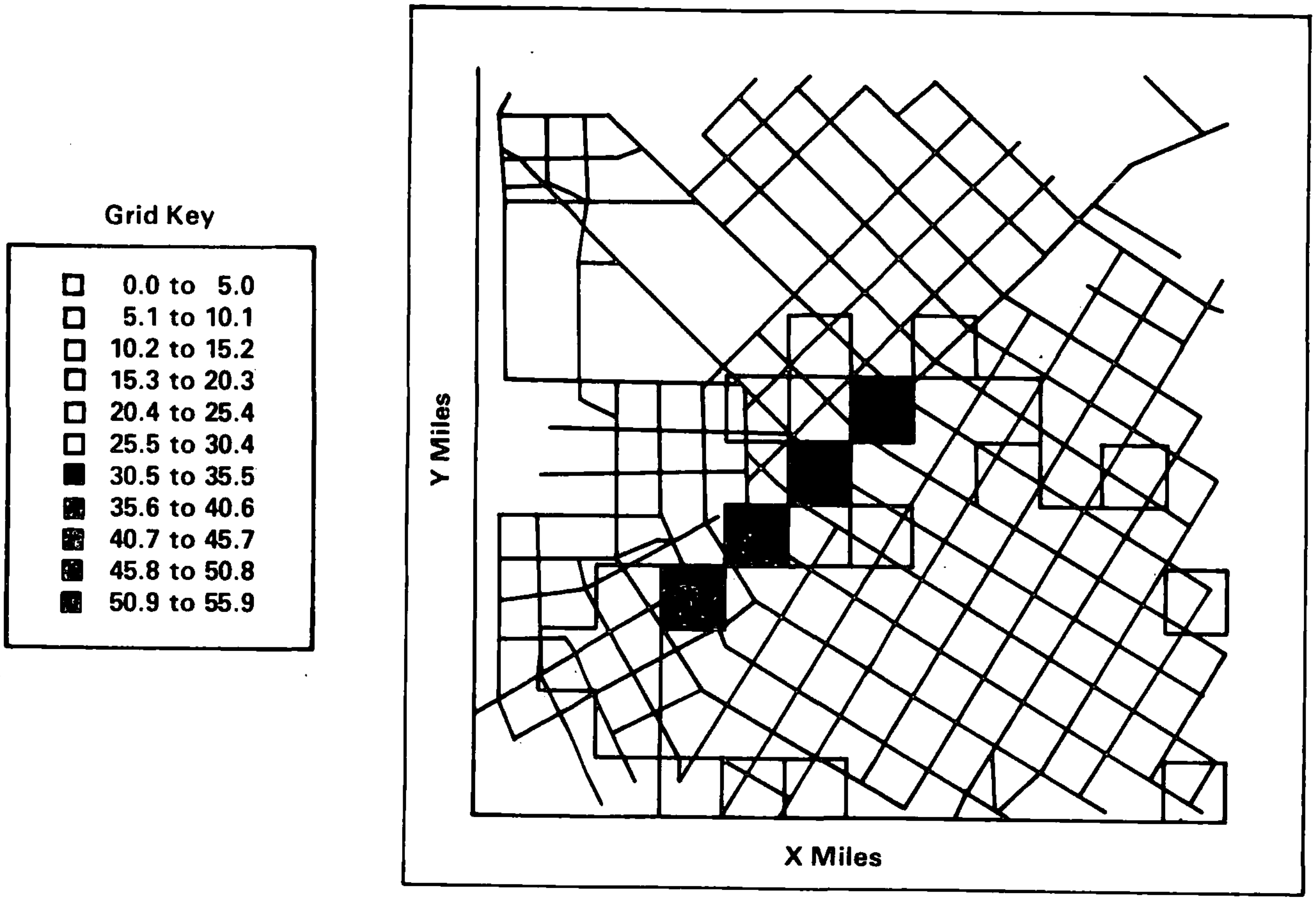
X Assault-Sexual
♠ Assault-Stranger
Y Assault-Nonstranger



Source: Used by permission: © 1978 Minnesota Crime Prevention Center
2344 Nicollet Avenue, Minneapolis, Minnesota 55404, (812)870-0780
Adapted for Chaos City

EXHIBIT 4-23

COMPUTER MADE GRID MAP, ASSAULTS IN CENTRAL NEIGHBORHOOD, CHAOS CITY, 1977



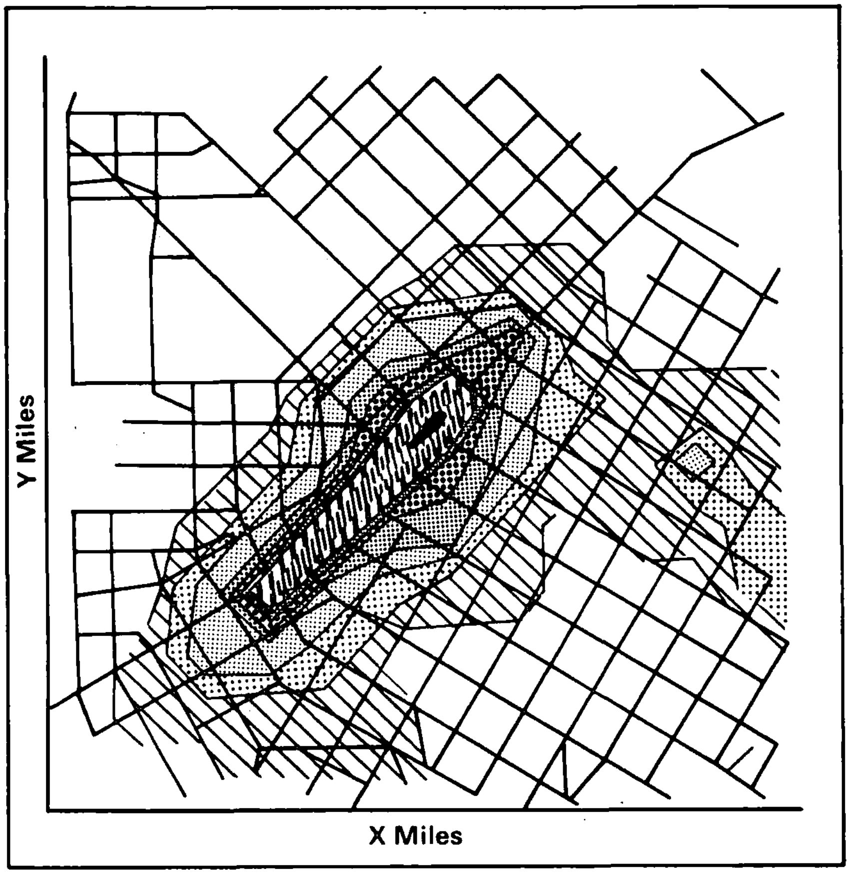
Used by permission: Minnesota Crime Prevention Center, 2344 Nicollet Avenue, Minneaplois, Minnesota 55404 (812)870-0780.
Adapted for Chaos City.

EXHIBIT 4-24

COMPUTER MADE CONTOUR MAP, ASSAULTS IN CENTRAL NEIGHBORHOOD, CHAOS CITY, 1977

Smoothed Contour Key

- 0.0 To 2.7
- 2.8 To 5.5
- 5.6 To 8.3
- 8.4 To 11.1
- 11.2 To 13.8
- 13.9 To 16.6
- 16.7 To 19.4
- 19.5 To 22.2
- 22.3 To 25.0
- 25.1 To 27.8
- 27.9 To 30.6

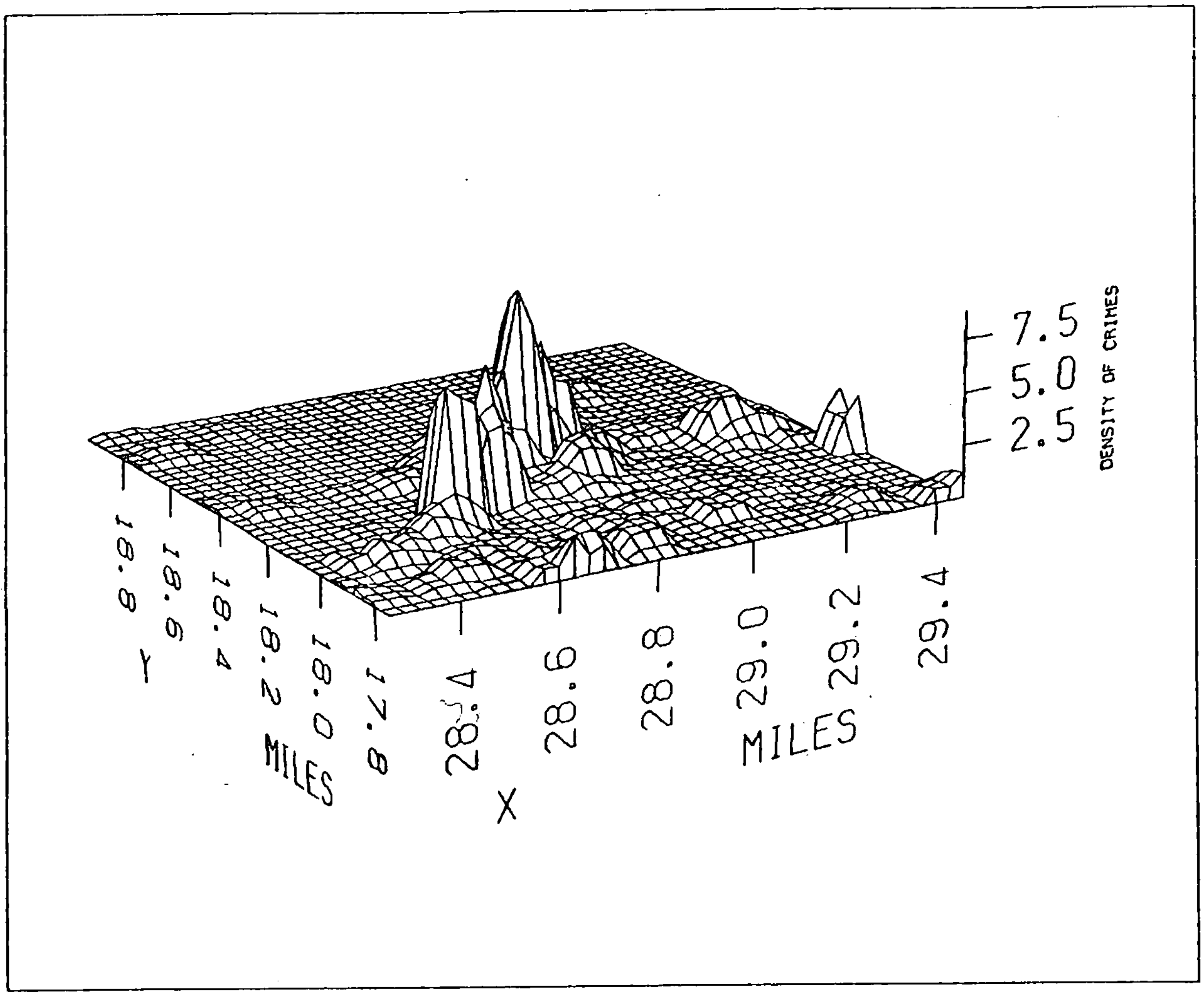


Source: Used by permission:
Minnesota Crime Prevention
2344 Nicollet Avenue
Minneapolis, Minnesota
(812)870-7780
Adapted for Chaos City

The last computer made map, Exhibit 4-25, presents a density plot of assaults in Central. Peaks in the map indicate "hot spots" -- locations of the greatest incidence of assault. The highest peak on this map is the location of the T. Doos' Cafe in downtown Chaos City.

EXHIBIT 4-25.

COMPUTER MADE DENSITY MAP,
ASSAULTS IN CENTRAL NEIGHBORHOOD,
CHAOS CITY, 1977

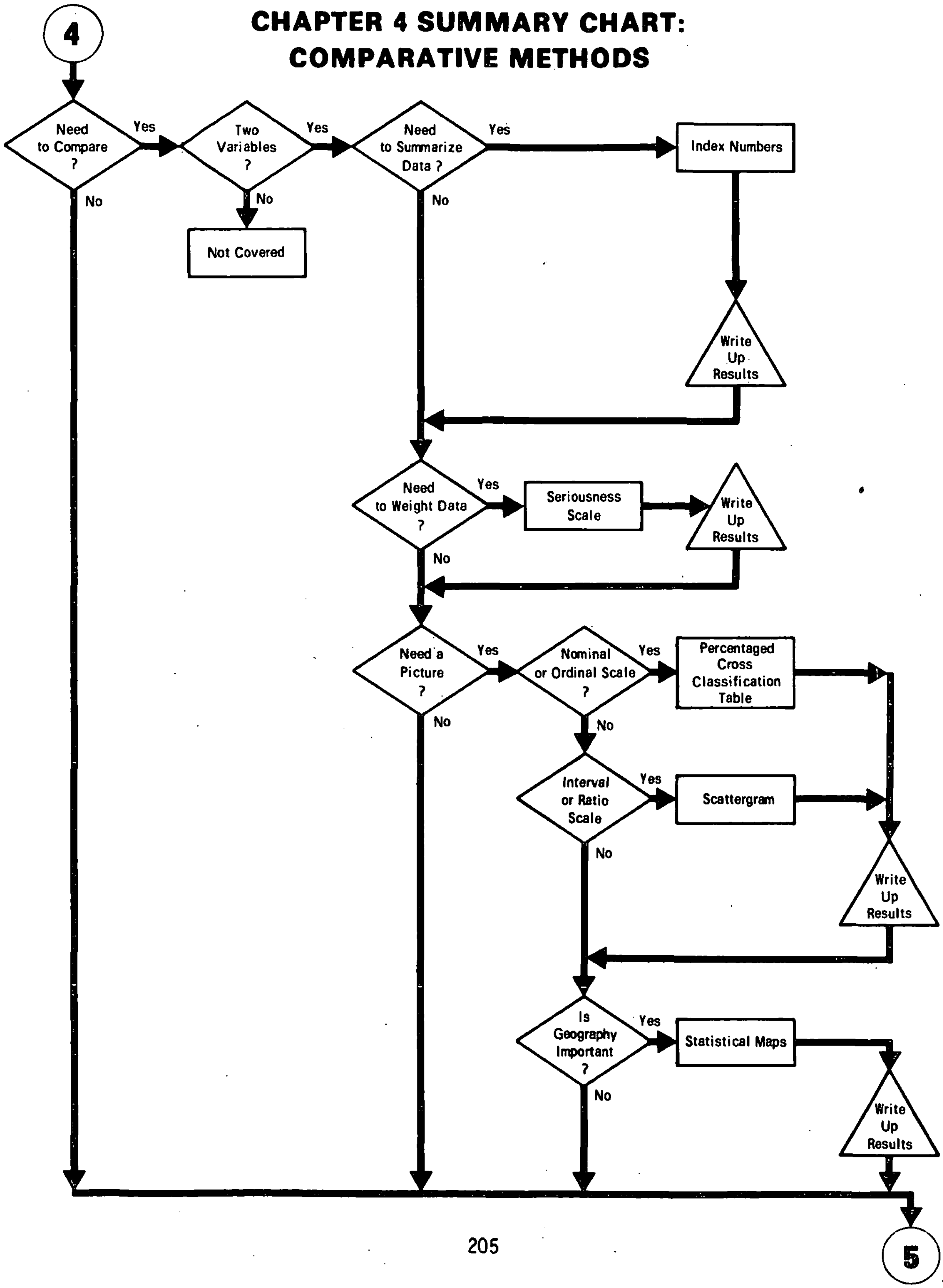


VI. Conclusion

Comparative methods covered in this chapter are useful in examining and suggesting relationships between two or more variables. Exhibit 4-26 summarizes these methods and is a guide to their selection. In the following chapter, inferential statistics is briefly covered and methods for testing relationship are considered.

EXHIBIT 4-26

CHAPTER 4 SUMMARY CHART: COMPARATIVE METHODS



[1]Thorsten Sellin and Marvin E. Wolfgang, The Measurement of Delinquency (New York: John Wiley & Sons, 1964), pp. 274-318.

[2]Heller and J.T. McEwen, "Applications of Crime Seriousness Information in Police Departments," Journal of Research in Crime and Delinquency 12 (Jan. 1975), pp. 44 - 50.

[3]Ibid.

[4]Stephen Colman, An Analysis of Minnesota's Criminal Justice System, a Report prepared by the Governor's Commission on Crime Prevention and Control, Statistical Analysis Center, June 1976, pp. 17 - 21.

[5]Edward R. Tufte, Data Analysis For Politics and Policy (Englewood Cliffs: Prentice-Hall, 1974), p. 108.

[6]Adapted from a report prepared by the Minnesota Crime Prevention Commission, "Computer Display Techniques For Research Social Issues." 2344 Nicollett Avenue, South Minneapolis, Minnesota 55504, September 1978.

CHAPTER 5

INFERENTIAL METHODS

Introduction

A major objective of statistics is to reduce large quantities of data to a form which is easy to manage, to understand, and to communicate. The descriptive and comparative methods presented in Chapters Three and Four are used for this purpose. A second objective of statistics is to assist in making inferences or generalizations based on incomplete information and usually with some consideration to the uncertainty of the conclusions. Three issues are central to a discussion of inferential methods: (1) the type of hypotheses being analyzed; (2) the incompleteness of the data to be used in making generalizations and drawing conclusions; and (3) how confident it is necessary to be in the conclusion.

Inference involves two different types of hypotheses: statements of difference and statements of association. Statements of difference involve comparing groups to see if they are similar or dissimilar. For example, Chaos City analysts may be interested in the effect of gender and age on criminal victimization. Their hypothesis is that female senior citizens are more prone to street crimes than the general population. To evaluate this statement victimization rates for subpopulations, particularly for female senior citizens, are compared to the city victimization rates for selected crimes. Tests of difference are used to aid in the determination of whether observed differences are significant or the result of chance and/or of sampling error.

Measures of association are used to summarize the relationship between two or more variables. They should not be regarded as a substitute for logic or common-sense. Inferential methods are used only to help identify whether a relationship appears to exist between variables. For example, in Chapter Four, scattergrams were used to examine the relationship between population density and the incidence and rate of certain crimes. As a second example consider the statement, "well lit streets may reduce the fear of crime." A recent study concluded:

- Well lit streets may reduce the fear of crime, but there is no statistically significant evidence that street lighting reduces crime itself.
- Evidence is unclear as to whether better lighting reduces the number of crimes or merely displaces crime.
- The rate of crime in certain well-illuminated areas actually increases; this increase might on the one hand be accounted for by car thieves, as an example, being better able to see what they are doing, and on the other, by more crime being reported because residents can better see incidents taking place.
- The "uniformity of lighting" is perhaps the most important element in reducing fear of crime. This is due, in part to reducing the apparent darkness of one street, as compared to a brighter adjacent street.[1]

Such findings were based on interviews with personnel in 60 street lighting projects, and on-site visits to 17 projects. In this study, as in most, a sample of street lighting projects was used as the basis for making generalizations about the effects of all street lighting projects.

As discussed in chapter Two it is often impossible, impractical, and/or unnecessary to observe an entire group of individuals or projects. Instead of analyzing data for the entire population of interest, a small portion of a population is observed. This small portion is called a sample. The robbery data set (Exhibit 1-4) is a small sample (n=15) of all Chaos City robberies in 1977. Inferential methods are designed to facilitate discussion of populations of interest based on sample data.

Finally, inference involves the use of probability in stating conclusions. Sampling requires that conclusions be carefully qualified. There is always a chance, when generalizing from a sample to a population, of being wrong in your conclusions. Assignment of a level of significance to conclusions is an important aspect of inferential methods, and usually is most critical in terms of proper interpretation of findings.

This chapter begins with a general discussion of the process and concepts of statistical tests which is followed by a consideration of four such tests: the t-test, chi square goodness-of-fit test, chi square test of independence and the correlation coefficient. The first two tests are used to address questions of difference, while the latter two may be used to assess a relationship. A discussion of time series methods and least squares regression as used in estimating trends and for prediction concludes the chapter. The prediction problem is treated as an extension of the logic of testing causal relationships and of correlation methods. A major premise of least squares regression is that the past and future are related, and estimates of some future state may be based on past trends. Predicting the robbery rate for Chaos City in 1982, for example, requires a method of estimating the predicted numerical value for the 1982 robbery rate, as well as determining how wrong the prediction is likely to be. An example of the use of least squares regression in causal models concludes the Chapter.

I. Statistical Testing

A statistical test is a step-by-step procedure that is used to help organize the various factors that must be considered to assess a hypothesis with a set of data. It assumes that a preliminary problem specification has been prepared, that data have been collected, and that descriptive and comparative methods have been applied. It is a central aspect of all inferential methods and consists of seven sequential steps:

1. State the null hypothesis
2. State an alternative hypothesis
3. Select a statistical test
4. Determine the level of significance
5. Calculate the test statistic

6. Compare the test statistic to its table value
7. Interpret the findings

Following is a discussion of the first four steps. The section that follows focuses on the calculation and interpretive steps.

A. State the Null Hypothesis

In chapter 1, descriptive and causal hypotheses were discussed. In the introduction to this chapter, two types of causal hypothesis were defined: statements of difference between groups and statements of relationship between variables. A null hypothesis (H_0) is a statement asserting no difference or no relationship. Examples of such null hypotheses are:

H_0: No Difference (or change)

- There is no difference in the mean age of black robbery offenders and white robbery offenders in Chaos City.
- There is no difference in the mean incidence of robbery in Mid-Western Cities and Southern Cities.
- There was no change in Chaos City residents' evaluation of the police between 1975 and 1977.

H_0: No Relationship

- There is no relationship between where a person lives and his fear of crime in Chaos City.
- There is no relationship between fear of crime and evaluation of police services in Chaos City.
- There is no relationship between population density and the crime rate.

B. State Alternative Hypothesis

The alternative hypothesis (H_a) is usually the motivating concern behind an analysis. It is the affirmative statement of the null hypothesis; e.g., population density has a positive effect on the robbery rate and police evaluations improved between 1975 and 1976. The reason for specifying both a H_a and a H_0 is that statistical tests are generally based on "proof by contradiction; that is, we try to support the (alternative) hypothesis by showing that the null hypothesis is false."[2]

C. Select the Appropriate Statistical Test

A statistical test is used for determining the statistical significance of the difference and/or association between two variables. It is a test in that a calculated statistic (from the data) is compared to a predicted value of the statistic (obtained from tables of such statistics). What is being tested is whether the observed difference or association could reasonably be attributed to chance and/or sampling error.

Three criteria used to select an appropriate test statistic are: (1) the type of question being asked (difference or association); (2) the measurement scale of the variables; and (3) the size of the sample. The chapter chart (Exhibit 5-45) at the end of the chapter is a useful guide in selecting the methods discussed.[3]

D. Determining the Level of Significance

The level of significance is interpreted as the probability of an association or a difference having resulted from chance or sampling error, i.e., if the level of significance is set at .05, it would indicate the probability of the observed difference or association having resulted from sampling error or chance was 5 in 100. This means that if a population were sampled 100 times, only 5 times would the observed results occur as a result of chance alone.

William Hays in a brief essay on "Significance Tests and Common Sense" made the following points:

> "... all that a significant result implies is that one has observed something relatively unlikely given the hypothetical situation, but relatively more likely given some alternative situation. Everything else is a matter of what one does with the information. Statistical significance is a statement about the likelihood of the observed result, nothing else. It does not guarantee that something important, or even meaningful has been found."[4]

E. General Considerations

Problems in utlizing statistical tests usually result from the improper statement of the null hypothesis, a misunderstanding of the underlying assumptions of such tests, and the misinterpretation of the findings. Perhaps the greatest danger in applying inferential methods is what is referred to as a "spuriousness". For example, a conclusion is spurious when either there are illegitimate inferences of causation or when two variables are related only by a third:

> Studies have indicated a high correlation between poverty and delinquent behavior. Children of poor families naturally tend toward crime and delinquency.

The point here is that the existence of a correlation does not prove the causal connection. As an example of the second problem, consider the earlier discussion of the relationship between density and the crime rate. The model implied here is:

higher density
higher crime rate

which apparently has some merit. However, population density does not directly cause crimes to occur. Instead, there must be some intervening factors such as reduced police visibility which results in the higher crime rates:

higher density
less police visibility
higher crime rate

A final problem in making inferences is suggested by the scattergrams in Chapter Four. In these scattergrams only cities with populations of between 250,000 and 400,000 are presented. What would the scattergram look like if all U.S. cities were plotted? Could the same inferences be drawn about the relationship between law enforcement and crime incidence? Measurement error, sampling error, and logical errors must be carefully considered in evaluating the results of a statistical test.

II. T-Test

A. Assumptions

Do black robbery offenders differ from white robbery offenders with regard to their mean age? Does the mean elapsed time for felony case dispositions in the Chaos City Police Department exceed the standard of five working days? The first question involves making an inference about a difference from two samples. The second question involves testing the significance of a single mean. However both questions may be analyzed using a t-test if the test's assumptions and conditions are met. These include:

(1) the sample(s) is independently drawn;
(2) the population is normally distributed and its mean(s) and variance(s) are unknown;
(3) the variable-of-interest is an interval or ratio scale measure; and
(4) the sample is small (less than 30).

The assumption that the underlying distribution of a variable is normal (i.e., bell-shaped) is important to many inferential methods including the correlation and regression techniques discussed at the end of the chapter. Several methods are used for checking this assumption, the most direct being an inspection of the histogram. If it appears bell-shaped, has only one mode, and not many outliers, one may reasonably assume a normal distribution. Fortunately, the practical necessity of a normal distribution or the need for a particular sample size is not great in a t-test and many of the assumptions can be violated without great risk.[5]

B. A One-Sample Problem

Chaos City analysts have been asked to assess the Police Department's compliance with a standard established by the state legislature that felony cases--from the point of arrest to police disposition--should be processed in less than four working days. The analysts observed the disposition of the first nine felony arrests in 1978 and recorded the elapsed times. These were (in days): 1, 2, 2.5, 3, 1, 2.5, 3.5, 4.5, 4.0, and 6.0. The null hypothesis is that the mean elapsed time is greater than or equal to the four day standard. This may be expressed as:

$$H_0: \bar{x} \geq 4$$

The alternative hypothesis is that the mean is less than four days, or

$$H_A: \bar{x} \quad 4$$

This problem requires that the sample mean and the standard deviation be calculated and, based on these, a t-statistic determined. Exhibit 5-1 presents these calculations. The calculated value of the t-statistic is 2.02. The analysts decide on a significance level of .05 and since the number of degrees of freedom is equal to (n-1) or 10-1 = 9, the table value of t may be found in Exhibit 5-2 to be 1.833. In this exhibit the columns correspond to levels of significance--.10, .05, .025--and the rows to degrees of freedom--8 to 25. Since the calculated t (2.02) is greater than the table t (1.833), there is sufficient evidence to reject the hypothesis and conclude that the mean time is less than four days. However, the six day maximum value in the sample should be a concern, and a larger sample might be developed to confirm the conclusion.

EXHIBIT 5-1.

T-TEST, CALCULATIONS OF t-STATISTIC, ELAPSED TIME FELONY CASE DISPOSITION, CHAOS CITY POLICE DEPARTMENT, 1977

1. Calculate Mean and Standard Deviation

Variable	N	Min	Max	Mean ($\bar{X}$)	Standard Deviation(s)
Elapsed Time	10	1	6	3.00	1.5635

2. Calculate the t-Statistic

$$t = \frac{\bar{x} - (\text{value})}{s/\sqrt{N}} \qquad \text{where } 4 = \text{value}$$

$$t = \frac{3.0 - 4}{1.5635/\sqrt{10}}$$

$$t = 2.02$$

Source: hypothetical data

EXHIBIT 5-2.

CRITICAL VALUES OF t-STATISTIC

d.f.*	$t_{.10}$	$t_{.05}$	$t_{.025}$
8	1.397	1.860	2.306
9	1.383	1.833	2.262
10	1.372	1.812	2.228
11	1.363	1.796	2.201
12	1.356	1.782	2.179
13	1.350	1.771	2.160
14	1.345	1.761	2.145
15	1.341	1.753	2.131
16	1.337	1.746	2.120
17	1.333	1.740	2.110
18	1.330	1.734	2.101
19	1.328	1.729	2.093
20	1.325	1.725	2.086
21	1.323	1.721	2.080
22	1.321	1.717	2.074
23	1.319	1.714	2.069
24	1.318	1.711	2.064
25	1.316	1.708	2.060

*d.f. = degrees of freedom

Source: William Mendenhall, Introduction to Probability and Statistics 3rd Ed. (Belmont: Duxbury Press, 1971), p. 419.

C. A Two Sample Problem

Chaos City analysts are also interested in learning if the mean age of white robbery offenders is greater than the mean age of black robbery offenders. Using the data from Exhibit 1-4, they propose a t-test of the null hypothesis that the mean age of the white offender group is equal to or less than the black group. This may be expressed as:

$$H_0: \bar{x}_1 \leq \bar{x}_2$$

Where x_1 = mean age, white robbers and
x_2 = mean age, black robbers

The alternative hypothesis is the mean age of the white group is greater than that of the black group. This may be expressed as:

$$H_a: \bar{x}_1 > \bar{x}_2$$

The next step in performing a t-test is to calculate, first, the sample means and standard deviations for the two groups; second, calculate a "pooled-variance" statistic based on both samples; and third, using the "pooled-variance" statistic, calculate the t-statistic. These calculations are presented in Exhibit 5-3.

EXHIBIT 5-3.

t-TEST, CALCULATIONS OF t-STATISTIC,
MEAN AGE OF BLACK AND WHITE ROBBERY OFFENDERS,
CHAOS CITY, 1977

1. Calculate Group Means and Standard Deviations.

DESCRIPTIVE MEASURE No. 1 of RACE: WHITE

Variable 1	N_1	Minimum	Maximum	Mean($\overline{X}_1$)	Std Dev(S_1)
OFF. AGE	8	20.000	41.000	28.500	6.1644

DESCRIPTIVE MEASURE No. 2 of RACE: BLACK

Variable 2	N_2	Minimum	Maximum	Mean($\overline{X}_2$)	Std Dev(S_2)
OFF AGE	6	16.000	24.000	19.333	2.8752

2. Calculate the "pooled variance".

$$S^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$$

$$S^2 = \frac{(8 - 1)38 + (6 - 1)8.27}{8 + 6 - 2}$$

$$S^2 = 25.61$$

3. Calculate the t-statistic

$$t = \frac{\overline{x}_1 - \overline{x}_2}{S\sqrt{1/n_1 + 1/n_2}}$$

Where $S = S^2$

$$t = \frac{28.5 - 19.3}{5.06\sqrt{1/8 + 1/6}}$$

$$t = 3.367$$

Source: hypothetical data

In a two sample test the number of degrees of freedom is equal to $n_1 + n_2 - 2$ or in this problem (8 + 6-2) or 12 d.f. Using a level of significance of .05, the table t-statistic is 1.782. Since the calculated t-statistic (3.367) exceeds the critical value of t (1.782), there is sufficient evidence to reject the null hypothesis and conclude that the difference in mean ages (28.5 versus 19.3) is significant.

Exhibit 5-4 is a standard output of a MIDAS program used to calculate a t-statistic for the data just described. In column #1 of the output is the label of the variable being tested and the total sample size. In column #2, the mean, variance, and sample size for white robbery offenders only is printed. In column #3 is printed the same descriptive statistics for the comparison group--black robbery offenders. The calculated t-statistic is presented in column #4. Note that the output t-statistic is slightly smaller than the calculated t-statistic. This is due primarily to rounding error. The degree of freedom is presented in column #5. Column #6 is the "attained significance level" which is the smallest significance value for which the t-statistic calculated leads to a rejection of the null hypothesis. With the attained significance equal to or greater than .0057, including .05, it is very likely that the mean age of black robbery offenders is less than the mean age of white robbery offenders. The practical significance of such a finding, of course, must be related to programmatic or policy alternatives under consideration.

EXHIBIT 5-4.

t-TEST, MIDAS OUTPUT,
MEAN AGE OF BLACK AND WHITE OFFENDERS,
CHAOS CITY, 1977

Column #1		#2	#3	#4	#5	#6
VARIABLE	RACE	WHITE	BLACK	TEST STATISTIC	DF	SIGNIF
1.	MEAN	28.500	19.3330	T = 3.3539	12	.0057
OFF AGE	VAR	38.000	8.2667			
(TOTAL=14)	N	8	6			

Source: hypothetical data

III. Chi Square Goodness-of-Fit Test

A. An Example

A second test of difference is used to compare the distribution of a categorical variable against an expected distribution. A survey was conducted of Chaos City residents 12 years of age or older. One of the questions was, "How would you rate the performance of the Chaos City Police?" Respondents were given three choices: good, average or poor. It was expected that about 1/3 of the residents would evaluate performance as poor, 1/3 as good and 1/3 as average. The Chi Square Goodness-of-Fit test may be used to compare this expected distribution to the survey results presented in Exhibit 5-5.

EXHIBIT 5-5.

EVALUATION OF POLICE PERFORMANCE,
PUBLIC OPINION SURVEY,
CHAOS CITY, 1977

Evaluation of Police Performance	n	%
Good	561	37.7%
Average	680	45.7%
Poor	246	16.5%
TOTAL	1487	99.9%*

* does not total 100% due to rounding error.

Source: hypothetical data

In this example, the null hypothesis is that there is no difference between the category proportions. The alternative hypothesis is that at least one of the category proportions is not equal to 1/3. The percentages indicate that the null hypothesis is false but, to be sure, a statistical test is performed. The first step in calculating a chi square statistic is to determine the expected cell counts based on the hypothesized proportions of 1/3 in each cell. The second step is to calculate the chi square statistic using the formula indicated in Exhibit 5-6. The calculation of both the expected cell counts and the chi square statistic are presented in this exhibit.

EXHIBIT 5-6.

CALCULATION OF χ^2,
GOODNESS-OF-FIT STATISTIC,
POLICE PERFORMANCE RATINGS,
CHAOS CITY, 1977

1. Calculate the Expected Cell Frequencies

Evaluation	Observed (O)	Expected (E)
Good	561	1487 (1/3) = 495
Average	680	1487 (1/3) = 495
Poor	246	1487 (1/3) = 495
TOTAL	1487	

2. Calculate Chi Square Statistic

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

Where E = expected category frequency
O = observed category frequency

$$\frac{(561 - 495)^2}{1487} + \frac{(680 - 495)^2}{1487} + \frac{(246 - 495)^2}{1487}$$

$$= 2.93 + 23.02 + 41.70$$

$$= 67.64$$

Source: hypothetical data

The table value of χ^2 is determined by first setting a level of significance, and, second, determining the number of degrees of freedom associated with the problem. As with a t-test, a .05 level of significance will be used. To calculate the number of degrees of freedom (K - 1) used, where K equals the number of categories. The number of degrees of freedom in this problem is equal to 3-1 or 2 d.f. Critical values of the chi square statistic are presented in Exhibit 5-7. The table value of χ^2 for a = .05 and 2 d.f. is equal to 5.99. Since the calculated value (203.19) exceeds the table value (5.99) there is sufficient evidence to indicate the "fit" is not good at all and the null hypothesis is rejected. This evidence supports the clear impression, drawn from simple inspection of percentages give, that the majority of Chaos residents favorably evaluate their police services.

EXHIBIT 5-7.

CRITICAL VALUES OF CHI SQUARE

	DEGREES OF FREEDOM	5%	1%
VALUES OF CHI SQUARE AT 5% & 1% LEVELS OF SIGNIFICANCE	1	3.84	6.63
	2	5.99	9.21
	3	7.81	11.34
	4	9.49	13.28
	5	11.07	15.09
	6	12.59	16.81
	7	14.07	18.48
	8	15.51	20.09
	9	16.92	21.67
	10	18.31	23.21

Source: Robert Parsons, Statistical Analysis: A Decision-Making Approach (N.Y.: Harper and Row, 1974), p. 824.

B. Assumptions

The χ^2 goodness-of-fit test is only appropriate under the following conditions and assumptions:

(1) The variable-of-interest is either nominal or ordinal or is a grouped interval or ratio level measure.
(2) Category assignments are mutually exclusive and exhaustive.
(3) The outcomes are independent.
(4) Sample size is large ($n > 30$).
(5) Expected category counts are greater than 5.

C. Use in Assessing Change

As a second example, consider an analysis of the changing pattern in the community's evaluation of police services. Two years prior to the 1977 Chaos City survey, an identical community survey had been conducted and the same evaluative question was asked. The percentage distribution by rating for both surveys is presented in Exhibit 5-8. The percentages indicate a general improvement in the evaluation but, to be sure, the analyst decides to test if the current rating is identical to the one of two years ago. The null hypothesis, therefore, is that there was no change in resident evaluations of the police. The alternative hypothesis is that the evaluation of police performance in 1977 was different than in 1975.

EXHIBIT 5-8.

EVALUATION OF POLICE PERFORMANCE, CHAOS CITY, 1975 and 1977

Evaluation	Percent 1975	Percent 1977
Good	36.2	37.7%
Average	44.1	45.7%
Poor	19.7	16.6%
n	145.0	148.0%

Source: hypothetical data

Exhibit 5-9 presents the calculation of, first, the expected category frequencies, and second, the chi square statistic. In this problem the 1975 category percentages are used to derive expected category counts. The comparison of observed category counts and expected category counts is the test of difference and the hypothesis is that the 1977 distribution is the same as two years ago.

EXHIBIT 5-9.

CALCULATION OF χ^2 GOODNESS-OF-FIT STATISTIC,
CHANGE IN POLICE PERFORMANCE RATINGS,
CHAOS CITY, 1975-1977

1. Calculate the Expected Cell Frequencies

Evaluation	Observed (1977)	Expected (1977)
Good	561	1487 (36.2) = 538
Average	680	1487 (44.1) = 656
Poor	246	1487 (19.7) = 293
TOTAL	1487	

2. Calculate Chi Square Statistic

$$\chi^2 = \Sigma \frac{(0-E)^2}{E}$$

$$\chi^2 = \frac{(561-538)^2}{561} + \frac{(680-656)^2}{680} + \frac{(246-293)^2}{246}$$

$$\chi^2 = .94 + .84 + 8.98$$

$$\chi^2 = 10.76$$

Source: hypothetical data

The number of degrees of freedom is equal to K - 1 where K is the number of categories or in this problem 3-1 or 2 d.f. Assuming a level of significance of .05 from Exhibit 5-7, the table value of χ^2 is equal to 5.99. Since the calculated value exceeds the table value, the conclusion is that the null hypothesis of no change may be rejected at the .05 level, and as the percentages indicate, some improvement has occurred.

D. Use in Making Comparisons Between Jurisdictions

As a last example consider the distribution of selected crimes in Chaos City as compared to the state distribution of these same crimes. The percent distribution by crime is presented in Exhibit 5-10 for both Chaos City and the state of Paradise. These percentages indicate that Chaos City is very similar in its profile to the statewide experience in these crime categories. As a check on this impression, a test of the null hypothesis of no difference between the two is made; that is, a test of whether the Chaos City crime distribution is identical to the Paradise crime distribution is made. The alternative hypothesis is that the two distributions are different.

EXHIBIT 5-10.

PERCENT DISTRIBUTION FOR SELECTED CRIMES,
CHAOS CITY AND STATE OF PARADISE, 1977

	Percent Distribution 1977	
Category	Chaos City	State of Paradise
Residential Burglary	38.2%	38.0%
Commercial Burglary	9.8%	10.0%
Commerical Robbery	3.8%	4.0%
Street Robbery	6.6%	7.0%
Assault	18.9%	18.5%
Rape	.8%	.8%
Auto Theft	21.9%	21.7%

N = 18,300
Source: hypothetical data

Exhibit 5-11 presents the calculation of the expected cell frequencies based on state percentages and the chi square statistic. With the number of degrees of freedom equal to 7 - 1 or 6 d.f. and the level of significance equal to .05., the table value of χ^2 is equal to 12.59. Therefore, the null hypothesis can not be rejected (12.59 > 9.05), and it can be concluded that the two profiles are, indeed, similar.

EXHIBIT 5-11.

CALCULATION OF X^2 GOODNESS-OF-FIT STATISTIC,
COMPARISON OF CRIME IN CHAOS CITY
AND THE STATE OF PARADISE, 1977

1. Calculated Expected Values

Category	Observed	Expected
Residential Burglary	7000	18300 (38%)* = 6954
Commercial Burglary	1800	18300 (10%) = 1830
Commercial Robbery	700	18300 (4%) = 734
Street Robbery	1200	18300 (7%) = 1281
Assault	3450	18300 (18.5%) = 3385
Rape	150	18300 (0.8%) = 146
Auto Theft	4000	18300 (21.7%) = 3971
	18300	

*State of Paradise percent distribution

2. Calculate Chi Square Statistic

$$X^2 = \Sigma \frac{(O-E)^2}{E}$$

$$X^2 = \frac{(7000-6954)^2}{6954} + \frac{(1800-1830)^2}{1830} + \frac{(700-734)^2}{734}$$

$$+ \frac{(1200-1281)^2}{1281} + \frac{(3450-3385)^2}{3385} + \frac{(150-146)^2}{146}$$

$$+ \frac{(4000-3971)}{3971}$$

$$X^2 = .30 + .49 + 1.57 + 5.12 + 1.25 + .11 + .21$$

$$X^2 = 9.05$$

Source: hypothetical data

IV. Chi Square Test of Independence

The chi square statistic may also be used as a test of association to help interpret cross-classification tables. The test indicates the degree of independence of two classifications. For example, Chaos City analysts have produced a cross-classification of police evaluation by neighborhood and have percentaged this data in Exhibit 5-12. Substantial variation is evident: for example, 67.7% of the Washington residents evaluated police services as good but only 13.1% of Park residents felt the services were good. No Washington residents evaluated performance as poor but 33% of Park residents rated service as poor. The analysts suspect that there is an association between neighborhood residence and citizen evaluation of police performance.

EXHIBIT 5-12.

PERCENTAGED CROSS-CLASSIFICATION,
POLICE EVALUATION BY NEIGHBORHOOD,
CHAOS CITY SURVEY, 1977

EVALUATION	NEIGHBORHOOD					
	Central	Westside	University	Park	Washington	TOTALS
Good	64 25.8%	197 49.0%	98 39.2%	47 13.1%	155 67.7%	561 37.7%
Average	122 49.2%	161 40.0%	130 52.0%	193 53.9%	74 32.3%	680 45.7%
Poor	62 25.0%	44 10.9%	22 8.8%	118 33.0%	0 0.0%	246 16.5%
TOTALS	248 16.7%	402 27.0%	250 16.8%	358 24.1%	229 15.4%	1487

Source: hypothetical data

A. Assumptions

The chi square test of independence is used to test a null hypothesis of independence between two classifications. In this example the null hypotheses is that evaluation of police performance is independent of neighborhood. The alternative hypothesis is that a respondent's attitude about police services depends on their place of residence. A chi square test requires, at a minimum:

(1) two nominal or ordinal variables that have been cross-classified,
(2) a large sample size (if too large, however, chi square statistic is not very useful),
(3) outcomes which are independent, and categories that are mutually exclusive and exhaustive, and
(4) expected cell counts which are greater than five.

Since the first three requirements are met in this problem, the Chaos City analyst proceeds to use a chi square statistic.

B. Calculations and Interpretation

Calculations of expected values for this cross-classification are presented in Exhibit 5-13. These values represent the cell counts one would expect to find assuming the null hypothesis is true. Once the expected values have been determined, the chi square statistic can be calculated. This calculation is presented in Exhibit 5-14.

EXHIBIT 5-13.

CALCULATION OF EXPECTED CELL COUNTS*, POLICE EVALUATION BY NEIGHBORHOOD, CHAOS CITY SURVEY, 1977

Good, Central	E_1	=	$\frac{(561)(248)}{1487}$	= 94
Good, Westside	E_2	=	$\frac{(561)(402)}{1487}$	= 152
Good, University	E_3	=	$\frac{(561)(250)}{1487}$	= 94
Good, Park	E_4	=	$\frac{(561)(358)}{1487}$	= 135
Good, Washington	E_5	=	$\frac{(561)(229)}{1487}$	= 155
Average, Central	E_6	=	$\frac{(680)(248)}{1487}$	= 113
Average, Westside	E_7	=	$\frac{(680)(402)}{1487}$	= 184
Average, University	E_8	=	$\frac{(680)(250)}{1487}$	= 114
Average, Park	E_9	=	$\frac{(680)(358)}{1487}$	= 164
Average, Washington	E_{10}	=	$\frac{(680)(229)}{1487}$	= 105
Poor, Central	E_{11}	=	$\frac{(246)(248)}{1487}$	= 41
Poor, Westside	E_{12}	=	$\frac{(246)(402)}{1487}$	= 67
Poor, University	E_{13}	=	$\frac{(246)(250)}{1487}$	= 41
Poor, Park	E_{14}	=	$\frac{(246)(358)}{1487}$	= 59
Poor, Washington	E_{15}	=	$\frac{(246)(229)}{1487}$	= 38

*Expected Value = $\frac{\text{(Row Total) (Column Total)}}{\text{TOTAL}}$

Note that all expected cell counts are greater than five, thus, this problem meets one of the requirements for applying the chi square statistic.

EXHIBIT 5-14.

CALCULATION OF CHI SQUARE STATISTIC,
POLICE EVALUATION BY NEIGHBORHOOD,
CHAOS CITY SURVEY, 1977

Use the following formula to calculate chi-square:

$$\chi^2 = \Sigma \frac{(0 - E)^2}{E}$$

where: 0 = Observed cell counts
E = Expected cell counts

Using the observed cell count data from Exhibit 5-13 and the expected cell counts from Exhibit 5-14 a chi square statistic can be calculated:

$$\chi^2 = \frac{(64-94)^2}{94} + \frac{(197-152)^2}{152} + \frac{(98-94)^2}{94} + \frac{(47-135)^2}{135} +$$

$$\frac{(155-155)^2}{155} + \frac{(122-113)^2}{113} + \frac{(161-184)^2}{184} + \frac{(130-114)^2}{114} +$$

$$\frac{(193+164)^2}{164} + \frac{(74-105)^2}{105} + \frac{(162-41)^2}{41} + \frac{(44-67)^2}{67} +$$

$$\frac{(22-41)^2}{41} + \frac{(118-59)^2}{59} + \frac{(0-38)^2}{38}$$

$$\chi^2 = 9.57 + 13.32 + .17 + 57.36 + 0 + .72 + 2.88 + 2.25 + 5.13$$

$$+ 9.15 + 357.09 + 7.90 + 11.8 + 84.9 + 38$$

$$\chi^2 = 600.24$$

Source: hypothetical data

The next step in performing a chi square test is to determine a table value for the chi square statistic. This requires deciding on a level of significance and determining the degrees of freedom associated with the problem. The concept of degrees of freedom as applied to a cross-classification problem is illustrated in Exhibit 5-15. In the diagram, assume that all the marginals have been assigned values, that is Row Total 1, Row Total 2, Column Total 1 through Column Total 6 are all specified. The consequence is that only the checked cells can be assigned values freely. Once these cells have been assigned, the remaining cells of the table must take on specified values. In this context the number of degrees of freedom is equal to the number of freely specified cells which is equal to five. In the police performance problem there are three rows and five columns; therefore the number of degrees of freedom is equal to (3-1)X(5-1) or 8. The table value of χ^2 for 8 d.f. and a level of significance of .05 (from Exhibit 5-7) is 15.51. Since the calculated value of chi square (278.43) exceeds the table value (15.51), the null hypothesis is rejected. The analysts conclude that resident attitudes about police performance do depend on the neighborhood in which they live and, in particular, residents of Washington and Westside rate police services favorably while residents of Park and Central tend to be less favorably disposed toward the police.

EXHIBIT 5-15

DEGREES OF FREEDOM IN A CROSS CLASSIFICATION TABLE

Degrees of Freedom are determined by multiplying the number of rows minus one times the number of columns minus one.

(Rows – 1) (Columns – 1) = Degrees of Freedom

✓ = Freely Specified

O = Not Freely Specified

	CT1	CT2	CT3	CT4	CT5	CT6
RT1	✓	✓	✓	✓	✓	O
RT2	O	O	O	O	O	O

2 × 6

(2 – 1) (8 – 1) = 5 Degrees of Freedom

C. A Second Example

A second question on the Chaos City survey asked residents if they were limiting their activity due to a fear of crime. Respondents could answer 'yes' or 'no'. Analysts tested the null hypothesis that the limiting of activity did not depend on neighborhood. Exhibit 5-16 is the MIDAS output for this cross-classification, including the expected cell counts (expected), and the chi square statistic. Some variation is evidenced in the dependent variable (limited activity) across the columns (i.e., across the categories the independent variable neighborhood), e.g., the column % varies from 41.2% in University to 56% in Central for the percent of respondents who answered 'yes'. The table value of χ^2 with d.f.= 4 and a level of significance equal to .05 is 9.49. Since the calculated χ^2(15.36) exceeds the table value (9.49) there is sufficient evidence to conclude that the percent of Chaos City residents who limit their activity does depend on neighborhood.

EXHIBIT 5-16.

CROSS-CLASSIFICATION AND X^2 MIDAS OUTPUT,
LIMIT ACTIVITY BY NEIGHBORHOOD,
CHAOS CITY SURVEY, 1977

		NEIGHBORHOOD				
LIMITED ACTIVITY		Central	Westside	University	Park	Washington
N		248	402	250	360	229
Total %		16.7	27.0	16.8	24.2	15.4
Yes	685	139	181	103	169	93
Expected		114	185	115	166	105
Total %	46.0	9.3	12.2	6.9	11.3	6.2
Row %		20.3	26.4	15.0	24.7	13.6
Column %		56.0	45.0	41.2	46.9	40.6
No	804	109	221	147	191	136
Expected		134	217	135	194	124
Total %	54.0	7.3	14.8	9.9	12.8	9.1
Row %		13.6	27.5	18.3	23.8	16.9
Column %		44.0	55.0	58.8	53.1	59.4

Total = 1489
Chi Square = 15.360

Source: hypothetical data

D. General Considerations

To summarize, the Chi Square test may be used to indicate the degree of independence of two classifications thus aiding in the interpretation of cross-classification tables. Chi Square requires categorical data, assumes that outcomes are independent, and assumes that there is a minimum expected cell frequency of at least five for each cell. The test does not preclude spurious relations nor does it indicate the presence or absence of intervening factors. Finally, the Chi Square test of independence should be used in conjunction with percentage comparisons of a cross-classification table, thus enriching the interpretation of the categorical data.

Problems in utilizing tests of association, such as chi square, usually result from an improper statement of the null hypothesis, a misunderstanding of the underlying assumptions of such tests, and/or a misinterpretation of the findings. Perhaps the greatest danger in applying tests of association is the problem of imputing a causal relationship when none, in fact, exists. Such spurious relationships are made when either there are illogical inferences of causation or when two variables are related only by a third (an intervening variable). In the two previous examples an intervening variable may be the age composition of the neighborhood, i.e., a higher proportion of senior citizens live in Central and Central has the highest proportion of respondents who limit their activity due to a fear of crime. Such factors need careful attention in performing this type of statistical test.[7]

V. Correlation Coefficient

A. Characteristics

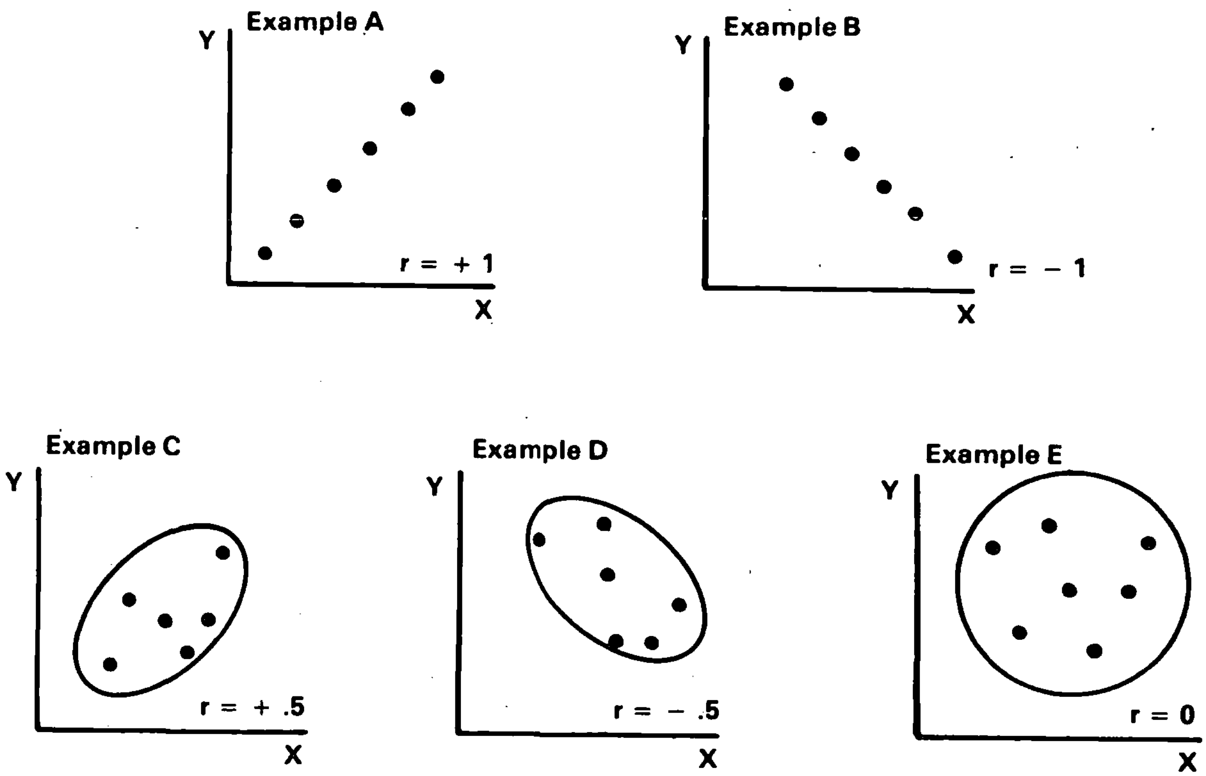
The correlation coefficient (r) is a measure of association which is used to describe the degree to which one interval or ratio scale variable is related to another. It is a frequent companion to descriptive and comparative methods, particularly scattergrams.

Values of the correlation coefficient range between -1 and +1. High positive correlations reflect distributions in which high values of the independent variable (x) are associated with high values of the dependent variable (y) and small values of x are associated with small values of y. As an example there is a positive correlation (+.69) between the number of police per 100,000 population and the robbery rate in the 27 city data set (Exhibit 3-4): i.e., the higher the robbery rate, the higher the police rate, generally. A negative correlation indicates that high values of the independent variable (x) are associated with low values of the dependent variable -- an inverse relationship. The correlation between the age of victims and the dollar value of stolen property for the robbery data set (Exhibit 1-4) is -.44; older victims tend to have less property stolen from them (although r is not significant at the 5% level). Section D discusses the testing of the significance of r.

Scattergrams of five different relationships and their associated correlation coefficients are presented in Exhibit 5-17.

EXHIBIT 5-17

SCATTERGRAMS AND CORRELATION COEFFICIENTS



The direction of a correlation (positive or negative) can be seen instantly by whether the scattergram slopes up (Examples A and C) or down (Examples B and D) from left to right. The fatter the scatter (Example E) the smaller the r, the extremes being r = 1 (then the scattered points fall exactly on a straight line) and when r is 0.[8]

B. Calculation and Interpretation

To illustrate the calculation of a correlation coefficient, seriousness scores for each of ten offenses have been determined by Chaos City analysts. These seriousness scores are correlated with the elapsed time from arrest to police disposition. (See Exhibit 5-1 which calculates a t-statistic for the elapsed time.) Exhibit 5-18 presents the formula and calculation of the correlation coefficient between seriousness (x) and elapsed time (y). A strong positive correlation of .84 indicates that as the seriousness of a felony offense increases so does the police processing time. The practical significance of a correlation coefficient varies from a slight relationship (0 to +.24), some relationship (+.25 to +.49), moderate relationship (+ .50 to + .74), to a strong relationship (+.75 to +1.).[9] Note that a correlation coefficient should not be interpreted as a percentage, e.g., .83 is not 83.6%.

EXHIBIT 5-18.

CALCULATION OF CORRELATION COEFFICIENT,
EFFECT OF SERIOUSNESS ON PROCESSING TIME,
FELONY ARRESTS, CHAOS CITY, 1977

1. Prepare Matrix

	(Elapsed Time) Y	(Seriousness) X	XY	Y^2	X^2
	1.0	3	3	1.00	9
	2.0	5	10	4.00	25
	2.5	4	10	6.25	16
	3.0	7	21	9.00	49
n = 10	1.0	17	17	1.00	289
	2.5	14	35	6.25	196
	3.5	18	63	12.15	324
	4.5	34	153	20.25	1156
	4.0	24	96	16.00	576
	6.0	42	252	36.00	1764
	30.0	168	660	112.00	4404

2. Calculate Correlation Coefficient

$$r = \frac{n\,(\Sigma\, xy) - (\Sigma\, x)\ \ (\Sigma\, y)}{n\sqrt{\Sigma x^2 - (\Sigma x)^2}\ \ \ n\sqrt{\Sigma y^2 - (\Sigma y)^2}}$$

$$r = \frac{10\ (660)\ -\ 30\ (168)}{10\sqrt{(4404) - 168^2}\ \ \ 10\sqrt{(112) - 30^2}}$$

$$r = \frac{1560}{1865}$$

$$r = .836$$

Source: hypothetical data

C. Testing the Significance of r

The correlation coefficient, like the mean and standard deviation, is a descriptive statistic for a population of interest. However, for a sample such as the ten case example just presented, if it can be assumed that such a sample represents a random sample from a larger population of offenses, then the correlation coefficient calculated is an estimate of the unknown population coefficient. In such problems, the null hypothesis to be tested is that (rho) -- the population correlation coefficient -- is equal to zero. If the null is true, then there is no relationship. The alternative hypothesis is that the correlation coefficient is not equal to zero, and that a relationship exists.

Exhibit 5-19 presents table r values for specified degrees of freedom and two levels of significance. The number of degrees of freedom is equal to n-2: in this problem (10-2) or 8 d.f. Assume that $\alpha = .05$, the table value of r is equal to .576. Since the calculated value of .836 exceeds the table value, there is sufficient evidence to reject the null hypothesis and conclude the two variables are positively correlated. Thus, as seriousness increases in offenses, police and prosecutors may predict an increase in the processing time required to dispose of a case.

EXHIBIT 5-19.
CRITICAL VALUES OF r

d.f.*	Level of Significance .05	.01
3	.878	.959
4	.811	.917
5	.754	.874
6	.707	.834
7	.666	.798
8	.632	.765
9	.602	.735
10	.576	.708
11	.553	.684
12	.532	.661
13	.514	.641
14	.497	.623
15	.482	.606

* degrees of freedom = n-2

Source: Snedecor, George W. & Cochran, William G. Statistical Methods. 6th Edition. University Press, 1974 p. 557. Ames, Iowa State.

Exhibit 5-20 presents: (1) descriptive statistics for elapsed time and seriousness; (2) a scattergram of these two variables; and (3) correlation statistics. The correlation statistics provided are: (1) the number of cases, (2) the degrees of freedom (n-2), and (3) the critical values of r at two significance levels -- .05 and .01. This MIDAS output indicates that for the sample of nine offenses, the calculated value of r should exceed .6319 in order to reject the null hypothesis of $\rho = 0$ at the 5% level of significance and exceed .7646 (which it does) at the 1% level.

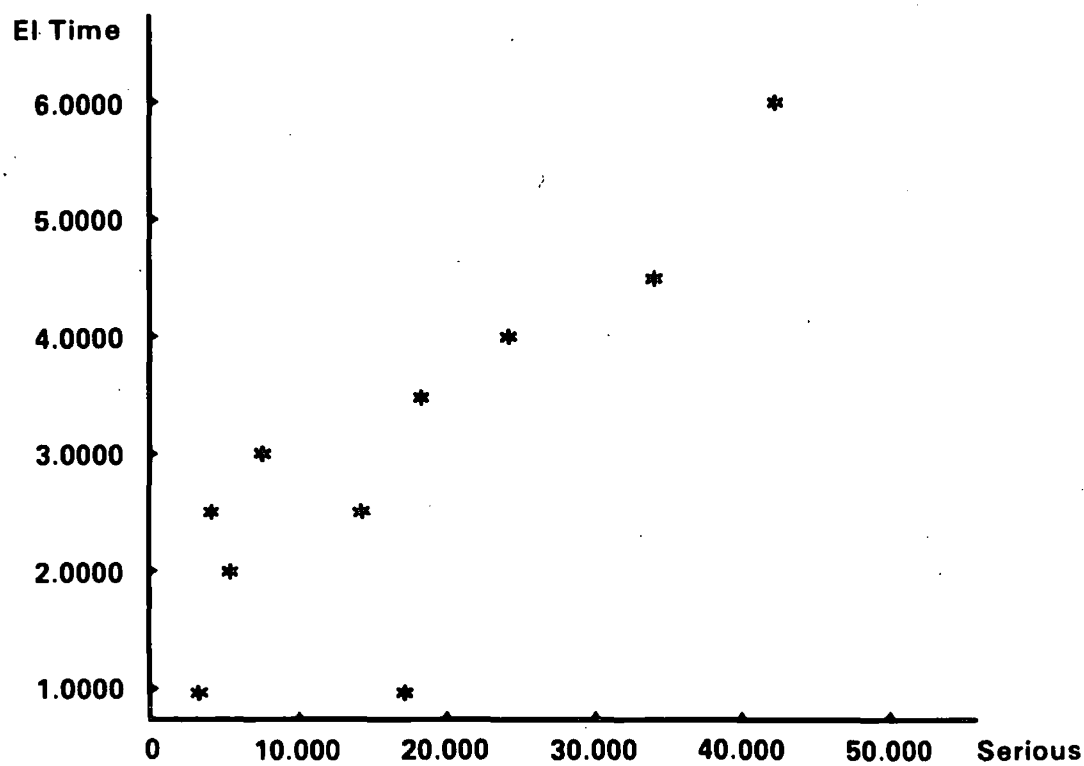
EXHIBIT 5-20

MIDAS OUTPUT, EFFECT OF SERIOUSNESS ON ELAPSED TIME, FELONY ARRESTS, CHAOS CITY, 1977

1. Descriptive Measures

Variable	N	Minimum	Maximum	Mean	Std Dev
1. El Time	10	1.0000	6.0000	3.0000	1.5635
2. Serious	10	3.0000	42.000	16.800	13.256

2. Scattergram



3. Correlation Statistics

N = 10 DF = 8 RC .0500 = .6319 RC .0100 = .7646

Correlation between 1. El Time and 2. Serious = .8363

Source: Hypothetical Data

C. State-Level Example

In Exhibit 5-21, data for the fifty states are presented on three variables: general local government expenditures in 1970, current operation police expenditures in 1971, and current operation police expenditures in 1976.[10] Exhibit 5-22 presents a MIDAS output that describes and relates local government expenditures and the 1971 police expenditure. A strong, positive correlation (.9353) significant at the 1% level is evidenced; i.e., states with high local government expenditures tend to have high police expenditures. Exhibit 5-23 describes and relates the local expenditure with the 1976 police expenditure. Note the significant increase in police expenditures -- from an average of about $1.6 million to over $3 million. The reduced correlation between general and police expenditures -- from .93 in 1971 to .89 in 1976 -- may not be significant. Finally, the increased range and standard deviation indicate greater variation, generally in 1976 police expenditures relative to 1971 levels.

EXHIBIT 5-21.

COMPARATIVE STATE DATA SET

STATE	GEN LOC*	POL E71*	POL E76*
ALABAMA	7077	99.54	227.89
ALASKA	880	85.05	196.68
ARIZONA	4859	119.37	279.81
ARKANSAS	3501	52.21	103.59
CALIFORNIA	83063	1229.60	2214.00
COLORADO	6566	85.47	153.73
CONNECTICUT	7996	131.50	212.56
DELAWARE	1533	49.61	101.87
FLORIDA	16450	276.56	451.09
GEORGIA	10197	121.88	302.61
HAWAII	1254	2.67	12.91
IDAHO	1670	36.96	51.83
ILLINOIS	29186	393.16	608.84
INDIANA	13131	188.17	336.37
IOWA	8143	142.85	181.19
KANSAS	6729	79.07	121.72
KENTUCKY	5694	138.22	289.53
LOUISIANA	8688	146.82	375.81
MAINE	1839	49.89	84.60
MARYLAND	11606	168.19	416.69
MASSACHUSETTS	17802	158.54	375.55
MICHIGAN	22708	351.67	650.41
MINNESOTA	13300	80.45	215.32
MISSISSIPPI	4703	100.65	186.08
MISSOURI	11142	145.01	239.15
MONTANA	1809	27.85	44.89
NEBRASKA	4170	52.22	103.59
NEVADA	1870	24.14	61.49
NEW HAMPSHIRE	1543	28.18	53.01
NEW JERSEY	21401	314.43	539.34
NEW MEXICO	2676	64.09	114.53
NEW YORK	84902	695.26	1073.20
NORTH CAROLINA	10319	224.19	391.70
NORTH DAKOTA	1694	13.57	27.27
OHIO	27466	282.59	447.45
OKLAHOMA	5350	96.43	198.94
OREGON	6249	118.99	200.14
PENNSYLVANIA	27601	506.67	1131.50
RHODE ISLAND	1982	31.86	63.24
SOUTH CAROLINA	4021	104.96	227.56
SOUTH DAKOTA	1701	26.00	52.72
TENNESSEE	9032	102.34	157.83

TEXAS	25797	268.66	788.28
UTAH	2685	40.48	99.81
VERMONT	937	34.58	57.99
VIRGINIA	9692	252.28	519.45
WASHINGTON	9681	147.57	250.81
WEST VIRGINIA	2946	62.44	128.91
WISCONSIN	14873	108.57	218.10
WYOMING	1112	16.35	47.28

*in $100,000, GEN LOC = Total General Local Expenditures, 1970, POL E71 = Police Operating Expenditures, 1971, POL E76 = Police Operating Expenditures, 1976.

Source: Employment and Expenditures 1976 and U.S. City and County Data Book, 1972.

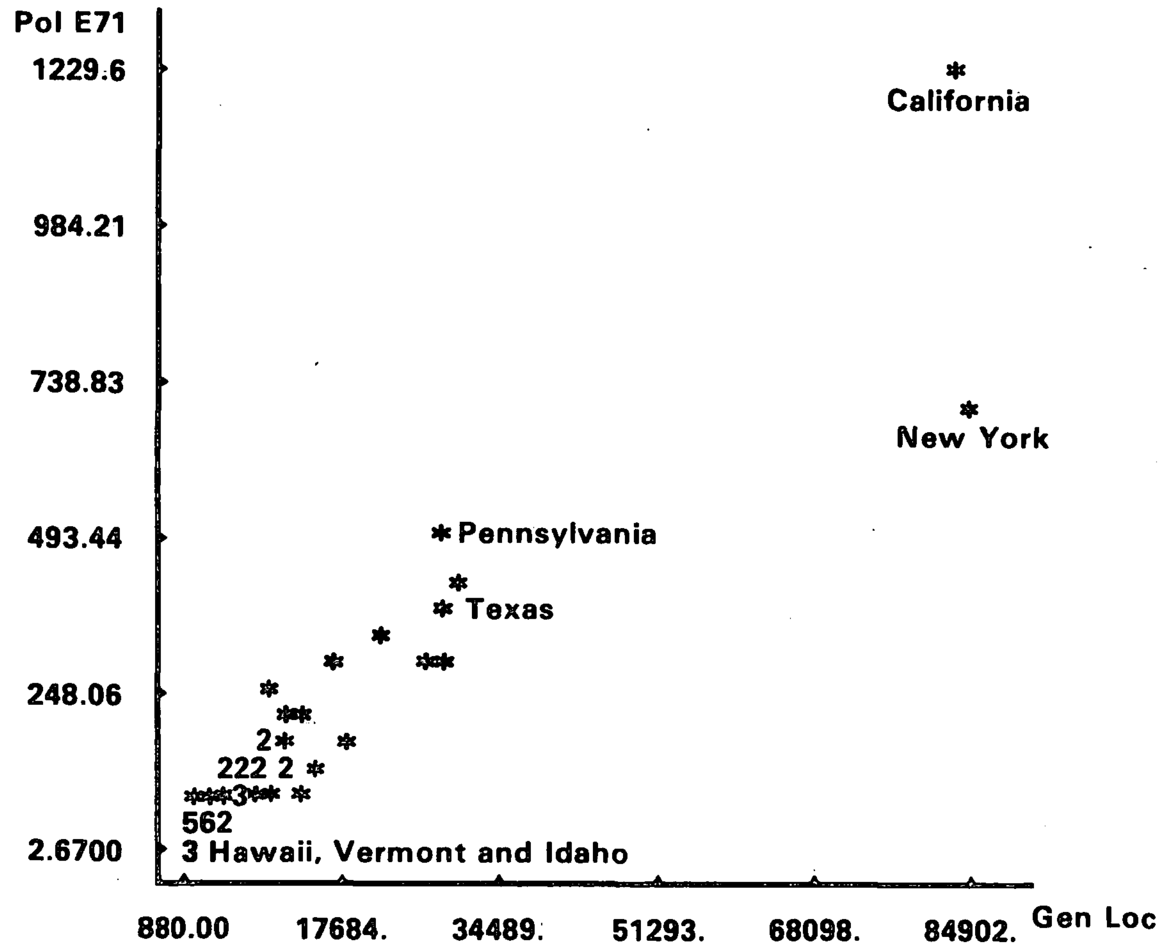
EXHIBIT 5-22

MIDAS OUTPUT, EFFECT OF GENERAL LOCAL EXPENDITURES ON POLICE EXPENDITURES, 1971

1. Descriptive Measures

Variable	N	Minimum	Maximum	Mean	Std Dev
7. Pol E71	50	2.6700	1229.6	161.56	203.87
445. Gen Loc	50	880.00	84902.	11724.	16892.

2. Scatter Plot N = 50 out of 50 7. Pol Curr vs. 445. Gen Loc



Source: Exhibit 5-21

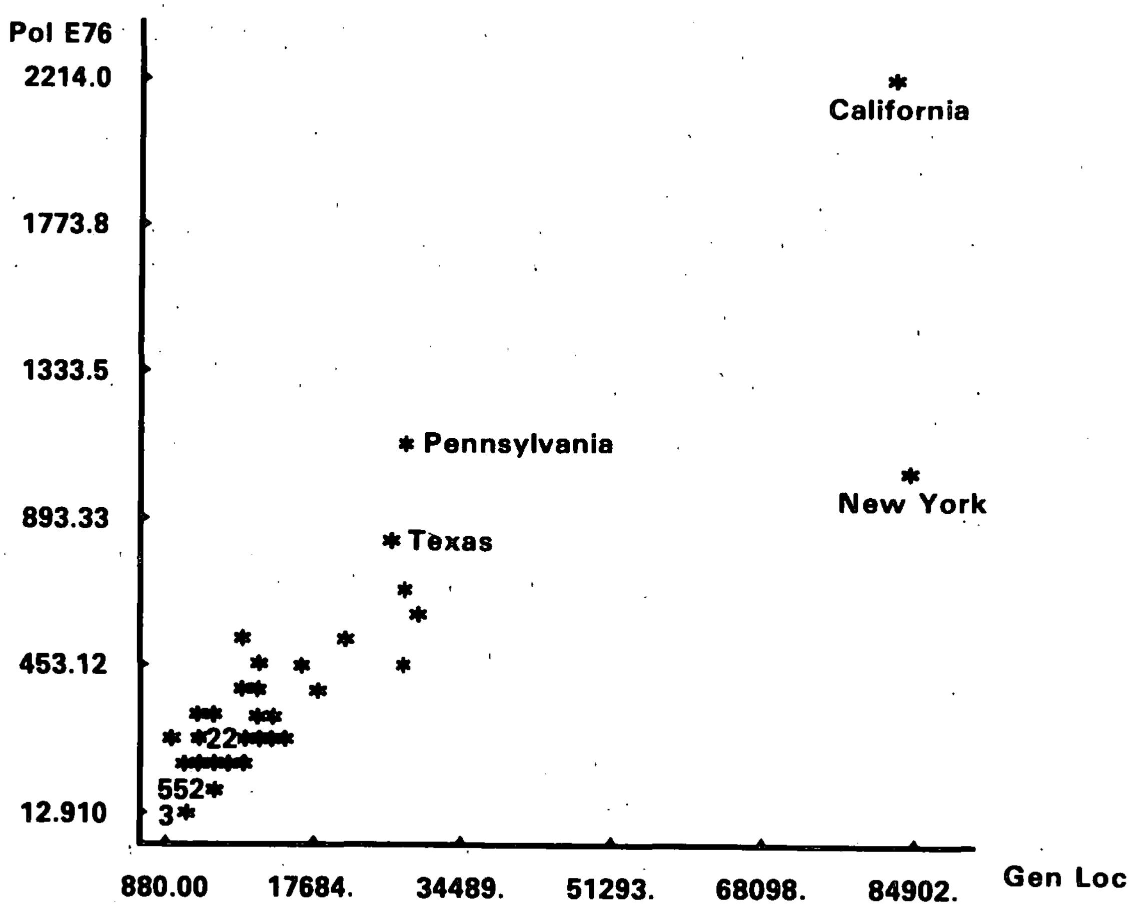
EXHIBIT 5-23

MIDAS OUTPUT, EFFECT OF GENERAL LOCAL EXPENDITURES ON POLICE EXPENDITURES, 1976

1. Descriptive Measures

Variable	N	Minimum	Maximum	Mean	Std Dev
277. Pol E76	50	12.910	2214.0	307.78	368.91
445. Gen Loc	50	880.00	84902.	11724.	16892.

2. Scatter Plot N = 50 out of 50 277. Pol Curr vs. 445. Gen Loc



3. Correlation Matrix

N = 50 DF = 48 RC .0500 = .2787 RC .0100 = .3610

Correlation between 277. Pol Curr and 445. Gen Loc = .8970

VI. Least Squares Regression

An inferential method widely used for prediction purposes is least squares regression. In this section the discussion of regression is focused on its application to time series data, although it has a much wider range of application as demonstrated by the example that concludes this section. The section first discusses characteristics of time series data, then introduces descriptive methods of trend analysis and then concludes with a discussion of least square regression. Throughout this section the prediction problem and the treatment of time series data are highlighted.

The systematic analysis of patterns over time is an essential aspect of criminal justice analysis because of the following:

- Prevention of crime is one basic goal of the criminal justice system.
- Criminal justice resources are limited; crime prevention priorities and system actions that are responsive to local remedial action must be identified.
- Evaluation of existing crime prevention programs and assessment of the likely consequences of future crime prevention strategies are most effectively accomplished through the analysis of past and present data.
- There is continually greater reliance on more systematic techniques for analyzing crime trends and predicting crime as the criminal justice system acquires more and better quality data, installs computer facilities, and statistical techiques are refined and mastered.

Time series analysis involves techniques for categorizing and studying movements in time series data (that is, movements in data consisting of successive values of a variable at monthly, yearly, or other regular time intervals). All types of data, e.g., UCR, victimization, system performance, system resources, and juvenile justice, are amendable to such analyses.

What is the value of time series analysis? Change over a short time period -- most notably that from one year to the next -- can be misleading. Longitudinal data enable the analyst to conceptualize patterns and also facilitate further analyses. This has relevance for the following:

- Putting statistics in historical perspective -- a static picture does not say much about long term trends that may carry into the future.
- Assessing the relationship between existing programs and crime conditions -- for example, a sharp increase in reported rape between 1977 and 1978 after eight years of slow but steady increases might suggest that a program implemented in 1978 making it easier and less embarrassing for women to report a rape has had a desired impact.

- Estimating current condition -- for instance, UCR data often are not published for almost a year after they are collected. Time series analysis makes it possible to use data from past years to develop estimates of the current crime situation. A locality's crime profile for the current year can be constructed from these estimates for planning and evaluation.
- Determining the need for remedial actions -- for example, a planner may discover that the proportion of juvenile felons in Chaos City increased significantly in 1978, a fact that might encourage consideration of a range of programmatic responses. A review of trends for the prior ten year period might disclose that the proportion of juvenile felons is susceptible to large proportional changes -- both increases and decreases -- but has, in fact, changed relatively little since 1969. The analyst could then reasonably conclude that the increases in 1978 do not represent a fundamental shift.
- Forecasting -- an analysis of past system expenditures may permit one to make certain assumptions about future workloads and resource requirements. Based on these assumptions one can employ certain statistical techniques to predict systematically future resource needs.

A. Estimating a Trend

In chapter four the technique of preparing a time chart was described. This section covers procedures used to describe a time series data set. Specifically, short and extended time series are considered, as is the problem of seasonal or other regular fluctuations in a time series.

1. Short versus extended time series

Generally, it is easier to understand a current problem and predict future conditions on the basis of extended time series than on the basis of shorter ones. Short time series have a tendency to mask general trends. For example, a three-year series of annual robbery data might look like Exhibit 5-24. A longer ten-year series might reveal a very different trend, as seen in Exhibit 5-25. To minimize the error in description and prediction, it is sometimes helpful to use as long a time series as is available.

EXHIBIT 5-24.

THREE YEAR TIME SERIES OF ANNUAL ROBBERY DATA, CHAOS CITY, 1971–1974

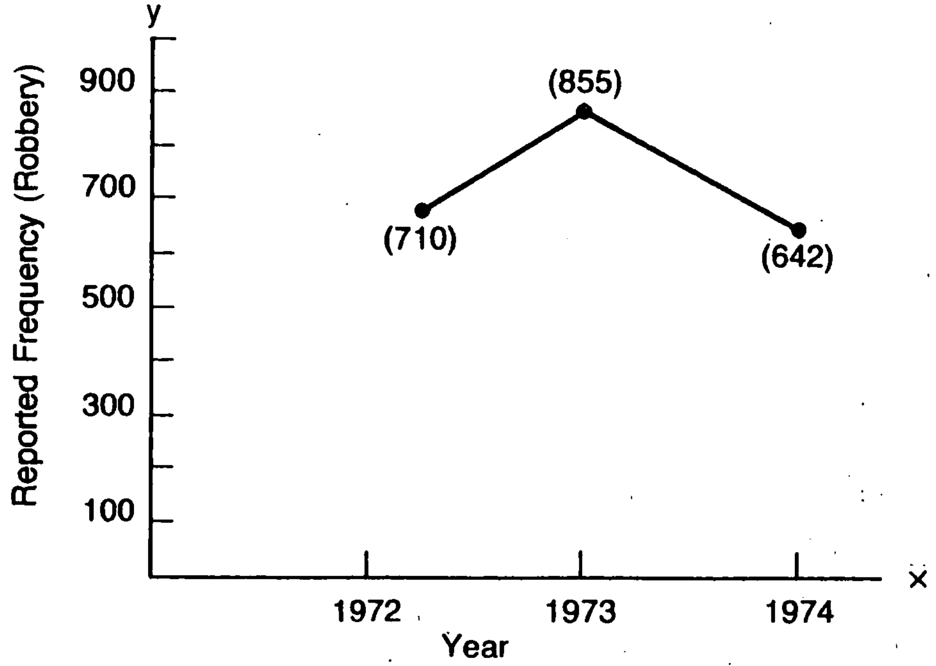
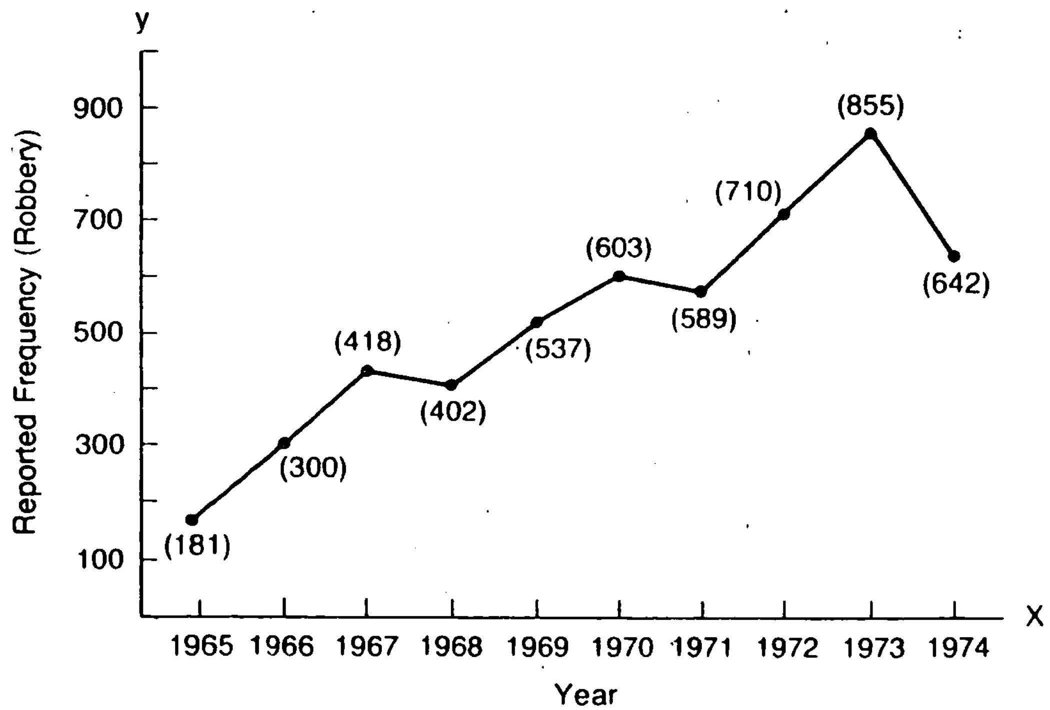


Exhibit 5-25.

TEN YEAR TIME SERIES OF ANNUAL ROBBERY DATA, CHAOS CITY, 1965–1974

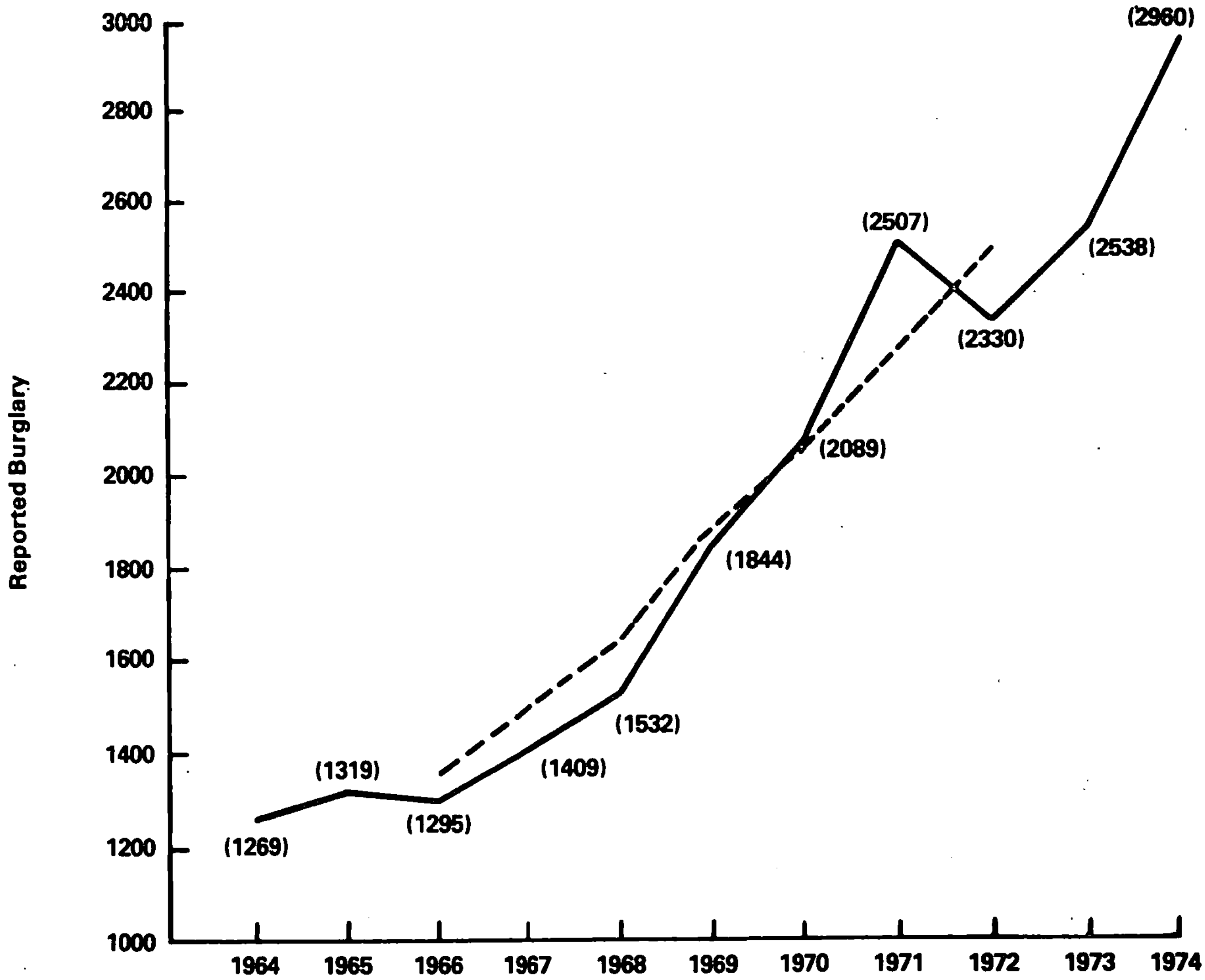


Source: hypothetical data

Extended time series lend themselves to comparative analysis, especially between different jurisdictions. Exhibit 5-26 is an eleven year time series of reported burglaries in Chaos City which clearly have been on the increase. This trend is compared to the burglary trend in four other cities in Exhibit 5-27. Also presented in the exhibit is the U.S. burglary trend. This required a second scale which is on the right side of the time chart. The change in scale between Exhibits 5-26 and 5-27 produces a marked de-emphasis of the importance in the increase of burglaries displayed for Chaos City.

EXHIBIT 5-26.

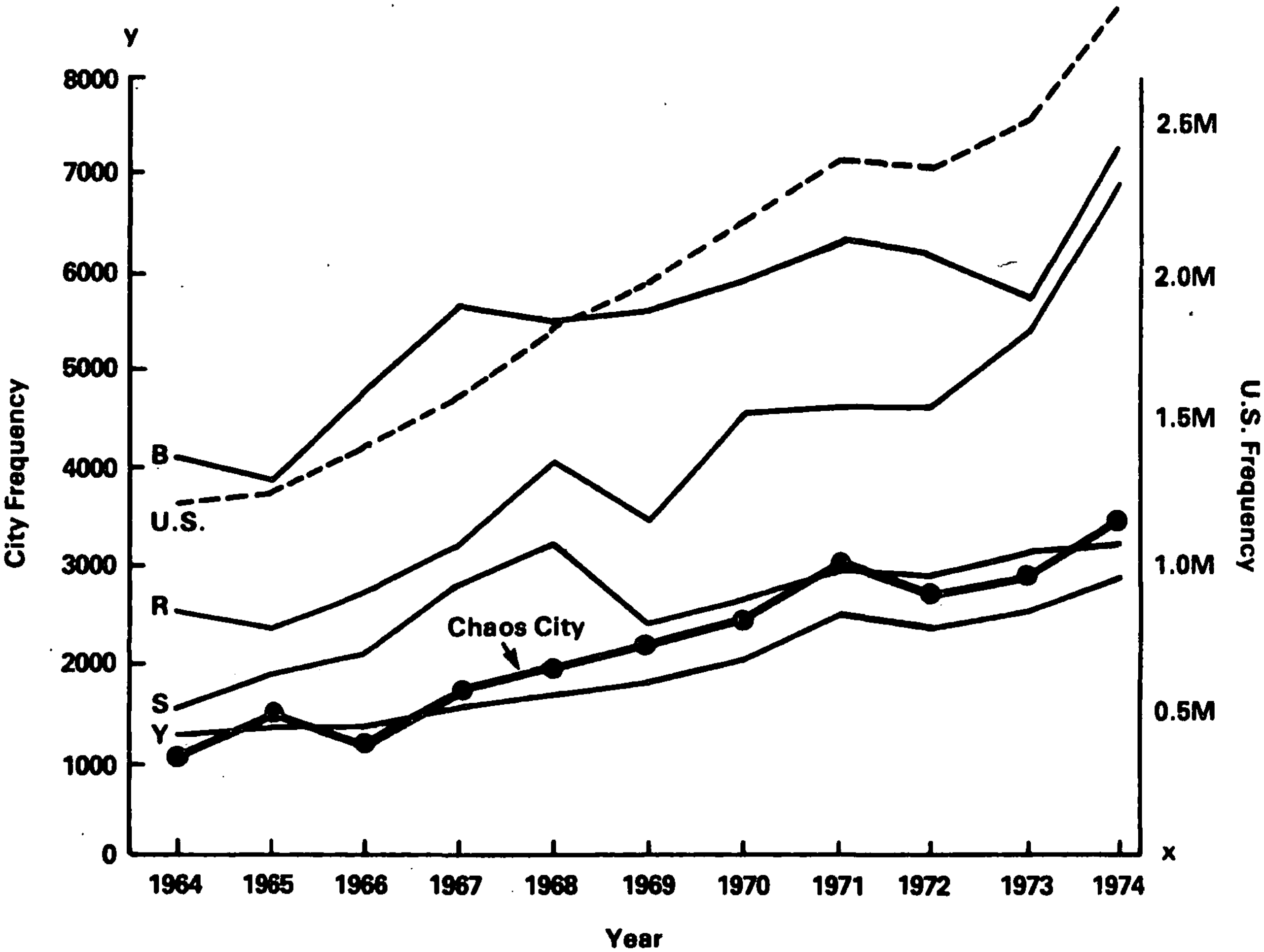
ELEVEN YEAR TIME SERIES OF ANNUAL FREQUENCY OF REPORTED BURGLARY, CHAOS CITY, 1964-1974



Source: hypothetical data

EXHIBIT 5-27

ANNUAL FREQUENCY OF REPORTED BURGLARY FOR UNITED STATES, CHAOS CITY AND FOUR OTHER CITIES, 1964-1974

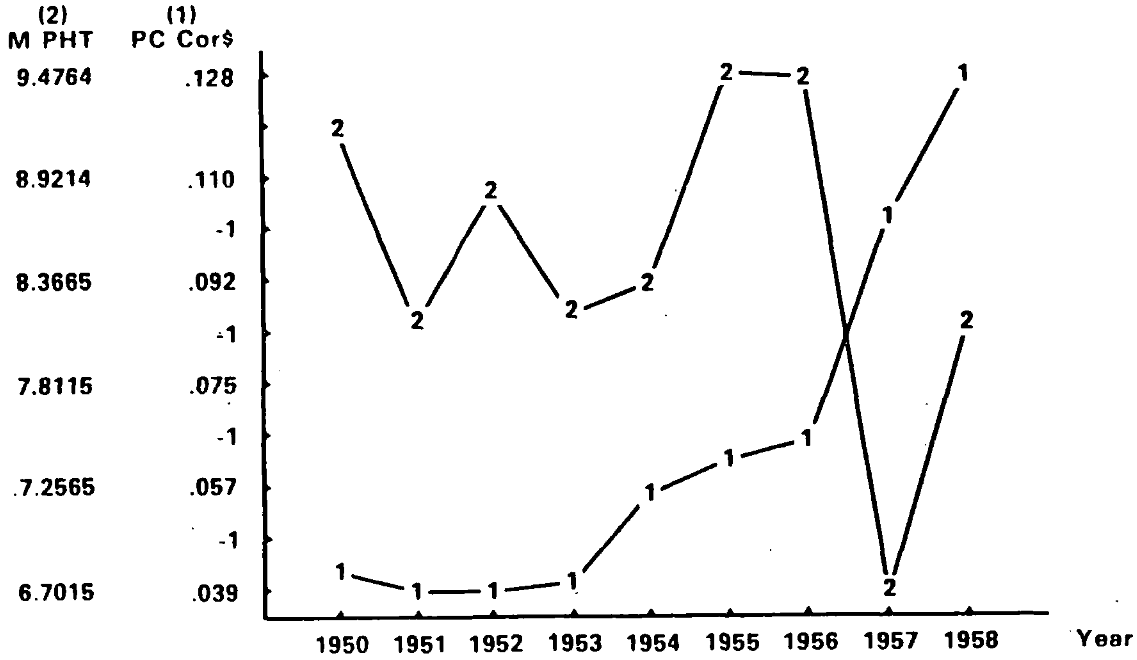


Source: hypothetical data.

As a last example of a short and extended time series, examine the two trends presented in Exhibits 5-28 and 5-29 which plot the variables -- per capita expenditure for jails in Chaos City (PS Cor $, in cents) and the number of murders per hundred thousand population (M PHT). In Exhibit 5-28 the period 1950-1958 is covered. Note the fluctuation in the murder rate and the steady increase in the expenditure figure. Exhibit 5-29 extends this series over a thirty year period. As may be seen, the nine year period 1950-1958 was the end of a relatively constant pattern in both variables which was followed by a dramatic increase between 1958-1973. The slash marks in the year scale indicates years excluded due to missing or unreliable measures. The parallel increase in the murder rate and jail expenditures is quite clearly illustrated in this time chart.

EXHIBIT 5-28

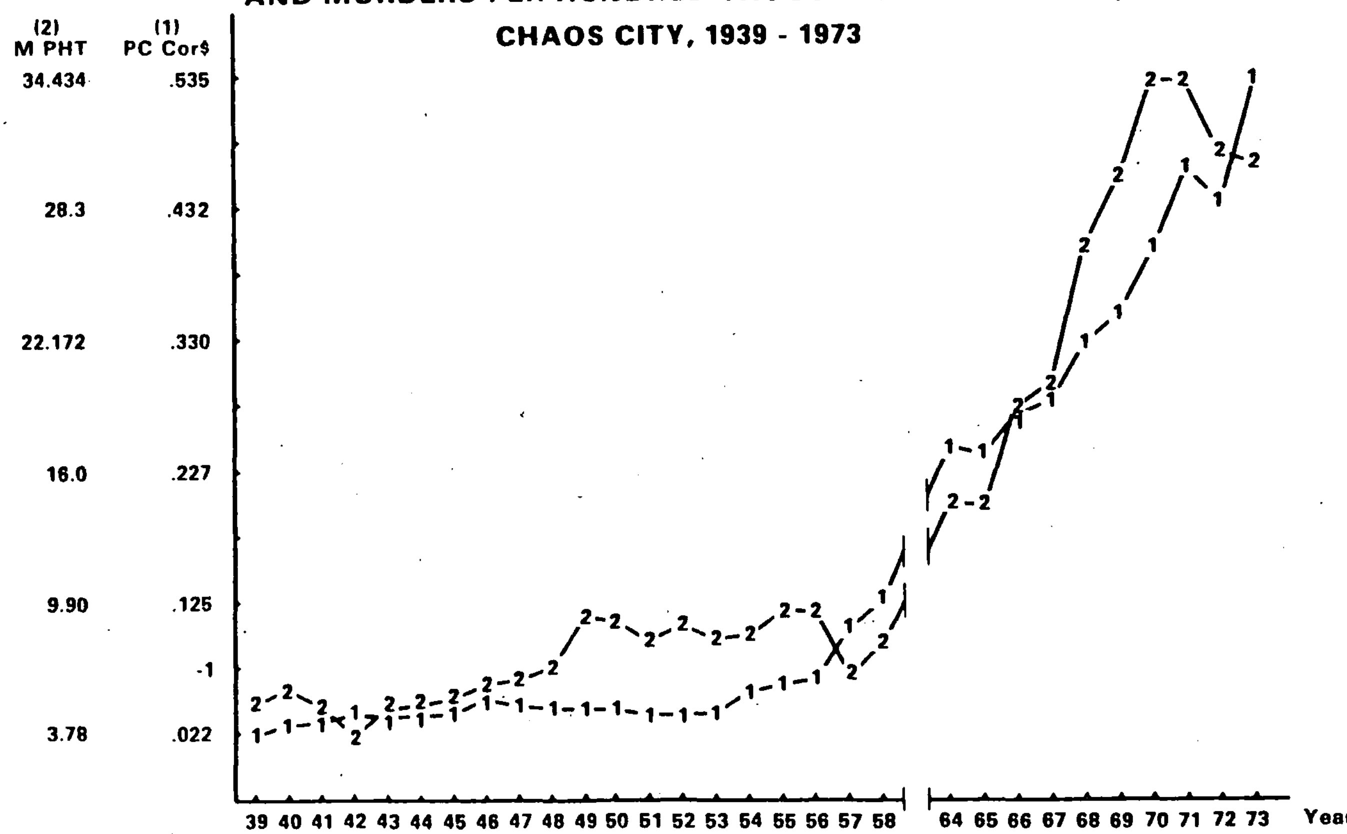
NINE YEAR TIME SERIES, PER CAPITA JAIL EXPENDITURES AND MURDERS PER HUNDRED THOUSAND POPULATION, CHAOS CITY, 1950-1958



Source: Hypothetical Data

EXHIBIT 5-29

THIRTY YEAR TIME SERIES, PER CAPITA JAIL EXPENDITURES AND MURDERS PER HUNDRED THOUSAND POPULATION, CHAOS CITY, 1939 - 1973



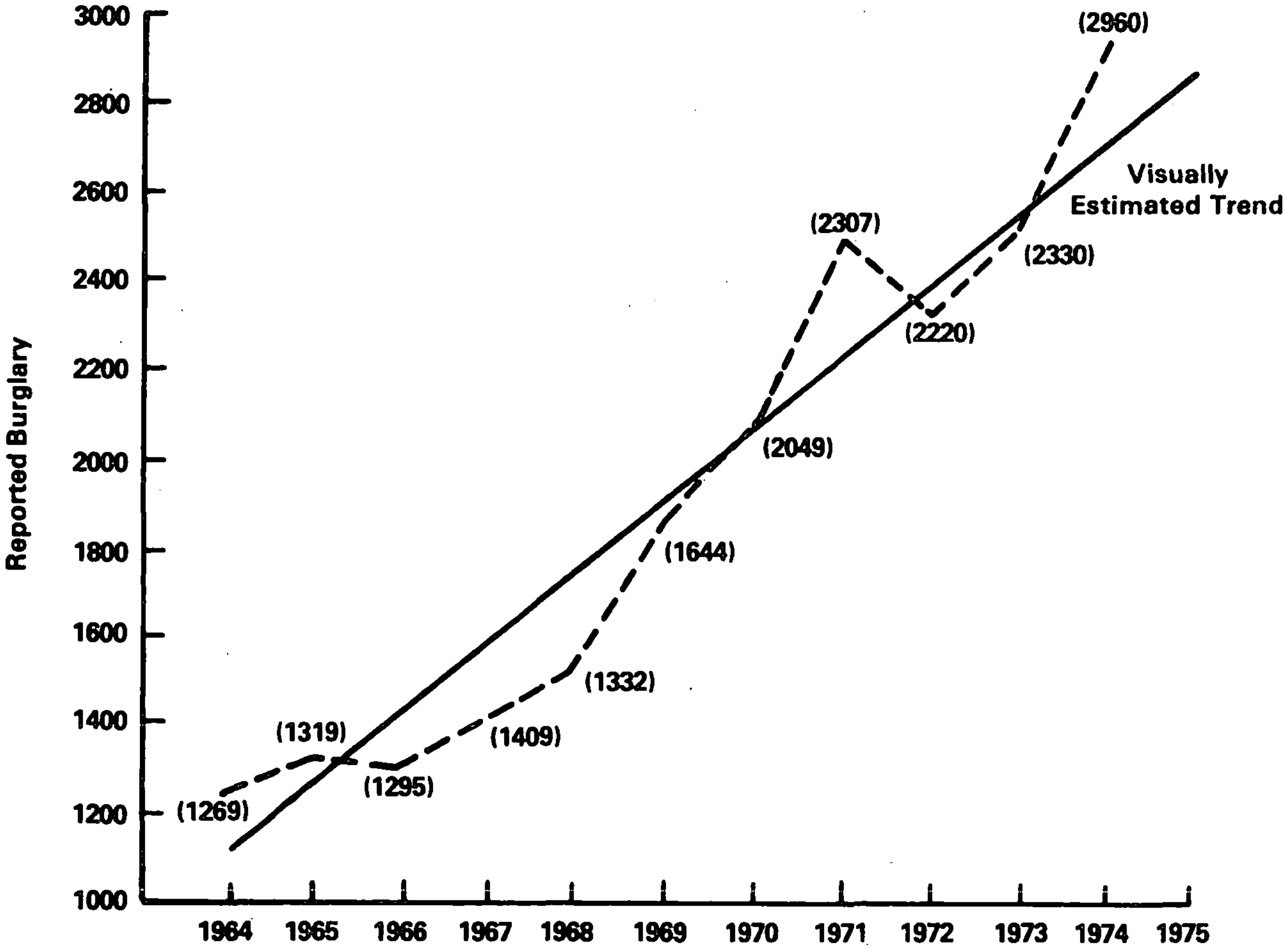
Source: Hypothetical Data

2. Estimating a trend using a moving average

There are several different methods for estimating a trend in an extended time series. Examining the plot and visualizing a line or curve that "best fits" the data is one such method. Such a visually determined trend line is presented in Exhibit 5-30. Using this trend line it is possible to develop rough point estimates of the incidence of burglary over this ten year period. For example, the estimated incidence of burglary in 1970 is about 2100. Precision of a visually estimated trend line generally decreases if a time series exhibits irregularities and cyclical functions, or if only a few data points are available. A major disadvantage of a visually estimated trend is its dependence on the visual acuity and subjective judgment of the analyst.

EXHIBIT 5-30.

VISUALLY ESTIMATED TREND, BURGLARIES, CHAOS CITY, 1964-1975



Source: hypothetical data

A less subjective method of estimating a trend is to use a moving average. A moving average is calculated by first deciding the time interval over which the moving average will be determined; second, summing the values of the variable over this time period (the moving total); and third, dividing the moving total by the number of intervals being used. The robbery data in Exhibit 5-30 contains two components: a smooth component, representing the general long-term trend; and a fluctuating component which indicates regular changes, such as annual, seasonal, or hourly variations. The moving average method, by reducing such fluctuation, helps to identify the long-term trend. A five year moving average is calculated and plotted in Exhibit 5-31 for the ten year burglary data.

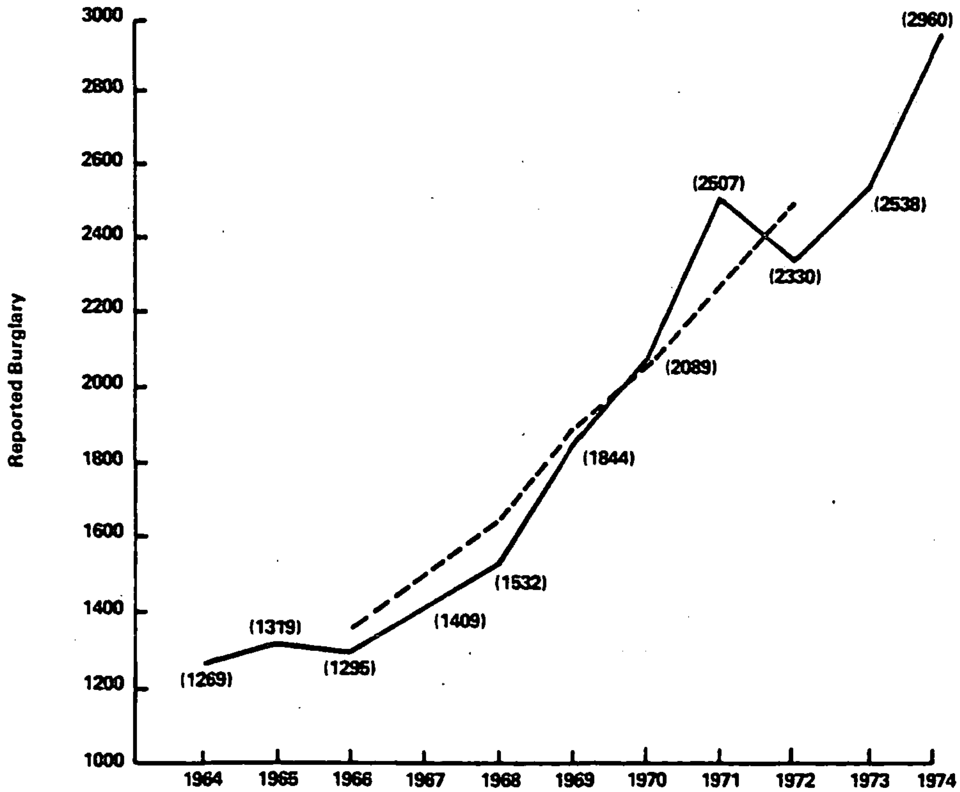
EXHIBIT 5-31.

CALCULATION OF A TEN YEAR MOVING AVERAGE,
BURGLARIES, CHAOS CITY, 1964-1974

1. **Calculate Ten Year Moving Average.**

Year	Burglaries	Five Year Moving Total	Five Year Moving Average
1964	1269		
1965	1319		
1966	1295	6824	1365
1967	1409	7399	1480
1968	1532	8169	1634
1969	1844	9381	1876
1970	2089	10302	2060
1971	2507	11308	2262
1972	2330	12424	2485
1973	2538		
1974	2960		

2. **Plot Ten Year Moving Average.**



Source: hypothetical data

3. Seasonal Variations in a Time Series

Cyclical variations in time series play a significant part in understanding the causes of criminal justice problems, and in studying the impacts of programs and policies on these problems. Changes in the residential burglary rate, may simply be seasonal, i.e., the result of recurring seasonal factors such as weather, outdoors activities, vacations and increased hours of darkness, or they may be the result of other irregular or random factors. One method for identifying the seasonal component of a time series involves the calculation of an index which reflects the cyclical variation.[11]

Chaos City analysts have collected monthly data on residential burglaries for the period 1975 through 1977. This data is reported in the first column of Exhibit 5-32. In working with monthly data it is often useful to adjust each month's value according to a "30 day month." For example, there are 31 days in January but only 28 days in February. If there is a ten percent decline in residential burglaries during this two month period, is it because February was colder than January or because February has ten percent fewer days? By adjusting each month to a 30 day estimate, improved month-to-month comparisons may be made in the following examples; however, no such adjustment is made in the monthly residential burglary total. The first step in calculating a seasonal index is to calculate the 12 months totals for each possible midpoint (i.e., 6 months prior and 6 months past). Since the data in column two are arrayed at the mid-points between months, a twenty-four-month moving total is calculated in column three; this centers the data on specific months.

EXHIBIT 5-32.

CALCUATION OF SEASONAL INDEX, RESIDENTIAL BURGLARIES BY MONTH, CHAOS CITY, 1975-1977

Year and Month	(1) Burglaries	(2) 12 month Moving Total	(3) 24 month Moving Total	(4) 12 mo. Centered Moving Average	(5) Seasonal Index	(6) Ave. S.I.
1975						
Jan	221					
Feb	241					
Mar	210					
Apr	200					
May	238					
June	330	3083				
July	402	3034	6117	254.9	157.7	
Aug	393	2957	5991	249.6	157.6	
Sept	301	2915	5872	244.7	123.0	
Oct	237	2903	5818	242.4	97.7	
Nov	120	2893	5796	241.5	49.7	
Dec	190	2857	5750	239.6	79.3	
1976						
Jan	172	2773	5630	234.6	73.3	67.2
Feb	164	2703	5476	228.2	71.9	76.8
Mar	168	2672	5375	224.0	75.0	76.3
Apr	188	2582	5254	218.9	85.9	84.2
May	228	2598	5180	215.8	105.7	104.8
June	294	2556	5154	214.8	136.9	128.5
July	309	2522	5078	211.6	145.0	156.9
Aug	332	2503	5025	209.3	158.6	158.1
Sept	270	2468	4971	207.1	130.4	126.7
Oct	147	2421	4889	203.7	72.2	85.0
Nov	136	2372	4793	199.7	68.1	58.9
Dec	148	2282	2654	193.9	76.3	77.8
1977						
Jan	138	2191	4473	186.3	61.1	
Feb	145	2077	4268	177.8	81.6	
Mar	133	2038	4115	171.5	77.6	
Apr	141	2065	4103	170.9	82.5	
May	179	2067	4132	172.2	103.9	
June	204	2149	4086	170.3	119.8	
July	218					
Aug	231					
Sept	169					
Oct	174					
Nov	138					
Dec	130					

Source: hypothetical data

The third step is to divide each of the twenty-four month totals by 24 to obtain the 12 centered moving average. The last value in Column 4 -- 170.3 for June 1977 -- represents the average monthly incidence of residential burglary for the 12 month period centered at June. The last column is calculated by dividing the actual monthly incidence by the corresponding moving average; e.g., for June 1977, 204 divided by 170.3 times 100 equals 119.8. This is interpreted as meaning that June was 120% as great as the average incidence for the twelve month period centered at June. These seasonal indices help isolate the seasonal changes in the time series. Clearly the months May - September have seasonal indices greater than their averages, indicating a strong seasonal variation in residential burglary incidence in Chaos City during the summer months. The last column simply is an average of two seasonal indices calculated for each month. This average may then be used to deseasonalize the time series.

It is frequently useful to estimate the deseasonalized values of a time series in order to examine changes in light of estimated seasonal influences, i.e., whether the observed changes in the incidence in residential burglaries is greater than or less than values based on seasonal factors alone. Deseasonalized values of the residential burglary data are presented in Exhibit 5-33. These are calculated by dividing the monthly incidence by the seasonal index expressed in decimal form, e.g., Jan. 1975 = 221/.672 = 328. These 328 robberies represent the deseasonalized or seasonally adjusted incidence of residential burglaries. By multiplying each of these deseasonalized monthly values by 12 a seasonally adjusted annual incidence may be estimated, e.g., 328 x 12 = 3936 incidents.

EXHIBIT 5-33.

DESEASONALIZED TIME SERIES, RESIDENTIAL BURGLARY BY MONTH, CHAOS CITY, 1975-1977

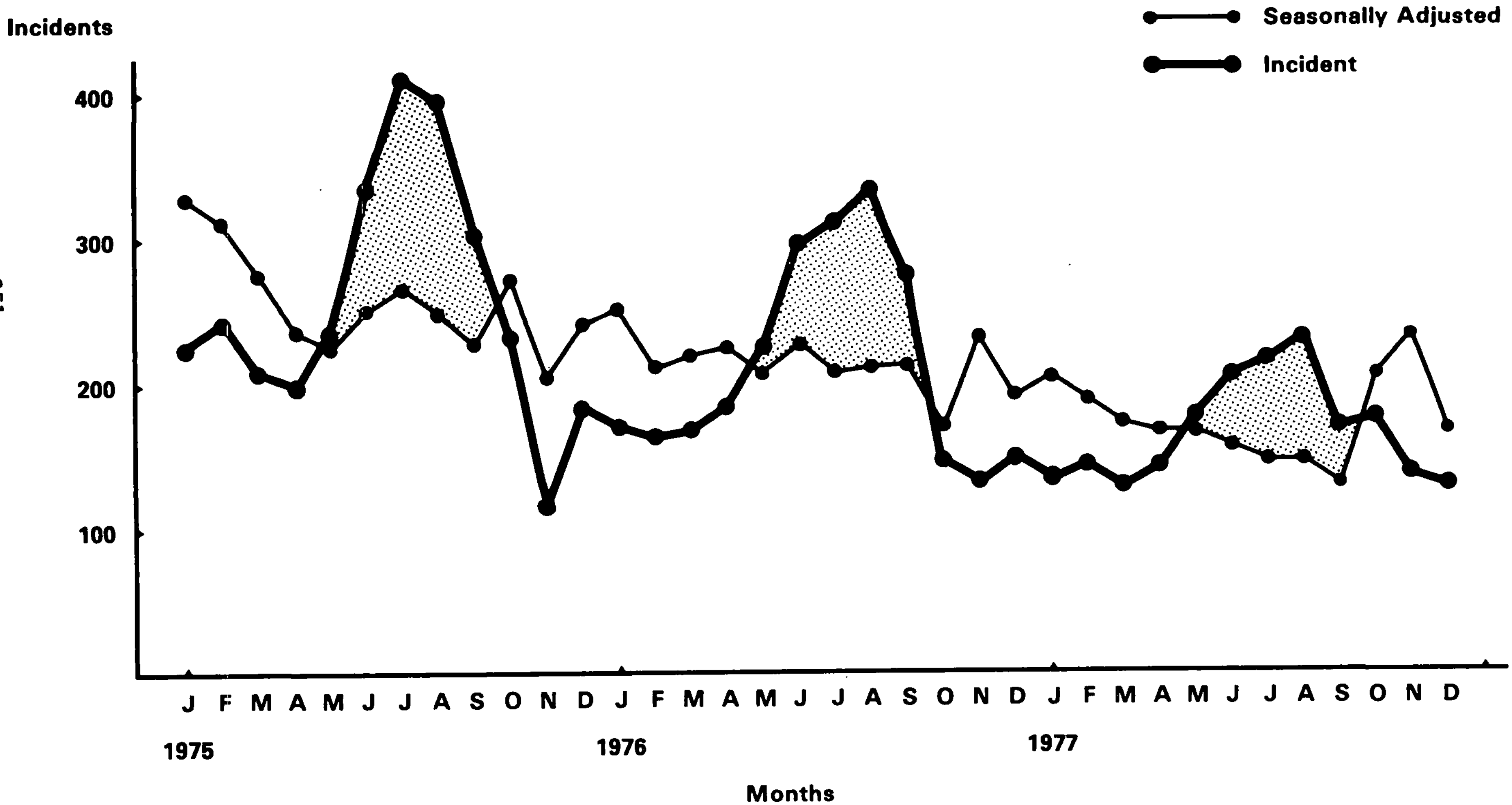
1975	Burglaries	Deseasonalized Incidence
Jan	221	328
Feb	241	313
Mar	210	275
Apr	200	238
May	238	227
June	330	257
July	402	264
Aug	393	249
Sept	301	238
Oct	237	278
Nov	120	204
Dec	190	244
1976		
Jan	172	256
Feb	164	213
Mar	168	220
Apr	188	223
May	228	217
June	294	229
July	309	203
Aug	332	210
Sept	270	213
Oct	147	172
Nov	136	231
Dec	148	190
1977		
Jan	138	205
Feb	145	189
Mar	133	174
Apr	141	167
May	179	171
June	204	159
July	218	144
Aug	231	146
Sept	169	133
Oct	174	205
Nov	138	234
Dec	130	167

Source: hypothetical data

Exhibit 5-34 plots the incidence and the seasonally adjusted incidence of residential burglaries. Comparing the two trends indicates the significant seasonal fluctuation in residential burglaries. The shaded area on the graph indicates the months for which the actual incidence was greater than the deseasonalized incidence. Such comparisons are useful in analyzing past or current performance and conditions to determine an appropriate course of action, and in developing operational forecasts, schedules and goals for the future.[12]

EXHIBIT 5-34

COMPARISON OF INCIDENT AND SEASONALLY ADJUSTED TREND IN RESIDENTIAL BURGLARY, CHAOS CITY, 1975 - 1977



B. Regression in Time Series Analysis and Causal Models

There are three main elements of any forecast. First, the analyst must decide on a time frame for the specific prediction. Changing the points in time for the prediction could effect both the specific tool to be used as well as the final product. Second, many forecasting procedures rely on the past and specifically use relevant historical data to make predictions. This assumes the past, or some portion of the past, is a good predictor of the future. The third element is that forecasts are characterized by uncertainty which will inevitably produce errors in the analyst's predictions.

There are basically three types of forecasting methods, two of which will be presented in this section. Time series models utilize historical data of the variable to be forecast in making a prediction. This method assumes that the trends that occurred in the past are stable and will recur in the future. Such models are unable to account for significant policy changes, or environmental changes and, hence, are limited in measuring the impact of proposed actions. Their major use is in establishing a baseline prediction which assumes maintaining current conditions and trends.

The second type of forecasting method is the causal model. This technique utilizes closely associated variables to make a prediction of a dependent variable. That is, population growth is a good indicator of index crime change, and so the analyst uses readily available population projections to model and to predict the crime rate. Causal models, in addition to being difficult to develop, require more historical data than do time series models, and require an ability to accurately predict the independent variables (e.g., population). However, causal models can more readily incorporate policy or environmental changes.

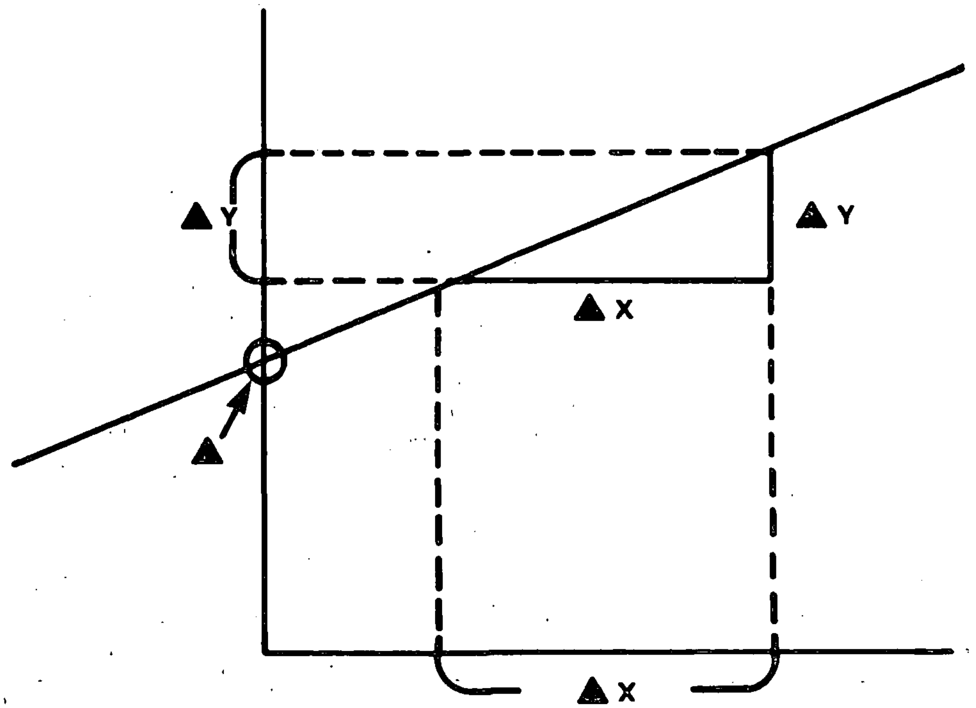
The third type of forecasting method depends primarily on individual or group judgments about the future. These qualitative approaches range from the Delphi method to visionary forecasting. The central components of such methods are subjective judgments and rating schemes.[13]

1. Purpose and Approach

Least squares regression is a prediction method that is used to determine future estimates of a dependent variable given information about the independent variable(s) it is related to. As used in bivariate (two variable) problems, the regression line is the "best-fit" of a line to the data. Exhibit 5-35 presents the basic concepts associated with determining such a regression. Any line displayed on an x-y grid is defined by two factors: (1) the location on the y-axis of its intercept (A in the exhibit) and (2) its slope (B in the exhibit). Least squares regression is a procedure used to estimate values of the slope and of y-intercept for a set of data consisting of two interval or ratio scale variables. Exhibit 5-36 contains the steps and formula used to estimate the slope (B) and y-intercept (A).

EXHIBIT 5-35

SLOPE AND Y-INTERCEPT



$$B = \frac{\Delta Y}{\Delta X}$$

Source: hypothetical data

EXHIBIT 5-36.

FORMULA FOR REGRESSION COEFFICIENTS

Step 1: Calculate Sums

Step 2: $$B = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{N\Sigma X^2 - (\Sigma X)^2}$$

Step 3: $$A = \frac{\Sigma Y - B\Sigma X}{N}$$

Step 4: $$\hat{Y} = A + BX$$

2. Application

Following is the calculation of the slope and y-intercept for the burglary data presented in Exhibit 5-26. Note in Exhibit 5-37 the x variable (year) is renumbered for ease of calculation. The first step is to calculate the required summations as indicated in step 1. Next, the appropriate substitutions are made into the formula for the slope--step 2. For this problem the slope of the line is equal to 174 burglaries per year, i.e., an increase of one year results in an increase of 174 burglaries. The third step is to calculate the y-intercept (A) by substituting the appropriate values into the formula. The y-intercept is interpreted as the value of y (burglaries) when x (year) is equal to zero. The intercept is 871 burglaries. With these two pieces of information the regression line can be plotted. This line is the "best-fit" to the data and is graphed in Exhibit 5-38. To graph the regression line, first anchor the line at the y-intercept; second count over 1 unit on the x-axis and either up or down the number of units indicated by the magnitude and sign of the slope -- place a dot. In this example the slope is positive so the count is up 174 units. Finally connect the intercept and the dot and extend the line.

EXHIBIT 5-37.

CALCULATION OF REGRESSION COEFFICIENTS, INCIDENCE OF BURGLARY, CHAOS CITY, 1964-1974

Step 1: Calculate Sums

Year	X	Y	XY	X^2	Y^2
1964	1	1269	1269	1	1610361
1965	2	1319	2638	4	1739761
1966	3	1295	3885	9	1677025
1967	4	1409	5636	16	1985291
1968	5	1532	7660	25	2347024
1969	6	1844	11064	36	3400336
1970	7	289	14623	49	4363921
1971	8	2507	20056	64	6285049
1972	9	2330	20970	81	5428900
1973	10	2538	25380	100	6441444
1974	11	2960	32560	121	8761600
Σ	66	21092	145741	506	44040702

$\Sigma N = 11$
$\Sigma X = 66$
$\Sigma Y = 21{,}092$
$\Sigma XY = 145{,}741$
$\Sigma X^2 = 506$
$\Sigma Y^2 = 44{,}040{,}702$

Step 2: $$b = \frac{N \Sigma XY - (\Sigma X)(\Sigma Y)}{N \Sigma X^2 - (\Sigma X)^2} = \frac{(11)(145741) - (66)(21{,}092)}{N(506) - (66)^2}$$

$$= \frac{1{,}603{,}151 - 1{,}392{,}072}{5566 - 4356} = \frac{211079}{1210}$$

$$= 174.45$$

Step 3: $$a = \frac{\Sigma Y - b \Sigma X}{N} = \frac{21092 - (174.45)(66)}{11} = \frac{21{,}092 - 11{,}513.7}{11}$$

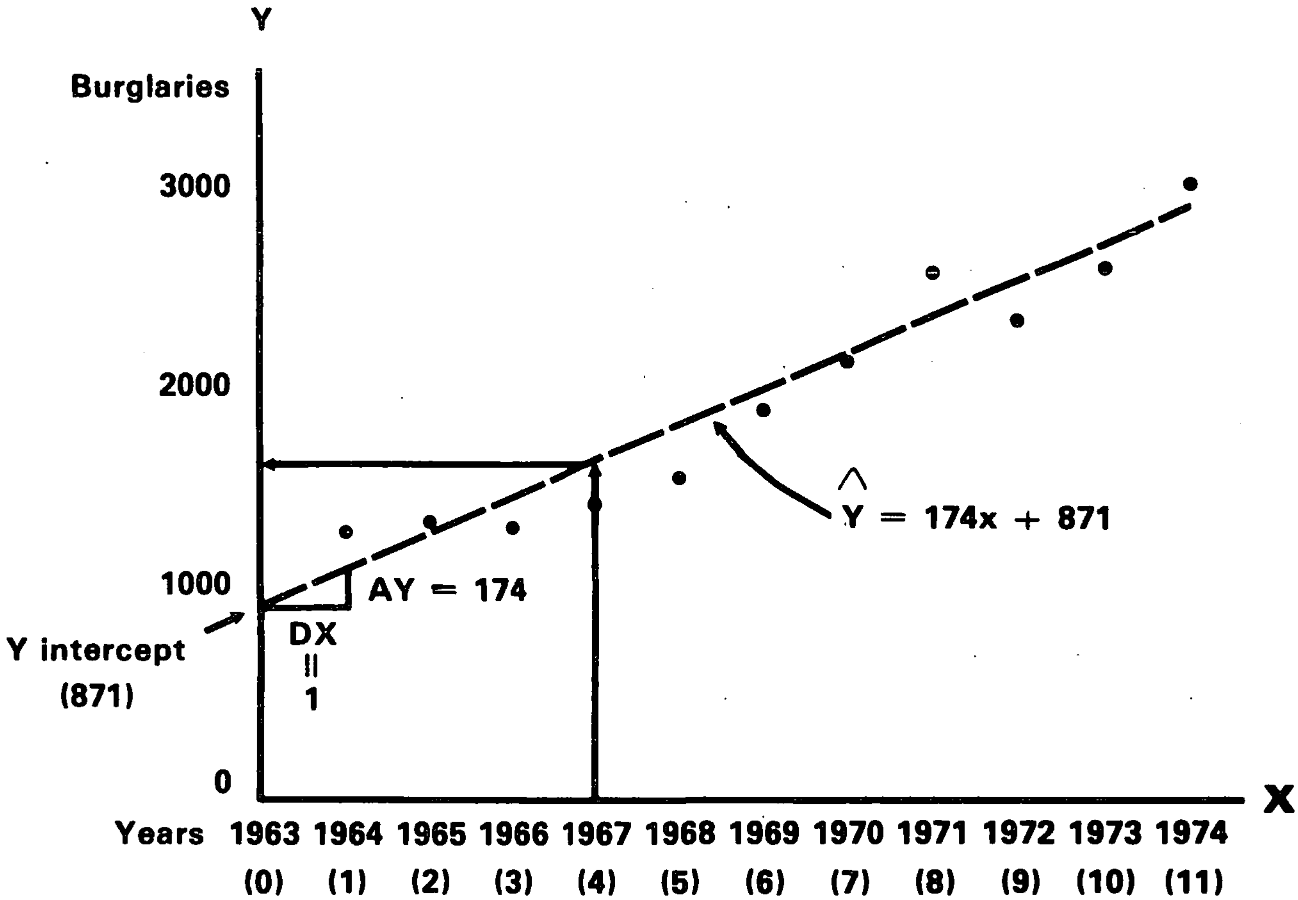
$$= 870.75$$

Step 4: $\hat{Y} = 174.45X + 870.75$

Source: hypothetical data

EXHIBIT 5-38

REGRESSION LINE, INCIDENCE OF BURGLARIES, CHAOS CITY, 1964 - 1974



Source: Hypothetical Data

The estimated values of the number of burglaries for different years can be directly read off the chart; e.g., the estimated number of burglaries in 1967 is obtained by reading up to the line at 1967 and over to the Y-axis. The 1967 value is about 1600. A more accurate estimated value may be obtained by substituting 4 (for 1967) into the regression equation; e.g., $Y_{67} = 174x + 871$ or $Y = 174(4) + 871 = 1567$ burglaries. By substituting the values of 12 to 22 one at a time into the equation, a set of predicted values can be obtained for the incidence of burglary. These are presented in Exhibit 5-39. They represent a prediction of the number of burglaries in Chaos City for the period 1975-1985 based on the actual incidence between 1964-1971.

EXHIBIT 5-39.

PREDICTED INCIDENCE OF BURGLARY,
CHAOS CITY, 1975 - 1985

Year	Predicted Burglaries
1975	2964.1
1976	3138.6
1977	3313.0
1978	3487.5
1979	3661.9
1980	3836.4
1981	4010.8
1982	4185.2
1983	4359.7
1984	4534.1
1985	4708.6

Source: hypothetical data

3. Assessment of Prediction

There are a number of statistics used to assess the accuracy and usefulness of a regression. Three such statistics are the standard error, the coefficient of determination and the estimation of a prediction interval. These are based on the simple premise that the higher the correlation between X and Y the more accurate will be the prediction. The accuracy of a prediction may be assessed by, first, calculating the differences between the predicted and actual Y values, and then summing the squares of these differences. The differences between predicted and actual Y values are called the residuals. The higher the correlation, the smaller the residual value.

A statistic which incorporates the residual value is the Standard Error of Estimate (SE). The SE is the standard deviation of the residuals. Its formula is:

$$SE = \sqrt{\frac{\Sigma(Y - \overline{Y})2}{n - 2}}$$

If the SE is relatively large compared to the standard deviation of the dependent variable, the prediction of Y on the basis of X is unreliable. The smaller the SE, generally, the better the prediction. For example, the calculation of the standard error is presented in Exhibit 5-40. Step one requires calculating: (1) predicted values using the regression equation; (2) calculating the residuals by subtracting the actual from the predicted value for each year; and (3) squaring and summing the residuals. Step two involves substitution into the formula for the standard error. The SE for this time series is equal to 167 burglaries. This may be interpreted as meaning that if two parallel lines are drawn one standard error in distance from the regression line, about 68% of the sample should be enclosed between these lines; and 95% within two standard errors. In this example, five or 50% are within one standard error and all eleven or 100% are within two standard errors. Also note that the standard error of 167 is small in comparison to the standard deviation of 599.81 burglaries. These indicate the regression may be a good "fit" and predictor.

EXHIBIT 5-40.

CALCULATION OF STANDARD ERROR,
BURGLARY INCIDENCE,
CHAOS CITY, 1964-1974

Step 1:

Year	Burglary Incidence	Predicted Incidence	Residual	Residual Squared
1964	1269.0	1045.2	-223.770	50074.00
1965	1319.0	1219.7	- 99.327	9865.90
1966	1295.0	1394.7	99.118	9824.40
1967	1409.0	1568.6	159.560	25461.00
1968	1532.0	1743.0	211.010	44525.00
1969	1844.0	1917.5	73.455	5395.60
1970	2089.0	2091.9	2.900	8.41
1971	2507.0	2266.3	-240.650	57915.00
1972	2330.0	2440.8	110.790	12275.00
1973	2538.0	2615.2	77.236	5965.50
1974	2960.0	2789.7	-170.320	29008.00
				250317.81

n = 11

Step 2:

$$SE = \sqrt{\frac{250317.81}{9}} = 166.8$$

Source: hypothetical data

A second check of the regression is the coefficient of determination (r^2). This statistic, based on the correlation coefficient, ranges in value from 0 to +1 where high values indicate the amount of improvement in prediction the least squares regression offers over the mean value. This is frequently interpreted as the amount of variation in the dependent variable "explained" by variation in the independent variable. The coefficient of determination may be calculated by first estimating the correlation coefficient and then squaring it. These calculations are performed in Exhibit 5-41 using the eleven year burglary data. The coefficient of determination, r^2, is + .93 which is interpreted as meaning only 7% of the variation in burglaries is unexplained and that the regression is a very useful prediction model for this data.

EXHIBIT 5-41.

CALCULATION OF THE COEFFICIENT OF DETERMINATION, INCIDENCE OF BURGLARY, CHAOS CITY, 1964 - 1974

Step 1: r = Person's Correlation Coefficient

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\left[N\Sigma X^2 - (\Sigma X)^2\right]\left[N\Sigma Y^2 - (\Sigma Y)^2\right]}}$$

Step 2:

$$N\Sigma XY - (\Sigma X)(\Sigma Y) = 211,079$$

$$N\Sigma X^2 - (\Sigma X)^2 = 1,210$$

$$N\Sigma Y^2 - (\Sigma Y)^2 = 11(44,640,702) - (21092)^2$$

$$= 484,447,772$$

Step 3:

$$r = \frac{211,079}{\sqrt{(1210)\ (39,575,258)}} = \frac{211,079}{\sqrt{47,886,062,180}}$$

$$r = \frac{211,079}{218,830}$$

$$r = \pm.9645$$

Step 4: r^2 = Coefficient of determination

$$r^2 = .9645^2 = .93$$

Source: hypothetical data

A third procedure used to assess a regression equation is to estimate a prediction interval for each predicted value of the dependent variable. For example, the predicted incidences of burglary in 1975 and 1985 using the regression equation of Y = 174.45X + 870.75 are 2964 and 4709 burglaries, respectively, (substitute 12 for 1975 and 22 for 1985). To estimate a 95% prediction interval for these two estimates, i.e., the range of predicted values in 1975 and 1985 that we could be 95% likely to contain the actual incidence, the following formula is used:

$$PI = Y \pm (t_{n-2,.05})\ SE \sqrt{1 + \frac{1}{n} + \frac{(x-\bar{x})^2}{\Sigma(x_i-x)^2}}$$

Exhibit 5-42 presents the calculation of these two prediction intervals: the interval in 1975 is 1594 to 3334 burglaries; the interval in 1985 is 4136 to 5282 burglaries. The prediction interval gets larger, at an increasing rate, the farther a predicted value is from the actual data. This widening of the prediction interval's minimum and maximum values is represented in Exhibit 5-43. As the interval widens the likelihood of error in the prediction increases. Consequently, in time series regressions, the farther out in time from the base period, the more likely an error in the prediction. As long as prediction intervals stay reasonably small, as in 1975 for the burglary data, the prediction accuracy is likely to be high. However, the size of the 1985 prediction interval should caution the analyst from being confident in the predicted value.

EXHIBIT 5-42.

CALCULATION OF PREDICTION INTERVALS,
INCIDENCE OF BURGLARY,
CHAOS CITY, 1975 AND 1985

Step 1: Given the formula, sample size, and date to be predicted, calculate the basic statistics.

<u>Formula</u>: $PI = Y + (t_{n-2}, .05)\ SE \sqrt{1 + \frac{1}{n}\ \frac{(x-\bar{x})^2}{\Sigma(x_i-x)^2}}$

<u>Sample Size</u>: n = 11

<u>Year to be Predicted</u>: x = 12 (1975)

<u>Calculate</u>:

$\bar{x} = 5.5$
$(x_i-x)^2 = 112.75$
1975 = 2964
SE = 167

Step 2: Substitute the basic statistics into the formula

$$1975\ PI = 2964 \pm 1.833 \left[167 \sqrt{1 + \frac{1}{11} + \frac{(12-5)^2}{112.75}} \right]$$

$$= 2964 \pm 1.833\ (202)$$

$$= 2964 \pm 370 \text{ burglaries}$$

Step 3: Repeat this procedure to estimate prediction interval for 1985

Given: n = 11
x = 22 (1985)

Calculate Y = 4709

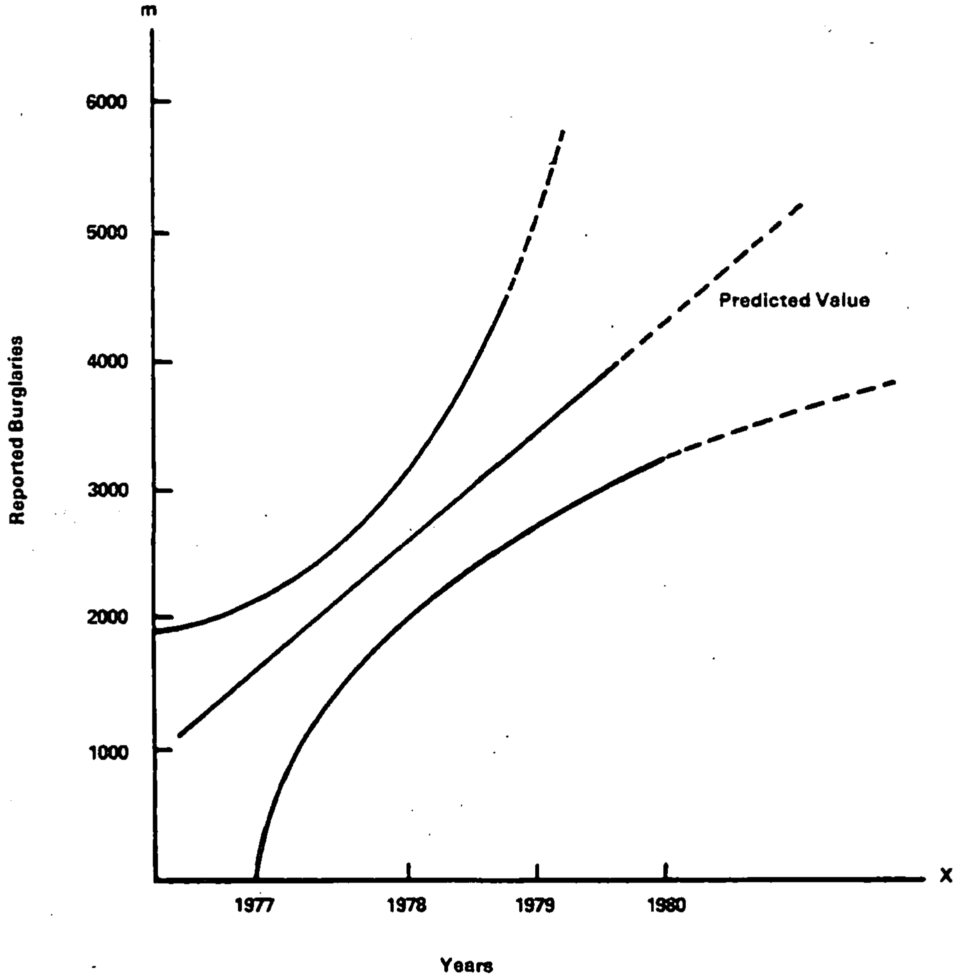
$$1985\ PI = 4709 \pm 1.833 \left[167 \sqrt{1 + \frac{1}{11} + \frac{(22-5.5)^2}{112.75}} \right]$$

$$= 4709 \pm 573 \text{ burglaries}$$

Source: hypothetical data

EXHIBIT 5-43

UPPER AND LOWER LIMITS OF PREDICTION INTERVALS FOR ESTIMATED VALUES OF THE DEPENDENT VARIABLE



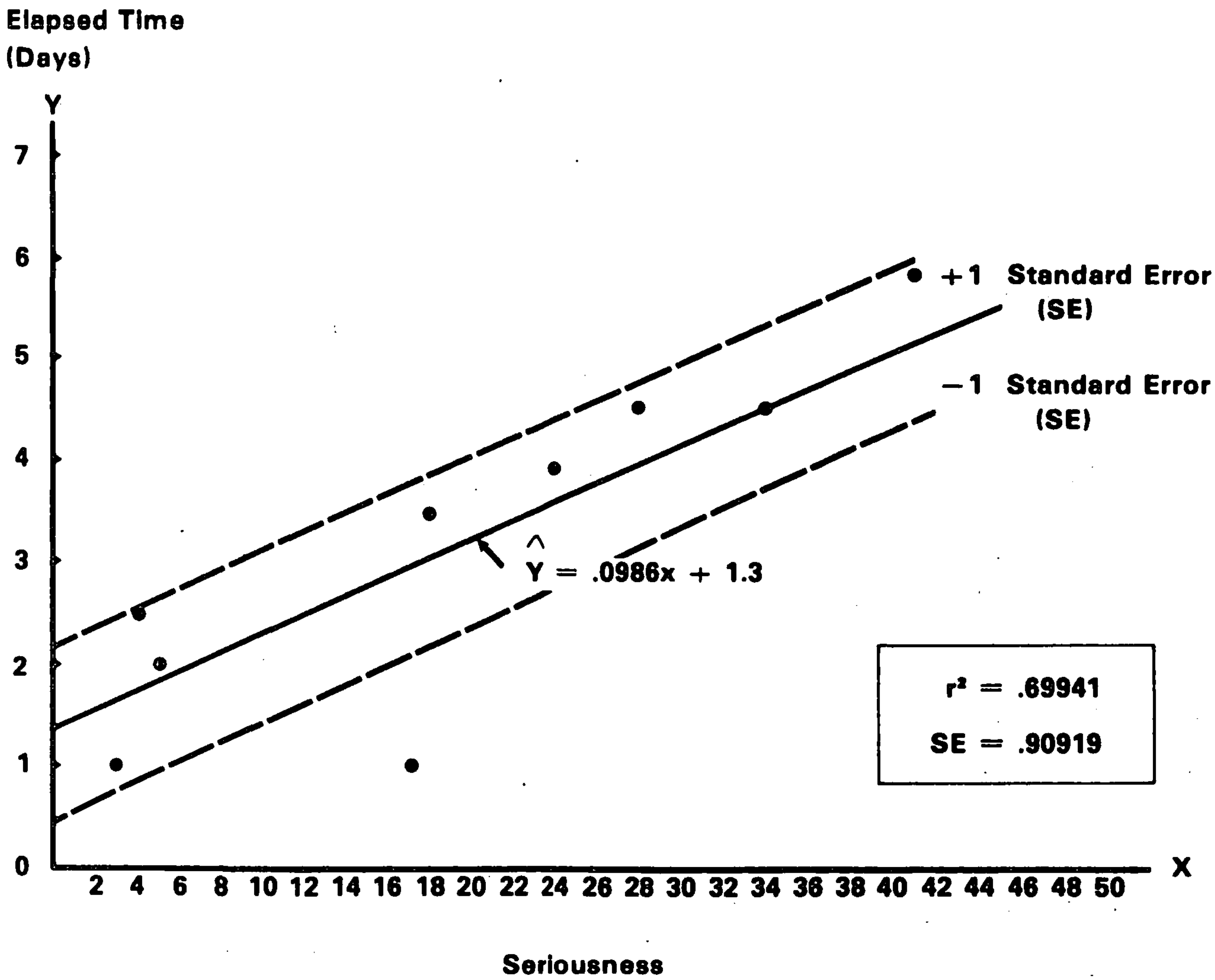
Source: hypothetical data

4. Regression in Causal Models

Prediction of a dependent variable may be based on other independent variables besides the passage of time. Such models are referred to as causal models since there is an implied causal relationship. Consider the problem of predicting the processing time necessary for the police to dispose of a felony case with a seriousness score of 15. Exhibit 5-44 presents descriptive statistics for nine felony cases on two variables -- elapsed time and seriousness. The scatterplot and correlation of seriousness and elapsed time is also displayed in the exhibit. There is evidence of a strong positive relationship, i.e., the more serious the felony case, the longer the processing time required.

EXHIBIT 5-44

REGRESSION LINE AND STANDARD ERROR, EFFECT OF SERIOUSNESS ON ELAPSED TIME, FELONY CASES, CHAOS CITY POLICE DEPARTMENT, 1977



The calculation of a regression equation in which the dependent variable (y) is elapsed time and the independent variable (x) is seriousness results, in a slope equal to .0986 and a y-intercept of +1.3 days. (This latter value is the elapsed time for a felony case having a zero seriousness score, a theoretically significant but practically irrelevant fact.) These may be expressed in equation form as $\hat{Y} = .0986x + 1.3$. The standard error is .909 and r^2 is equal to .70 indicating the usefulness of the equation for prediction. Finally, the predicted elapsed time for a felony arrest with a seriousness score of 15 is determined by the equation $y = .0986\ (15) + 1.3$, and is equal to 2.8 days. The 95% prediction interval is between 1.0 and 4.5 days (a large interval due to the scatter of the plot).[14] Exhibit 4-44 presents the graph of this regression and also plots the lines indicating one standard error. Note that 80% of the values are within one SE and 100% are within two SE indicating a good-fit of the regression to the data.

VII. Summary

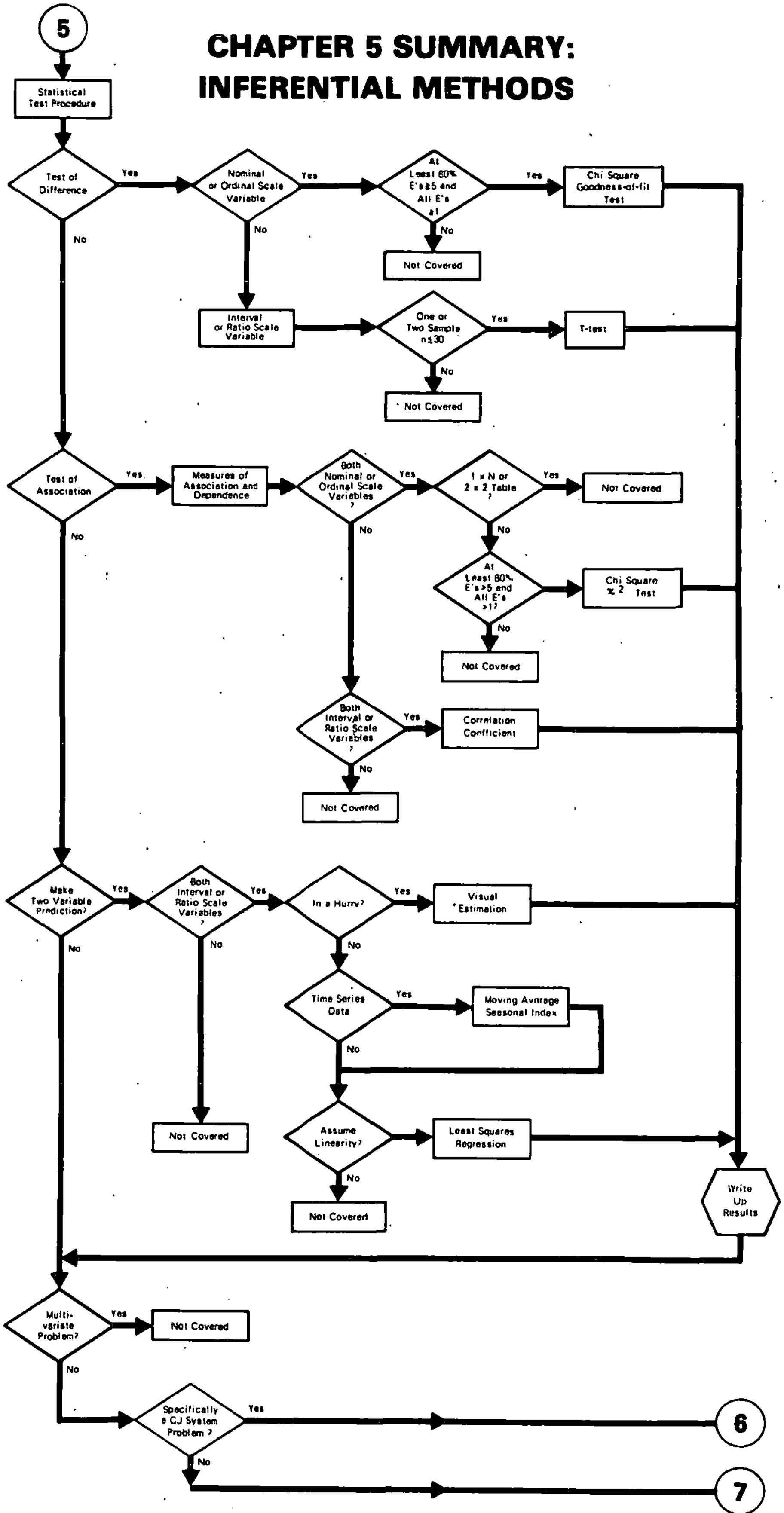
Least squares regression as applied to time series data or in causal models is a powerful predictive tool based on the assumption that all relevant factors will continue to operate as they have in the past. Small standard error values and high coefficients of determination indicate the usefulness of the method in making a prediction. Large standard errors and low r^2 values indicate that a regression should be used with caution. Similarly, small prediction intervals indicate a "good fit" of the regression line and the data.

Least squares regression builds upon problem specification and descriptive and comparative analyses. The analyst should first describe each of the variables of interest in terms of the identified hypotheses. The data should next be evaluated for possible comparative analysis including the development of indices, scattergrams, or cross-classifications; inferential methods should be considered to enrich and expand the descriptive and comparative analyses.

This chapter has examined a range of inferential methods organized, in two parts: (1) tests and measures of association and difference, including the t-statistic, chi square and the correlation coefficient; and (2) least squares regression and time series methods. A flow chart guide to inferential methods and to the chapter is presented in Exhibit 5-45.

EXHIBIT 5-45

CHAPTER 5 SUMMARY: INFERENTIAL METHODS



[1]U.S. Department of Justice, "Lights Reduce Fear of Crime," LEAA Newsletter 8, No. 6 (June/July 1979): 1

[2]Lyman Ott, William Mendenhall and Richard Larson, Statistics: A Tool for the Social Sciences, 2nd ed. (North Scituate: Duxbury Press, 1978), p. 228.

[3]A good introductory statistics text organized, in part, on the basis of selecting the appropriate statistic is Thad R. Horshbarger, Introductory Statistics: A Decision Map Approach, 2nd ed. (New York: MacMillan Publishing Company, 1977). A useful and easy-to-follow guide to inferential statistics is: Frank Andrews, et. al., A Guide for Selecting Statistical Techniques For Analyzing Social Science Data, (Institute for Social Research, Ann Arbor, Michigan: 1974).

[4]William L. Hays, Statistics For the Social Scientist, 2nd ed. (N.Y.: Hold, Rinehart and Winston, 1973), pp. 384-386.

[5]Statistical Research Laboratory, University of Michigan, Elementary Stœtistics Using MIDAS, 2nd ed. (Ann Arbor, Michigan: 1976), pp. 253-276.

[6]Ibid, p. 125. A further assumption of the t-test is that the sampling variances are equal. An F test is the standard check of this assumption. For the offender age data the F statistic equals 4.5968 with an attained significance of .0561.

[7]Herman J. Loether and Donald G. McTavish, Descriptive and Inferential Statistics (Boston: Allyn and Bacon, 1976), pp. 259-300.

[8]R. L. D. Wright, Understanding Statistics (New York: Harcourt, Brace, Jovanovich, Inc., 1976), p. 244.

[9]J.P. Guilford, Fundamental Statistics in Psychology and Education (New York: McGraw Hill, Inc., 1956), p. 145.

[10]Sources for these data were: Employment and Expenditures, 1976 and the U.S. City and County Data Book, 1972.

[11]John Neter, William Wasserman and G.A. Whitmore, Fundamental Statistics For Business and Economics, 4th ed. (Boston: Allyn and Bacon, Inc., 1973), pp. 699-719.

[12]Ibid, pp. 700-701.

[13]John C. Chambers, Satender K. Mullick and Donald Smith, "How to Choose the Right Forecasting Technique," Harvard Business Review (July-August 1971): 49.

[14]$$PI = 2.78 \pm 1.860 \left[.9091 \sqrt{1 + \frac{1}{10} + \frac{(15-16.8)^2}{1581.6}} \right]$$

CHAPTER 6

DATA INTERPRETATION SYSTEMS

Introduction

There are several orientations that may appropriately be used to study criminal justice organizations. In this chapter a systems approach is defined and outlined. A system in this context consists of a regularly interacting or interdependent group of agencies forming a unified whole. Criminal justice agencies include:

> Any court with criminal jurisdiction and any other government agency or subunit, which defends indigents, or of which the principal functions or activities consist of the prevention, detection, and investigation of crime; the apprehension, detention, and prosecution of alleged offenders; the confinement or official correctional supervision of accused or convicted persons; or the administrative or technical support of the above functions.[1]

The five major types of organizations encompassed by this definition are law enforcement agencies, prosecutional agencies, public defender's offices, courts, and correctional agencies. These agencies perform an enormous variety of complex operations; however their collective activities may be characterized as: (1) goal oriented and (2) organized in a sequential manner.

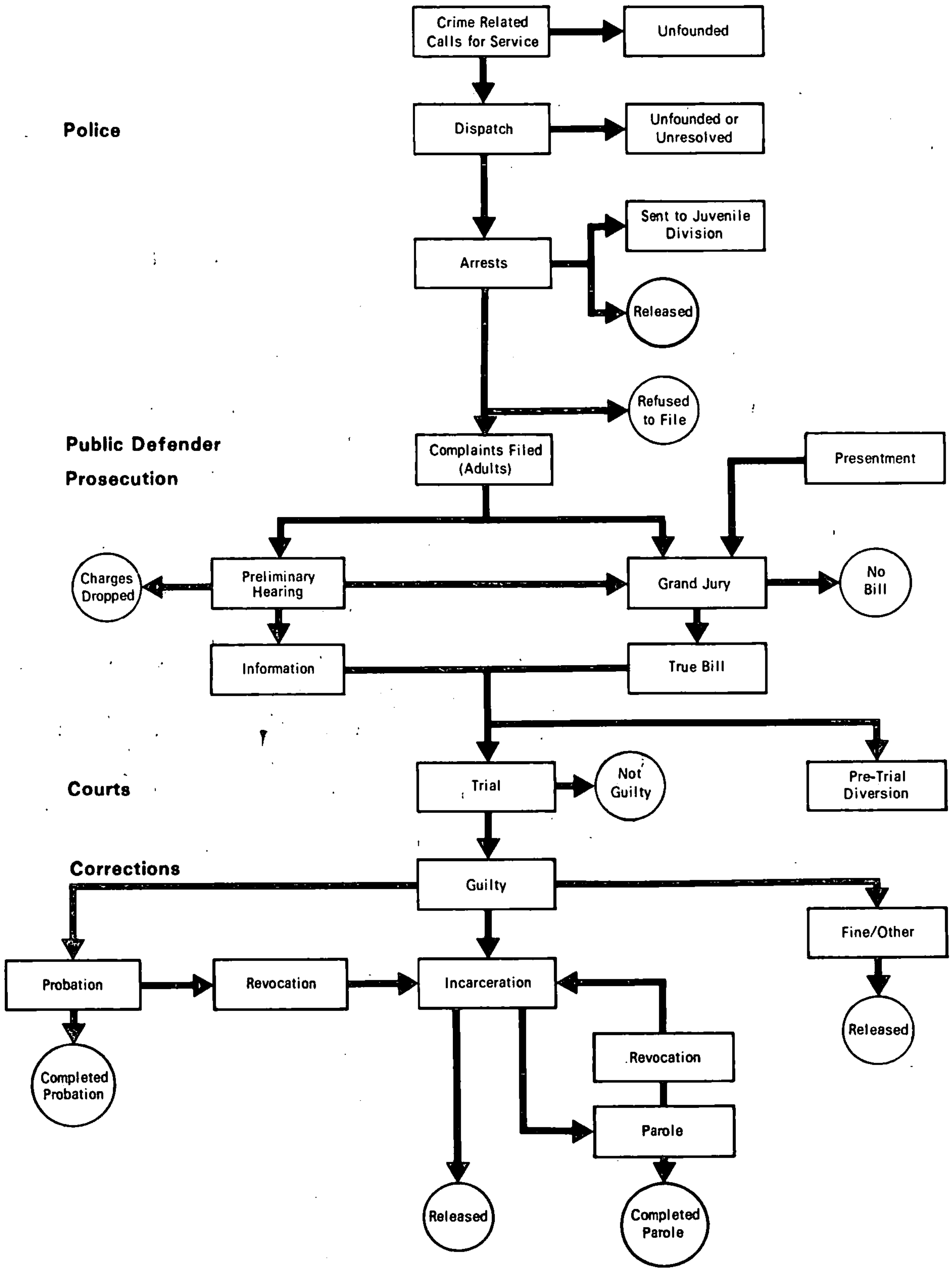
The purpose of the criminal justice system is to deal with crime and delinquency. While each agency or component pursues specific objectives that may or may not be consistent with other agencies of the system, broad goals such as crime reduction, just and speedy dispositions, and cost-efficient operation are, generally, shared among agencies. In addition, the agencies and the activities of the criminal justice system are organized in a sequential manner in response to problems created by the commission of criminal acts. The President's Commission on Law Enforcement and Administration of Justice referred to this sequence as a continuum or orderly progression of events in which the agencies serve as filters through which cases are sifted: some move downstream to the next agency and decision point, while others remain and/or are disposed of.

Exhibit 6-1 is a view of the criminal justice system emphasizing its constituent agencies. The agencies respond to criminal acts and interact in such a way that offender and case flows are established. The flow of cases is from top to bottom in the exhibit, with each circle signifying a release point or disposition. The overall structure and process in a jurisdiction may vary somewhat from the exhibit due to differences in the legal codes and statutes which provide a framework for the delivery of criminal justice services.

One tool used to help describe system-related concerns are flow charts. In the following section the use of flow charts and disposition trees is discussed. A second tool used to analyze a system is the input/output model. Following a definition of selected system variables, an example of input/output analysis concludes the chapter.

EXHIBIT 6-1

THE CRIMINAL JUSTICE SYSTEM



I. Flow Charts

A major descriptive method used in system studies is flow charting. Flow charts help to identify problems and gaps in knowledge and tighten the logic of an argument about a system problem. Flow charts, like other graphic techniques, highlight and focus the attention of a reader or an audience.

There are five types of flow charts typically used in criminal justice studies. A process flow chart outlines the major components of a process, and in the case of Exhibit 6-1, the emphasis is on the movement of an offender from one stage in the process to the next. Operations charts illustrate the essential operational aspects of a system. Exhibit 6-2 is an operations flow chart for a patrol deployment decision-making system used by the Chaos City Police Department. Note that in the exhibit:

(1) a rectangle is used to present an instruction or information
(2) a diamond-shape is used to indicate decision points, or places where choices must be made
(3) circles, ovals or triangles are used to indicate products or end points in the flow, process or operation
(4) arrows indicate the direction of the flow, process, or operation.

This particular model emphasizes the interaction of crime analysis in deployment decisions.[2]

A third type of flow chart depicts dependency chains in a sequence of events. Examples of such dependency chains are the time charts presented in Chapters 3 and 5 and the Gantt and PERT Charts presented in Chapter 8. Perhaps the most common flow chart is the organization chart in which flows of authority and responsibility in an organization are displayed. Exhibit 6-3 is an organization chart for the Chaos City Regional Planning Unit. Generally, solid lines are used to indicate the lines of authority and dotted lines indicate "confer and advise" relationships. Issues of span of control, unity of command, chain of command, and the division of labor in an organization may be illustrated and diagnosed with organization charts.

EXHIBIT 6-2

OPERATIONS FLOW CHART: DEPLOYMENT DECISION MAKING SYSTEM

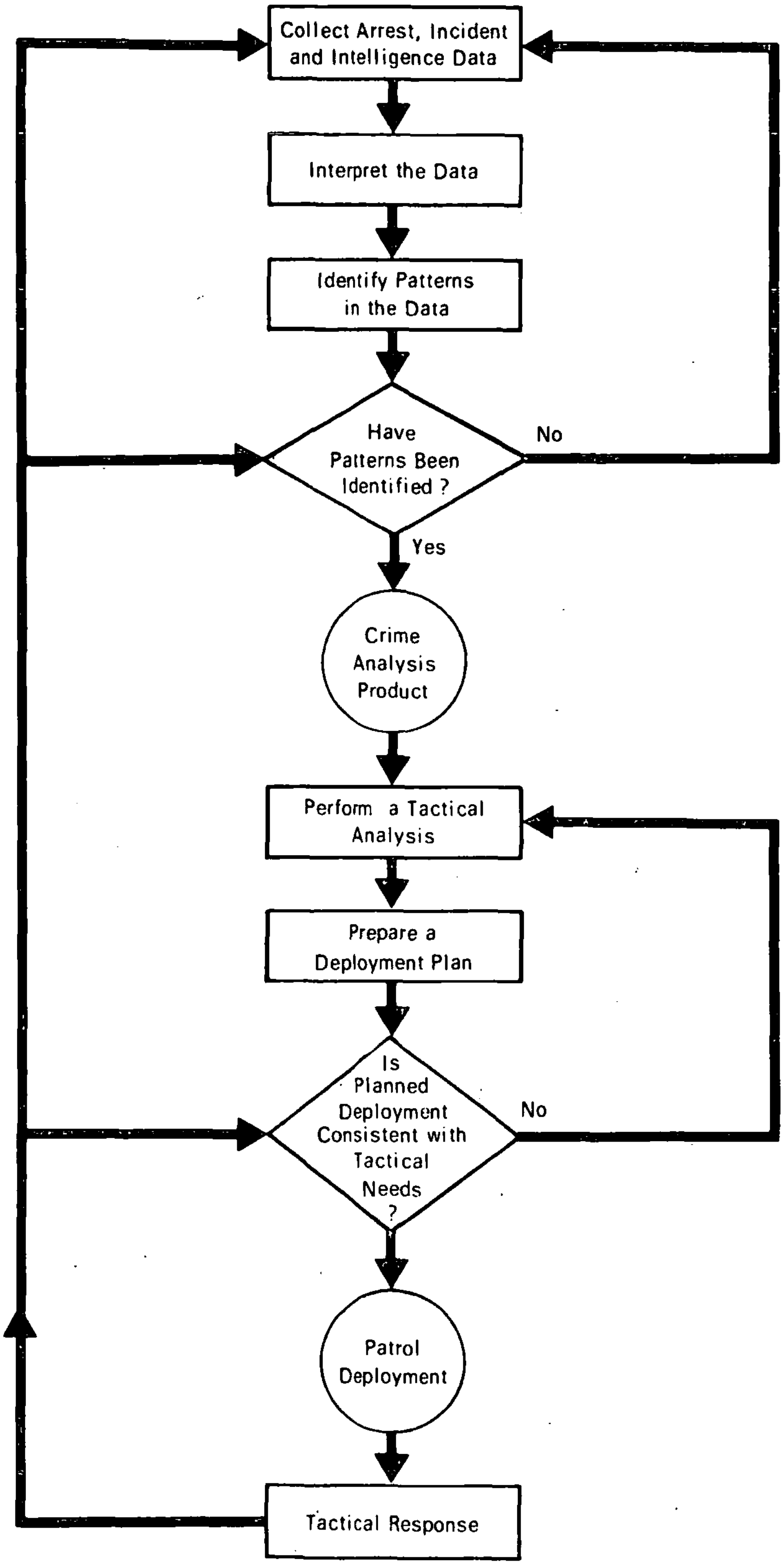
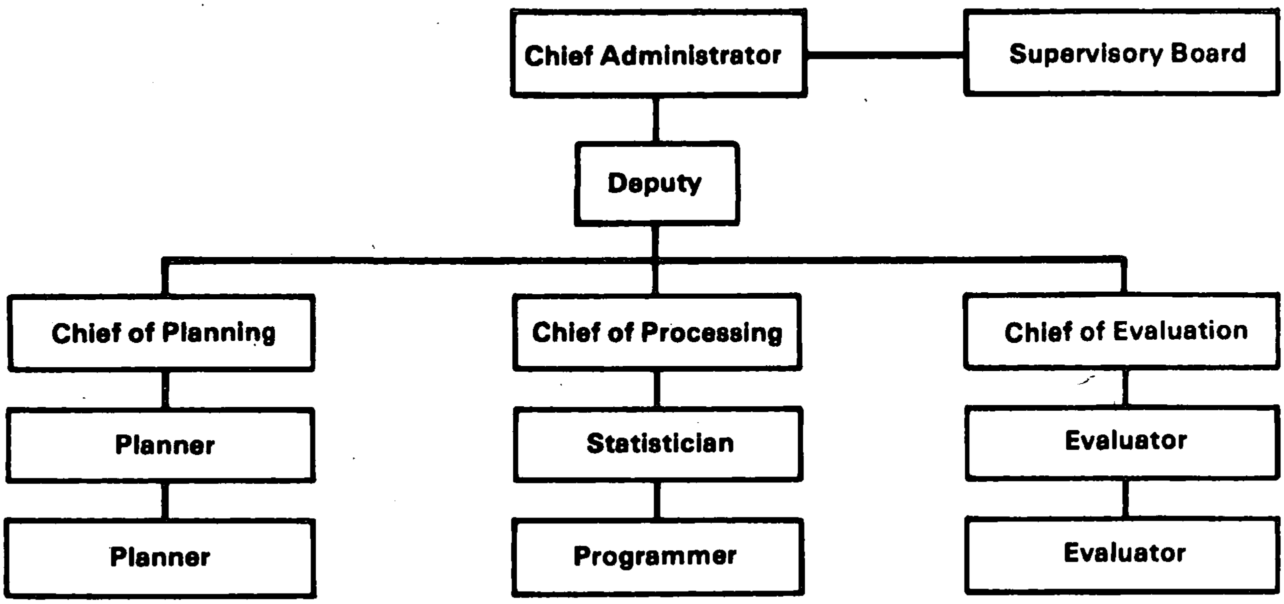


EXHIBIT 6-3

ORGANIZATION CHART, CHAOS CITY REGIONAL PLANNING UNIT, 1979

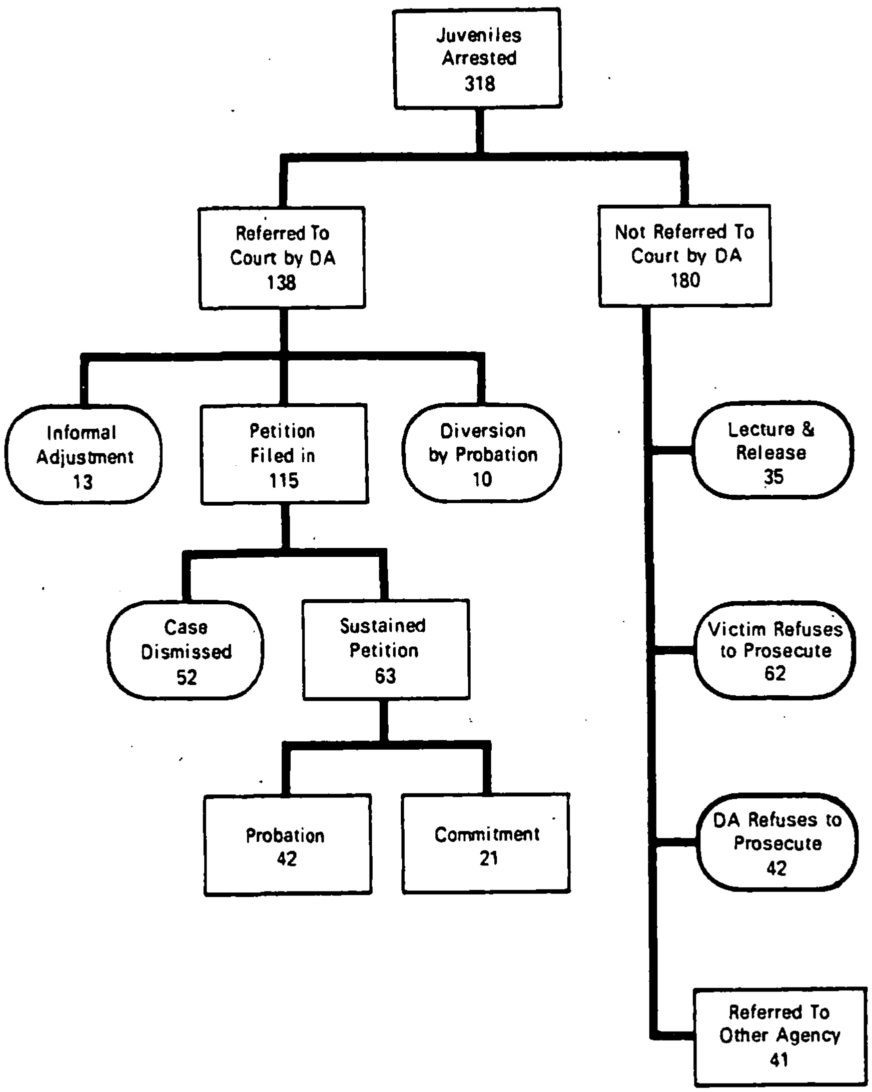


Source: Chaos City, Regional Planning Unit, 1977, hypothetical data

The fifth and final type of flow chart indicates the divergence or convergence of an offender flow to one of several possible outcomes. This is the principle of a disposition tree, a widely used method in criminal justice. Exhibit 6-4 is a disposition tree for the flow of felony offenders in the State of Paradise for 1977. Note that the tree is structured by agency and disposition, and that only a portion of the criminal justice system is covered.

EXHIBIT 6-4

DIVERGENCE FLOW CHART ASSAULT ARRESTS (JUVENILES ONLY) CHAOS CITY, 1977

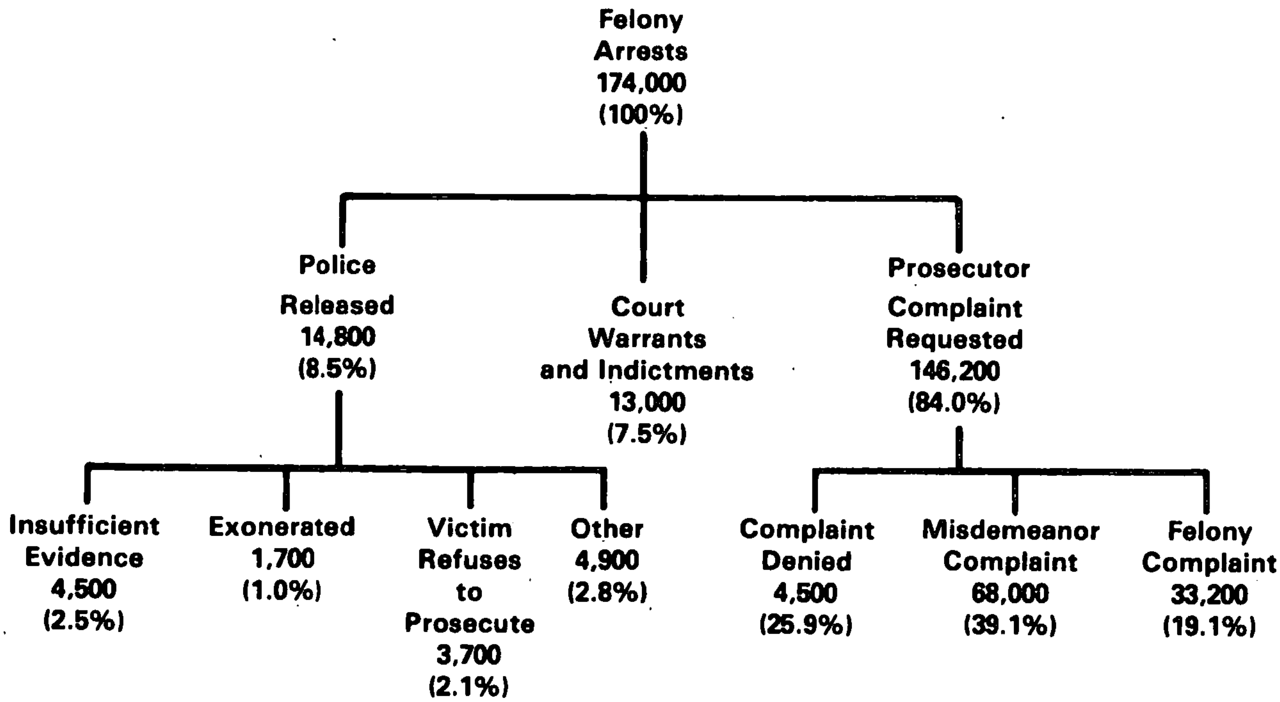


Source: Chaos City Regional Planning Unit, 1977.

Exhibit 6-5 covers the upper portion of the tree presented in 6-4: reasons for complaint denied are not included. Each limb of the tree represents a portion of all felony arrests. Note that felony complaints are requested for only 19.1% of all felony arrests. Input percentages are calculated by using felony arrests (174,000) as the denominator or base. Note also that 8.5% of all those arrested on felony charges are released by the police.

EXHIBIT 6-5

DISPOSITION TREE
FELONY COUNT
(WITH INPUT PERCENTAGES)
STATE OF PARADISE
1977

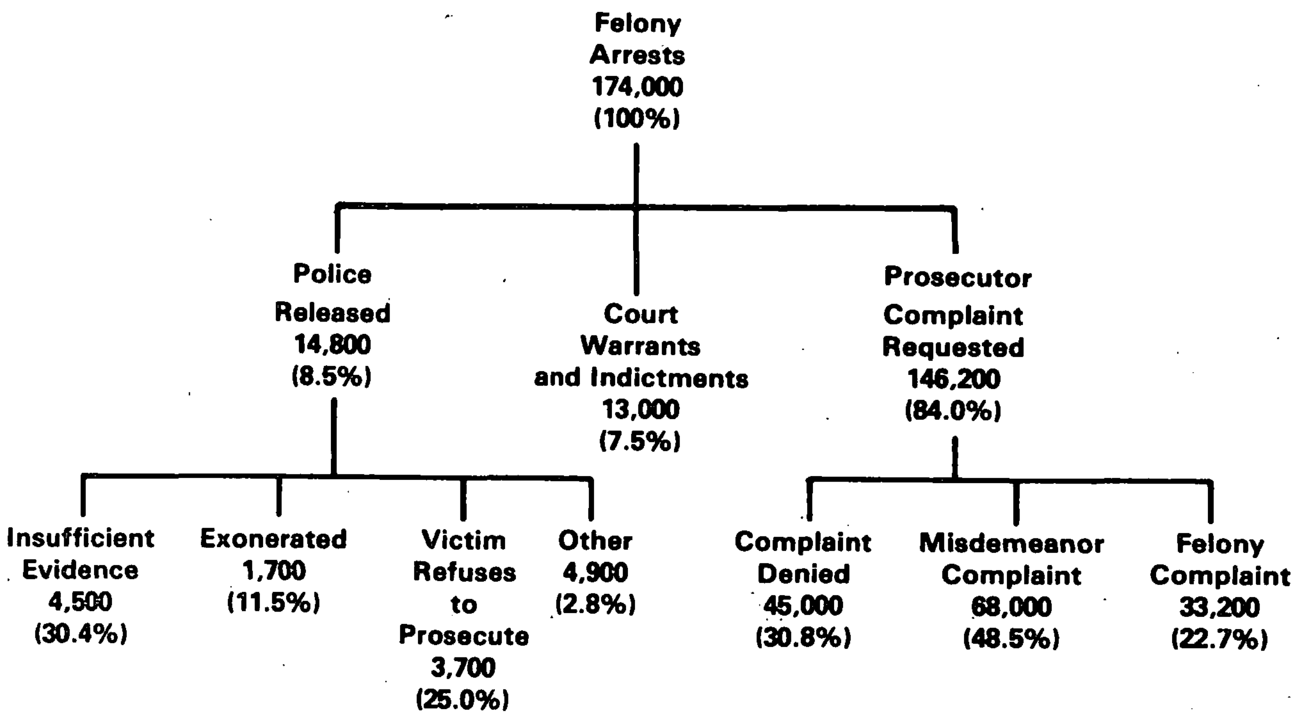


Source: hypothetical data

A second way of presenting the same data is by decision point percentages. These percentages are calculated by using the preceding stage, or decision point, as the denominator. Exhibit 6-6 presents decision point percentages for the disposition data of Exhibit 6-5. This format focuses the reader's attention on specific decisions made and their consequences, e.g., the consequence of the prosecutor's requesting complaints in felony arrests. Note the importance of insufficient evidence as an explanation of police release and the large percentage of felony complaints denied by the prosecutor. This is useful in identifying the consequences of decisions.

EXHIBIT 6-6

DISPOSITION TREE
FELONY COUNT
(WITH DECISION POINT PERCENTAGES)
STATE OF PARADISE
1977

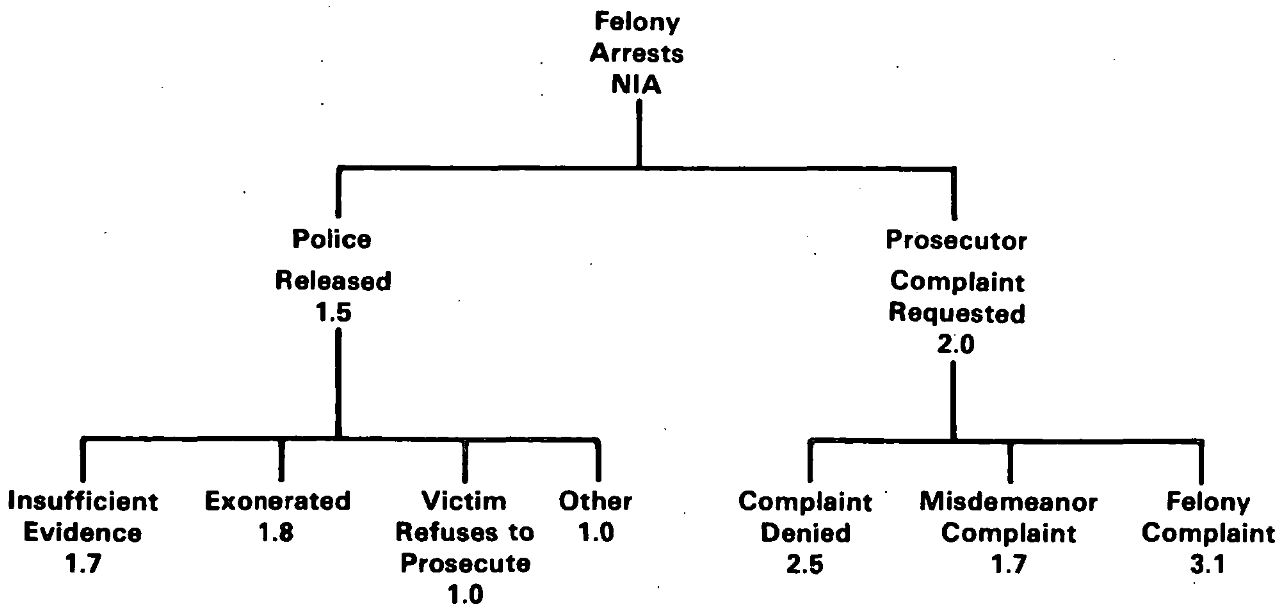


Source: hypothetical data

A third type of disposition tree is used to indicate elapsed time from the point of arrest to each specific type of disposition. Exhibit 6-7 presents the disposition of felony arrests in Paradise with the mean elapsed time indicated. Time is measured in days and includes weekends and holidays. An average of over three days elapsed before the Prosecutor issued a felony complaint and nearly two days elapsed on arrests in which insufficient evidence was found.

EXHIBIT 6-7

DISPOSITION TREE
FELONY COUNT
(WITH ELAPSED TIME)
STATE OF PARADISE
1977



Source: hypothetical data

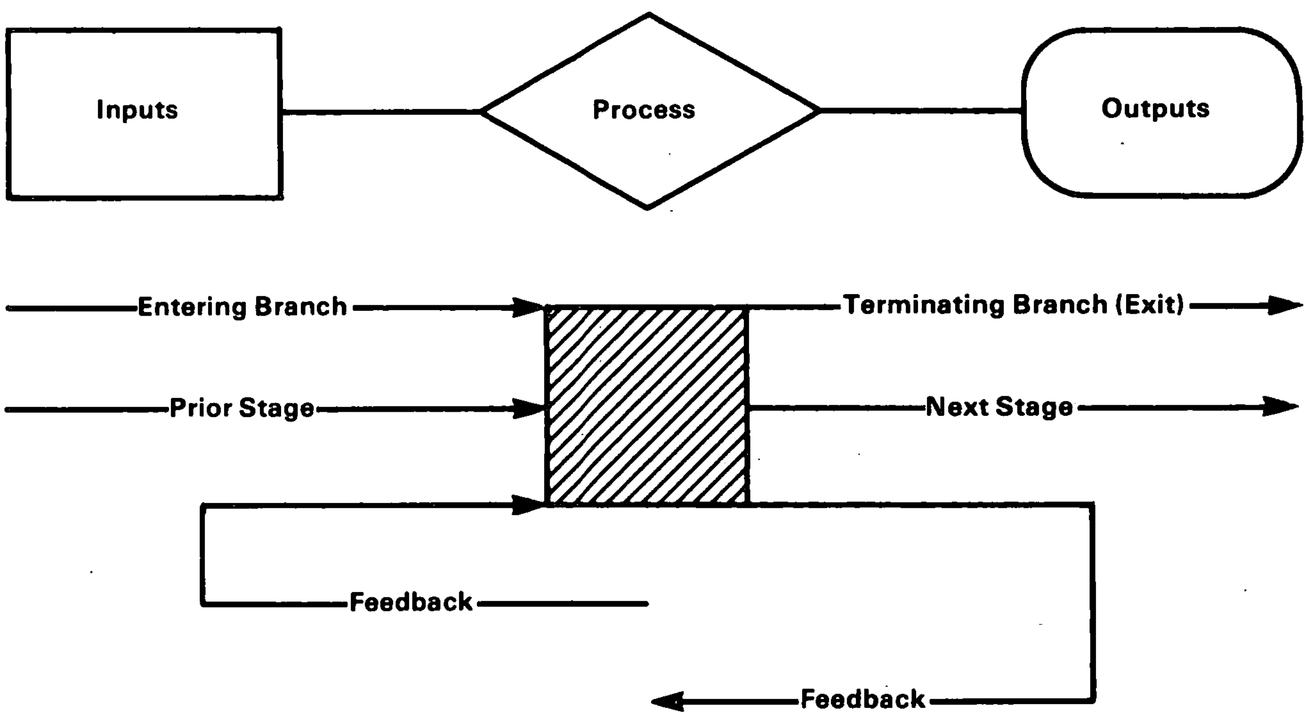
In summary, flow charts may be used to illustrate a wide variety of system characteristics ranging from procedural and organizational attributes to offender flows measured in the number of offenders, percentages, mean elapsed time, or mean cost. They are a valuable method of analyzing criminal justice system problems. Caution should be taken, however, to avoid excessive reliance on such charts. For example, dispositions trees are more effectively used to present small portions of large processes. When used to illustrate a complex system they have a tendency of becoming a "bushy mess" to the reader. Chapter seven discusses some common-sense rules to follow in developing and using graphics, such as flow charts, in a report or presentation.

II. Input/Output Analysis

Another tool that is useful in analyzing the criminal justice system is the input/output models illustrated in Exhibit 6-8. This model may be applied either at a "macro" level, e.g., the criminal justice system for Chaos City, or at a "micro" level for a particular decision making process of a particular agency such as felony trials in the Chaos Criminal Court. In this model inputs may come from three sources: an entering branch (felony arrests in the police department), a prior stage (complaints filed from Police to Prosecutor in Exhibit 6-1), or feedback (parole revocations). Similarly, there are three forms of output -- terminating branch (a disposition), next stage (transfer from one stage to the next), and feedback.

EXHIBIT 6-8

GENERAL SYSTEM MODEL



The application of this input/out model requires: (1) definition and measurement of the major system concepts and variables and (2) a description and comparison of these measures for a particular agency, jurisdiction, or process. The following section defines and gives examples of three major system concepts and their related variables. A case study applying input/output analysis to the problem of court backlog in Chaos City concludes the chapter.

A. System Concepts

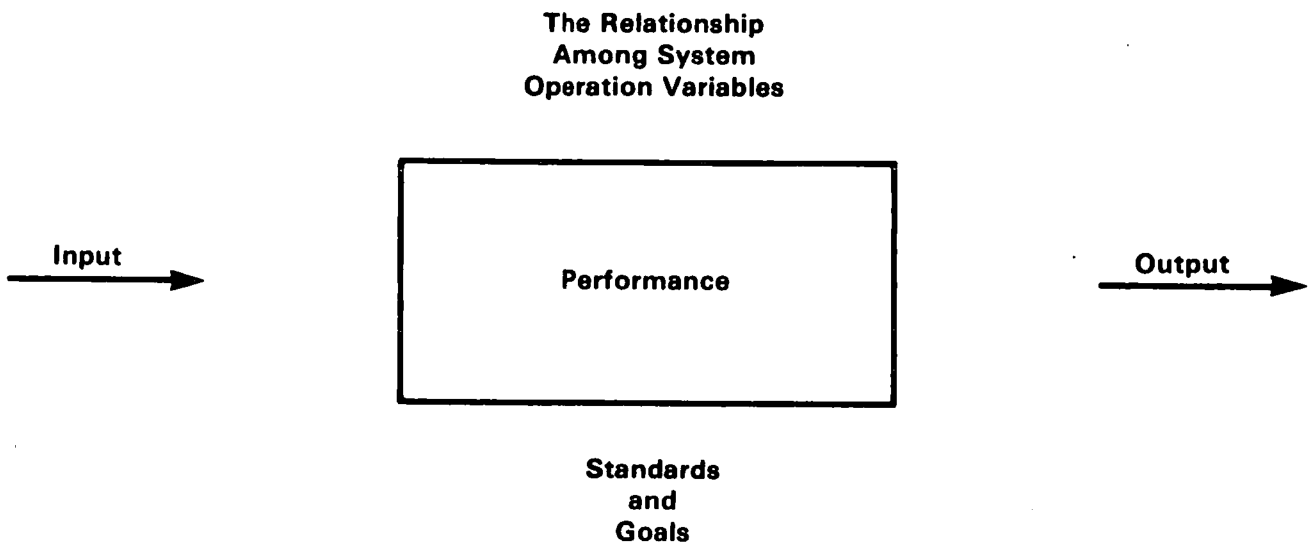
There are three concepts used to analyze the criminal justice system: environment, administration, and system operations. The criminal justice system's environment consists of all external factors that influence the system. These include measures of crime (e.g., type, volume, location, rate, victim, and offender characteristics), its correlates (e.g., population change, unemployment attitude measures, family stability), and the activities and operation of related private and public agencies. An assumption of input/output analysis is that there are relationships among environmental factors, administrative decisions, and system operation. Change(s) in one may result in changes in the other. For example, shifts in public attitudes towards offenders may influence sentencing practices in the Chaos Criminal Court resulting in changes in the county prison population. Environmental factors also help to define the overall mission of the criminal justice system and establish the types and limits of publicly acceptable sanctions. In this sense the environment provides two types of inputs -- crimes to which the system responds and attitudes which help to shape the form of the response.

Administration is a concept that refers to agency and/or system goals and standards, the organization of activities and management of resources. The establishment of policies and regulations, administrative procedures, and the creation or reorganization of an agency can critically influence system operations and may affect the environment. The environment, administration, and system operation are interdependent and interactive. Input/output analysis while focusing on system operations should reflect this fact.

At the center of input/output analysis is an understanding of system operations, the third major system concept. System operations refers to the functions and activities of the criminal justice agencies. Exhibit 6-9 is an input/output model applied to system operations. Note that it is embedded in administration and the environment, and that crimes form the environment and goals and standards form administration or inputs to system operation.

EXHIBIT 6-9

SYSTEM OPERATION, INPUT/OUTPUT MODEL

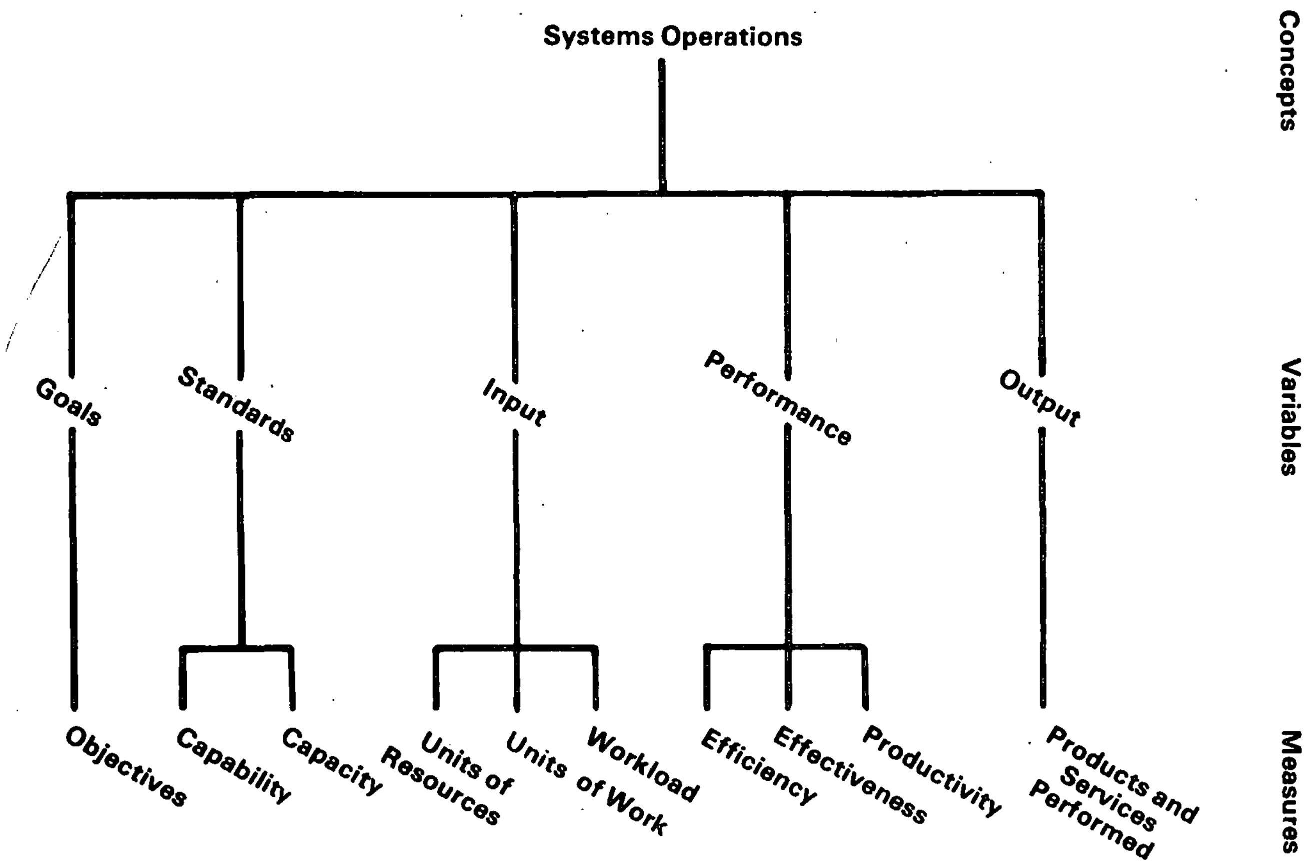


In Exhibit 6-10 the component variables used to analyze system operations are diagrammed. The following sections discuss each of these system operation variables and their related measures.

EXHIBIT 6-10

SYSTEM OPERATIONS, VARIABLES AND MEASURES

Elaboration of System Operations



1. Goals

In Exhibit 6-10, goals are measured by objectives. These are either explicit statements or implicit assumptions about the criminal justice system's operation. A goal is defined as a desired future state usually described in general terms. In contrast an objective is defined as a specific condition to be attained by a specific set of activities stated in time-limited and measurable terms. An example of a goal might be to reduce the cost of operating a vocational counseling program for ex-offenders. The objective might be to cut costs by 15% in three months.

2. Standards

A standard is an established criteria by which administrative decisions can be made. Typically such standards are based on professional experience and/or comparable national, state, or local jurisdiction standards. Two frequently used types of standards are capability and capacity. Capability (Ca) is the expected level of output at a planned level of productivity with a specified amount of resources in a given time period.

Ca = Resource Measure x Productivity Standard

For example, assume a productivity standard of 1,800 cases per judge per year. In a court with 15 judges a measure of the court's capability would be to process 27,000 cases per year:

27,000 cases per year = 15 judges x 1800 cases/judge

A second type of standard is capacity (Cp). This refers to the potential output when productivity is maximized with a specified level of resource in a given time period:

Cp = Resource Measure x Maximum Productivity Standard

For example, the minimum case cost during 1977 in the Chaos City Court was $210. This cost could be assumed to be a reasonable indicator of maximum productivity (i.e., minimum cost). Given a budget of $6.5 million and a maximum productivity standard of $210 per case, the capacity of the court would be to process 30,952 cases.

30,952 cases = $6.5 million/$210 per case

There are many other types of standards besides capability and capacity. However, most standards are explicit in their measurement and similar in their applications. Standards are important to the design and planning of programs and for evaluation purposes.

3. Resources

Inputs are defined as the work to be processed and the resources available to process work through the criminal justice system or its component agencies. Following is a list of some common resource measures for criminal justice agencies:

Police	Prosecutors	Courts	Corrections
Officers	Attorneys	Judges	Officers
Weapons	Clerks	Courtrooms	Institutions
Vehicles	Office Equipment	Clerks	Equipment
Office Equipment	Time	Equipment	Budget
Budget	Budget	Time	Time
Time		Budget	

The resources for an anti-fencing unit in the Chaos Police Department might consist of (1) a budget of $61,000 per year; (2) five sworn officers and one secretary; and (3) three police cars plus equipment and office space. In measuring resources several distinctions are frequently important.

- o staff and operational resources should be distinguished;
- o operating and capital expenditures should be distinguished;
- o fixed costs and variable costs should be distinguished; and
- o direct and indirect costs should be distinguished.

Another measure of input is work. Work is defined as the type, amount, and importance of units to be processed through the criminal justice system or its component agencies within a specific time period. Examples of work units include:

Measures (weekly) of:

Police	Prosecutor/Courts	Corrections
Calls for service	Cases	Pre-Sentence investigations
Arrests	Hearings	Probationers supervised
Criminal investigations	Filings	Parolees supervised
Court Appearances		Inmates supervised

Generally work measures cannot be directly compared between different types of criminal justice agencies since different work measures are used.

A derived input measure that relates resources and work is workload. Workload is defined as the units of work to be processed per unit of resource. For example, the motor vehicle accident division of the Chaos Police Department has five officers (resource); they must investigate an average of 150 accidents per month (work). Therefore the workload is 30 investigations per officer per month. Workload is usually expressed as a rate that compares measures of work with measures of resources:

$$\text{Workload} = \frac{\text{Work Measure}}{\text{Resource Measure}}$$

As a second workload example, in January it is estimated that 600 convicted felons will be sentenced to a state prison which is expected to have 300 cells available. The expected workload is equal to two felons per cell:

$$\text{Workload} = \frac{\text{600 felons}}{\text{300 cells}}$$

Usually workload measures are restricted to rates of work per employee; however, as just illustrated, workload rates may be developed for other types of resources such as cells, courts, or dollars.

4. Performance

Performance is defined as the implementation of administrative decisions, the conduct of operations, and the accomplishment of tasks. There are three common measures of performance: productivity (P), efficiency (E), and effectiveness (Ef). Productivity is the amount of work that can be produced or processed with specified resources in a given amount of time. It is usually expressed as a rate that compares measures of output (described in the next section) with measures of resources consumed or budgeted.

$$P = \frac{\text{Output Measure}}{\text{Resource Measure}}$$

For example, the five person motor vehicle accident team investigated 80 accidents in December. The average productivity for each officer was 16 accident investigtions:

$$P = \frac{\text{80 investigations}}{\text{5 officers}}$$

Efficiency is the ratio of output to work, and it is usually expressed as a percent, percent change, or percent difference.

$$E = \frac{\text{output measure}}{\text{work measure}}$$

For example, in 1978 the Chaos Police Department followed-up on 10,989 out of a total of 46,560 reported larceny thefts. The efficiency of the police in the follow-up of larceny-theft reports is 23.6%:

$$E = \frac{\text{10,989 follow-ups (1978)}}{\text{46,500 reported larceny thefts (1978)}}$$

The analyst should be cautious in the development and interpretation of efficiency measures. They invite naive comparisons subject to significant measurement error, particularly when made between jurisdictions.

A third performance measure is effectiveness. This measure is defined as the extent to which objectives and standards have been achieved. Measures of effectiveness compare planned performance or output to the performance or output achieved:

$$Ef = \frac{\text{output or performance measure}}{\text{objective or standard}}$$

The Chaos Police Department has set an objective of a response time on all nonemergency calls of not greater than six minutes. During the past year a sample of 685 non-emergency calls was taken. Of these 620 had response times of less than six minutes. Therefore the Chaos Police Department was 90.5% effective in meeting its standard of less than a six minute response time.

$$Ef = \frac{\text{620 less than six minutes}}{\text{685 non-emergency calls}} = .905$$

There are several "traps" to avoid in using these definitions of efficiency and effectiveness. A police agency may be very efficient if it investigates every reported offense but would be ineffective if it made no arrests. Effectiveness relates to how well an agency accomplishes its goals and not just how efficiently it accomplishes its mission.

5. Output

The final variable used to describe system operation is output (O). This variable is measured in terms of work produced or services rendered in a specified time period. An example of an output measure for the Prosecutor's Office in product terms is the 36 complaints filed by the Prosecuting Attorney in Chaos Criminal Court during January. The 80 investigations by the motor vehicle accident team in December is an example of a service output.

Exhibit 6-11 illustrates the basic components used to analyze system operations. The rows and columns are directly observable measures of system operations. Each cell represents a different possible derived measure defined by combining the respective measures. Three analytic levels are indicated: measures may be obtained for individuals or small groups, for an organization or agency, or for a collection of agencies or a system such as criminal justice. An input/output analysis is performed in two steps. First system concerns are identified and a problem specification prepared that includes identification of the analytic level. Second, measures of objectives, resources, work, products, and services are collected and described. Third, derived measures of capability, capacity, work load, efficiency, effectiveness, and productivity are calculated and described. Finally, comparisons overtime of specific measures or between jurisdictions may be performed. Exhibit 6-12 summarizes the types of research questions appropriate to an input out analysis.

EXHIBIT 6-11

SYSTEM OPERATIONS MATRIX, DERIVED MEASURES AND APPLICATIONS

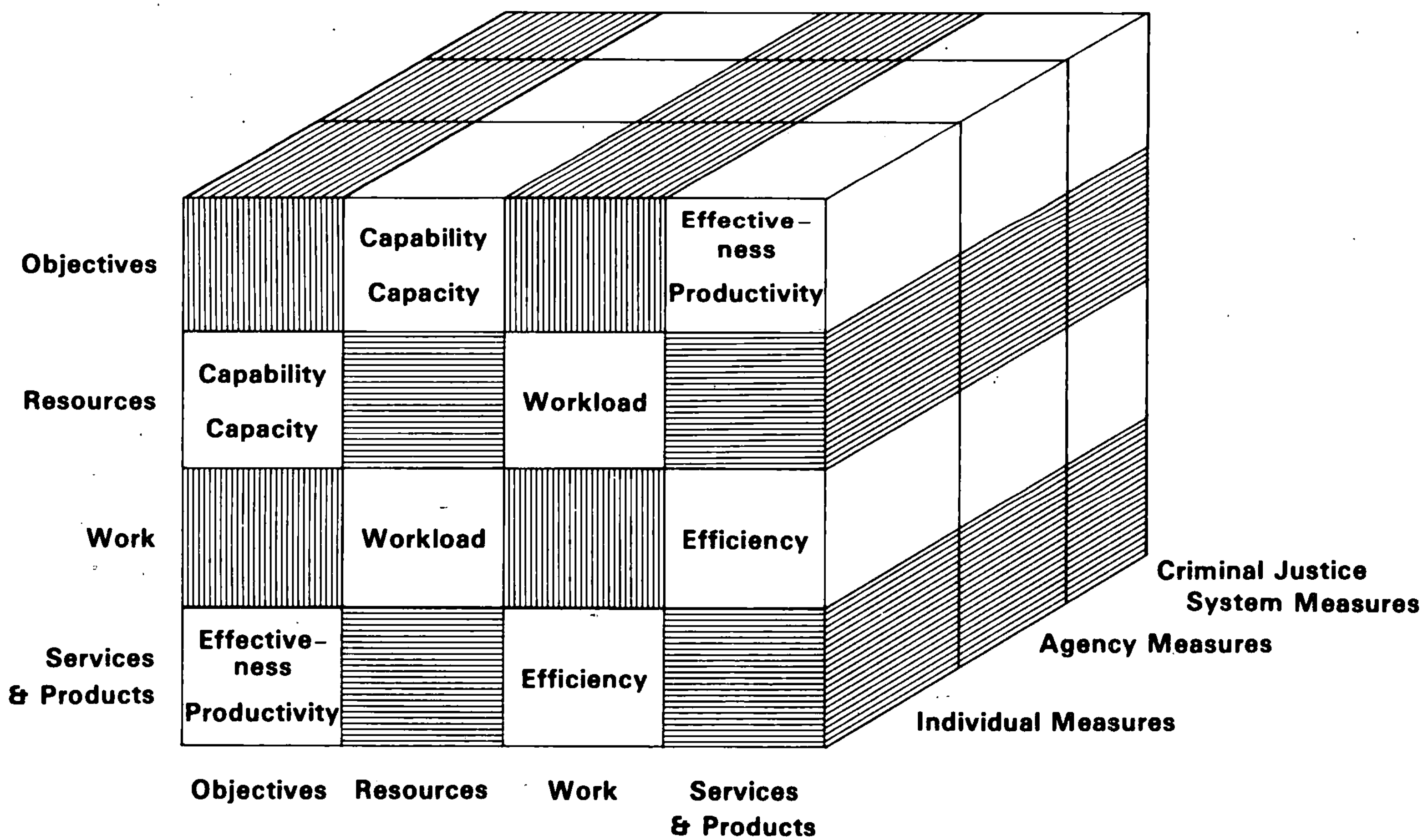


EXHIBIT 6-12.

SUMMARY OF SYSTEM CONCEPTS,
VARIABLES AND MEASURES

I. ENVIRONMENT:

What factors outside the system affect the system?

II. ADMINISTRATION:

How is the work to be organized and managed? What are the goals and standards?

III. SYSTEM OPERATIONS:

How does the system function and how do components within the system interrelate?

A. Goals and Objectives: What is expected?

B. Standards: What is ideal?

1. Capability: How much is expected to be done?

2. Capacity: How much can be done using maximum potential?

C. Input: What is to be done and what is available to do it?

1. Resources: What is available to work with?

2. Work: What is to be done?

a. Workload: How much work has to be done per unit of resources?

D. Performance: What are the results?

1. Productivity: What results are accomplished with the resources used?

2. Efficiency: How much of the work to be done is done?

3. Effectiveness: How does the result compare to goals, standards, objectives or estimates?

E. Output: What has been done?

In the following section an input/output analysis is used to analyze the Chaos Criminal Court. Concerns have been raised by the Chief Judge and other elected officials about the growing backlog of cases, the high cost of operation and, generally, inadequate performance during a period of rising community crime.

B. Chaos Criminal Court

In response to the Mayor's request for an analysis of the operations of the Chaos City Court, the Regional Analysis Group (RAG) has collected five years of data pertaining to the court. This data is presented in Exhibit 6-13. Following is an analysis of (1) the resource, work, output, and workload data; (2) system performance measures; and (3) the capability and capacity of the court. The concluding section examines alternative strategies for reducing court backlog.

Throughout this analysis several simplifying assumptions have been made. For example, the use of measures of central tendency and the treatment of all cases as alike from a processing perspective grossly simplifies reality. Separating the the caseload into groups by crime seriousness and/or crime type would significantly improve the following discussion as would the examination of the variation in case processing and not just the central tendencies. Similarly, backlog and caseload, are frequently examined in terms of individual judges and in elapsed time terms. For political reasons the Regional Planning Unit did not develop individual profiles. It was also determined that collecting elapsed time data would be prohibitively expensive and too time consuming. Finally, the aggregated nature of readily available data precluded the development of crime seriousness groups.

EXHIBIT 6-13.

CHAOS CRIMINAL COURT DATA SET, 1973-1977

	1973	1974	1975	1976	1977	% Change 1973-1977
Resources						
# Judges	12	13	13	15	15	25.0%
#Hrs/J/yr	1600	1600	1600	1600	1600	--
# Judges Hrs	19200	20800	20800	24000	24000	25.0%
Budget($)	3.1	3.6	4.0	5.6	6.5	109.0%
Expended($)	3.0	3.1	3.3	4.8	6.0	100.0%
Budget Share	7.4%	7.9%	8.4%	9.1%	9.4%	27.0%
Work						
# Cases	28000	28500	28200	29100	30000	7.1%
Arrests	18000	18900	19200	21500	22000	22.2%
New Trials	1200	300	400	700	1000	-16.6%
Pending Cases	8800	9300	8600	6900	7000	-20.5%
Output						
# Cases	15000	14000	15050	16000	20000	33.3%
Convictions	12750	12740	12943	12000	14000	9.8%
Acquittals	500	650	350	700	400	-2.0%
Dismissals	1750	610	1757	3300	5600	22.0%
Backlog	9300	8600	6900	7000	10000	7.5%

Source: hypothetical data

1. Input and Outputs

a. Resources

The data in Exhibit 6-13 indicate that during the 1973-1977 period there has been a significant increase in criminal court resources. The number of judges increased by 25% while the budget more than doubled going from $3.1 million in 1973 to $6.5 million in 1977. Not only has there been an absolute increase in resources, but the court's resources relative to other local criminal justice agencies also has increased. For each dollar budgeted for criminal justice in Chaos City, 7 cents went to the court in 1973 and over 9 cents in 1977. Finally, the court has had a surplus of unspent monies in each year during the period. This surplus ranged from $100,000 in 1973 to a high of $800,000 in 1976.

b. Work

There has been a gradual increase in the number of court cases involving new arrests. There also has been a pronounced change in the mix of cases before the court: a larger proportion of the caseload is new arrests and a smaller proportion is the previous year's backlog of cases. As a percentage of the caseload, new arrests increased from 64.2% to 73.3% between 1973 and 1977 while pending cases decreased from 31.4% to 23.3%.

The number of cases as used here refers to the number of cases filed in the Chaos Criminal Court during each of the specified years. It is a common work unit in Court studies. The case count is based on the number of defendants and includes active cases only. A case is concluded through court dispostion -- the final judicial decision terminating a criminal proceeding by a judgment of acquittal or dismissal or a specific sentence for a conviction. The pending case category is the number of cases filed but which have not been disposed of during the year.[3]

c. Output

Court output increased from 15,000 cases in 1973 to 20,000 cases in 1977.

Exhibit 6-14 indicates a significant drop in the conviction rate (number of convictions divided by the number of cases disposed of and a significant increase in the dismissal rate. The number of cases not acted upon due to insufficient time or resources during the year is referred to as the backlog. The backlog increased by 7.5% during the 1973-1977 period. Exhibit 6-15 (see next page) organizes the data on work and output into an input/output format for the 1977 data. Note that while there were 30,000 cases in 1977, the total output was only 20,000 cases resulting in a backlog of 10,000 cases.

EXHIBIT 6-14.

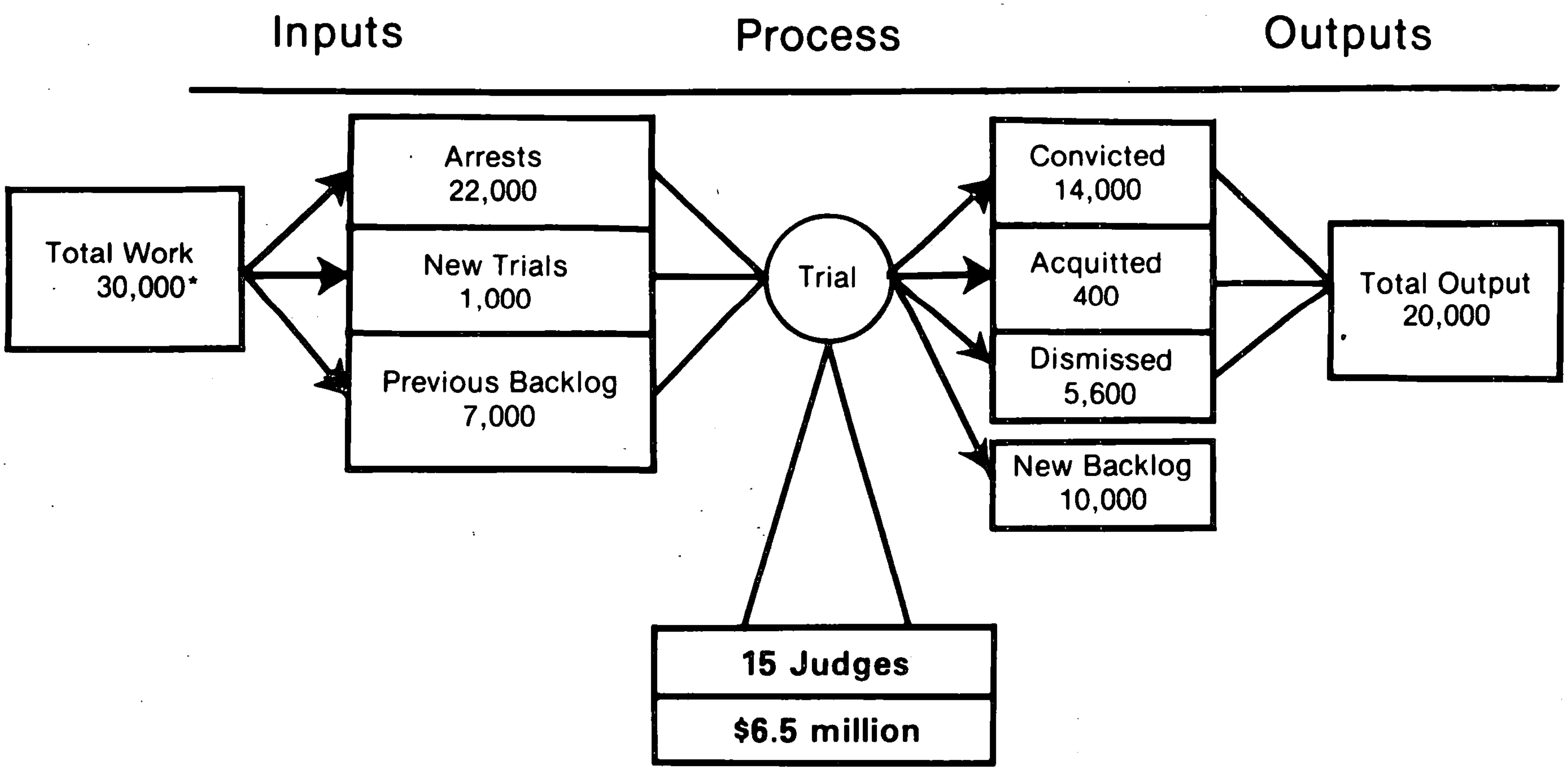
CONVICTION, ACQUITTAL AND DISMISSAL RATES, CHAOS CRIMINAL COURT, 1973-1977

	1973	1974	1975	1976	1977	% Change
Conviction Rate	85.0%	91.0%	86.0%	75.0%	70.0%	-17.6%
Acquittal Rate	3.3%	4.6%	2.3%	4.4%	2.0%	-3.9%
Dismissal Rate	11.7%	4.4%	11.7%	20.6%	28.0%	139.3%

Source: hypothetical data

EXHIBIT 6-15

CHAOS CRIMINAL COURT, INPUTS AND OUTPUTS, 1977



*All measures are "cases"

Source: Hypothetical data

d. Workload

The 1977 the courts' workload was 2,000 cases per judge. There were also 48 judge minutes available for each case. Exhibit 6-16 presents the trend in these two workload measures. While the amount of time per case has increased from .68 of one hour (41 minutes) to .80 (48 minutes) the number of cases tried by each judge has declined from 2,333 cases per judge to 2,000. Consequently, both workload indicators suggest a significant decrease in court workload between 1973 and 1977.

EXHIBIT 6-16.

WORKLOAD MEASURES,
CHAOS CRIMINAL COURT, 1973-1977

Workload Measure	1973	1974	1975	1976	1977
Cases/Judge/Year	2333.3	2192.3	2169.2	1940	2000
Judge-Hrs/Case	.685	.729	.737	.824	.80

Source: hypothetical data

2. Performance

a. Productivity

Three productivity measures were derived from the data in Exhibit 6-13: (1) the number of cases tried per judge per year; (2) the average cost per case each year; and (3) the average judge hours per case each year. Note that a productivity index is constructed using resource and output measures: workload is calculated using resource and work measures. Thus the third productivity index is calculated using the total output of cases, while the comparable workload indicator is calculated using the caseload. Exhibit 6-17 presents these three productivity indicators for 1973-1977. No clear pattern or trend is apparent in terms of judge-hrs/case or cases/judge. Thus while workload has significantly decreased, productivity has remained about the same. However, there has been a marked increase in the average cost per case between 1973 and 1977 of over 50%.

EXHIBIT 6-17.

PRODUCTIVITY MEASURES,
CHAOS CRIMINAL COURT, 1973-1977.

Productivity Measures	1973	1974	1975	1976	1977
Cases/Judge/Year	1250	1076.9	1157.7	1066.7	1333.3
Cost/Case	$200.00	$221.43	$219.27	$300.00	$300.00
Judge-Hrs/Case	1.28	1.48	1.38	1.50	1.20

Source: hypothetical data

b. Efficiency

Several possible efficiency indicators may be derived from this data set. First, consider the relationship between output and work measures. For example, in 1977 there was an output of 20,000 cases compared to a caseload of 30,000 cases, or a 66.6% efficiency in processing cases. Exhibit 6-18 presents this efficiency measure for the 1973-1977 period. Note especially the improved efficiency of the court between 1976 and 1977. During this period there was an overall improvement of 24.5% in percentage of cases processed.

EXHIBIT 6-18.

EFFICIENCY MEASURE, CHAOS CRIMINAL COURT, 1973-1977

Efficiency Measure	1973	1974	1975	1976	1977	% Change 1973-77
Percent Cases Processed	53.5%	49.1%	53.4%	55.0%	66.6%	24.5%

Source: hypothetical data

A second type of efficiency measure may be derived by comparing two or more jurisdictions. For example, the mean caseload and output of 15 criminal courts in the State of Paradise during 1977 (excluding Chaos City) was 13,000 and 11,000 respectively. Thus, the average efficiency of criminal courts in the state in terms of processing cases is 11,000 divided by 13,000 or 84.6%. Chaos Criminal Court may be compared using the percent change (or difference) formula.

$$\text{Efficiency} = \frac{66.6 - 84.6}{84.6} = -21.3\%$$

Chaos Criminal Court in 1977 processed 21.3% fewer cases than the average of the other 15 criminal courts in the state.

c. Effectiveness

In 1972 the State Trial Judge Association determined that a reasonable productivity standard is 1,800 cases per judge per year. By comparing this standard to court productivity, a measure of effectiveness may be determined. In Exhibit 6-19, there is some improvement in the court's effectiveness, although the Chaos Criminal Court remains far from the statewide productivity standard.

EXHIBIT 6-19.

EFFECTIVENESS MEASURE, BASED ON PRODUCTIVITY STANDARD, CHAOS CRIMINAL COURT, 1973-1977

	1973	1974	1975	1976	1977
Productivity (Cases per judge per yr)	1250.0	1076.9	1157.7	1066.7	1333.3
Productivity Standard	1800.0	1800.0	1800.0	1800.0	1800.0
Effectiveness	69.4%	59.8%	64.3%	59.3%	74.1%

Source: hypothetical data

A second type of effectiveness measure may be based on an objective of not increasing the previous year's backlog. For example, in Exhibit 6-20, between 1976 and 1977 the backlog increased from 7,000 cases to 10,000 cases. Assuming an output standard of not increasing the 7,000 case backlog, the court was only 70% effective. Note the decreasing effectiveness of the court in dealing with the backlog problem over this period.

EXHIBIT 6-20.

EFFECTIVENESS MEASURE BASED ON OUTPUT STANDARD,
CHAOS CRIMINAL COURT, 1973-1977

	1974	1975	1976	1977
Output	8600	6900	7000	10000
Output Standard	9300	8600	6900	7000
Effectiveness	108.1%	124.6%	98.0%	70.0%

Source: hypothetical data

3. Capability and Capacity

The development of capability measures also requires the setting of standards and objectives. Using the State Trial Judges Association productivity standard of 1,800 cases per judge each year, one measure of the court's capability in 1977 is 27,000 cases per year, i.e., 15 judges x 1,800 cases per judge. The first row of Exhibit 6-21 is this capability measure for the period 1973-1977.

EXHIBIT 6-21.

CAPABILITY MEASURES, CHAOS CRIMINAL COURT, 1973-1977

Capability Measure	1973	1974	1975	1976	1977	% Change
Cases per Year (Based on cases per judge)	21,600	23,400	23,400	27,000	27,000	25.0%
Case per Year (Based on $ per Case)	11,273	13,091	14,545	20,364	23,636	109.7%
Case per Year (Based on Average time per case)	19,200	20,800	20,800	24,000	24,000	25.0%

Source: hypothetical data

With a fixed productivity standard and an increase in the number of judges, the capability of the court to process cases also increased as indicated.

A second capability measure is derived from the $275 per case productivity standard also established by the Trial Justices. With a budget of $6.5 million in 1977, this means that the courts' capability is equal to 23,636 cases, i.e., $6,500,000/$275 per case. The second row of Exhibit 6-21 presents the cases per year for which funds have been budgeted assuming an average cost of $275/case. The final capability measure is determined by assuming a productivity standard of one judge-hour per case. If the average time per case in 1977 was equal to one judge-hour, the number of cases that could be disposed of would be equal to 24,000, i.e., 24,000 judge-hours x one judge-hour per case. Over this period, as indicated by all three measures, the court's capability to process cases increased.

Setting objectives and standards are an important part of studying system operations. Many times goals are stated in qualitative terms not readily translated into objectives and/or standards. Frequently external sources such as LEAA's Standards and Goals publications are a useful source of quantitative objectives and standards. Similar agencies in comparable jurisdictions also may have developed a useful set of standards. Where no such external source exists, intuition, experience, and common sense may prove useful in experimenting with standards and objectives in the conduct of this type of analysis.

Capacity is based on establishing a maximum productivity standard. For example, the minimum case cost during 1976 was $210. This figure is assumed to be a reasonable indicator of maximum productivity. If the average cost per case in 1977 was $210, 30,952 cases could have been processed. This is one estimate of the court's capacity in 1977. Assuming this $210 maximum productivity standard for the period results in capacity estimates of 14,762 cases in 1973, 17,143 cases in 1974, 19,048 cases in 1975, and 26,667 cases in 1976.

In summary the following findings are noted:

- Court resources have significantly increased; however, court spending has not kept pace with growth in budget.
- There has been a gradual increase in caseload with a greater proportion being new arrests.
- While court output has increased over this period, there has been a significant decline in the conviction rate and an increse in the dismissal rate.
- Court workload has significantly declined during this period.
- Productivity has declined in terms of costs per case (which has increased); the individual judge's productivity has not significantly changed over the period.
- The efficiency of the court in terms of the percentage of caseload processed has improved; however, in comparison to other criminal courts, the Chaos Court is significantly less efficient.
- The court has been less effective in recent years in dealing with the backlog problem.
- Court capability and capacity have both increased over this period.

Consequently, there appears to be a major gap between the court's capabilities and capacities on the one hand and its performance on the other. In a period of increasing resources and decreasing workloads, productivity has not kept pace. The consequences of decreasing effectiveness, increases in the average cost per case, and a growing backlog of cases are serious. This evidence, generally, supports the initial concerns of the Mayor. In the last section two alternative policies for remedying these problems are discussed: further increasing court resources and improving court productivity.

4. Considering Policy Options

Two options are considered for dealing with the backlog problem. Even though a significant increase in resources has been allocated to the Chaos Criminal Court, the result -- in the face of an increasing caseload -- has been negligible in terms of a growing backlog of cases. However, one possible strategy is to further increase the number of judges. For example, if productivity remained at 1.2 judge-hours per case and resources had been increased to 22.5 judges, there would have been no court backlog in 1977. An alternative strategy is to increase the average productivity of the court. For example, if resources were held constant at 15 judges and productivity was increased to .8 judge hours per case, the court backlog would have been eliminated in 1977.

Obviously trade-offs between resources and productivity are necessary to remedy the backlog problem. Increased resources are an added burden to the taxpayer and a political liability, while increasing productivity poses real threats to fair proceedings and may be unpopular with the legal community. Yet, the backlog itself, is expensive to the taxpayer and may be a hardship on the defendant. In Exhibit 6-22 a matrix is presented which indicates the size of the backlog in 1977 under different assumptions regarding court resources and productivity. A 7.4% increase in productivity results in a 17.5% decrease in the backlog: a 6.6% increase in resources results in a 13.3% decrease in the backlog. These "marginal utilities" are a useful method for assessing alternative policies.[3]

EXHIBIT 6-22.

EFFECT OF INCREASING PRODUCTIVITY AND RESOURCES ON COURT BACKLOG, CHAOS CRIMINAL COURT, 1977

Productivity Standard (PS) (Judge-Minutes Per Case)	Resources (Number of Judges)								
	15	16	17	18	19	20	21	22	23
72	10,000	8667	7333	6000	4666	3333	2000	666	0
67	8,507	7075	5642	4209	2776	1343	0	0	0
62	6,774	5226	3677	2129	580	0	0	0	0
57	4,737	3053	1368	0	0	0	0	0	0
52	2,308	462	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0

Source: hypothetical data

The "marginal utilities" concept provides an index of the resultant change in values of performance indicators occurring from planned changes in resource levels. For example, how many more (or less) residential burglaries would be committed as a result of incremental changes to police patrol strength? Or, what difference would occur in criminal justice processing times with the addition of a new judge and/or changes in the facilities, equipment, and staff for that Judge? While these questions are difficult to answer, it is clear that answers would be invaluable toward making the most effective and efficient use of police officers, judges, parole officers, correctional facilities, or other resources.

Correlating agency-to-agency impacts of resource changes represents an important aspect of input/output analysis. For example, increasing court productivity and/or resources will increase output resulting in increased work for the corrections agency. A graphic illustration of this type of interaction and how it relates to input/output analysis is presented in Exhibit 6-23.

Effects can be gleaned from the respective "marginal utilities." Implications of changes in the value of an output indicator in one agency can be compared to the need for change in the value of a related performance indicator for another agency. An example may serve to clarify this concept.

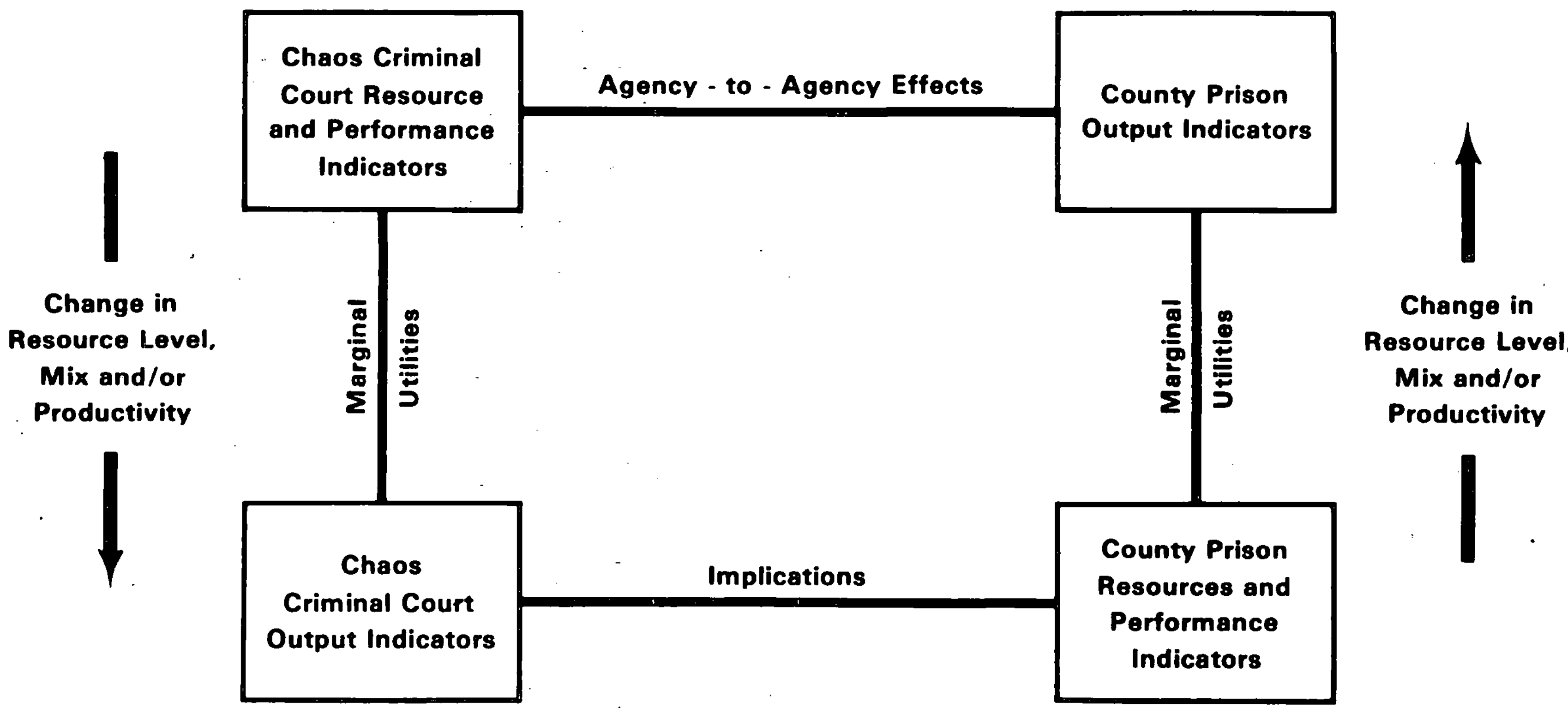
Suppose that in 1978 one additional judge is provided, the court and the judges agree to an average productivity of 62 minutes per case. The caseload in 1978 is predicted, using least squares regression, to be 30,140. Sixteen judges could process, in 1978, at a productivity level of 62 minutes per case, approximately 24,774 cases. Assuming the conviction rate is the same as in 1977, approximately 75% or 18,580 offenders are convicted. Of those convicted, approximately 30% or 5574 offenders are sentenced to terms in the county prison. (In 1977, of the 14,000 convictions, 4200 offenders were sent to the county prison.) This is an increase of 33% in the work or caseload of the county prison which must, consequently, adjust to the changed performance of the Chaos Court.

An analyst performing this type of analysis should be cautioned against taking too "mechanistic" a view of system operations. The criminal justice system rarely converts resource investments into benefits as directly as implied by marginal utility-type analysis. Adaptability may be a more appropriate term to use when describing the criminal justice system. "For example, the number of commitments to correctional institutions by the courts generally are greater than or equal to the amount of space. When more prison space is available, more offenders are sent to prison. Such action is probably due to the informal informational networks which exist. Because of this informality, such feedback and change is difficult to anticipate and measure but should be accounted for by the analyst."[4]

Exhibit 6-23 illustrates this interaction between changes in resources and/or performance in the Chaos Criminal Court and its downstream impact on the work of the County Prison. Changes in Criminal Court activity similarly impacts the Prosecutor and Public Defender caseloads and the work of police who must testify at the increased number of trials. These interactive costs also must be factored into a final policy recommendation on the input/output analysis for dealing with the backlog problem.[5]

EXHIBIT 6-23

MARGINAL UTILITIES AND INTERAGENCY EFFECTS OF CHANGING RESOURCES AND/OR PRODUCTIVITY, CHAOS CRIMINAL COURT AND COUNTY PRISON, 1978



Source: Hypothetical Data

III. Summary

This chapter began with a description of the criminal justice system and how flow charts are used to analyze it. As indicated in Exhibit 6-24, flow charts should be used along with the descriptive methods covered in chapter three to fully clarify the system problems being examined. Three concepts used to analyze systems were discussed. Particular emphasis was given to system operations which was elaborated into its component variables and measures. These were used to conduct an Input/Output analysis of the Chaos Criminal Court's operation during the 1973-1977 period. While few of the comparative or inferential methods were used in the example, as Exhibit 6-24 indicates, they may be appropriate in an Input/Output analysis for testing hypotheses and/or making predictions of system operations.

Finally, the study of criminal justice system operations might include consideration of each of the following functions:[6]

(1) <u>Patterns and Trends in Operations</u>

This includes the elaboration of input, performance, and output indicators over time and between agencies and/or jurisdictions; consideration should be given to the level, rate of change, and mix of these indicators.

(2) <u>Administrative Profiles</u>

The standards and objectives of the agencies and organizations under study are made explicit, as are the uses of such standards and objectives to monitor system operations and to prepare exception reports.

(3) <u>Environmental Profiles</u>

Demographic, crime, and other environmental variables that have a direct impact on criminal justice agency operations are discussed.

(4) <u>Predicting System Operations</u>

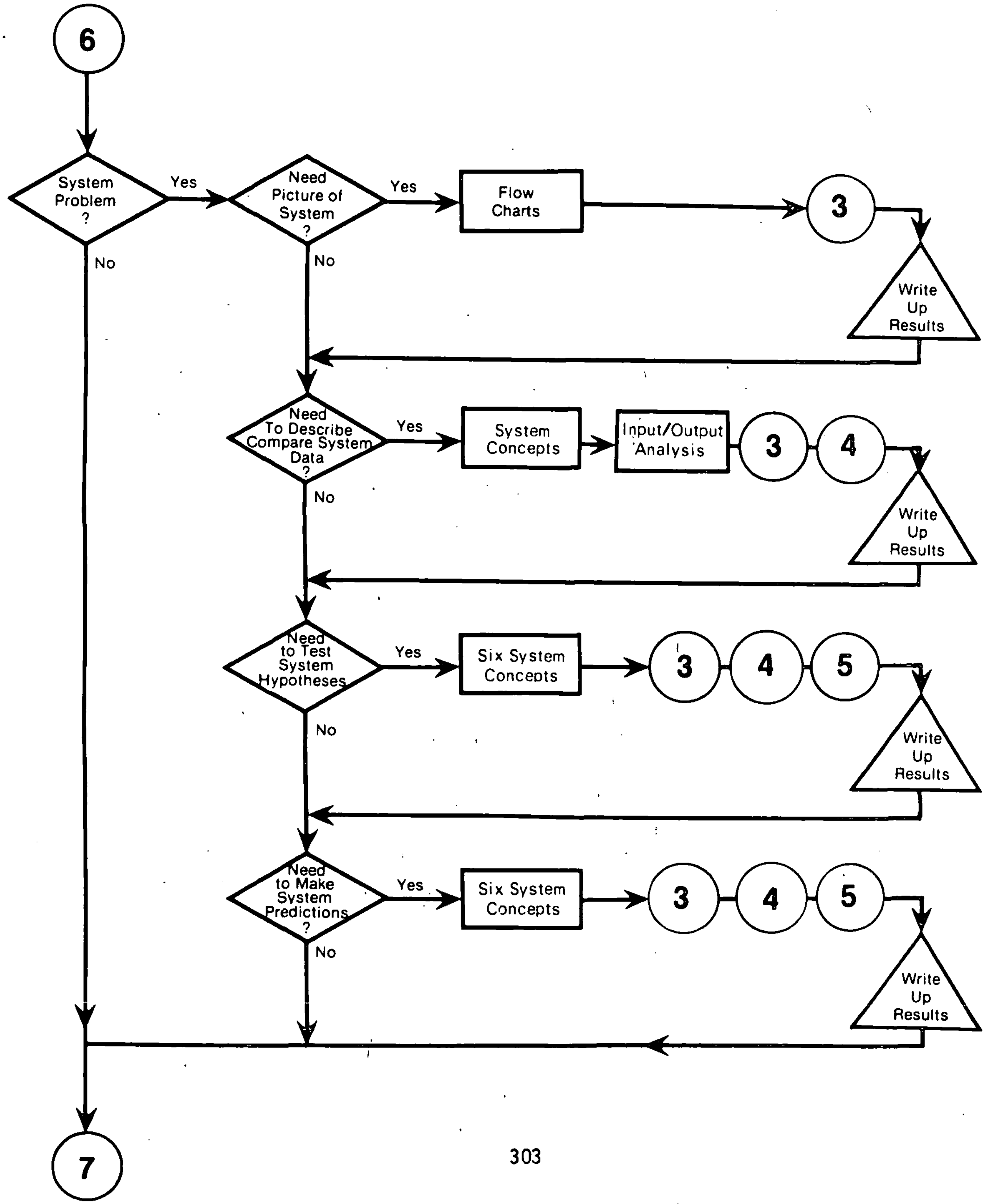
Forecasting caseloads, resources and output in light of changing levels of performance requires the use of inferential methods and input/output analysis. It may also require consideration of future crime volume by type of crime.

(5) <u>Policy Options</u>

Resource and performance issues in light of changing patterns in caseloads and output are discussed. Providing insight into the implications of resource allocation decisions and program and policy options for decision makers is a major theme of this chapter and of this text.

EXHIBIT 6-24

CHAPTER 6 SUMMARY CHART: DATA INTERPRETATION SYSTEM



[1]U.S. Department of Justice, National Criminal Justice Information and Statistics Service, Dictionary of Criminal Justice Data Terminology, A Report prepared by Search Group, Inc. SD-DCJ-1, 1976, p. 37.

[2]G. Hobart Reiner et. al. Crime Analysis Operations Manual, Integrated Criminal Apprehension Program, U.S. Department of Justice, LEAA, June 6, 1977, pp. 1-7 to 1-9.

[3]U.S. Department of Justice, Dictionary, pp. 20 and 40.

[4]Marianne Zawitz and Benjamin H. Renshaw, Memorandum to Richard Ulrich, Bureau of Criminal Justice Statistics (January 21, 1980).

[5]This chapter focuses on introducing an approach to analyzing system operations. Readers with interests and skills beyond those treated are encouraged to consider the developing literature in operations research and economics as applied to criminal justice. Following are selected publications that should be useful in this regard:

Alfred Blumstein and Richard Jarson, "A Systems Approach to the Study of Criminal Justice," Operations Research for Public Systems, Philip M. Morse ed. (Cambridge:, MIT Press, 1969).

Alfred Blumstein, "Management Science to Aid the Manager: An Example from the Criminal Justice System" Sloane Management Review 15 (Fall, 1973): 35-48.

Richard C. Larson and Jan M. Chaikin, "Methods for Allocating Urban Emergency Units: A Survey" Management Science 19 (Dec. 1972): 110-130.

Stuart Nagel and Marian Neef, "What's New About Policy Analysis Research?", Transaction/Society, 1978.

R. W. Anderson, The Economics of Crime (London: MacMillan Press, 1976).

Lee R. McPheters and William B. Strong, ed. The Economics of Crime and Law Enforcement (Springfield: Charles C. Thomas, 1976).

[6]Suggested by a similar list prepared by the International Association of Chiefs of Police. See Samson K. Change, et. al. Crime Analysis System Support: Descriptive Report of Manual and Automated Crime Analysis Functions. A Report prepared for the National Criminal Justice Information Statistics Service, LEAA, May, 1979.

CHAPTER 7

PRESENTATION OF FINDINGS

Introduction

This chapter suggests methods of making effective presentations both written and orally before an audience. The importance of a strong presentation cannot be stressed enough since all the products of analysis are useless if they are not persuasively presented to the proper individuals and organizations. The chapter is divided into three parts: (1) an introduction covering the factors that should be considered in preparing a presentation; (2) a discussion of the role of the analyst in making a presentation; and (3) guidelines for preparing improved written reports and oral presentation.

I. Considerations in Preparing a Presentation

The problem of organizing facts and opinions into an organized presentation is a major challenge in doing analysis. The preparation for presentation is necessary to develop a strong argument. When presentations are not properly prepared, essential facts and messages may be camouflaged, misinterpreted, or lost. There are several factors that the analyst should consider in preparing a presentation, these include: (1) the objectives and organization of the material; (2) the responsibilities of the presenter (or writer); and (3) the pitfalls of inadequate preparation.

A. Objectives

A well-written or presented problem statement develops in the audience a clear sense of the underlying concerns that motivated the analysis. At a minimum the statement needs to cover why the problem is important and in which areas the decision maker can effectively devote their attention. Not only should the analyst address the nature of the problem, but also should relate the message to the decision maker's authority.

A second objective is to organize the material effectively. "Sound organization is characterized by unity, coherence, relevance, conciseness, and comprehensiveness."[1]

Unity refers to the development of a central theme to which each component of the report or presentation may be linked. Making the theme explicit in a single clear statement or paragraph should have a high priority in preparing a presentation. Coherence is the overall structure or design of the report. In the concluding section of this chapter a recommended format for developing a written problem statement is presented. Using such a format, as well as providing links between sections of your presentation, should increase coherence.

The relevance of a presentation is, in part, a function of the analyst's understanding of his/her audience and the minimizing of distracting anecdotes, opinions, and images which seem to be related to the subject. The analyst should weed out such excess material unless it can be tied convincingly to the theme and subject of the presentation.

The analyst should avoid repetitive and/or redundant information.

> A very common organizational fault is to deal with a topic, drop it, take up a second idea, perhaps a third, and then return to the first. The beginner is learning to be concise when (he/she) can cut his/her message into parts and paste it together again so that all of the statements about a given topic are clustered together.[2]

Another organizational consideration is comprehensiveness. All important concerns and hypotheses and the central theme need to be dealt with. The amount of detail and depth of a presentation varies, of course, by the audience's understanding and knowledge of the subject. Exhibit 7-1 is a technical checklist to use as a guide in reviewing the comprehensiveness of your analysis. A major purpose of a preparation is to familiarize yourself thoroughly with the material. When making a presentation, the analyst should assume ownership and responsibility for its content. By following this checklist, a quality control check is made, at the same time the analyst is reviewing the content of the material.

The conceptual foundation establishes the presentation's theme, must be clearly stated, and relate directly to the audience's concerns. The hypotheses should relate directly to the theme and be measurable, accurate, testable, and important. They should as well cover the magnitude of the problem, its rate of change, temporal aspect, seriousness, persons affected, spatial aspects, and the system's response to the problem. Measures used in the analysis should be correct, properly and fully interpreted and useful to the reader or audience.

B. Analyst's Responsibilities

The responsibilities of the analyst in preparing a presentation include: (1) making certain the information is transmitted clearly and succinctly; (2) assuring that the material is in a form and language that is meaningful to the audience or reader; and (3) "selling the product" and not just presenting a "problem statement." The relatively brief attention spans of most audiences means that rambling, prolonged, or confused presentations will "turn off" many individuals and alienate others. With few exceptions most of the problems criminal justice analyst's deal with are complex, impinging on other systems, other problems, and real people. These "others" may be of primary importance to the audience and a skilled presenter will build these interrelationships into the material.

The effort expended between a first draft of a presentation and its final form is usually significant. The process of revision and refinement involves several activities. These include:

- altering the approach and language to better suit the audience;

- o reviewing the technical content;
- o reconsidering the evidence used to support the conclusions; and
- o reconsidering the arrangement of material.[3]

Refinement should be considered a continuous process. However, decisions must be made, deadlines occur and, unless the analyst is prepared, conventional wisdom, intuition, or worse will be the dominant influence on the decision-making process.

EXHIBIT 7-1.

TECHNICAL CHECKLIST

- o Is there a well-stated conceptual foundation for the problem statement?
- o Have the critical hypotheses been selected?
- o Are the variables and measures reliable and valid?
- o Are the statistical techniques used appropriately?
- o Are the data used effectively and interpreted correctly?

II. Achieving Perspective

A major aspect of preparing a presentation is the development of an understanding about the intended audience and the analyst's role in decision-making. Three groups which usually comprise the audience for criminal justice analyses are elected officials, criminal justice administrators, and private citizens. Each has different interests and needs to which the analyst should try to respond.

For example, politicians tend to be pragmatic rather than idealogical. They frequently must work under the stress of a crisis and the demand for action. In dealing with conflict, politicians try to:

(1) anticipate public and interest group reactions
(2) make use of political symbols
(3) simplify issues
(4) personalize and particularize issues
(5) be solution-oriented

Criminal justice administrators, in contrast, tend to be program and agency-oriented. Their focus is frequently on issues of accountability and responsibility. Administrators are drawn into conflicts over the jurisdiction of problems, the criticism of performance or operations, or resource allocation. Aaron Wildavsky suggests several strategies taken by bureaucrats used to maintain or increase their allocation of the budget. Some of these include finding and cultivating clientele groups, acting confident and cultivating trust from other decision-makers, and avoiding over-promising and under-performing.[4] Analysts need to consider such aspects of their environment if they are to be an influence.

Public and organized interest groups play an important part in criminal justice decision-making. The analyst should be sensitive to their perceptions, interests, and needs.

The issues of fear of crime and concerns over government costs are common to public discussion of criminal justice. The public, as do interest groups, uses a variety of methods for communicating their feelings and beliefs to decision makers. These range from letters-to-the-editor to public hearings and informal meetings. The analyst should monitor these expressed interests and consider them in preparing a presentation.

Another important element in achieving perspective is to understand fully your own role in the decision making process. Chapter 1 discussed this issue in some detail. One additional concept that may be useful is the distinction between the old and new expert presented in Exhibit 7-2. Reality rarely exists in terms of opposites as presented in the exhibit. However, the contrasts are useful in describing the orientation of this text in terms of the role analysts should play in decision-making. A second perception of the analyst's role is presented in Exhibit 7-3. Most of these role types are not mutally exclusive; that is, each analyst tends to integrate the consultant, trainer, and leader roles into a style that is suited to the situation and the individual's personality. Nevertheless, the emphasis is on the analyst being both responsive to the needs of the decision maker and a problem-seeker.

III. Guidelines for Effective Presentations

The following guidelines are relevant to both the preparation of a written report and the preparation and delivery of oral presentations. A basic theme running throughout these guidelines is that the analyst should stick to a priority message. An analyst cannot expect to convey all that is known about a problem or all the data collected and analyses performed; rather, the analyst must select and develop priority messages which are of major importance to the decision-maker. A related theme is that decision-makers have limited time to devote to the task of listening to or reading a staff report, regardless of the critical nature of the problem or of the effort devoted to the analysis. If the analyst doesn't maximize this opportunity, it will leave the audience with a blurred or incorrect impression. Following is a discussion of two factors that need to be considered in developing an oral or written presentation: (1) organization and (2) emphasis.

EXHIBIT 7-2.

CHARACTERISTICS OF THE OLD AND NEW EXPERT

Old Expert	New Expert
Solution Oriented	Problem Oriented
(defines a problem in terms of a solution)	(explores a situation to find the problem)
bounded	unbounded
emphasis on primary effects	secondary and tertiary effects
simplifying	complexifying
assumption accepting	assumption challenging
Question Answering Expertise	Question Asking Expertise
error denying	error embracing
surprise-free	surprise embracing
System Closing	System Opening
elitist	democratic
technocratic	public
comforting	threatening
conflict masking	conflict exposing
product oriented	process oriented
Organization Captive	Boundary Spanning
protected	exposed
"hired gun"	free floating
institutional	personal
client-oriented	issue-opportunistic
Politically Explicit	Politically Ambiguous
late in political process	early in political process
choice related	issue formulating
well-defined expectations	uncertain expectations

Source: R. Burco in Donald N. Michael, On Learning to Plan and Planning to Learn (San Francisco; Jossey-Bass Publishers, 1976), p. 1975.

EXHIBIT 7-3.

ROLES OF THE ANALYST

Role Type	Function
Conveyor	To transfer knowledge from producers (scientists, experts, scholars, developers, researchers) to decision makers.
Consultant	To assist decision makers in identification of problems and resources, to assist in linkage to appropriate resources; to assist in adaption to use: facilitator, objective observer, process analyst.
Trainer	To transfer by instilling in the decision makers an understanding of an entire area of knowledge or practice.
Leader	To effect linkage through power or influence in one's group, to transfer by example or direction.
Innovator	To transfer by initiating diffusion in the criminal justice system.
Defender	To sensitize the decision maker to the pitfalls of innovations, to mobilize public opinion, public selectivity, and public demand for adequate applications of analysis.

Source: Adapted from R. Havelock in Donald Michael, On Learning to Plan and Planning to Learn (San Francisco: Jossey Bass, 1977), p. 243.

A. Organization

There are many approaches to organizing a presentation. Following is a list of rules, suggested by David Ewing, that can be used to help select the particular facts and ideas that will be included in a presentation:

1. Consider how much background is necessary before you present ideas, directives, or recommendations for change.
2. Your credibility with your readers affects your strategy.
3. If your audience disagrees with your ideas or is uncertain about them, present both sides of the argument.
4. Put your strongest points last if the audience is very interested in the argument, first if it is not so interested.

5. Do not hope to change attitudes by offering information alone.
6. "Testimonials" are most likely to be persuasive if drawn from groups with which readers (or the audience) associate.
7. Be wary of using extreme or "sensational" claims, facts, or examples to support your message.
8. Tailor your presentation to the reasons for reader's (or audience's) attitudes, if you are pretty sure of them.[5]

Such a set of rules helps to identify the priority messages. It also makes clear the importance of the intended audience in developing and organizing a presentation.

A general pattern or framework should be used to integrate the different pieces of information. Some of the more common patterns are:

- time order (historical, or when giving directions, what is to done first, second, last);
- space order (geographical, left to right);
- classification (such as crime or system operation concepts);
- cause and effect (first outline causes, then discuss effects, useful in predicting future events);
- simple to complex (begin with descriptive analysis and introduce more complex analyses gradually);
- problem-solution (begin with analysis of problem, then suggest solution);
- proposition-support (state your case, then provide evidence);
- support-proposition (provide evidence then draw proposition as conclusion or allow audience to infer proposition);
- effect to cause (first discuss effects, then suggest possible causes -- useful in analyzing present problem);
- method of residues (list representative solutions, then object to and eliminate all but the last);
- climax order (list points in increasing order of importance); and
- anticlimax (list points in decreasing order of importance).[6]

B. Emphasis

Emphasis in a presentation is the consequence of organization as well as the methods used to clarify and interpret. There are three concerns in this regard: (1) the effective use of data; (2) the use of contrasts and comparisons; and (3) anticipating audience or reader questions and issues.

1. The Use of Data

The pupose of data in a report or presentation must be clearly understood by the analyst and the reader.

> In general, observations have most value when the investigator has examined them, made some interpretation, and arranged them to show some pattern. The average reader does not want raw data any more than he wants raw sugar cane. Both have value, but the refined product is usually the more palatable.[7]

Some general considerations in selecting data for a presentation are: (1) data must be consistent and supportive of the narrative; (2) selection of data should be based on their relevance, clarity, accuracy, and their assistance to the reader in understanding the problem; and (3) too much or poorly organized data can confuse a presentation. All tables, charts, and graphs used in a presentation should be fully labeled and correctly interpreted in the narrative. A good report or presentation does not leave the interpretation of the data up to the reader.

2. Contrast and Comparison

A well-prepared presentation makes use of silent contrasts and comparisons and powerful combinations to achieve emphasis. Problem statements should provide, if possible, a sense of the dynamics of a problem, i.e., its history, current status, and future consequences. The analyst should try to reinforce a presentation by comparisons and analogies with which the audience is familiar. Examples and illustrations drawn from neighborhood aspects of the problem or a specific incident of the problem are more easily understood by an audience than are conceptual arguments. The use of comparisons and contrasts the audience understands focuses and holds attention and helps people to remember the priority messages.

3. Audience Awareness

Emphasis also is based on the analyst's perception of his/her audience. The assumptions of a presentation should be made explicit. The presentation should be critiqued prior to its delivery to develop an awareness of what the weak points are and what questions may be anticipated. Rehearsal and editing should be from the audience or reader's perspective and responses to anticipated questions should be either edited into the presentation or planned for. Finally, the analyst should use terms important to the audience. While technical language is helpful if the audience knows it, it is not helpful if there are no technically trained people.

IV. Preparing a Written Report

A written report typically provides greater detail than an oral presentation, it may be used to supplement an oral presentation or stand-by itself, and it can be broadly disseminated. In developing a written report the author should avoid major omissions of evidence and/or interpretation. The importance of logical organization and consistency in form and content should be based on the reader's needs. Poorly organized reports have little impact. The use of an organizing framework is as important in a written report as it is in an oral presentation. In Exhibit 7-4 a recommended outline for a Problem Statement is illustrated.

EXHIBIT 7-4.

WRITTEN REPORT ORGANIZATION

Section 1.0 — Introduction

1.1 Statement of concerns
1.2 Nature and source of concerns
1.3 Scope of concerns

Section 2.0 — Analysis Methodology

2.1 Definition of terms used
2.2 Measurement reliability and validity
2.3 Data collection procedures used
2.4 Statistical methods used

Section 3.0 — Findings

3.1 Conceptual Hypothesis #1 - Supporting variable and measurement hypotheses, results, interpretations, and conclusions
3.2 Conceptual Hypothesis #2 - Supporting variable and measurement hypotheses, results, interpretations, and conclusions
3.3 Etc.

Section 4.0 — Discussion of findings in general

4.1 Discussion of findings in relation to the concerns expressed
4.2 Discussion of limitations

Section 5.0 — Summary

5.1 Highlights
5.2 Conclusions

Section 6.0 — Appendices

This format is consistent with the logic and procedures discussed throughout the text. A problem statement should include all of the indicated information. In many instances full information may not be available, or a special audience may not require all that is indicated. The analyst should always be aware of the audience to whom the statement is addressed and must balance and proportion the report accordingly. For example, one of the significant problems in communicating an analysis to a decision maker is how to convey important details. Special formats such as in Exhibit 7-4 or an Executive Summary can be instrumental in building interest, confidence, and directing attention to specific areas of the full report. Appendix A, at the conclusion of this chapter, is a fully developed problem statement prepared by Chaos City analysts.

A second important consideration in preparing a written report is the style of writing. Ewing identifies over a dozen different styles including:

- abstract, bloodless;
- elaborate, meticulous;
- excessive, redundant;
- figurative, metaphorical;
- logical, systematic;
- oratorical, flower; and
- plain, straightforward.

He suggests, in addition, some "do's and don'ts for any style:"

1. Vary the structure and length of your sentences.
2. Avoid the elongated-yellow-fruit school (i.e., house becomes an abode, habitat, living quarters, domicile, etc.).
3. Go easy on euphemisms (e.g., "eliminate with extreme prejudice" was a euphemism and historical dodge for the word "kill").
4. No matter how technical your communication, try to frame some thoughts in an active who-did-what-to-whom way.
5. Avoid excessive words (e.g., in the proximity of, near; resultant effect, effect; and advance planning, planning.)[8]

V. Conducting a Briefing

There are three factors to be aware of in conducting a briefing: (1) the materials used; (2) the manner of presentation; and (3) achieving proper emphasis and balance. Materials that may be used to support an oral presentation include a summary outline or report and visual aids. The analyst might develop a brief outline to distribute to the audience that succinctly covers the briefing's content and that highlights priority messages. The use of visual aides such as a flip chart, overheads, or slides can be effective if they are clear, neat, and informative. In developing visual aids for a presentation be sure they are relevant to the priority messages and integrated into the delivery. Don't assume that the audience will see in a particular chart the same meaning you give to it. By appropriately setting the stage for a visual aid and using proper commentary guiding the audience's interpretation, employing visual aids can have significant positive effects on a presentation.[9]

The manner of presentation also is a significant factor. This includes specifying individual responsibilities if more than one person is involved, giving attention to the audience's needs, and paying attention to delivery style. Frequently a group will give a presentation in which specific assignments have not been made. The consequences are obvious to the audience and embarrassing to the presenters. In considering the audience make sure that the presenter: (1) faces them; (2) locates the visual aides in a manner so that they are easily read; (3) avoids "loaded" words and negative symbols; and (4) is responsive to their reactions and questions.

Finding a balance in an oral presentation requires the analyst to prepare a delivery that is both technically complete and has perspective on the problem. Problem specification, measurement, and data interpretation must be refined and adjusted to the interests and concerns of the audience.

VI. Conclusion

A well prepared Problem Statement, is a delicate balance between concepts, variables, measures, hypotheses, and data interpretation.[10] If too little emphasis is given to the conceptualization of a problem, the resulting hypotheses and data interpretation will suffer. (See Chart I of Exhibit 7-5). Typically, when too little thought is given to concepts, the result is massive "number crunching" without the production of much information. The analyst compares, graphs, contrasts, correlates, tabulates, and re-analyzes large volumes of data which result from an aimless searching when specific hypotheses are not constructed. Suppose a patrol commander were to ask for an analysis of the department's performance without reducing his vague concerns to specific concepts. The result would be dismay, ambiguity, an excessive number of analytic false starts, and the production of a confusing accumulation of answers without questions.

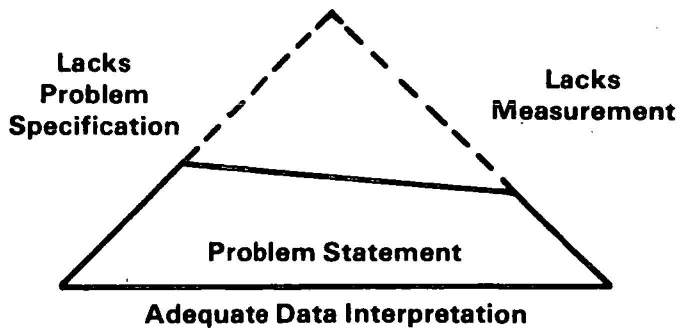
Another type of imbalance involves insufficient measurement. In this situation, concerns have been refined to specific concepts; but the process for securing data to analyze these concepts is haphazard, unscientific, superficial, or mismanaged. Not infrequently, the analyst is presented with specific questions; but, due to the pressures of time, inadequate preparation, or insufficient technical capability, the measurement of the concepts is insufficient or inadequate. The statistical procedures employed are superficial. Sampling procedures are inadequate. The amount of data gathered is too small or unrepresentative. tive. Computational errors are made, and inappropriate statistical procedures are applied. (See Chart II Exhibit 7-5).

For example, the analyst responds to the patrol commander's concerns about performance by examining only the calls for police service on Friday and Saturday nights, disregarding the other days of the week. Or imagine if the analyst doesn't take into consideration seasonal fluctuations and the effects of weather conditions on response time.

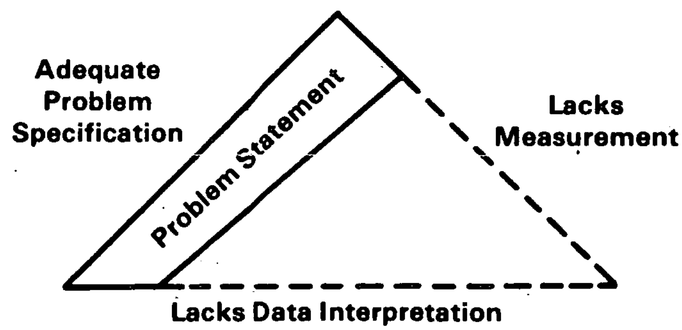
EXHIBIT 7-5

PROBLEM STATEMENT TRIANGLE

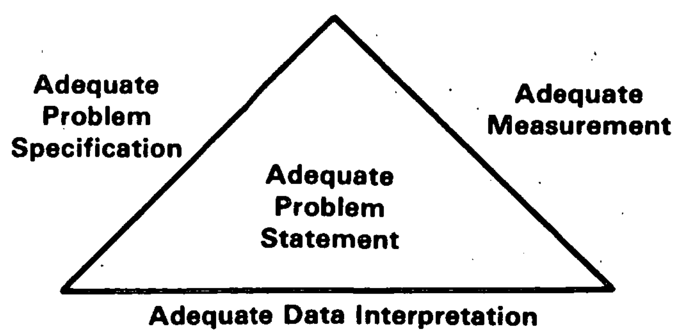
1. Analysis With Inadequate Problem Specification And Measurement



II. Analysis With Inadequate Measurement And Data Interpretation



III. A Well Balanced Analysis Produces Adequate Problem Statements

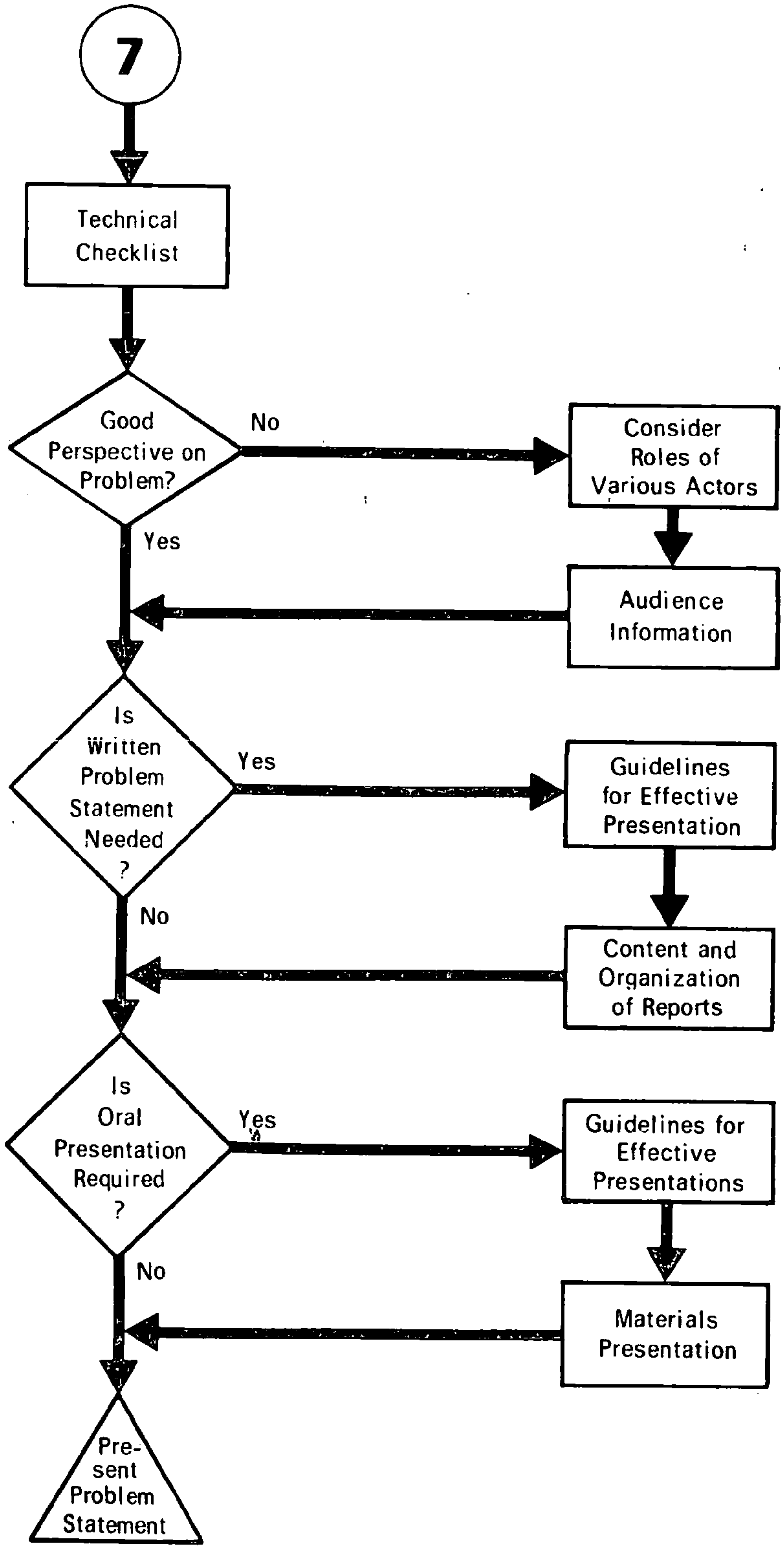


Supposing the analyst only uses graphic or statistical techniques with which he is familiar even though the data do not meet minimum assumptions. This type of imbalance results in problem statements which are superficial and unsubstantiated. The results of such analyses are difficult to replicate and do not lead to confident generalizations. Since this imbalance frequently results in superficial analyses, the resulting problem statements may include suggested alternatives which attack symptoms not problems. They address the transitory aspects of the problem and may not result in any long-term solutions.

A well-balanced Problem Statement consists of adequate problem specification, measurement, and data interpretation as illustrated in Chart III of Exhibit 7-5; also important are the organizational and delivery considerations discussed in this chapter. These are presented in the concluding chart -- Exhibit 7-6. Each aspect of an analysis -- from identification of concerns to delivering a report -- warrants attention to detail in its performance and presentation. In this manner the analyst may have a greater confidence in the accuracy and relevance of his/her work and a greater impact on decisions effecting criminal justice.

EXHIBIT 7-6

CHAPTER 7 CHART: PRESENTATION OF FINDINGS



[1]William Howell and Ernest Bormann, Presentational Speaking for Business and The Professions (New York: Harper & Row, 1971), p. 111.

[2]Ibid, p. 112.

[3]Donald H. Menzel et. al., Writing A Technical Report (New York: McGraw-Hill Book Company, 1961), pp. 15-20.

[4]Aaron Wildavsky, The Politics of the Budgetory Process, 2nd ed. (Boston: Little, Brown and Company, 1974), pp. 63-123.

[5]David W. Ewing, Writing For Results in Business, Government and the Professions (New York: John Wiley & Sons, 1974), pp. 72-90.

[6]Howell and Bormann, Presentational Speaking, pp. 120-121.

[7]Menzel, p. 37.

[8]Ewing, Writing For Results, pp. 364-411.

[9]Howell and Bormann, Presentational Speaking, p. 268.

[10]The ideas in this summary were suggested by Charles Friel, San Houston State University.

CHAPTER 8

MANAGING ANALYSIS

Introduction

The management problems associated with doing analysis include: (1) maintaining the technical quality of the products by monitoring procedures and tasks; (2) using available staff effectively; (3) controlling expenditures; and (4) ensuring the products developed are responsive to the decision makers' needs. In this chapter management skills and tools particularly useful in planning an analysis are covered. These include identifying tasks and procedures, establishing a schedule, labor allocation, and budget. These are presented in the context of an Analysis Plan which is a written document or oral presentation which systematically outlines and describes a sequence of events and procedures for conducting an analysis.

I. Analysis Plan

The structure of this text closely parallels the components of an Analysis Plan. These components include:

I. Analysis Objectives.

  A. Questions to be Answered.
  B. Problems Specification.

II. Analysis Procedures.

  A. Elaboration of Measures.
  B. Data Collection Plan.

III. Analysis Methods.

IV. Presentation and Dissemination Plan.

V. Work Plan

  A. Tasks and Schedule.
  B. Labor Allocation.
  C. Budget.

Establishing the objectives of a proposed analysis has several important dimensions that were discussed in some detail in chapters one and two. The statement of objectives should be convincing in terms of the importance of the proposed analysis and clear in terms of what is to be included and what has been left out.[1] In addition, the problem specification should identify good hypotheses easily linked to the objectives and questions the analysis is to address.

The second part of an Analysis Plan presents a discussion of the sources of data and data collection procedures to be used. The analyst should make explicit the specific data to be collected, where and how this data is to obtained, and the instruments to be used (e.g., questionnaires, interview protocols), if any. Chapter 2 covered many of the techniques and issues central to preparing a Data Collection Plan. However, an important subject area in this section of a plan, not covered by this text, is of research design. The quality of criminal justice analysis depends, in large part, on the design choice, particularly in doing evaluative studies.[2]

The third part of an Analysis Plan indicates the methods that will be used in examining the data for each hypothesis. In preparing this section be sure to check the assumptions and appropriateness of the methods selected.[3] Should the need arise for unfamiliar multivariate or advanced methods, experts should be consulted to ensure appropriate selection and application.

An important component of an Analysis Plan is a description of the expected products. A detailed outline of the final report might be included and a discussion of the methods for distributing information about results presented. A central issue in this section is the identification of the primary and secondary audiences for the information and the methods of communication to be used to reach these audiences.

The last component is the Work Plan which is the major focus of this chapter. This portion of an Analysis Plan outlines the tasks and activities of the analysis, identifies major events and milestones, and establishes a schedule. It is important that this schedule and description of tasks be consistent with the prior sections of the plan and provides sufficient time for each of the critical tasks such as data collection or report writing. Also included in the Work Plan is the labor collection or report writing. Also included in the Work Plan is the labor allocation which identifies, by position, the time necessary to complete each task. The last part of the Work Plan is the budget. This is a translation of the preceeding sections into a statement of resource requirements. Typically, the rationale for all budgeted items is included in an accompanying narrative. Finally, there should be a clear correspondence between the budget, labor allocations, and schedule. In Exhibit 8-1 the different components of an Analysis Plan are identified and are linked to the respective chapters in this text which treat each topic.

Analyses, like most administrative activities, require some degree of prior planning. Formal written Analysis Plans are the exception in most criminal justice work; most prior planning involves more of an intuitive mental checklist done more or less spontaneously when necessary. The degree of formalization in planning an analysis depends on several factors including the scale of the proposed study, the amount of resources involved, and the need to form a consensus about aspects of the analysis. In general, a more formal Analysis Plan is not required on small-scale studies, "crisis" studies, studies requiring confidentiality, studies not needing a consensus on what the problems are or how they should be analyzed, low-priority studies, and studies that are exploratory and which require significant innovation as they proceed.

EXHIBIT 8-1

ANALYSIS PLAN DEVELOPMENT, COMPONENTS, AND USES

STAGES DEVELOPING AN ANALYSIS PLAN	State concern for which analysis is needed	Specify concepts, variables, measures, hypotheses	Assess measures and hypotheses	Identify & select data sources	Select analysis techniques	Perform analysis	Identify audience and use for findings	Select presentation format & dissemination procedure	Determine manpower, equipment, time and funds needed
ANALYSIS PLAN COMPONENTS	Questions to be answered	Problem specification	Prioritized list of hypotheses	Data collection plan	Selected analysis techniques	Interpretation of findings	Audience identification & use for products	Presentation and dissemination	Tasking, Labor allocation, and costing
USE (WHAT EACH STAGE TELLS THE ANALYST)	WHY	WHAT	WHAT	HOW	HOW	WHO WHAT WHEN WHERE WHY	FOR WHOM	FOR WHOM	WHEN, BY WHOM & HOW MUCH
MODULE REFERENCE	MODULE 1: PROBLEM SPECIFICATION		MODULE 2: DATA SYNTHESIS		MODULES 3,4,5,6 METHODS OF ANALYSIS		MODULE 7: PRESENTATION OF FINDINGS		MANAGING ANALYSIS

Formal Analysis Plans are used to help assure accurate results produced in a cost-effective manner. By forcing the analyst to think through each of the components, potential sources of error may be eliminated and efficiencies achieved. The lack of analysis planning frequently results in missed opportunities, overspending, and inferior products. Such efforts, characterized as "data grubbing," are usually based on vague understandings of concerns and are subject to criticism for being erroneous in their conclusions, are of poor technical quality, and are over-priced.

Finally, there are many occasions when a formal Analysis Plan may be required. Frequently budget requests and grant applications must be accompanied by an Analysis Plan. Federal, state, and private funding agencies usually require a detailed outline of a proposed analysis before authorizing funds to cover its cost. The outline in Exhibit 8-1 covers the types of issues raised by decision-makers about proposed studies.

There are obviously many possible ways of organizing an Analysis Plan, but the major components generally are similar. The process of preparing such a plan follows the logic of the text. Following the Chapter Summary Charts presented in this text, in sequence, should be a useful guide. However, new information or insights may result in changes to the original hypothesis or the data collection efforts. The lack of available data or the complexity required to analyze certain hypotheses may result in a revised problem specificaton. Similarly if the data collection effort is estimated to cost more than the available budget, changes in the plan must be made. However, it is important to work through each stage, and to link each component to all components, so that inconsistencies may be avoided, gaps in logic or design eliminated, and a strong structure for conducting an analysis established.

II. Work Plan

The Work Plan is one of the most important aspects of analysis, since scheduling and resource allocation are needed to ensure that the analysis tasks actually get done, are completed on time, and the results are of high quality. A number of management tools are available to assist in this effort. These tools are used to aid in determining:

(1) the tasks and sequence of tasks necessary to complete the analysis
(2) the types and amounts of manpower required and special skills needed to peform each task
(3) major milestones and target dates
(4) a time schedule for use of resources to perform tasks

Following is a discussion of each part of a Work Plan. These include the tasks and schedule, labor allocation, and budget.

A. Tasking

Tasking refers to the identification of tasks and activities, establishment of milestones, and the development of a time schedule. By breaking an analysis effort into its component tasks, a better understanding of the overall project should be obtained. Frequently the outline of tasks and time schedule presents to the reader or audience the first coherent structure of planned analysis. It should be obvious that the outline of tasks must be consistent with the preceding sections of the plan. Following is a discussion of two techniques used to help organize the tasks of an analysis.

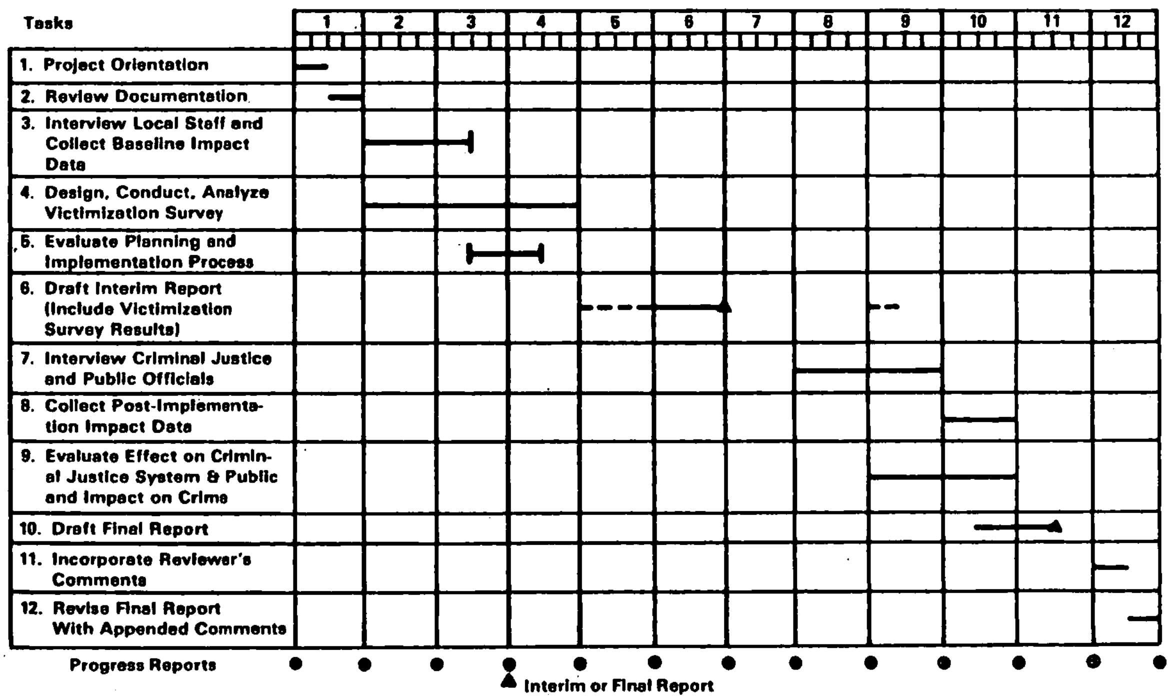
1. Gantt Chart

Henry Gantt developed a scheduling chart in 1917 that has become widely used and known as the Gantt Chart. The Governor of the State of Paradise has requested an analysis by the Criminal Justice Analysis Center of the impacts, if any, which state-funded local crime reduction programs are having. A Gantt Chart prepared by the Center's staff for this evaluation is presented in Exhibit 8-2.

EXHIBIT 8-2

STATE ANALYSIS OF LOCAL CRIME REDUCTION PROGRAM IMPACTS BY MONTH

GANTT CHART



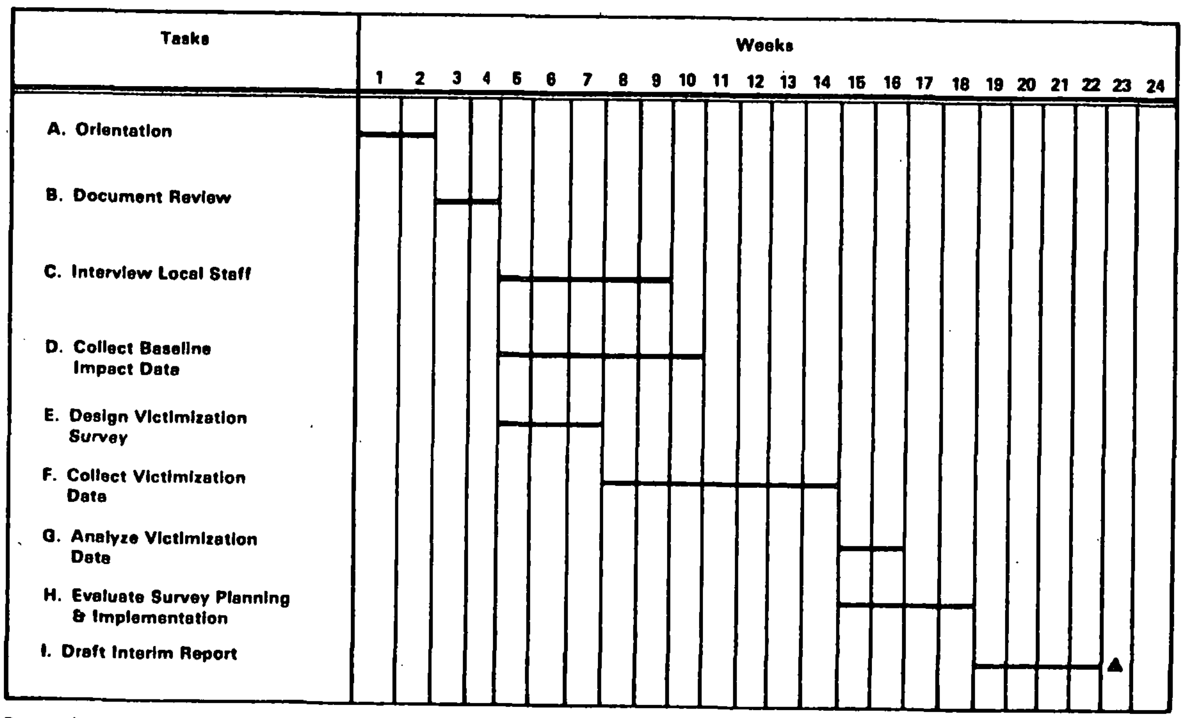
Source: hypothetical data

In the exhibit the rows are used to indicate activities or tasks. These should be discrete to avoid overlapping. In the proposed study there are 12 tasks identified. The analysis has been broken into four stages: (1) initial project orientation; (2) collection of pre-project data including interview data, official crime data, and victimization data; (3) collection of postproject data (including same items as in 2); and (4), preparation of a final report.

The columns of this exhibit are used to indicate months of the project. Products are indicated by triangles, and lines indicate the starting time, duration, and completion data for each task. Task 4, the victimization survey, is scheduled to begin during the second month and conclude by the end of the fourth month. Note that in the sixth and eleventh months of the chart no scheduled activity is planned. These gaps are used to allow for slippage in the schedule. However, using the month as a time interval builds in an additional four week slippage automatically (4 x 12 = 48 weeks). To correct for this as well as to provide greater detail in scheduling, the preferred time interval of a Gantt Chart is the week. Exhibit 8-3 presents a Gantt Chart for the first six tasks of Exhibit 8-2 (through drafting the interim report). Greater task detail is provided in the weekly Gantt and the automatic slippage is avoided.

EXHIBIT 8-3

GANTT CHART
STATE ANALYSIS OF LOCAL CRIME REDUCTION PROGRAM IMPACTS, BY WEEK



Source: hypothetical data

2. PERT Chart

A limitation of the Gantt Chart is that it does not indicate which activities must be completed before others can begin or which sequence of tasks should be given highest priority. These problems are particularly significant in large and/or complex analysis projects. The PERT (Program Evaluation and Review Technique) technique was developed in the 1950's by the U.S. Navy for coordinating and controlling complex projects involving a large number of geographically dispersed contractors. In its application to analysis planning and management, PERT allows the analyst to examine the interrelationships of tasks over time. In turn, this information permits an estimate of the duration of those tasks which are expected to take the longest and which are crucial to completion of the project on schedule.

Nine activities or tasks are identified in Exhibit 8-3. Exhibit 8-4 converts each of these activities into its component events. For example, the Project Orientation (A) consists of two events: (1) start project and (2) complete orientation. In this manner 18 events have been identified for the nine activities. In the PERT Chart, events are indicated by numbered circles. Arrows between circles indicate activities that link events and the direction or flow of these activities. The duration of each activity is indicated above the solid arrows. For example, the duration of activity I -- Draft Interim Report -- is four weeks. Dotted arrows indicate a relationship but no required activity time, e.g., between (16) victimization data analyzed and (17) start interim report.

In this report three tasks may be accomplished simultaneously: staff interviews, baseline data analysis, and victimization survey. These separate tasks are indicated by the branching at event (4) into three paths. By adding the times along each possible path in a PERT Chart, the longest or critical path may be determined.

Path 1: A, B, D, H, I = 18 weeks
Path 2: A, B, C, H, I = 17 weeks
Path 3: A, B, E, F, H, I = 22 weeks
Path 4: A, B, E, F, G, I = 20 weeks

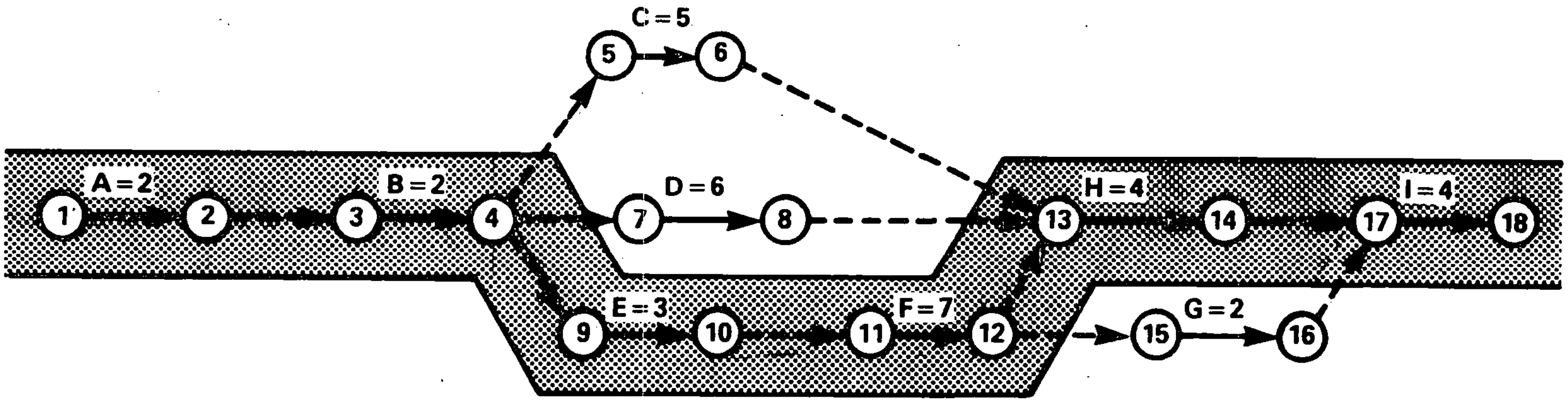
The critical path in this project is path 3 and it is indicated on the exhibit with shading. Delays of three, four and two weeks might be tolerated during the project along the other three paths without affecting the completion of the Interim Report. Any delays along the critical path would jeopardize completing the Interim Report on schedule.

In an actual application, the PERT network could be specified in more detail. The classic PERT technique also contains procedures for estimating activity times where uncertainty is involved. Estimates are obtained for the "most likely" time or subtask manager; the person directly responsible for the work is reponsible for both the estimates and task completion.

PERT is most useful for large-scale and complex problems such as scheduling and tracking the tasks a large metropolitan or state criminal justice planning agency undertakes over a year period. However, PERT can also be useful on a more informal basis for smaller projects as well

EXHIBIT 8-4

PERT NETWORK WITH CRITICAL PATH INDICATED FOR ANALYSIS PROJECT (TASK = TIME IN WEEKS)



Events

1. Start Project
2. Complete Orientation
3. Begin Document Review
4. Finish Document Review
5. Start Staff Interviews
6. Finish Staff Interviews
7. Collect Baseline Data
8. Baseline Data Collected
9. Design Victimization Survey
10. Survey Design Completed
11. Collect Victimization Data
12. Victimization Data Collected
13. Evaluate Survey
14. Complete Evaluation
15. Analysis of Victimization Data
16. Victimization Data Analyzed
17. Start Interim Report
18. Finish Draft Report

Key
- O Event
- --- Relationship
- → Sequence of events
- A = 2 Time between events showing number of weeks

Project managers who have used PERT techniques say that its advantages are that it facilitates:

- understanding the relationships and precise nature of the constraints during the development of an Analysis Plan;
- monitoring progress and slippage during implementation;
- identifying priorities for resource reallocation through use of the critical path as the highest priority; and
- reminding individual task managers of their schedules and progress.

Software programs for computerized PERT charting and monitoring are available. An example of the type of output available from a software package is shown in Exhibit 8-5. This exhibit shows information, for one of the task managers, during week 9 of the Analysis Tasks outlined in the PERT Chart in Exhibit 8-4. A major advantage of this system is that it provides an automatic reminder to task managers about the status of the work for which they are responsible. This computerized system removes the onus from the project managers for reminding staff of their schedule commitments and the standardized reporting system similarly relieves managers of ongoing manual data collection.

In summary, Gantt Charts are a useful means for indicating the weekly time line for each task. They are easy to construct and easy to understand. However, they fail to show the interrelationship of tasks. PERT Charts are used to identify precedent and concurrent relationships between all activities and events. They help to identify priority tasks and to assess the probability of meeting deadlines. However, they are more useful for large, complex projects which are infrequently undertaken in criminal justice analysis.[4]

B. Labor Allocation

Once target dates and milestones, based on preliminary estimates of staff workloads and performance, have been identified on a Gantt Chart, a labor allocation chart can be developed. Knowing how many person-hours to assign each activity requires that the analyst has completed similar tasks. A safety margin should be built in to each estimate since many managers tend to under-estimate the actual time necessary to complete analytic tasks.

The first step in developing a labor allocation chart is to select a particular position associated with the project, i.e., Project Director or Interviewers, and indicate on the Gantt Chart the personnel requirements for the project. For example, in Exhibit 8-6 each weekly column indicates the planned allocation of the Project Director's time for each task. No more than 40 hours is allowed in each column; thus in week nine the Director is allocated 30 hours to interview local staff, five hours to help collect baseline data and five hours to help in the victimization data collection. The final column indicates the amount of the director's time planned for each task and the total time required of the director (880 hours). Approximately 17% of his/her time is planned for interviewing local staff and 18% for drafting the Interim Report.

EXHIBIT 8-5

PERT REPORT
STATE ANALYSIS OF LOCAL CRIME REDUCTION IMPACTS, 2/3/77

Page 1 | Page 1

Component: Local Programs Overall Responsibility: John Buchanan Phone: 5364

Office	Person Responsible	Action Step Description	Start Date	Time Est.*	Time Used*	Status	% Compl	Pland Compl	New Compl	Documentation for Verification
Analysis Design	James McPherson	Design Interviewing Instrument	1/3	5	5	C	100	1/7		Interview Instructions
Analysis Design	James McPherson	Training Interview Staff	1/10	2	2	C	100	1/11		Interview Assignments
Analysis Design	James McPherson	Conduct Interviews	1/12	18	20	I	95	2/3	2/8	Weekly Completion Checklists
Analysis Design	James McPherson	Conclude Interviews				S	00	2/4	2/9	Completions Interview Checklist

* (in Days)

____
Signature

This report lists each of the action steps for which you have primary responsibility. Please report current status of these activities in the following manner.

1. Check the information under status (STA.). "S" means that the action step is scheduled but not yet begun. "I" means that the action step is in progress. And "C" means that the action step is complete. The space under VERIFICATION lists the documentation required to verify completion of the action step. A "V" in the status column indicates that the documentation has been received and recorded by the AIDP Office.

2. Examine the information under the percent complete (% COMPL) and status (STA.) headings. If the information presented is no longer correct, line through the incorrect information and place the correct information in the space above.

3. If you must request a completion date later than the date listed, write this new estimated completion date in the new completion date (NEW COMPL.) column. This request will be reviewed by the person responsible for your component.

4. Sign the report in the space provided and return the form to Dr. Buchanan's office.

Source: hypothetical data

EXHIBIT 8-6

PROJECT DIRECTOR, LABOR ALLOCATION ON GANTT CHART

GANTT CHART

State Analysis of Local Crime Reduction Program Impacts

Tasks / Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Project Director Hours
A. Orientation	40	40																							80
B. Document Review			40	40																					80
C. Interview Local Staff									30	15	35	35	35												150
D. Collect Baseline Impact Data					20	5	5	5	5	20															60
E. Design Victimization Survey					20	35	35																		90
F. Collect Victimization Data								35	5	5	5	5	5	40											100
G. Analyse Victimization Data															20	30									50
H. Evaluate Survey Planning & Implementation															20	10	40	40							110
I. Draft Interim Report																			40	40	40	40	▲		160
	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	
Total Hours	——— 40 ———																								880

Source: hypothetical data

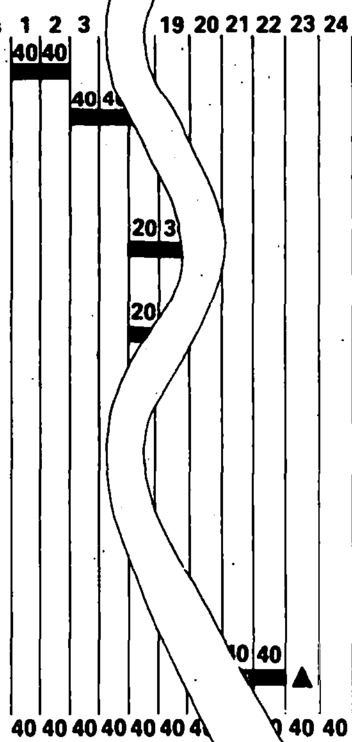
The same procedure is followed for each position required to perform the proposed analysis. These Gantt Charts give a clear picture of weekly assignments of staff to tasks by position. By consolidating the Gantt Charts as indicated in Exhibit 8-7, using only the total hours column for each Gantt Chart, an estimate of total task hours and the labor requirements of an entire project may be developed. The consolidated Gantt Charts are, then, directly transferred to the labor allocation chart in Exhibit 8-8. The labor allocation indicates the heavy emphasis given to the victimization survey and the need for part-time assistance to help in the victimization survey effort.

EXHIBIT 8-7

CONSOLIDATED GANTT CHARTS

Labor Allocation Chart - Obtained by Consolidating the Gantt Charts for Separate Positions

State Analysis of Loc Impacts



Tasks	Project Director Hours	DEP. P.D. Hours	Sec'y Hours	S. Design Hours	Sr. Anal. Hours	Anal. Hours	Int. Hours	Coders Hours	Total Hours
A. Orientation	80	80	80		160				400
B. Document Review	80	80	80		160	80			480
C. Interview Local Staff	150	150	150			160			610
D. Collect Baseline Impact Data	60	70	70			120			320
E. Design Victimization Survey	90	80	80	120	160				530
F. Collect Victimization Data	100	100	100		560		1600	80	2540
G. Analyze Victimization Data	50	40	40		160	80			370
H. Evaluate Survey Planning & Implementation	110	120	120						350
I. Draft Interim Report	160	160	160		120				600
		880	880	120	1320	440	1600	80	6200

Source: Hypothetical Data

EXHIBIT 8-8

LABOR ALLOCATION CHART

Tasks	Proj. Dir.	Dep. Proj. Dir.	Secretary	Survey Designer	Sr. Analysts	Analyst	Interviewers	Coders	Total Hours
A. Orientation	80	80	80		160				400
B. Doc. Review	80	80	80		160	80			480
C. Int. Local Staff	150	150	150			160			610
D. Collect B. Data	60	70	70			120			320
E. Design V. Survey	90	80	80	120	160				530
F. Collect V. Data	100	100	100		560		1600	80	2540
G. Analyze V. Data	50	40	40		160	80			370
H. Evaluate V. Survey	110	120	120						350
I. Interim Report	160	160	160		120				600
Total	880	880	880	120	1320	440	1600	80	6200

Source: hypothetical data

C. Budget

The last component of the Work Plan is the budget. Assessing the cost of a proposed analysis should be straightforward once the Gantt and Labor Allocation Charts have been prepared. A sample budget is provided in Exhibit 8-9 for the victimization survey tasks of the project (activities E, F and G of the labor allocation chart). Three major budget categories are included: (1) salaries and wages; (2) direct expense items; and (3) indirect costs. Salaries and wages are based on an hourly rate for each position and the estimated hours required. Also included are the fringe benefits for these employees. The direct expenses include the costs of equipment and purchased services such as keypunching.

EXHIBIT 8-9.

SAMPLE BUDGET FOR
PROPOSED VICTIMIZATION SURVEY

SALARIES & WAGES	HOURLY RATE	HOURS	COST
Project Director	12.21	240	2,930
Deputy Proj. Director	10.54	220	2,319
Secretary	5.64	220	1,241
Survey Designer	8.65	120	1,038
Senior Designer	8.03	880	7,066
Analyst	5.17	80	414
Interviewers	3.50	1600	5,600
Coders	5.00	80	400
Total S & W			21,008
Fringe 30% of S & W			6,302
TOTAL DIRECT LABOR			27,310
EXPENSES			
Computer			1,467
Printing			1,000
Telephone			8,400
Keypunch/Verification			1,250
Total Expense			12,117
TOTAL DIRECT COSTS			39,427
*INDIRECT (70% of S & W)			14,706
TOTAL COSTS			54,133

*Negotiated percentage only applicable for a grant or contract application. Not used in operational budget.

Source: hypothetical data

The costs of the direct expenses have been estimated based on the assumption of 5,000 telephone interviews to be completed in a six week period. The last category of indirect costs include overhead costs for such items as office space, heating, and lighting. Normally in an operational agency budget, this category is not included.

In developing a cost estimate, the analyst should assess the scope of each task, costs of alternative approaches to performing the task, and the consequences of reduced cost alternatives on the project schedule, on products, and on management. The basis for costing an alternative may be professional judgment, cost experience in comparable activities, ceilings set by available resources, a pre-test, and/or pure guestimates. For example, if only $40,000 (74% less) was available for this phase of the project, a revised budget could be prepared based on proportionate ceilings within each category: $20,180 would be available for salaries and wages; $8,954 for direct costs, and $10,866 for indirect costs. If resources will not stretch to cover all costs, a significant scaling down of activities and products should be built into the Work Plan.

Rationales need to be developed in this budget for each expense item. Computer costs are based on a contract with Paradise University's Computing Center that includes computer time and one terminal for an estimated $177.25 per month for 12 months. Printing costs are based on twenty copies of two reports, each 200 pages in length (2.5¢ per copy including printing, collating, and binding). Telephone charges are based on a service contract with the telephone company for six watt lines for a three month period to conduct the victimization survey as well as $50 per month for miscellaneous phone charges. The keypunch and verification estimate is based on a per record charge of 20¢ and an estimate of 6,250 records.

In preparing a budget narrative the analyst must be aware of areas in the budget which either comprise a large portion of the budget (e.g., survey costs), are weak in their justification (e.g., the computer charge does not specify the amount of computer time allotted), or are potential cost-reduction items. In a review of the budget these will likely be focused on by a funding source.

All costs of the analysis project should be identified in the budget. If different sources of funds are to be used, the distribution of expenses by funding source should be indicated. In summary, in developing a budget, the following should be considered:[5]

- All other components of the Analysis Plan and, particularly, the Work Plan must be prepared prior to drafting a budget.
- The budget should have the same detail as other components of the Analysis Plan and should be prepared by the person most knowledgeable about the tasks of the project.
- A record of all budget calculations, assumptions, and/or rationales should be kept for future reference and for monitoring of expenses.
- All expenses included in the budget should be well documented in the Work Plan, either in the budget narrative or in appendices,

e.g., the service contracts. It may be desirable to reference budget items to other components of the Analysis Plan that justify the proposed expenditure.

III. Benefits of Planned Analysis

From the perspective of the city manager, mayor, or taxpayer, Analysis Plans help to ensure that a useful product will result from a proposed project. Such planning permits a wider participation in the setting of analytic priorities by citizens, interest groups, and decision makers within the jurisdiction who may be interested or have a need for the results of the analysis effort and whose support may be essential for its funding. From the manager's or supervisor's perspective, preparing Analysis Plans has several advantages. This perspective:

- helps provide staff direction and organization while reducing the uncertainty and risk of analysis efforts
- gives the manager information necessary for establishing a realistic and cost-effective analysis agenda
- facilitates staff and agency performance evaluation in that a clear plan exists by which conduct may be compared
- facilitates early agreement by key participants on the problem(s) and desired products
- provides the manager with concrete proposals for analyses to be performed should additional funds be made available

Of course, the detailed planning of a major analysis effort is expensive. Time spent in preparing and writing such a document is a real expense. The relative effort spent by staff in planning an analysis must be carefully determined by the manager.

Ernest Allen conducted an analysis of the shortcomings of disapproved Analysis Plans submitted to DHEW. While the data are close to 20 years old, Allen's findings still are a useful checklist for planning an analysis effort:[6]

Problem Specification

- The problem is of insufficient importance or is unlikely to produce any new or useful information.
- The proposed research is based on a hypothesis that rests on insufficient evidence, is doubtful, or is unsound.
- The problem is more complex than the investigator appears to realize.
- The research as proposed is overly involved, with too many elements under simultaneous investigation.
- The description of the nature of the analysis and of its significance leaves the proposal nebulous, diffuse, and without clear purpose.

Methods

- The proposed tests, or methods, or scientific procedures are unsuited to the stated objective.
- The description of the approach is too nebulous, diffuse, and lacking in clarity to permit adequate evaluation.
- The over-all design of the study has not been carefully thought out.
- The statistical aspects of the approach have not been given sufficient consideration.
- The approach lacks scientific imagination.
- The data the investigator proposes to use is unsuited to the objectives of the study or is difficult to obtain.
- The number of observations is unsuitable.

Analyst

- The analyst does not have adequate experience or training, or both, for this project.
- The analyst appears to be unfamiliar with recent pertinent literature or methods, or both.
- The analyst proposes to rely too heavily on insufficiently experienced associates.
- The analyst is spreading himself too thin; he/she will be more productive if he/she concentrates on fewer projects.
- The investigator needs more coordination with colleagues.

Management

- The requirements for equipment or personnel, or both, are unrealistic.
- It appears that other responsibilities would prevent devotion of sufficient time and attention to this analysis.
- The institutional setting is unfavorable.

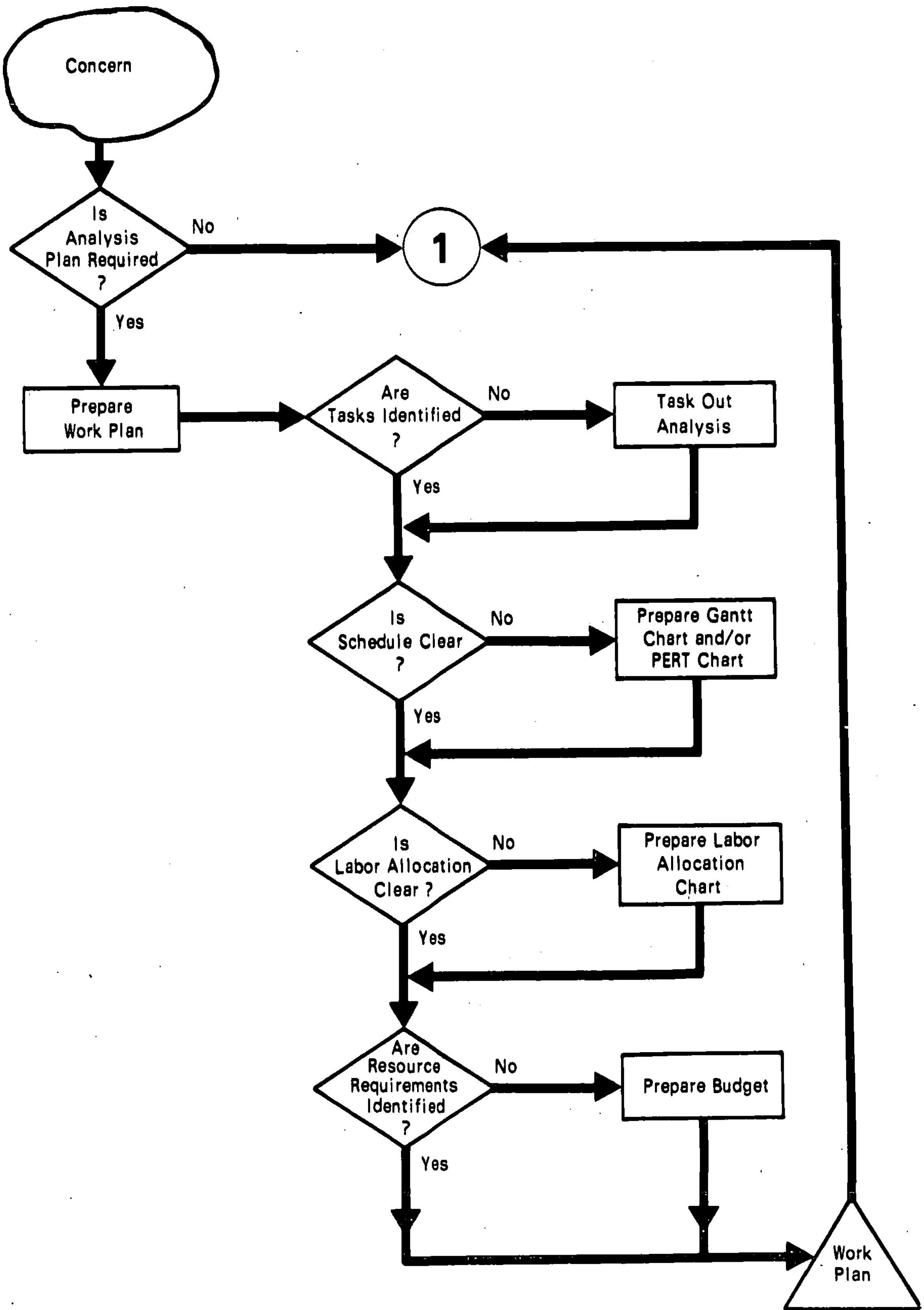
IV. Conclusion

Effective analysis projects must be carefully planned and well managed. In this chapter, the outline of an Analysis Plan and the management tools used to organize an analysis have been presented. The steps to follow in preparing a Work Plan are indicated in Exhibit 8-10.

Uncertainty and risk are inherent in the role of a criminal justice analyst who is actively involved with the decision-making process. By giving more attention to planning analyses formally, as described in this chapter, some of these uncertainties and risks may be dealt with. It is expected that, consequently, the analyst will play a larger and more constructive part in criminal justice decision-making.

EXHIBIT 8-10

CHAPTER 8 SUMMARY CHART: MANAGING ANALYSIS CHART



[1]David Krathwohl, How to Prepare a Research Proposal (Syracuse University, School of Education, 1966), pp. 7-10.

[2]Several excellent sources on research design are available. These include: Donald T. Campbell and Julian C. Stanley, Experimental and Quasi Experimental Designs for Research (Chicago: Rand McNally and Company, 1963); Thomas D. Cooke and Donald Campbell, Quasi-Experimentation: Design and Analysis Issues for Field Settings (Chicago: Rand McNally, 1979); particularly good introduction to research design is presented in John B. Williamson et. al., The Research Craft (Boston: Little Brown and Company, 1977).

[3]Krathwohol, Research Proposal, p. 13.

[4]Additional information on PERT may be found in Desmond L. Cook, Program Evaluation and Review Technique, U.S. Office of Education, 1966. See also Harry F. Evart, Introduction to PERT (Boston, Allyn and Bacon, 1964).

[5]Mary Hall, Developing Skills in Proposal Writing (Corvallis Office of Federal Relations, Oregon State System of Higher Education, 1971), p. 164.

[6]Ernest M. Allen, "Why are Research Grant Applications Disapproved?" Science (Nov. 25, 1960): 1533.

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