FINAL REPORT OF NATIONAL INSTITUTE OF LAW ENFORCEMENT PROJECT N1-71-128-G DERMATOGLYPHICS AND CRIME

"Descriptive Statistics of Fingerprints from the Files of NYSIIS"

Lawrence Razavi, M.D., M.P.H.
Tobey J.E. Reed, M.A.
James C. Wohlieb, B.A.

Behavioral Sciences Foundation
P.O. Box 8246
Boston, Massachusetts, 02114

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TABLE OF CONTENTS

Volume I (Report)

PREFACE

Basic statistics on fingerprint variability, categorized in terms of race, sex and demographic variables, are not available for the North American population. In identification work, classification is done by the Henry System, an arbitrary scheme unrelated to anatomical characteristics, and one which gives unwieldy and unequal dermatoglyphic categories. The result is an unnecessary loss of efficiency in fingerprint file usage, and an incidental lack of utility to medical and biological practitioners. This situation can be improved by using biometric techniques for classifying and analyzing fingerprints, because these are based on biological principles and because fingerprints are biological phenomena. Furthermore, it should be possible to build these techniques into an automatic (computer controlled) statistical procedure for accessing and updating files; and to search for fingerprints on the basis of their true probability of occurrence.

The purpose of this project was to:

1. Collect data on variability of fingerprints in the North American population from the files of NYSIIS (now NYSCJS).
2. Standardize methods for measuring and classifying fingerprints using anthropometric criteria.
3. Develop methods for coding and data processing.

Output

1. A crude data base has been obtained which specifies fingerprint pattern variation according to the following groups in the population: male/female; White/Black/Latin and Mongolian; criminal, mentally ill or civil licensee.
2. A classification manual on fingertip patterns has been prepared.
3. A model computer-usable fingerprint file search strategy has been designed using the above data base.

Resources for such work include:

1. Computing facilities and allied software.
2. Collaboration with NYSIIS and Taft Consulting Corporation.
3. Collaboration with local correctional and law enforcement agencies.

Future work should aim at:

1. Complete statistics on North American dermatoglyphics, digit by digit (specified by radial and ulnar counts) and including finger interdependency frequencies.
2. Full classification manual including coding procedures and equisized categorization of fingerprints, in computer compatible form.
3. Integrated library of software for analyzing data.

Acknowledgments

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All computing procedures at NYSIIS were conducted by Taft Consulting Corporation: their performance was of a high caliber and an integral part of the project. In our judgment, continued collaboration would be essential to any future work of this kind.

We should like to reemphasize the benefit obtained from our grant monitors, Dr. Helen Erskine and Mr. Louis Mayo during a time when reorganization at NYSIIS and NILE made it difficult for us to maintain our objectives. Some difficulties were experienced in that funds were not available for hiring personnel until some time after the starting date of the project; and the NYSIIS central processor was unavailable for a period of five months. We were able, however, to extend the grant at no cost for the added six months necessary and are particularly grateful for the efforts of the grant monitors.

SUMMARY

Scope

The substance of the report is contained in the volume of descriptive statistics of fingerprints from NYSIIS (Appendix A: Data Base). Appendix B deals with methodology (Manual, Coding Forms, Search Methods, and Software List).

The report is confined to descriptive statistics for identification and police science use only. It does not discuss medical studies on diseases which may be associated with variations in fingerprints: this is beyond the scope of NILE's interests, and the NYSIIS automated file, as presently constituted, does not allow full ten-digit comparisons necessary in bio-medical work.

Methods and Materials

Fingerprints were analyzed in several sub-samples taken from records in computer-retrievable format at the New York State Criminal Justice Service (NYSCJS) fingerprint files in Albany, New York. Prior to November, 1972, NYSCJS' name was New York State Identification and Intelligence System, NYSIIS.

The population from which the sample is drawn is all persons over the age of 18 who could have come in contact with NYSCJS because of an arrest, application for a State license or civil service employment, or commitment to a State mental institution. Our basic sample frame (2.7×10^6 persons) is drawn from all persons on the file over the age of 18 and entered into the file between mid-1968 and late 1972.

Samples were collected in Algol using a Burroughs 6700, bulk analysis was done in Fortran on a Burroughs 3500. Secondary analysis was done on a Hewlett-Packard Model 10 programable calculator. Graphing was done on a CalComp plotter using a PDP-7 computer. Statistical formulae used were derived from Chakravartti, Laha, and Roy 1969, and Steel and Torrie 1960.

Several sub-samples were extracted:*

1. 153,512 persons. This file contains all persons for whom no information was missing and who were consistently reported with respect to sex and race.
2. 191,269 persons**: This sample containes persons for whom height, year of birth earlier than 1946, and criminal histories were not screened for missing information. This sample and the first are not mutually exclusive.
3. 76,877 persons. This sample is a sub-set of sample #2 on which complex statistics were calculated.

This file has two primary advantages:

1. It is very large and spans a long period of time so that suitable sampling frames may be selected for various purposes without difficulty.
2. It is computer-retrievable so that large-scale processing is feasible.

There are four primary disadvantages:

1. The entire file is the result of numerous ad hoc methodological changes necessitated by the growth of the file since its inception in 1903. Hence, only cases may be used for whom full records are available and for those who entered the file during a relatively short time-frame during which methods and ascertainment would be relatively standardized. All persons in the present samples entered the file within the last five years.
2. The main purpose of the file is identification, and emphasis is placed on location of intra-digital characteristics such as minutiae and acquired anomalies. Speed of access and matching are the chief requirements and storage is limited to the pattern types which recur with greatest frequency.

2.1 The fingerprint pattern types are classified as ulnar loops, radial loops, whorls, plain arches, and tented arches. The definitions of pattern types are the same as those used in general dermatoglyphics usage with

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* Details of these samples in Appendix A.

** Raw data from the largest file are compiled in Appendix A-2. (NYSIIS I file).

the exception of tented arches. In dactyloscopy (identification), the term tented arch subsumes not only the classic tented arch in which the pattern has a single, central triradius but also includes patterns which anthropometricians would identify as loops. The difference is in the existence of a ridge which abuts at a right angle to the apex of the innermost recurving ridge; in anthropometrics this ridge anomaly is ignored where dactyloscopists call any pattern with "spoiling of the innermost recurve" a tented arch though it has no morphogenetic or classificatory similarity to the classed tented arch. Although this "misclassification" may affect any loop, it occurs most frequently in small loops. To some extent the difficulties are minimized because the computer file format does not record "arches" on all ten digits.

NYSCJS has on its computer only persons who do not have any arches or tented arches unless these patterns occur only on digits II or VII (the index fingers). Persons not fitting this description are in manual files. The reason for this is practical; arches of either type are rare on digits other than II or VII. The total percentage on all other digits is approximately the same as for these two digits alone -- about 7%, half of which occur on the third pair of digits.

2.2 NYSCJS records digits with 27 or more ridge counts as 26. Again the reason is practical because higher counts are rare except on the first digit. A test sample, not otherwise reported here, was run with and without the 26th ridge-class in order to evaluate the effect. There was no significant difference in the mean ridge count per digit although all digits had a slightly lower mean when the 26th ridge count class was excluded. The sole exception was the first digit which was two ridges lower; this result indicates the mean ridge count of digits I and VI as reported in this paper are probably one ridge or so too low.

2.3 NYSCJS records only the radial ridge count of whorls. Thus the total finger ridge count (TFRC) and mean ridge counts per digit cannot be calculated using the standard practice of taking the larger of the two possible counts (radial, ulnar) of whorls. The effect of this defect was investigated by analyzing a special test sample of 752 Caucasian males in which all radial and ulnar ridge counts were recorded. It was found that the radial count was also the larger count in 93% of whorls; the mean ridge count for any digit using only the radial side was 0.4 ridges lower than using the higher of the two sides. Again, this trends the extremes of the distribution in the same way as the defects described above.

The sum of the above deficits is that the tail ends of the distribution of ridge counts are arbitrarily truncated by loss of low and high values (exclusion of arches and 26+ counts). No conclusions can be drawn, therefore, about differences between sub-groups which depend on these extremes though these are often the statistical criteria most useful for analysis in anthropometric studies.

3. Non-dermatoglyphic characteristics of the file are

3.1 Sex and race: these descriptors are originally specified by the individual on application forms and by admitting officers on arrest booking sheets or hospital admission forms. NYSCJS records the number of times an individual is reported for each race and sex. Races are recorded as Caucasian, Negro, or Mongoloid with no provision for alternatives. Ethnic or ancestral origin, other than racial, is not known. Within these limitations, only cases in which the same race or sex has been consistently recorded were included in our sample.

3.2 Birth statistics: all persons in this sample are born in the United States or Canada, excluding Puerto Rico. Month and year of birth are recorded. Records in which birthplace or birthdates were not stated or were inconsistent were excluded.

3.3 Social characteristics: the basic divisions of this file are civil records, penal records, and mental health records. Under civil records, the type of license application, presence or absence of civil service employment application, and State employment are recorded. Under penal records the number and types of arrests, number and types of convictions (both specified by law code), type of imprisonment, length of sentence, type of release, narcotic user status, and NYSCJS' recidivist definition are recorded. Under mental health records the type of institution, reason for admission, and type of release are noted. It is uncertain whether these categories have more than label value, but some attempt was made to minimize lack of compatibility by sampling within a relatively short time-frame.

For the purposes of this paper initial grouping was made by sex, race, and definition of social (civil/criminal, depending upon whether an arrest record is present).

All samples are maximized, given the constraints of the file, although this results in unequal sample sizes. Maximization has the advantage of producing complete statistics on rare variants, such as the mean ridge count of radial loops on digit X of females; the frequency of this pattern on this digit is only 0.07%.

A note should be made of the fact that the information came from files used primarily for police sciences; name or identification number, individual identifiers and non-relevant information were rigorously excluded from this file. There is no possibility of identification of any specific individual -- the file was constructed to preclude this possibility.

Dermatoglyphic statistics were calculated as follows: Total finger ridge counts, mean finger ridge counts per digit, pattern-specific ridge counts per digit, pattern-specific summed ridge counts, overall pattern frequencies per digit, homologous digit and hand, number of patterns per set, ridge counts per number of patterns per set.

For ridge counts, variance and covariance matrices, regression and factor analyses and all possible t-tests were calculated. Since more data has been calculated than may be conveniently presented in one paper, only initial statistics which are in most general use to workers in the field will be reported. Fuller details will be presented in forthcoming papers. Comparative data from the literature case from papers published between 1892 and 1973 (a full bibliography will be published in the Bulletin of the International Dermatoglyphics Association).

Results

Total finger ridge count*

The total finger ridge count (TFRC) is the sum of one ridge count value for each digit per individual. It is intended to measure overall differences between populations in either pattern frequencies or pattern sizes. When Bonnevie originally proposed a summary statistic, she used the mean value for the two possible ridge counts of whorls as the single value for whorl-bearing digits (Bonnevie, 1924). Criticized by Gruneberg because a single value thus derived may reflect a wide variety of combinations of ridge counts on either side of the digit, Bonnevie adopted the convention of utilizing the larger of the two possible counts (Bruneberg '28, Bonnevie '32). Almost all authors have continued this convention (see especially Abel '37, '38; Geipel '35, '54; Holt '48 to '68). Rife '53 summed both whorl counts for a single value.

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* See Tables 1-3 and 33.

TFRCs and single digit mean ridge counts are shown in Table 2. At the top of the columns is a group number (from 1 to 12). These group numbers correspond to the group numbers in the tables in the Appendix in which all possible t-tests between these groups is charted. All of these data are from sub-sample number 1, with a total of 153,512 persons.

The mean TFRC for the entire population is 139.05, S.D. = 34.83, but this figure is biased towards males and Caucasians since the sample sizes are unequal. The mean TFRCs for males and females are 140.12, S.D. = 35.40, N = 131,833 and 132.52, S.D. = 34.35, N = 21,679 respectively. The male TFRCs are higher than the female in all races or civil/criminal groups except for Oriental criminals in which the female value is higher; this may be because of the small sample sizes in the Oriental groups. The small Oriental groups preclude definite statements about the dermatoglyphics of this group so that only general trends can be noted.

Considerable difference also exists between the racial groups. The Oriental groups tend to have the highest TFRCs, but they are only slightly higher than the Caucasian values and the differences between these groups are not statistically significant. Although only three studies in the literature in which the TFRC was given or could be calculated were located the mean reported TFRC for Orientals in the literature is 151.71, S.D. = 3.06, (total number of people = 839). Note that this S.D. is not the same as the standard deviation for a population (see Table 4).

The mean for Oriental males and females is 141.05, S.D. = 33.81, N = 263 and 143.48, S.D. = 31.82, N = 52. The male value, especially, is very close to the value for Caucasian males; 142.11, S.D. = 37.31, N = 92,955, whereas the Caucasian female value is considerably lower; 134.79, S.D. = 37.11, N = 12,854. The mean TFRC for Caucasian females may be somewhat higher than the true value because of the lack of data on arches on digits other than II or VII since females have more arches on these digits than males (see below). Comparison with the world literature indicates that the mean female TFRC reported for 104 Caucasian groups is 128.81. The literature mean for Caucasian males, 139.80, is very similar to the NYSCJS values. The NYSCJS values are not statistically significantly different from the literature values (using z-test of location in a normal curve); nonetheless the Caucasian female values appear to be low.

Persons of the Negro race have the lowest mean TFRCs; the mean for Negro males is 135.32, S.D. = 35.28, N = 38,615 and for females 129.13, S.D. = 34.12, N = 8,773. The comparative literature value for African males is 123.41, S.D. = 12.30, N = 11 studies (1,281 persons). There is no comparative literature for African females. Only one study of American Negroes is available, in which the mean TFRC for males is 119.0, S.D.= 40.8, N= 224: Female $\overline{X}$= 106.4, S.D.=47.4. Thus it is difficult to ascertain the degree to which the defects of the NYSCJS files affect the TFRC values for both the Negro and Oriental groups.

Despite the drawbacks of the file, all of the groups were subject to the same analysis. Therefore, it may be stated that the Negro groups have a mean TFRC that is lower than that of both Caucasians and Orientals. Whether Orientals have a higher TFRC than Caucasians has not been ascertained.

Although the definition of criminal used in this initial analysis of the file is crude, persons with one or more arrest charges are classified as criminal; significant differences between the criminal and non-criminal groups were found, especially in males. The TFRC of the criminal groups are about two ridges lower than the non-criminal groups. Although this difference is not as great as the five-to-six ridge difference between sexes or races, it is significant in most groups at the P = 0.001 level.

For Caucasian males, the non-criminal group has a mean TFRC of 143.83, S.D. = 37.31, N = 17,722; whereas the criminal group has a mean TFRC of 141.71, S.D. = 36.92, N = 75,233 persons. In all groups the standard deviations for the non-criminal samples are slightly larger than for the criminal groups, although the significance of this was not tested.

The only exception to the criminal/non-criminal difference is female Orientals in which the criminal group is 9.7 ridges higher. The sample size for non-criminal female Orientals is only four.

Digit I*

The thumbs are, for anatomical reasons, if no other, unique. They are the largest of the digits, in opposition to the fingers. In the factor analyses programs of several authors (listed in Knussmann, 1967), the thumbs are influenced by a factor which is not shared with any other digits. The same is true of our factor analyses, which were done slightly differently from those listed in Knussmann.

The mean ridge count of the right thumb is the highest of any digit. In the world literature, the mean ridge count of the thumb for 18 Caucasian European groups is 18.59, S.D. = 0.13, which is slightly lower than the NYSCJS groups in which the means are 19.54 and 19.27 for non-criminal and criminal groups respectively. For all of the groups, the right thumb does not show a consistent difference between the criminal and non-criminal groups. The difference between races is greater for digit I than for any other digit. The mean for Caucasian civil males is 19.54; for Negro civil males it is 16.89. The t-value for this difference is 33.55, which is decidedly significant. The Oriental and Caucasian values are very similar; the differences are statistically significant, but only barely so.

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* digital frequencies: see Tables 4-8, 20, 22-32.

For all of the groups, the females have a mean ridge count about two ridges lower than the males. This difference is statistically significant in all of the races except the Orientals.

Digit II

Contrary to the first digit, the right hand index finger shows the least variation between the races, sexes, or criminal groups. The highest mean is 12.54 for male Oriental non-criminals and the lowest is 10.90 for male Caucasian criminals. All of the others have mean ridge counts between 11.00 and 11.99. There does not appear to be any significant trends, although some of the differences are significant. Both White male criminals and Negro male non-criminals are significantly different from several other groups, but this is probably because these are the extreme values for groups of reasonable size.

The NYSCJS values are almost exactly the same as the pooled literature values. The literature female mean of means of 10.18 is low compared to NYSCJS but this is based upon only eleven studies.

Digit III

Digit III exhibits all three major differences. None of the absolute differences in the means of the various groups is great, but the differences which exist are uniform and consistent. For example, male means tend to be about 0.2 to 0.3 ridges higher than the female, and they are higher in all of the groups. The differences between sexes are also about 0.3 - 0.4 ridges: Orientals are highest, Caucasians are middle, and Negroes are lowest. The 0.3 - 0.4 ridge difference is incremental between groups so that Orientals and Negroes differ by twice this amount. This is the only digit in which the races divide into three groups, except for digit VII, the left hand homologue.

Unlike digits I and II, digit III shows a consistent difference between the criminal/non-criminal groups of about 0.2 ridges -- somewhat less than the sexual difference. Some of the Oriental groups are too small to evaluate. These differences are statistically significant for the male groups, but not for the females. For Caucasian males the t-value for the difference between the means is 4.78, which is significant at P = 0.001.

The mean ridge counts for the NYSCJS samples are considerably higher than the pooled European values. The pooled male mean is 11.49, compared with 12.48 for Caucasian male non-criminals. This is probably due to the lack of arches for this digit in the NYSCJS population, especially since arches have a zero ridge-count.

Digit IV

The fourth digit, like the third, exhibits all three kinds of differences and the absolute values of these differences is greater. For females, the racial differences are not uniform. As on all digits except II the male mean is higher than the female. The criminal/non-criminal differences are uniform for all groups, although the difference is not statistically significant for the females.

The NYSCJS means are again very similar to the pooled European values. In the literature, the reportage of the mean for digit IV of males varies more than for any other digit. The mean reported value is 15.95, S.D. = 1.30, N = 18 studies.

Digit V

Digit V is unique in not showing a consistent racial difference, although the sexual variation is present, and the criminal/non-criminal factor is small, but present. Males show a slight tendency to be higher in Caucasians than in Negroes; all of the racial differences are so small that

it is difficult to determine meaningful variation. The differences for males are statistically significant at the P = 0.001 level. For Caucasian male non-criminals, the mean ridge count is 13.94, for the Negro group it is 13.57; for females the respective means are 12.88 and 12.80. These means are almost exactly the same as those for the pooled literature data; male 13.24 and female 12.30.

Digit VI

The thumbs are unique not only in the greater differences in ridge counts between the sexes, etc, but also the difference in the means of the homologous digits is greater than for any other pair of digits. Digit VI of male Caucasian non-criminals has a mean of 17.04, compared to the mean of digit I of 19.54. In the pooled European literature values, the mean for digit VI is 15.68, compared to 18.59 for digit I.

The sex difference for Digit I is strong, males having a mean almost two ridges above the females. The mean for male Caucasian males is 17.04, the mean for the female group is 15.25 ridges. The t-value for this difference is 14.80, which is significant. The racial pattern for VI is the same as for I; that is, the Negro means are 2.0 - 2.5 ridges below both the Caucasians and Orientals. The criminal means are all 0.2 - 0.3 ridges below the non-criminal, with the exception of male Orientals. These differences are statistically significant for the Caucasian and Negro males, but not for the other groups.

Both thumbs have a pattern to the standard deviations which differs from that of the other digits. All of the other digits tend to show a greater standard deviation for Caucasians than for Negroes. Generally the Oriental standard deviations are also higher than the Negro values, but this is not always clear since the small size of these samples greatly influences the standard deviations. On the thumbs the Negro groups have greater variation in the ridge counts than either of the other racial groups. The difference is not great. For Caucasian male non-criminals the standard deviation for digit VI is 5.05; for Negro male non-criminals the S.D. is 5.32.

Digit VII

Unlike digit II, digit VII shows a distinct pattern to the differences in all three characteristics under discussion. Racially, Orientals have the highest mean ridge count which tends to be considerably above that of the other groups. Male non-criminal Orientals have a mean of 12.64, which compares to the Negro and Caucasian means of 10.89 and 10.59 respectively.

The criminal and non-criminal groups again differ by about 0.3 ridges, the difference being statistically significant for Negro females and Caucasian males. The Oriental female criminal mean is higher than the non-criminal mean, but the samples are too small for evaluation.

Digit VIII

Digit VIII shows a strong, consistent difference in the sexual means of about 0.6 ridges. The mean for Caucasian non-criminal males is 12.81; for females it is 12.05, the t-value for this difference is 6.45 which is highly significant. Both of these means are higher than the pooled literature values of 11.73 and 10.29 for males and females respectively. Using the z-test of location in a normal curve, the NYSCJS values are significantly high at probabilities less than 0.001. The reason for this difference is not known.

The mean ridge counts for the non-criminal groups are higher than for the criminal, with the exception of the Negro females in which the means for this characteristic are equal on digits VIII, IX, and X. Only the difference for male Caucasians is statistically significant for digit VIII; the criminal mean is 12.81 and the non-criminal is 12.63, the t-value for this difference is 4.29 which is significant at $P = 0.001$.

Digit IX

Both digits VIII and IX have higher means for Orientals than for Caucasians. The Caucasian means are higher than the Negro, thus a tripartite layering of the means is again present. For non-criminal males, the respective means are 16.32, 16.15, and 15.73 indicating a greater difference between Negroes and Caucasians than Caucasians from Orientals. Only the difference between Negroes and Caucasians is statistically significant: $t = 3.45, P < 0.001$.

Digit IX shows a consistent sex difference of about 0.5 - 0.7 ridges. These differences are significant for all groups except the Orientals. Male non-criminal Caucasians have a mean ridge count of 16.15, compared to the female mean of 15.40; the t-value is $6.14, P < 0.001$.

The criminal means are consistently lower than the non-criminal, but this difference is only statistically significant for Caucasian and Negro males. The male Caucasian criminal mean is 16.01, the non-criminal mean is 16.15; the t-value for this difference is $3.28, P < 0.001$. The non-criminal means are about 0.1 - 0.2 ridges lower in all of the groups except the Orientals. The Oriental non-criminal mean is lower than the criminal mean; 16.32 and 16.54 respectively. This difference is not statistically significant.

The female Caucasian non-criminal mean is somewhat above the pooled literature mean of 14.56 ridges, although the difference is not significant. The NYSCJS and literature means are more similar, 16.15 and 15.73 ridges, for males.

Digit X

The racial differences in the fingerprint mean ridge counts are apparent on the fifth digit of the left hand, although they weren't on the right hand. The mean for Caucasians is higher than that for Negroes; the Oriental situation is far from clear. The difference is about 0.2 - 0.3 ridges and is statistically significant for all comparisons except Negro male criminals versus Oriental male criminals and Negro male non-criminals versus Oriental male non-criminals. For Caucasian non-criminals the means, by sex, are 13.89 and 12.76 for males and females. All of the male values are 1.1 - 1.2 ridges higher than the female values, except in the Oriental comparisons.

The NYSCJS Caucasian, non-criminal means compare quite favorably with the pooled literature means of 13.40 and 11.92 for males and females. The means of the non-criminal groups are higher than for the criminal groups: for White males the means are 13.89 and 13.65 for non-criminals and criminals, this difference is statistically significant (t-value = 6.54, $P < 0.001$). All of the non-criminal means are higher, except for female Negroes. They are statistically significant only for males; the female Oriental difference (13.83, 7.00) for criminals and non-criminals is statistically significant -- $t = 2.56$, $df = 52$, $P < 0.02$ -- although the number of female non-criminals is very low (e.g., four). This is probably not a valid comparison.

Transformations*

The tables listing pattern frequency show rather large standard deviations and this suggests that pattern frequency figures are inherently less accurate for statistical processing than ridge counting figures. Pattern classification schemes use ideal examples of each pattern class but do not define the borderline that exists between pattern types. Many of these

*see Tables 9-15.

intermediate types, however, do exist and with no great rarity. On the other hand, ridge-counting is inherently more accurate since only one such border exists between the existence or absence of a ridge count of a given value; or equivalently between the absence or presence of triradii. Random errors will sum to zero and systematic errors may be reduced by rigorous definition of rules for ridge-counting, such as those suggested by Henry (1903) for use by fingerprint bureaus. The most straight-forward solution to the problem is to make use of radial and ulnar ridge counts to transform pattern classifications into digit-specified radial and ulnar ridge counts.

Data for pattern frequencies by digit have been collected for 163 studies. Grouped means were calculated for arches, loops (radial and ulnar) and whorls on each digit. Breakdown of the studies by georacial area is shown in Table 16. Data for the 43 European groups are presented in Table 17.

The existence of a ridge count (or, equivalently, a triradius) on a particular side of a digit may be inferred from the pattern type -- both LU and W have a ridge count on the ulnar side (US), etc. The percentage occurrences of a ridge count on each side of the digits were calculated for all 163 studies. The grouped mean values for the RS and US are presented for each group (Table 18) for homologous pairs of digits. Taking the frequency of occurrence of each of these counts, Table 18a is derived which is close to Table 18b.

The simplified pattern-type expectancies are calculated for the simplified percentage occurrences of a ridge count on either side of each digit (Table 19a). For example, for whorls a ridge count is present on both sides of the digit; for digit II 75.00% of the RS has a ridge count and 50.00% of the ulnar-side has a ridge count, thus the concurrent chance of both occurring is 75% X 50% or 38%.

The observed pattern frequencies for these 163 studies is shown in Table 19b. The concordance between the observed and expected values is rather great. This analysis indicates that the sides of the digits are independent, that the classical pattern types (ALW) are names specifying the existence of a ridge count on both sides of the digit (W), one side of the digit (L) or absent from both sides of the digit (A). Similarly, variations in the number of ridges on either side of the digit are codified in the names of the sub-groups of whorls.

The percentage occurrence of a ridge count on the RS of all digits is about 100% for all digits, except the second, in all the georacial groups. Therefore, differences which have been reported for the sexes and which may exist between races, are differences in the occurrence of a ridge count on the ulnar side of the digits and the mean value of the ulnar ridge counts.

This analysis also shows why Bonnevie's choice of the larger of the two ridge counts for whorls as the single value for inclusion in the TFRC was unfortunate because exclusion of the ulnar ridge count excludes the side of the digit which maximally reflects differences in various populations. It is therefore likely that analysis of the two sides of the digits independently will be of value to those working with specific groups.

Height*

Although the non-dermatoglyphic characteristics are not related to fingerprints, they are descriptive of the population and the differences between groups within this population. Four primary descriptive statistics were included in this preliminary analysis, and the definitions of these are sometimes rather crude. Height is recorded for each input into the NYSCJS system; the heights recorded here are the averaged values for each individual

*non-dermatoglyphic variables: Tables 21, 34-37.

averaged for all individuals in the sample. The non-dermatoglyphic characteristics exhibit some interesting patterns, often in contradistinction to other studies; they will be presented without comment, partially because we do not have sufficient information for rigorous analysis of these data.

Naturally, the mean heights of the females is shorter than the males, and all such differences are decidedly significant. The mean height for non-criminal Caucasian males is 69.98 inches; for females it is 64.24 inches. There is relatively little difference between the heights of the various races. The differences in the means of criminal male and female Caucasians are significantly lower than the means of the criminal male and female Negroes, although the differences for the non-criminal groups are not significant between these races. The Oriental and Caucasian height differences are statistically significant for males, but not for females; similarly for the Oriental-Negro comparison.

The average height of the criminals is between one-half and three-quarters of an inch less than that of the non-crimianls. Female criminals are an exception and are not shorter than their non-criminal counterparts. All of the differences are statistically significant, except for the Orientals. For Caucasian males, the mean criminal height is 69.10 inches; for non-criminals it is 69.98 inches. The t-value for this difference is 111.10; the probability that there is no real difference between these heights is astronomically low.

<u>Year of Birth</u>

The criminal groups are considerably younger than the non-criminal groups. The difference is about five to six years. This is not too surprising since the non-criminal groups are civil service applicants, license holders, and certain government employees. It has previously been well established

that criminals are often quite young at the time of first arrest. The correlation coefficient of the TFRC and the YOB is $r = 0.013$ for males and 0.019 for females; the t-values for the probability that $r = 0$ are 1.09 and 0.57 respectively. Since these correlations are non-significant, it appears that the difference between the times of birth of the criminal and non-criminal groups is not the cause of the dermatoglyphic differences in the mean ridge counts or TFRC.

The average age of the females is three to five months younger than the males in all groups except Oriental female criminals whose mean ages are exactly equal. Other than the Oriental groups, all of these differences are statistically significant except for the difference between non-criminal Negroes. The criminal Caucasians and Orientals are younger than the criminal Negroes; the non-criminal Negroes are slightly younger than the non-criminal Caucasians -- the Oriental mean ages are not clear with respect to this characteristic.

Number of Charges

The number of arrest charges per individual is higher for Negroes than for Caucasians or Orientals. This is probably because of the age differences in these groups. For Caucasians, the correlation coefficients for the number of charges and the YOB is $r = 0.11$, $t = 31.60$ for females and $r = 0.08$, $t = 8.78$ for males. Since the Negro groups tend to be somewhat older than the Caucasian or Oriental groups, they have had more time, past the age of 18, in which to get arrested.

The number of charges for females is considerably less than for males; for Caucasians, the mean number of charges for females is 2.10; for males it is 2.20, the t-value for this difference is 6.34, $P < 0.001$.

For Negroes, the sexual difference is even greater, the female mean is 2.65 arrests and for males it is 3.10 arrests, for a t-value of 16.08. The difference between the ages of these Negro groups was barely significant, t = 2.07 for mean YOBs of 45.64 and 45.86, males being younger. The mean number of arrests for Orientals is lowest of the racial groups, but the sexual difference is still present: for females the mean number of charges is 1.67, for males it is 1.94; this difference is highly significant, t = 54.27. *

Sentence Length

The mean length of sentences for Negroes is between two and two and a half times as large as for either Caucasians or Orientals. In addition, approximately the same ratio exists between males and females within each race. This is probably a sociological factor of selection against Negroes coupled with a tendency for women not to receive as long a sentence as males, or not to commit the same kinds of crimes (many of the female arrests in this file are for prostitution; many of the male arrests are for breaking and entering or theft).

The mean sentence length for Negro males is 10.68 months, for Caucasian males the mean sentence length is 4.22 months; the t-value for this difference is 18.21, although it is doubtful how meaningful this t-value is. There is no question but that the differences between these groups are statistically significant and meaningful, but the distributions are not Gaussian. The standard deviations are 7 - 8 times the means. For Negroes, the coefficients of variations are 718.82% and 802.87% for males and females. The standard deviations suggest that the distributions are bimodal rather than Gaussian. Unfortunately, the distribution of this characteristic has not yet been graphed.

* statistical summaries: see Tables 20-37.

Dissemination

Information on these results and volumes of basic statistics have been provided to our collaborators and interested local agencies including the following:

1. Massachusetts Department of Corrections, Research Department
2. Barnstable County Police Department, Criminalistics Research (Sheriff Lou Cataldo)
3. John Jay College of Criminal Justice, New York City (Professor Charles Kingston)
4. Fingerprint Bureau of the Metropolitan Police, London, England
5. International Dermatoglyphics Association, Johns Hopkins University (Dr. Digamber Borgoankar).

Conclusions

The NYSIIS file has certain unique advantages. No other body of data of this size or immediacy exists. It is automatically processable and serviced by a well-established computing system. This is important because updating will be necessary. However, NYSIIS has avoided entering certain measures described in the previous sections, and to realize the full potential of the system for improving classification and manipulation of the file, it is extremely important to store all possible dermatoglyphic information. Specific modifications to the file should be made as follows:

1. The file should be updated regularly according to the changing mix of the population at large and on the NYSIIS records, and volumes of current descriptive statistics issued.

2. Counts present on digits other than II and VII, and the distinction of plain arches from tented arches, and, possibly, tented arches from small loops (i.e., patterns with spoiled inner recurves); ulnar counts and whorls; and counts above 26, should be included as soon as possible.

While there may be some difficulties in re-training identification personnel in distinguishing spoiled loops from tented arches, the classificatory value of the distinction of the small loop sub-set of the loop population will be immediately evident. This should add no great labor to the task of measuring and classifying ridge counts precisely because it is a relatively infrequent finding. When present, however, it serves as an extremely useful method for characterizing a single digit and of itself may offer an extremely fast route to matching or locating particular prints. It is a strategic error to eliminate characteristics because they are rare, in order to save time and expense of recording: as much or more is lost in the time and cost of locating unique fingerprint patterns when many of their peculiar and special characteristics are not available.

3. These updated statistics can be useful for the following purposes:

3.1 Survey of the efficiency of the recording system: a surprisingly large number of rejects were encountered during the initial processing of the NYSIIS file, because of missing or unusable information.

3.2 Development of search table whereby fingerprints can be correlated with absolute frequencies or according to their covariance with other digits. This search table should, of course, be updated in the same way as the basic statistics on which it depends.

3.3 It should be useful to specify the descriptive statistics by more detailed social mental health and crime categories since these provide independent methods of categorizing data.

3.4 An integrated library of software should be completed to maintain the descriptive statistics up to date and to take account of modifications in recording techniques.

3.5 A rational classification scheme can be based on the above (biometric rather than arbitrary) measures and this will probably have more equisized boxes than the present Henry System or its derivatives.

3.6 Computational difficulties of multiple regression and factor analysis or hierarchial probability schemes require both a large body of data and an automatically processable file. It seems highly desirable to train specialists in techniques for using these statistical procedures and the NYSIIS file offers a good opportunity for this. The current access rate to NYSIIS is approximately 192,000 sets per year. Clerical cost of searching, which includes recoding and accessing, is about \$2 per search plus \$0.55 for amortizing of computer costs, and the time taken is two seconds. Manual searches, however, take about 10 to 15 minutes at a cost of approximately \$3. The overall saving is one of time rather than cash, and amounts to \$5.50 per search, i.e., $\$10^6$ per year. These figures alone make it desirable to make the file as fully computable and as complete as possible.

4. Because pattern classification is highly subjective compared to ridge counting, transformation of the data to more readily interpretable format is strongly recommended. The presence of a ridge count on one or other side of the digit defines the presence of a loop; the presence on both sides defines a whorl and absence on either side defines an arch. The frequency of a ridge count, of whatever value, will be the same as the frequency of the patterns arising from the presence of such ridge counts. The two tables of frequencies can be calculated independently. If this is done they are found to approximate extremely closely. This suggests that recording radial ulnar ridge counts on all digits may be sufficient for basic pattern classification into arch, whorl, loop ulnar and loop radial

as a preliminary method for quantifying classification schemes. The chief value would be to rationalize the initial classification of the files and make them more amenable to automatic computation.

Recommendations

Some of the following recommendations are implicit in the way in which data has been compiled for this report (Appendix A); and in the methodology used (Appendix B). These data provide the ground-work for future work which should aim at the following specific objectives:

1. Detailed digit-by-digit descriptive statistics, to include total radial and ulnar ridge counts and, by transformation, pattern types classified according to size as well as specific morphology.
2. Categorization of single and covariant groups of fingerprints into groups of similar size and greater amenability to automatic storage and access.
3. Probabilistic search strategy based upon the above criteria (see also Appendix B3).
4. Allied software for statistical processing:
   - 4.1 Access and retrieval packages (see Appendix B4)
   - 4.2 Descriptive statistics package (tabular frequencies by item, group, and category)
   - 4.3 Analytical statistics package (graphical distributions; comparisons between groups; multiple regression analyses).

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Table 1

Group	Mean TFRC	S.D.	N
Allrace, M&F	139.05	34.83	153,512
Allrace, Males	140.12	35.40	131,833
Allrace, Females	132.52	34.35	21,679
Caucasian, Males	142.11	37.31	92,955
Caucasian, Females	134.79	37.11	12,854
Negro, Males	135.32	35.28	38,615
Negro, Females	129.13	34.12	8,773
Oriental, Males	141.05	33.81	263
Oriental, Females	143.48	31.82	52

Mean TFRCs for general North American population (NYSCJS).

Total finger ridge counts for race- and sex-specified subgroups of the NYSCJS data. Race and sex are determined by asking the subjects.

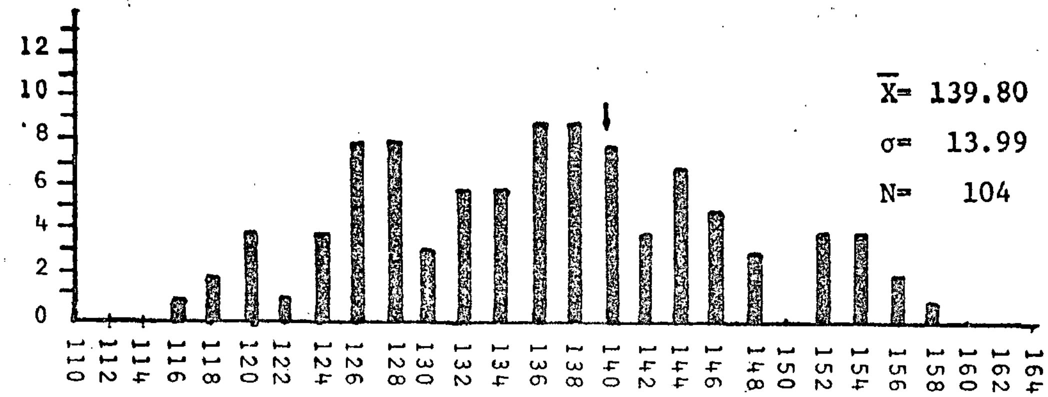
Table 2

Group	Mean	S.D.	N	M
Allrace, M&F	136.04	13.67	171	293,123*
Allrace, Males	139.80	13.99	104	226,142*
Allrace, Females	128.81	11.44	63	46,981*
Caucasian, Males	139.57	4.01	69	12,566
Caucasian, Females	129.13	6.20	43	7,618
Negro, Males	123.41	12.30	11	1,281
Native Amer. Males	139.81	16.84	13	1,753
Oriental, Males	151.71	3.06	3	839

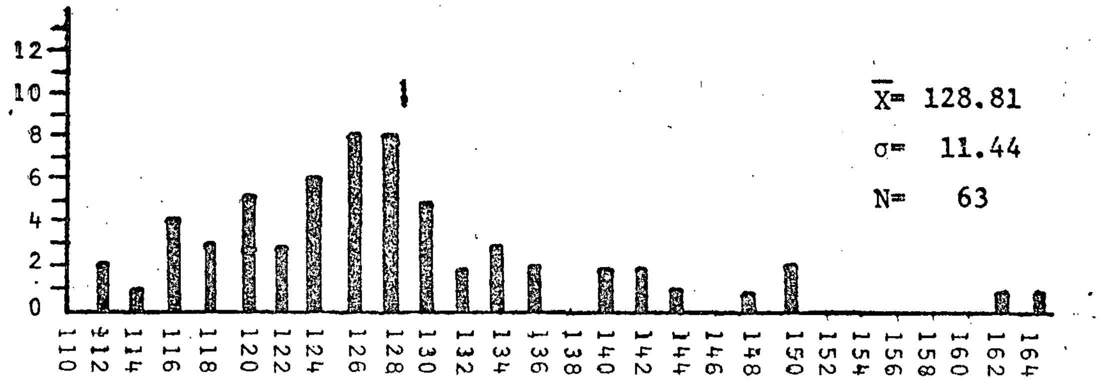
Grouped Mean TFRC Values for Pooled Georacial Groups from literature

Grouped mean TFRC values are calculated for 139 studies from the literature. N is the number of studies. M is the total number of persons in the studies. Asterisked studies include pooled data from 41 subgroups of the NYSCJS data. No literature data is available for non-Caucasian female groups.

Table 3



MALES



FEMALES

Distribution of Literature TFRCs

Distribution of TFRCs from literature sources; all races and ethnic groups are combined. The given statistics are unweighted for sample size. TFRCs from the NYSCJS data are included. Some outlying values are omitted such as a male TFRC of 205 and a female value of 90.

Table 4

Group	I	II	III	IV	V	VI	VII	VIII	IX	X
Allrace	18.40	10.55	12.07	15.87	13.51	16.08	10.01	12.42	15.71	13.38
Males	5.02	5.88	4.51	5.02	4.56	5.11	5.64	4.64	4.85	4.26
N=160,229										
Allrace	17.00	11.06	12.09	15.70	12.81	14.65	10.14	11.97	15.26	12.56
Females	4.86	5.31	4.22	4.94	4.56	4.92	5.27	4.54	5.03	4.44
N=31,040										
Caucasian	19.54	11.12	12.48	16.23	13.94	17.04	10.59	12.81	16.15	13.89
Males	4.78	6.05	4.83	5.25	4.81	5.05	5.68	4.89	5.02	4.42
N=17,722										
Caucasian	17.58	11.17	12.14	15.66	12.75	15.16	10.27	11.94	15.31	12.58
Females	4.79	5.50	4.47	5.28	4.79	4.90	5.33	4.80	5.32	4.67
N=10,920										
Negro	16.54	11.11	11.99	15.85	13.36	14.60	10.71	12.43	15.48	13.11
Males	5.22	4.80	4.29	4.80	4.29	5.25	4.82	4.56	4.67	4.08
N=36,699										
Negro	13.37	11.13	11.76	15.62	12.66	13.25	10.27	11.78	14.99	12.25
Females	5.04	4.45	4.07	4.80	4.28	5.07	4.60	4.48	4.79	4.22
N=8,280										

Mean Ridge counts per Digit

The mean ridge count per digit and the standard deviation are shown. The N for all items in a row is in the group column. Orientals are not shown separately because of their rarity in the NYSCJS files.

Table 5

Group	I	II	III	IV	V	VI	VII	VIII	IX	X
European Males N= 18	18.59	10.99	11.49	15.95	13.24	15.68	10.28	11.73	15.73	13.40
	0.13	0.28	0.23	1.30	0.13	0.20	0.27	0.25	0.11	0.08
European Females N= 11	16.14	10.18	10.67	15.11	12.30	13.36	9.32	10.29	14.56	11.92
	0.30	0.36	0.20	0.25	0.27	0.44	0.45	0.32	0.29	0.25
Indian Males N= 15	17.83	12.05	12.72	15.65	13.45	16.34	11.83	13.22	15.91	13.82
	1.24	0.93	0.81	0.87	0.98	1.19	0.83	0.84	0.88	1.05
Indian Females N= 9	15.84	11.64	11.98	12.63	15.15	14.67	11.04	11.97	14.96	12.81
	1.15	0.65	0.78	1.09	0.95	1.45	0.47	0.58	0.63	0.86

Pooled Mean Ridge counts per Digit

The grouped mean of the reported mean ridge counts per digit from literature population analyses. The N is the number of studies. Below the means are the standard deviations of the range of reported values. No data is available for Negroes, Orientals, etc.

Table 6

Group	Digit I			Digit VI		
	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N
Allrace males	18.51	5.07	131,833	16.17	5.20	131,833
Allrace females	16.73	5.10	21,679	14.40	5.06	21,679
Caucasian males	19.32	4.78	92,955	16.82	5.04	92,955
Caucasian females	17.62	4.80	12,854	15.18	4.90	12,854
Negro males	16.56	5.23	38,615	14.61	5.25	38,615
Negro females	15.37	5.04	8,773	13.26	5.07	8,773
Oriental males	18.55	5.64	263	16.25	5.63	263
Oriental females	17.64	4.61	52	15.23	4.71	52

Mean Ridge counts of the First

Pair of Homologous Digits

The mean ridge counts of the thumbs exhibit the greatest variation between races in the NYSCJS data. The Negro means are about three ridges lower than the Caucasian or Oriental means.

Table 7

Digit Side	I	II	III	IV	V	VI	VII	VIII	IX	X
Radial side	18.59	7.78	11.40	15.47	13.39	15.71	7.74	11.23	15.31	13.12
with zero class	6.08	7.02	5.95	6.25	5.24	5.93	6.84	6.25	6.09	4.77
N= 752										
Radial side	18.89	11.68	12.23	15.77	13.54	16.27	11.25	12.42	15.58	13.17
w/o zero class	5.64	5.33	5.28	5.93	5.08	5.23	5.30	5.33	5.79	4.71
N=	740	501	701	737	744	726	517	680	739	749
Ulnar side	6.38	7.86	2.82	6.63	1.68	4.18	6.86	2.75	4.76	1.23
with zero class	8.09	8.45	6.51	7.51	3.98	7.08	8.07	6.29	6.99	3.56
N=752										
Ulnar side	14.76	13.52	14.00	12.41	8.84	14.30	12.61	13.16	12.08	9.66
w/o zero class	5.17	6.79	7.28	5.82	4.47	5.13	6.86	7.25	5.97	4.26
N=	324	437	151	402	143	220	409	157	296	96

Ulnar and Radial Mean Ridge counts

The mean, standard deviation, and N for the individual sides of each digit are calculated both with and without the zero class of ridge counts. With the zero class, the N is the same for all digits. This data is from an auxiliary analysis of 752 white, American males (MBI data). NYSCJS does not record the ulnar ridge count.

Table 8

MALES	I	II	III	IV	V	VI	VII	VIII	IX	X
Ulnar Loops	16.75	10.29	11.28	13.93	12.92	14.66	10.34	11.69	14.29	12.96
	5.06	4.72	4.24	4.94	4.47	4.92	4.19	4.33	4.69	4.21
	79,367	55,253	123,580	72,965	129,485	97,946	64,196	124,891	95,541	138,162
Whorls	20.05	13.07	15.12	17.66	16.10	18.35	12.86	15.68	17.87	16.09
	4.40	4.27	4.02	4.35	3.97	4.57	4.23	4.01	4.24	3.51
	80,372	61,274	33,855	85,521	30,332	61,571	55,780	32,776	64,197	21,929
Radial Loops	16.17	11.18	9.56	9.76	8.40	15.28	8.98	6.50	8.77	8.56
	5.53	6.22	5.71	3.75	3.37	5.36	6.14	5.44	4.47	4.08
	490	28,681	2,794	1,743	412	712	24,768	2,562	491	138
FEMALES										
Ulnar Loops	15.55	10.51	11.46	14.05	12.38	13.26	9.80	11.20	13.79	12.17
	4.81	4.40	3.98	4.81	4.48	4.67	4.03	4.25	4.83	4.37
	17,742	13,326	25,635	16,533	26,836	18,802	12,430	24,191	18,555	26,831
Whorls	18.95	13.22	15.25	17.66	15.66	16.82	12.43	15.12	17.51	15.43
	4.19	4.07	3.85	4.30	4.01	4.48	4.11	3.97	4.44	3.76
	13,261	12,302	5,317	14,383	4,175	12,163	11,830	6,554	12,382	4,184
Radial Loops	14.27	10.88	6.00	8.68	6.90	14.00	9.76	4.86	7.50	6.80
	5.78	6.25	3.76	3.09	3.44	4.57	6.28	4.22	4.33	2.90
	37	3,732	88	124	29	75	4,737	295	103	25

Digit- and Pattern-specific Mean Ridge counts

The mean, standard deviation, and N of the ridge counts of each digit specified by the type of pattern on the digit. N is the number of digits and the number of persons. The total number of subjects is 160,229 males; 31,040 females.

Table 9

ALLRACE

Number of Ulnar Loops	MALES %	$\bar{X}$	S.D.	N	FEMALES %	$\bar{X}$	S.D.	N
0	1.45	----	----	1,011	1.20	-----	----	120
1	3.38	16.58	3.61	2,261	2.91	16.08	3.59	293
2	5.76	15.88	3.17	3,849	5.51	15.51	3.01	555
3	6.65	15.35	3.05	4,444	6.09	14.85	2.91	613
4	8.46	14.90	2.99	5,652	6.90	14.65	2.81	695
5	10.17	14.30	2.98	6,792	8.69	14.31	2.80	875
6	12.91	13.64	3.03	8,623	12.39	13.74	2.95	1,247
7	14.76	12.92	3.05	9,823	12.47	12.78	2.90	1,255
8	17.56	12.05	3.09	11,735	18.23	11.74	3.00	1,835
9	12.64	11.50	2.99	8,446	16.39	11.13	2.86	1,650
10	6.25	11.28	2.82	4,175	9.22	10.88	2.74	928

MSRC--Ulnar Loops

The Number of patterns indicates the number of ulnar loops in a set of ten digits. The % column indicates the percentage of persons in the population with the specified number of patterns. The $\bar{X}$ is the mean ridge count of the ulnar loops within the given number in a set; S.D. is the standard deviation. N is the number of persons in the sample with the given number of patterns per set. The total sample is 66,811 males and 10,066 females. See note on Chart #11.

Table 10

ALLRACE

Number of Whorls	MALES %	MALES $\bar{X}$	MALES S.D.	MALES N	FEMALES %	FEMALES $\bar{X}$	FEMALES S.D.	FEMALES N
0	19.24	-----	-----	12,857	24.20	-----	-----	2,435
1	14.40	14.60	5.84	9,622	13.10	13.60	5.32	1,310
2	14.49	15.72	4.57	9,678	12.79	14.85	4.04	1,287
3	11.28	15.72	3.73	7,535	10.61	14.99	3.59	1,068
4	9.72	15.89	3.34	6,495	10.66	15.25	3.27	1,073
5	8.29	16.20	3.07	5,540	7.61	15.87	3.00	766
6	7.13	16.47	2.82	4,762	6.32	15.89	2.66	636
7	5.87	16.84	2.76	3,923	5.69	16.41	2.67	573
8	5.08	17.29	2.65	3,391	5.20	16.91	2.65	523
9	3.17	17.80	2.57	2,117	2.77	17.17	2.68	279
10	1.33	18.10	2.55	891	1.15	17.69	2.77	116

MSRC--Whorls

The number of patterns indicates the number of whorls in a set of ten digits. All columns are the same as for MSRC--Ulnar Loops (Table 9). The total sample is 66,811 males and 10,066 females. The % column of these tables is the same as the outer border of Poll's Ambimanuars. See note under Table #11.

Table 11

ALLRACE

Number of Radial Loops	MALES %	MALES $\bar{X}$	MALES S.D.	MALES N	FEMALES %	FEMALES $\bar{X}$	FEMALES S.D.	FEMALES N
0	69.76	-----	----	46,606	76.21	-----	----	7,671
1	22.53	10.08	6.30	15,052	18.69	10.17	6.42	1,881
2	6.88	9.80	5.42	4,599	4.76	9.76	5.52	479
3	0.74	9.79	4.90	494	0.32	8.18	4.13	32
4	0.09	11.69	5.19	57	0.03	4.58	0.24	3
5	0.005	9.47	2.36	3	0.00	-----	-----	0
6	0.000	-----	----	0	0.00	-----	-----	0

MSRC--Radial Loops

The number of patterns indicates the number of radial loops in a set of ten digits. The total sample is 66,811 males and 10,066 females. No person in this sample had six or more radial loops.

The MSRCs of Tables 9,10, and 11 may be used to calculate the expected TFRC for a given combination of pattern types (e.g. per individual). The expected TFRC may be used in prediction of unknown digits as well as in clinical studies. If an individual has fewer than 6 patterns of the same type the means for each pattern on each digit are summed; when six or more of the same pattern are present, the mean for the number of patterns of the same type in the set is summed for that number.

Table 12

	MALES	FEMALES
A	1.01	0.67
R	3.88	2.93
U	61.71	65.04
W	32.39	30.69

The percentage of pattern types in the NYSCJS file. Male N equals 1,602,290 digits; female N equals 310,400 digits. Arch frequencies are spurious due to the nature of the file (see text).

Table 13

ALLRACE

MALES

Pattern Type	I	II	III	IV	V	VI	VII	VIII	IX	X
U	49.53	34.48	77.13	45.54	80.81	61.13	40.07	77.95	59.63	86.23
W	50.16	38.24	21.13	53.37	18.93	38.43	34.81	20.46	40.07	13.69
R	0.31	17.90	1.74	1.09	0.26	0.44	15.46	1.60	0.31	0.09
FEMALES										
U	57.16	42.93	82.59	53.26	86.46	60.57	40.05	77.93	59.78	86.44
W	42.72	39.63	17.13	46.34	13.45	39.18	38.11	21.11	39.89	13.48
R	0.12	12.02	0.28	0.40	0.09	0.24	15.26	0.95	0.33	0.08

Digit-specific Pattern Frequencies

The % of ulnar loops, whorls, and radial loops is given for each digit. Arch frequencies are only available for digits II and VII (see text). The N is 160,229 for each male digit; 31,040 for each female digit.

Table 14

	MALES					FEMALES				
	A	L	W	UL	RL	A	L	W	UL	RL
Allrace	4.07	57.69	37.63	52.86	3.68	4.94	59.44	35.12	56.04	3.06
	2.24	7.37	8.52	6.24	2.07	3.97	6.76	9.21	5.84	0.85
	269	269	269	120	120	145	145	145	60	60
European	5.17	65.06	29.67	60.33	5.44	8.08	65.80	26.11	61.88	4.21
	1.31	1.87	2.36	1.32	0.32	1.43	1.75	1.83	0.78	0.29
	69	69	69	23	23	30	30	30	14	14
India	2.77	53.18	43.28	50.72	2.54	1.71	55.84	40.78	55.02	2.15
	1.40	5.78	6.23	5.14	1.66	3.20	7.68	8.39	8.19	0.60
	74	74	74	37	37	39	39	39	12	12
Oriental	2.05	51.12	46.49	47.80	3.41	3.12	55.23	41.76	52.96	2.91
	0.81	3.60	3.59	2.77	0.53	1.51	3.72	3.92	2.85	0.51
	58	58	58	37	37	44	44	44	31	31
Amerindian	4.80	55.68	36.52	54.47	4.35	7.62	60.22	32.33	56.37	3.73
	0.33	1.63	1.75	0.59	0.15	0.84	3.13	2.89	-----	----
	19	19	19	13	13	5	5	5	1	1
African	6.57	62.68	30.25	65.98	3.49	8.60	64.29	26.67	64.68	2.85
	2.42	6.49	5.54	3.54	1.01	4.29	4.26	6.66	3.37	0.59
	49	49	49	5	5	27	27	27	3	3

Pooled Overall Pattern Frequencies

The mean, standard deviation, and N of the reported literature values for the basic pattern types. Calculation was weighted for sample size. The N is the number of studies included in each group; not all studies subdivided loops. NYSCJS studies not included.

Table 15

ALLRACE

ALLSEX

	A	L	W	UL	RL
$\bar{X}$	4.37	58.30	36.75	53.92	3.47
S.D.	2.99	7.20	8.84	6.28	1.78
N	414	414	414	180	180

Pooled Overall Pattern Frequencies

Mean, standard deviation, and N (number of studies) of 414 literature values weighted for sample size. All races and sexes combined; all are "normal", non-pathological samples. See text for limitations and description of method.

Table 16

Georacial groups	TFRC	per digit ridge-count	ten-digit patterns (ALW)	ten-digit patterns (ARUW)	per digit patterns (ARW)
European males	35	18	69	23	29
European females	28	11	30	14	14
Indian males	34	15	74	37	29
Indian females	15	9	39	12	14
Oriental males	3	--	58	37	26
Oriental females	--	--	44	31	21
African males	11	--	49	5	14
African females	--	--	27	3	4
Amerindian males	13	--	19	13	11
Amerindian females	--	--	5	1	--
Totals	139	53	414	163	162

Tabulation of Literature Studies

The number of studies for each georacial area used in compiling pooled literature statistics is given. The studies are not independent; most studies giving per-digit data also give ten-digit summary data, most studies giving ridge-count data also give pattern frequencies. Many literature sources give data for both sexes; none for more than one georacial area.

Table 17

Europeans

		I	II	III	IV	V	VI	VII	VIII	IX	X
MALES											
U	X=	50.96	31.61	74.11	46.38	81.36	62.58	38.05	75.34	61.20	87.40
	SD=	2.16	3.40	3.61	1.58	1.20	2.22	2.43	3.16	2.27	1.64
W		47.88	36.03	20.65	51.77	17.92	35.31	32.95	19.23	37.49	11.93
		2.97	2.74	1.02	2.30	1.71	3.94	2.32	1.75	3.29	2.30
R		0.46	21.29	2.05	1.12	0.22	0.36	18.26	1.87	0.32	0.07
		0.28	3.99	0.41	0.10	0.06	0.11	3.38	0.39	0.07	0.03
A		1.66	11.11	6.86	1.58	0.87	4.12	10.73	8.59	2.32	1.47
		0.33	2.33	1.08	0.43	0.34	0.47	1.60	1.04	0.36	0.36
FEMALES											
U		58.19	39.96	78.58	55.73	86.41	60.00	38.52	76.38	58.94	86.56
		2.09	5.06	6.69	4.22	0.51	1.95	2.58	2.82	2.22	0.61
W		40.85	37.46	16.27	44.19	12.44	36.69	35.92	19.56	37.26	12.10
		3.18	3.42	1.44	3.43	1.77	4.30	3.41	2.44	4.28	2.27
R		0.12	13.08	0.49	0.57	0.12	0.17	16.16	1.21	1.75	0.09
		0.18	1.89	0.40	0.33	0.07	0.33	1.81	0.59	2.42	0.04
A		4.51	8.59	9.67	3.93	2.83	7.59	9.96	14.71	5.65	4.84
		1.07	5.30	3.03	1.25	0.93	1.48	5.57	2.88	1.57	1.52

Digit-specific Pattern Frequencies

Pooled European Literature

The mean reported frequencies for 29 male studies and 14 female studies. The mean and standard deviation for each category are given. The N is the same for all pattern types.

Table 18

Observed %

Table 18a:

Digit Pair	I	II	III	IV	V
RS	97.80	74.95	94.11	97.70	98.23
US	50.96	51.96	28.12	54.23	22.86

Simplified %

Table 18b:

Digit Pair					
RS	100.00	75.00	100.00	100.00	100.00
US	50.00	50.00	25.00	50.00	25.00

Occurrence of a ridge-count per digit side.

The observed and simplified percentages of the occurrence of a ridge count on either side of the digit is shown for the five homologous pairs of digits. The observed values are the means of eight georacial areas, which summarize data from 163 studies.

Table 19

Table 19a: Expected %

Digit Pair:	I	II	III	IV	V
A	0	13	0	0	0
L	50	50	75	50	75
W	50	38	25	50	25
LU	50	38	75	50	75
LR	0	13	0	0	0

Table 19b: Observed %

Digit Pair:	I	II	III	IV	V
A	2.59	7.00	5.29	1.39	0.93
L	49.60	51.13	69.29	45.55	74.71
W	50.48	38.00	26.51	53.67	22.62
LU	47.33	36.96	67.61	44.03	75.61
LR	0.48	13.99	1.62	0.56	0.24

Expected and observed pattern frequencies.

The expected pattern frequencies are calculated from the simplified percentages of a ridge count on either side of the digit.

Group Number:	1	2	3	4	5	6	7	8	9	10	11	12
	WHITE				NEGRO				ORIENTAL			
	CRIM		CIVIL		CRIM		CIVIL		CRIM		CIVIL	
Variable	F	M	F	M	F	M	F	M	F	M	F	M
Rct 1	17.58	19.27	17.84	19.54	15.37	16.55	15.24	16.89	17.67	18.54	17.25	18.68
	4.79	4.78	4.81	4.78	5.04	5.22	5.00	5.39	4.73	5.77	3.30	4.47
Rct 2	11.17	10.90	11.25	11.12	11.13	11.11	11.28	11.45	11.65	11.09	11.75	12.54
	5.50	5.94	5.65	6.05	4.45	4.80	4.39	4.88	5.76	6.02	4.50	3.77
Rct 3	12.14	12.29	12.28	12.48	11.76	11.99	11.97	12.78	13.40	12.35	13.00	13.46
	4.47	4.75	4.48	4.83	4.07	4.29	4.02	4.33	4.70	5.40	4.69	4.54
Rct 4	15.66	16.10	15.84	16.28	15.62	15.85	15.73	16.15	16.69	16.20	18.25	16.79
	5.28	5.21	5.37	5.25	4.80	4.80	4.68	4.81	4.90	4.39	5.44	4.08
Rct 5	12.75	13.72	12.88	13.94	12.66	13.36	12.80	13.57	13.67	12.75	9.50	12.29
	4.79	4.76	4.86	4.81	4.28	4.29	4.39	4.38	5.51	4.68	5.69	4.05
Rct 6	15.16	16.77	15.25	17.04	13.25	14.60	13.37	14.86	15.21	16.30	15.50	15.89
	4.90	5.03	4.92	5.05	5.08	5.25	4.92	5.32	4.88	5.80	1.92	4.06
Rct 7	10.27	10.37	10.53	10.59	10.27	10.71	10.51	10.89	11.13	10.80	10.25	12.64
	5.33	5.59	5.33	5.68	4.60	4.82	4.43	5.09	6.01	6.15	5.74	4.08
Rct 8	11.94	12.63	12.05	12.81	11.78	12.43	11.75	12.61	12.85	12.92	14.00	13.50
	4.80	4.82	4.82	4.89	4.48	4.56	4.34	4.61	5.52	5.13	1.83	4.38
Rct 9	15.31	16.01	15.40	16.15	14.99	15.49	14.84	15.73	17.15	16.54	18.00	16.32
	5.32	5.02	5.37	5.02	4.78	4.67	4.67	4.70	5.00	5.24	4.40	4.20
Rct 10	12.58	13.65	12.76	13.89	12.25	13.11	12.18	13.30	13.83	13.06	7.00	13.07
	4.67	4.40	4.64	4.42	4.22	4.08	4.06	4.14	5.22	4.77	3.37	3.82
TFRC	134.56	141.71	136.09	143.83	129.09	135.19	129.68	137.73	144.23	140.56	134.50	145.18
	37.02	36.92	37.20	37.31	34.47	35.06	33.77	35.50	41.50	42.71	22.13	24.90
N=	10,920	75,233	1,934	17,722	8,280	36,699	493	1,916	48	235	4	28

Table 20
MEAN FINGER RIDGE COUNTS

The mean number of ridges per digit and the standard deviation are given for each digit and the TFRC--total finger ridge count.

Group Number	1	2	3	4	5	6	7	8	9	10	11	12
Variable	WHITE				NEGRO				ORIENTAL			
	CRIM		CIVIL		CRIM		CIVIL		CRIM		CIVIL	
	F	M	F	M	F	M	F	M	F	M	F	M
Height[1]	63.71	69.10	64.24	69.98	64.17	69.26	64.29	70.11	64.33	68.13	65.75	68.25
	5.27	5.15	3.29	4.20	4.61	4.52	2.68	4.37	3.05	5.39	3.10	2.62
YOB[2]	46.98	47.30	40.46	41.08	45.64	45.86	41.12	41.53	46.17	46.17	39.75	45.89
	8.08	8.22	9.85	9.33	7.99	8.51	8.59	8.75	8.57	8.16	11.47	7.44
Charges[3]	2.10	2.20	-----	-----	2.65	3.10	-----	-----	1.67	1.94	-----	-----
	1.55	1.62			1.78	1.93			1.36	1.55		
Sentence[4]	2.35	4.22	-----	-----	4.18	10.68	-----	-----	1.83	4.75	-----	-----
Length	23.97	41.81			33.56	76.77			3.30	31.65		

Table 21

Sociological Variables

The mean and standard deviation of the height, YOB, number of charges, and sentence length for the various sub-populations of this sample. Sentence length is not distributed normally, hence the S.D. is many times the mean.

[1] height; the average reported height for individuals in inches.

[2] YOB; reported as the year with the century omitted, hence 46.98 means that the average birthdate for white criminal females is December 28, 1946.

[3] charges; the mean number of arrest charges per sub-population. Six-or-more charges were recorded as six.

[4] sentence length; the mean full length of sentence (not necessarily time served) in months.

Statistical Note

All t-values are the absolute value of two-tailed t-tests, corrected for sample size. Asterisks indicated the level of significance as follows:

(*) = P 0.05%

(**) = P 0.001%

T-values which are not significant are not marked. The formula used was derived from Chakravarti, Laha, and Roy; Handbook of Applied Statistics, Wiley Press, (1967).

Table 22

Means

Digit	Sex M	Sex F	Race W	Race N	Race O	Status C	Status NC	Comment
I	+	-	+	-	+	=	=	all differences strong
II	=	=	=	=	=	=	=	
III	+	-	+	-	++	+	-	all differences slight
IV	+	-	+	-	++	+	-	female C/NC not significant
V	+	-	=	=	=	+	-	female C/NC both =
VI	+	-	+	-	+	+	-	female C/NC not significant
VII	+	-	-	-	+	+	-	all differences slight
VIII	+	-	+	-	++	+	-	Negro female N/NC =
IX	+	-	+	-	++	+	-	" " "
X	+	-	+	-	?	+	-	" " "

Standard Deviations

Digit	Sex M	Sex F	Race W	Race N	Race O	Status C	Status NC	Comment
I	+	-	-	+	-	=	=	Cauc. sex =
II	+	-	+	-	+	=	=	
III	+	-	+	-	+	=	=	
IV	?	?	+	-	?	=	=	Cauc. sex + -
V	=	=	+	-	?	+?	-?	all differences slight
VI	+	-	-	+	=?	=	=	
VII	+	-	+	-	++	+?	-?	
VIII	+	-	+	-	+	+?	-?	strong sex difference
IX	varies		+	-	+	=	=	W + -, N - +, O = = (Sex)
X	=	=	+	-	?	=	=	

Relative Difference Chart

Group number:	1	2	3	4	5	6	7	8	9	10	11	12
Race	CAUCASIAN				NEGRO				ORIENTAL			
Criminal/ Civil	CRIM.		CIVIL		CRIM.		CIVIL		CRIM.		CIVIL	
Sex	F	M	F	M	F	M	F	M	F	M	F	M
N=	10,920	75,233	1,934	17,722	8,280	36,699	493	1,916	48	235	4	28
Group Number:	1	2	3	4	5	6	7	8	9	10	11	12

GROUP NUMBER KEY

Table 23

Group Number:	1	2	3	4	5	6	7	8	9	10	11
2	34.35**										
3	2.19*	12.92**									
4	33.55**	6.80**	14.79**								
5	30.99**	70.02**	19.60**	64.36**							
6	18.59**	86.69**	10.70**	64.34**	18.60**						
7	10.59**	18.63**	10.64**	19.66**	0.55	5.51**					
8	5.78**	21.47**	5.83**	22.79**	11.69**	2.76*	6.12**				
9	0.12	2.32*	0.25	2.71*	3.15*	1.49	3.22*	1.00			
10	3.00*	2.33*	2.04*	3.18*	9.45**	5.82**	7.89**	4.40**	0.98		
11	0.14	0.84	0.25	0.96	0.75	0.27	0.80	0.14	0.17	0.44	
12	1.21	0.65	0.91	0.95	3.47**	2.16*	3.55**	1.75	0.92	0.13	0.61

Digit I

t-values for mean ridge-count differences.

Table 24

Group Number:											
2	4.50**										
3	0.63	2.61*									
4	0.60	4.58**	0.89								
5	0.43	3.56**	0.98	0.15							
6	0.94	6.18**	1.21	0.17	0.34						
7	0.46	1.45	0.11	0.58	0.72	0.77					
8	2.10*	4.04**	1.15	2.27*	2.72*	2.96*	0.68				
9	0.60	0.88	0.48	0.60	0.79	0.77	0.53	0.28			
10	0.20	0.51	0.40	0.07	0.14	0.07	0.48	1.02	0.58		
11	0.21	0.29	0.18	0.21	0.28	0.26	0.21	0.12	0.04	0.22	
12	1.32	1.46	1.20	1.24	1.66	1.57	1.48	1.18	0.73	1.24	0.38
	1	2	3	4	5	6	7	8	9	10	11

Digit II

t-values for mean ridge-count differences.

Table 25

Group Number:											
2	3.02*										
3	1.27	0.05									
4	5.88**	4.78**	1.70								
5	6.05**	9.69**	4.96**	11.68**							
6	3.19*	10.11**	2.90*	11.89**	4.44**						
7	0.83	1.48	1.41	2.31*	1.11	0.11					
8	1.23	0.09	0.03	1.74	4.93**	2.85*	1.42				
9	1.94*	1.62	1.70	1.32	2.77*	2.27*	2.31*	1.76			
10	0.68	0.18	0.20	0.42	2.14*	1.25	1.04	0.22	1.25		
11	0.38	0.30	0.32	0.22	0.61	0.47	0.51	0.33	0.16	0.24	
12	1.56	1.31	1.39	1.08	2.21*	1.82	1.90	1.44	0.06	1.05	0.19
	1	2	3	4	5	6	7	8	9	10	11

Digit III

t-values for mean ridge-count differences.

Table 26

Group Number:	1	2	3	4	5	6	7	8	9	10	11
2	8.20**										
3	1.39	2.14*									
4	9.62**	4.08**	3.45**								
5	0.58	8.04**	1.81	9.68**							
6	3.44**	7.86**	0.03	9.53**	3.89**						
7	0.30	1.56	0.42	2.28*	0.51	0.52					
8	3.81**	0.44	1.89	0.99	4.39**	2.73*	1.74				
9	2.65*	2.11*	2.35*	1.86	2.97*	2.66*	2.75*	2.18*			
10	1.56	0.30	0.97	0.22	1.83	1.14	1.21	0.15	1.76		
11	0.98	0.82	0.89	0.75	1.10	1.00	1.07	0.87	0.22	0.75	
12	1.12	0.70	0.92	0.51	1.28	1.03	1.16	0.69	0.82	0.55	0.65

Digit IV

t-values for mean ridge-count differences.

Table 27

Group Number:											
2	19.91**										
3	1.04	7.73**									
4	20.31**	5.40**	9.22**								
5	1.38	19.48**	1.94	20.66**							
6	12.56**	12.50**	4.77**	14.24**	13.33**						
7	0.22	4.30**	0.31	5.20**	0.70	2.86*					
8	6.99**	1.39	4.66**	3.21*	8.34**	2.13*	3.48**				
9	1.32	0.08	1.11	0.39	1.62	0.50	1.27	0.15			
10	0.00	3.12*	0.37	3.76**	0.32	2.15*	0.14	2.68*	1.19		
11	1.36	1.78	1.39	1.85	1.48	1.80	1.50	1.86	1.45	1.37	
12	0.52	1.60	0.64	1.82	0.46	1.32	0.61	1.54	1.16	0.51	1.23
	1	2	3	4	5	6	7	8	9	10	11

Digit V

t-values for mean ridge-count differences

Table 28

Group Number:											
2	31.37**										
3	0.75	13.13**									
4	30.87**	6.26**	14.80**								
5	26.28**	60.31**	15.67**	56.18**							
6	10.14**	66.94**	5.37**	51.44**	21.13**						
7	7.95**	14.97**	7.59**	15.93**	0.48	5.17**					
8	2.44*	16.39**	2.36*	17.82**	12.37**	2.15*	5.65**				
9	0.07	2.15*	0.06	2.51*	2.66*	0.81	2.48*	0.45			
10	3.50**	1.44	3.02*	2.22*	9.03**	4.95**	7.09**	3.87*	1.22		
11	0.14	0.51	0.10	0.61	0.89	0.34	0.87	0.24	0.19	0.28	
12	0.79	0.92	0.69	1.20	2.75*	1.31	2.67*	1.02	0.63	0.36	0.19
	1	2	3	4	5	6	7	8	9	10	11

Digit VI

t-values for mean ridge-count differences.

Table 29

Group Number:											
2	1.80										
3	1.95	1.20									
4	4.75**	4.67**	0.47								
5	0.005	1.61	2.15*	4.51**							
6	8.20**	9.98**	1.64	2.59*	7.60**						
7	1.00	0.56	0.05	0.30	1.14	0.91					
8	4.70**	3.99**	2.14*	2.19*	5.19**	1.54	1.49				
9	1.11	0.93	0.77	0.65	1.28	0.59	0.88	0.32			
10	1.50	1.17	0.73	0.56	1.73	0.28	0.72	0.24	0.34		
11	0.01	0.04	0.10	0.12	0.01	0.19	0.12	0.25	0.28	0.18	
12	2.35*	2.15*	2.09*	1.91	2.73*	2.12*	2.48*	1.82	1.19	1.54	1.05
	1	2	3	4	5	6	7	8	9	10	11

Digit VII

t-values for mean ridge-count differences.

Table 30

Group Number:											
2	14.09**										
3	0.97	5.23**									
4	14.70**	4.29**	6.45**								
5	2.31*	15.37**	2.36*	16.18**							
6	9.85**	6.61**	3.57**	8.72**	11.80**						
7	0.86	4.07**	1.28	4.76**	0.16	3.32**					
8	5.71**	0.18	3.69**	1.65	7.29**	1.68	3.76**				
9	1.32	0.32	1.14	0.07	1.65	0.64	1.64	0.37			
10	3.10*	0.91	2.59*	0.36	3.83**	1.63	3.21*	0.95	0.08		
11	0.86	0.57	0.81	0.49	0.99	0.69	1.04	0.60	0.41	0.42	
12	1.72	0.95	1.58	0.75	2.03*	1.24	2.08*	1.01	0.53	0.57	0.22
	1	2	3	4	5	6	7	8	9	10	11

Digit VIII

t-values for mean ridge-count differences.

Table 31

Group Number:											
2	13.59**										
3	0.75	5.22**									
4	13.47**	3.28*	6.14**								
5	4.25**	17.63**	3.35**	17.58**							
6	3.49**	16.65**	0.77	15.02**	8.75**						
7	1.92	5.17**	2.14*	5.72**	0.68	3.07*					
8	3.30**	2.39*	2.02*	3.45**	6.15**	2.23*	3.77**				
9	2.39*	1.57	2.22*	1.38	3.11*	2.46*	3.25*	2.05*			
10	3.53**	1.63	3.08*	1.21	4.90**	3.45**	4.43**	2.47*	0.73		
11	1.01	0.79	0.97	0.74	1.26	1.08	1.35	0.96	0.33	0.55	
12	1.01	0.33	0.90	0.19	1.47	0.94	1.64	0.66	0.73	0.22	0.74
	1	2	3	4	5	6	7	8	9	10	11

Digit IX

t-values for mean ridge-count differences

Table 32

Group Number:	1	2	3	4	5	6	7	8	9	10	11
2	23.70**										
3	1.60	8.80**									
4	23.97**	6.54**	10.66**								
5	4.97**	27.61**	4.68**	28.48**							
6	11.54**	19.92**	3.62**	20.48**	17.13**						
7	1.84	7.40**	2.53*	8.50**	0.37	5.00**					
8	6.34**	3.49**	3.80**	5.63**	9.83**	1.99*	5.36**				
9	1.86	0.29	1.58	0.09	2.59*	1.23	2.62*	0.88			
10	1.59	2.05*	0.95	2.85*	2.90*	0.16	2.59*	0.80	1.00		
11	2.39*	3.02*	2.48*	3.12*	2.49*	2.99*	2.55*	3.04*	2.56*	2.52*	
12	0.56	0.70	0.36	0.98	1.03	0.05	1.13	0.29	0.67	0.01	3.01*

Digit X

t-values for mean ridge-count differences.

Table 33

Group Number:											
2	18.92**										
3	1.68	6.61**									
4	20.48**	6.84**	8.66**								
5	10.43**	29.71**	7.92**	30.38**							
6	1.64	28.18**	1.09	26.35**	14.34**						
7	2.87*	7.22**	3.48**	8.33**	0.37	3.47**					
8	3.48**	4.67**	1.40	6.83**	9.83**	3.08*	4.53**				
9	1.81	0.47	1.49	0.08	3.03*	1.78	2.79*	1.25			
10	2.45*	0.48	1.71	1.33	4.99**	2.33*	3.72**	1.13	0.54		
11	0.00	0.39	0.09	0.50	0.31	0.04	0.29	0.18	0.46	0.28	
12	1.52	0.50	1.29	0.19	2.47*	1.51	2.39*	1.11	0.11	0.56	0.81
	1	2	3	4	5	6	7	8	9	10	11

TFRC

t-values for TFRC ridge-count differences

Table 34

Group Number:	1	2	3	4	5	6	7	8	9	10	11
2	4.55**										
3	4.32**	4.44**									
4	13.07**	13.43**	------								
5	4.39**	0.09	5.47**	16.56**							
6	11.17**	18.21**	6.12**	18.52**	7.55**						
7	2.18*	2.24*	------	------	2.76*	3.09*					
8	4.30**	4.42**	------	------	5.45**	6.09**	------				
9	0.15	0.40	24.71**	74.82**	0.48	0.80	12.46**	24.59**			
10	1.50	0.20	6.61**	20.02**	0.26	1.18	3.33**	6.58**	0.64		
11	0.20	0.20	------	------	0.25	0.28	------	------	1.10	0.30	
12	0.52	0.53	------	------	0.66	0.74	------	------	2.94*	0.79	------

Sentence Length

t-values for mean sentence length differences.

Table 35

Group Number:											
2	101.88**										
3	4.21**	41.35**									
4	111.10**	21.17**	56.22**								
5	6.24**	83.58**	0.61	100.70**							
6	108.15**	4.98**	49.19**	17.89**	92.19**						
7	2.42*	20.73**	0.34	29.90**	0.58	24.34**					
8	50.20**	8.49**	47.17**	1.25	51.30**	8.04**	28.25**				
9	0.82	6.42**	0.20	9.31**	0.25	7.54**	0.11	9.11**			
10	12.71**	2.89*	15.76**	6.69**	12.92**	3.81**	12.84**	6.38**	4.72**		
11	0.77	1.30	0.92	2.01*	0.69	1.55	1.09	1.99*	0.89	0.88	
12	4.56**	0.87	6.43**	2.18*	4.68**	1.18	7.62**	2.25*	5.68**	0.12	1.75
	1	2	3	4	5	6	7	8	9	10	11

Height

t-values for mean height differences.

Table 36

Group Number:	1	2	3	4	5	6	7	8	9	10	11
2	6.34**										
3	59.50**	59.83**									
4	180.11***	180.83***	------								
5	22.89**	23.58**	65.36**	197.85**							
6	45.87**	74.48**	68.92**	208.64**	16.08**						
7	30.04**	30.16**	------	------	32.99**	35.00**					
8	59.22**	59.46**	------	------	65.05**	68.60**	------				
9	1.92	2.28*	54.52**	165.11**	3.81**	4.86**	27.49**	54.27**			
10	1.48	2.42*	55.17**	165.06	5.98**	8.53**	27.83**	54.91**	1.15		
11	2.71*	2.72*	------	------	2.97**	3.13**	------	------	2.43*	2.50*	
12	7.16**	7.19**	------	------	7.86**	8.29**	------	------	6.48**	6.62**	------

Number of Charges

t-values for mean number of charges differences.

Table 37

Group Number:	1	2	3	4	5	6	7	8	9	10	11
2	3.76**										
3	31.61**	35.94**									
4	54.72**	88.24**	2.76*								
5	11.43**	17.43**	24.51**	38.44**							
6	12.29**	27.24**	26.97**	59.48**	2.07*						
7	15.71**	16.62**	1.37	0.11	12.15**	12.27**					
8	26.91**	30.28**	3.57**	2.03*	19.93**	21.67**	0.92				
9	0.70	0.95	3.98**	3.78**	0.45	0.25	3.89**	3.63**			
10	1.52	2.09*	8.54**	8.34**	1.00	0.57	7.54**	7.74**	0.01		
11	1.79	1.84	0.14	0.28	1.47	1.44	0.32	0.41	1.41	1.55	
12	0.71	0.90	2.91*	2.73**	0.17	0.02	2.88*	2.62*	0.14	0.17	1.45

Age

t-values for mean YOB differences.

VOLUME II (APPENDICES)

APPENDIX A
NYSIIS (NYSCJS) FINGERPRINT STATISTICS

A.1 NYSIIS Sub-file Descriptions

NYSIIS I

1. Population Sampled

   All persons between the ages of eighteen and twenty-five on 10/1/71 who have been in the State of New York and could have had contact with NYSIIS by applying for a government job, applying for a state license, entering a state mental hospital, or being arrested for any felony or any misdemeanor (after 9/1/71). This is essentially any person who has been in New York between the ages of 18-25 as of 10/1/71.

2. Sample Description

   All persons on the NYSIIS computerized files who 1) was between 18-25 on 10/1/71, 2) did not have an arch or tented arch pattern on digits other than II or VII, and 3) did not have one or more prints classified as unknown patterns or ridge-counts.

3. Sample Size — 191,269 persons

4. Sex Breakdown — 160,229 males — 31,040 females

5. Racial Breakdown — not available

6. Sociological Breakdown — not available

7. Pattern Classification — arches, tented arches, ulnar loops, radial loops, whorls

8. Ridge-count Classification — radial count of all patterns, except ulnar count of radial loops

9. Dermatoglyphic Statistics — A LIST / B LIST } See Appendix

Both Galton's ridge-count only

Both A,T,R,U,W, patterns only.

10. General Description--Advantages

1. This sample is large; it is almost 100 times the size of the largest previous well-analyzed sample. This is important in obtaining normal values for rarer patterns and pattern combinations.

2. The size of the factor and nature of its collection reduces error caused by subjectivity of the fingerprint classifier to an absolute minimum. This file was compiled over many years by at least thirty classifiers.

3. The sample is the only study which is representative of the North American population. Although 50% of the file has at least one arrest on record and 5% have spent some time in prison, all other large samples have been either 1) 100% convicted criminals, or 2) closely related persons, and 3) all are European.

4. The data are computer-stored and therefore manageable. The calculation of descriptive statistics for a sample of this size by any other means would be impossible.

5. The sample is from identification bureau files, thus liason between dermatoglyphicists and forensic scientists is established. The police classification of fingerprints must be used. Methods of comparing procedures and classifications of fingerprints collected by different bureaux can be derived from the Gaussian distributions of some dermatoglyphic factors, thus increasing inter-agency efficiency.

11. General Description--Disadvantages

1. This sample is very coarse.

   a. pattern classification is limited to A,T,R,U,W.

   b. arches and tented arches are limited to digits II and VII

   c. race is not specifiable

   d. no sociological data is available.

   e. whorl ridge-counts are counted on only one side.

   f. pattern direction of whorls is not available.

2. The sample is not tractable. The various factors of importance such as pattern types and ridge-counts cannot be re-arranged or re-grouped for analysis.

3. The lack of arch and tented arch distributions precludes analysis of five-finger constellations of patterns and accurate multi-digital correlational analysis.

4. Ridge-counts are recorded as twenty-six by NYSIIS if they are 26 or greater. Since ridge-counts on individual digits can range to 42 this causes anomalous humps at the twenty-sixth ridge-count of patterns with high ridge-counts and distorts the descriptive statistics somewhat.

NYSIIS II

1. Population Sampled

Same as NYSIIS I except persons born after 1/1/50 were excluded. All other ages are present.

2. Sample Description

Same as NYSIIS I except:

a. persons born after 1/1/50 were excluded.

b. persons with one or more fingers with a ridge-count of 26 or greater were excluded.

3. Sample Size — 311,617 persons

4. Sex Breakdown — 260,736 males; 50,881 females

5. Racial Breakdown — not available

6. Sociological Breakdown — 261,269 criminals; 50,348 non-criminals and unknown

217,315	male criminals	43,421	male unknown
43,954	female criminals	6,927	female unknown

7. Pattern Classification — A,T,R,U,W

8. Ridge-count Classification — Galton's ridge count

9. Dermatoglyphic Statistics — Same as NYSIIS I plus
bidigital pattern frequency
bidigital ridge-counts

10. <u>General Description</u>--Advantages

This sample is primarily useful as a statistical comparator to the NYSIIS I and NYSIIS IV samples. The NYSIIS samples are so large that there is no valid value in the literature for most of the statistics studied. It is therefore necessary to have a separate sample which has been selected on different bases for comparison and more exact estimation of the true parametric values.

Omission of the twenty-sixth ridge-count was intended because of some spurious incrementation of this ridge-count frequency due to the methods by which ridges are counted at NYSIIS. The distribution curves are therefore more Gaussian in this sample, and lend themselves more readily to tractable mathematical manipulation.

11. <u>General Description</u>--Disadvantages

The differentiation between the criminal and non-criminal groups in this sample was too poorly defined to be useful. In this sample, criminal means that the person has one or more arrests for a felony or misdemeanor and non-criminal means that no criminal record is on file at NYSIIS. In addition, approximately 5,000 of the non-criminal group do have known criminal records but were not separated in the computer screening process. Consequently only trivial differences are found in the dermatoglyphics of these two groups.

As in the NYSIIS I sample, data were neither racially nor sociologically made (June, 1972).

NYSIIS III

1. Population Sampled

All persons regardless of age who could have come into contact with NYSIIS at any time. This is virtually anyone over the age of eighteen in the northeastern United States.

2. Sample Description

The entire NYSIIS computerized file as of 1/1/72.

This includes anyone with fingerprint records at NYSIIS except persons with arches or tented arches on digits other than II and VII.

NYSIIS I and II are sub-samples of NYSIIS III.

3. Sample Size	approx. 2,600,000 persons
4. Sex Breakdown	approx. 85% male approx. 15% female
5. Racial Breakdown	not available
6. Sociological Breakdown	not available
7. Pattern Classification	A,T,R,U,W
8. Ridge-count Classification	Galton's ridge-count
9. Dermatoglyphic Statistics	not retrieved

10. General Description--Advantages

Although we have this data in tape format, no specific selection of data has yet been done. In effect, this file is being held in reserve and will be used to answer specific questions which follow from analysis of the other studies and which cannot be answered except with a file of this size. An example of this type of problem is: what is the distribution of pattern types on both hands in persons who have a radial loop on digit R-V? What is the pattern distribution in populations which have an ulnar loop on digit L-IV with a ridge-count of 15?

Obviously the number of questions of this type which could be asked is almost infinite; therefore use of this file is being delayed until sufficient analysis of the other samples has been done so that this file may be used most effectively. The theoretical background delineating the necessity and usefulness of this file is in the full report under Biological Theory.

11. General Description--Disadvantages

This file cannot be used for the same type of population samples as NYSIIS I, II, and IV because it is the entire file including unknown patterns, unknown ridge-counts, and other anomalies. When this file is reduced by exclusion of these it would produce a sample similar in size and definition as the NYSIIS II sample. Since this file was not collected for this purpose, this defect is apparent rather than real.

B. NYSIIS IV

1. Population Sampled

Same as NYSIIS I.

2. Sample Description

All persons in the computer-retrievable file except;

a. persons born outside of the USA and Canada.

b. persons with one or more unknown digits.

c. persons born after 1/1/48.

3. Sample Size	100,000 persons
4. Sex Breakdown	approx. 85% males
	approx. 15% females
5. Racial Breakdown	approx. 75% Caucasian
	approx. 25% Negro
	approx. 1% Other
6. Social Breakdown	20 variables--see attached list.
7. Pattern Classification	A,T,R,U,W.
8. Ridge-count Classification	Galton's ridge count
9. Dermatoglyphic Statistics	A List
	B List (partial)

10. General Description--Advantages

As in all the NYSIIS studies, the size of the study is its main advantage. This is especially true in this study in which race,

sex, and criminological data will subdivide the sample into units which must be large enough for dermatoglyphic analysis.

The criminal classes are clearly definable. In addition to the classification of criminal codes onto a sociological theory which will be provided by outside consultants, sub-samples may be composed of all persons in the sample who have violated one specific criminal law or one group of laws. This study coordinates and augments the other NYSIIS studies which have been undertaken.

11. General Considerations--Disadvantages

This sample will be composed of young persons. Of the approximately 50,000 with criminal histories, few will have more than four to five arrests and none will have a known history of recidivist activity.

In this sample the lack of arches and tented arches on digits other than II and VII is more critical than in the previous NYSIIS studies since literature sources have indicated that it is in these patterns that significant differences in the groups of interest are most likely to be found. However, other patterns and their ridge-counts may show similar differences in a large sample. All previous studies of this kind are small yet the trend towards higher frequencies of arches, tented arches, and small loops is readily demonstrated. The lack of arch and tented arch patterns makes analysis of this sample somewhat more involved.

NYSIIS IV VARIABLE LIST

1. Sex
2. Height
3. Race
4. Skin tone
5. Crime history
   a. Arrest charge
   b. Disposition charge
6. Crime category code
7. Admission type
   a. Transfer
   b. New admittance, etc.
8. Release type
   a. Parole
   b. Statutory release
   c. Escape, etc.
9. Disposition codes
   a. Committed criminally insane
   b. Committed narcotic user
   c. Committed alcoholic
   d. Truant, delinquent child, etc.
10. Release codes
    a. Paroled
    b. Transferred within department
    c. Court order release
    d. Death by electrocution, etc.

A.2 NYSIIS I Descriptive Statistics and Graphs

Tobey J.E. Reed

NYSIIS FINGERPRINT DATA CHARTS

Chart N°s	
	I. PATTERN FREQUENCY
Male: 1-5 Female: 22-26	These charts summarize the distribution of the pattern types in this sample. Pattern frequency may be specified for the population as a whole, for individual digits, and for the distributions of patterns by digit.
M-1 F-22	<u>Bimanual Pattern Frequency</u>
M-2 F-23	<u>Right Hand Pattern Frequency</u>
M-3 F-24	<u>Left Hand Pattern Frequency</u>
	These charts show the frequency of the pattern types in the population as a whole without regard to the distribution by digit. Thus, 61.74% of all male digits have an ulnar loop pattern (Chart 1, first column). Since there are ten digits, the mean number of ulnar loops per individual is 6.17 (Chart 1, column 3).
M-4 F-25	<u>Digit-specific Pattern Frequencies</u>
	These charts show the distributions of patterns on each digit. Thus, 17.9% of all patterns on digit II of males are radial loops; 34.48% of all patterns on this digit are ulnar loops, etc. (Chart 4, columns 3,4).
	NYSIIS does not record in its computer files persons with arches or tented arches on digits other than II or VII, therefore no information is available for other digits. One reason they have constructed their files in this way is that the frequency of arches and tented arches on the other digits is very low; the total of the other digits is, at a maximum, equal to that on digits II and VII.
M-5 F-26	<u>Digit Distribution of Patterns</u>
	These charts show the distribution of each pattern type by digit. Thus, Chart 5, column 2 shows that of all ulnar loops in males, 8.09% occur on digit I, 5.63% occur on digit II, etc. Under the whorl column, it may be seen that 55.28% of all whorls occur on the right hand and 44.78% occur on the left hand. The all-pattern column shows the theoretical distribution of patterns assuming random distribution.
	II. RIDGE-COUNT DISTRIBUTIONS
Males: 6-13 Females: 27-33	These charts summarize the distributions of ridge-counts in this sample. Ridge-counts may be specified by pattern-type or independently. This section specifies ridge-counts summed for all ten digits, for each pattern-type on each digit, and independently for each digit.

M-6 F-27 TFRC Values

Mean Digital Ridge-counts

These two distributions are on one chart. The total finger ridge-count (TFRC) is the sum of all the ridge-counts for ten digits without regard to pattern type. It may range from zero for persons with ten arches to about 350 for persons with ten large whorls. The TFRC summarizes both the pattern type and the pattern intensity (single-finger, ridge-count) in one number. The mean value for this sum for males is 136.26, $\sigma = 36.1$ (Chart 6, column 1).

The mean digital ridge-counts show the mean ridge-count for one digit. Since there are ten digits, it should be one-tenth of the mean TFRC; the value for males, 13.79 is not exactly one-tenth of the mean TFRC because of rounding off errors. (Chart 6, column 1)

M-7 F-28 Pattern-specific Mean Ridge-counts

These charts show the mean ridge-count for each pattern for each hand or for both hands. Thus, for males, the whorls on the left hand have a mean ridge-count of 16.34 ridges (Chart 7, column 1, row 14); radial loops on the left hand have a mean ridge-count of 8.91 (Row 8) Arches and tented arches are not inluded because they always have a ridge-count of zero.

M-8 F-29 Digit-specific Mean Ridge-counts

These charts show the mean ridge-count for each digit without specifying the pattern type. Thus, for males, the mean ridge-count for digit I is 18.40 and for digit II it is 10.55 ridges (Chart 8, column 1).

M-9 F-30 Digit and Pattern Specific Mean Ridge-counts

These charts show the mean ridge-count for each pattern on each digit, the mean for all patterns on each digit, and the mean for each digit regardless of pattern type. It is a combination chart; the following charts expand each column with the descriptive statistics.

M-10 F-31 Digit-specific Mean Ridge-counts -- Radial Loops

M-11 F-32 Digit-specific Mean Ridge-counts -- Ulnar Loops

M-12 F-33 Digit-specific Mean Ridge-counts -- Whorls

These charts show the mean ridge-count for each pattern on each digit on separate charts. For example, the mean ridge-counts for ulnar loops on digit V (Chart 11) of males is 12.92 (column 1) and the frequency of ulnar loops on digit V is 80.81% (column 9).

III. MULTIDIGITAL SUMMED RIDGE-COUNTS

Males: 13-21
Females: 34-42

Multidigital summed ridge-counts (MSRC) are a special kind of total finger ridge-count. For the TFRC, all ridge-counts are summed without regard to the pattern type. For the MSRC only those ridge-counts of a particular pattern type are counted. If an individual has two ulnar loops, three radial loops, four whorls and one arch, then the MSRC for ulnar loops is the sum of the ridge-counts for the two ulnar loops, the MSRC for whorls would be the sum for the ridge-counts for the four whorls, etc.

On these charts, the left-hand column gives the number of a particular pattern which are present. For example, for males, chart 15 shows that for a person with four ulnar loops on both hands the sum of the ridge-counts in a population has a mean value of 59.59 ridges for ulnar loops. This sum is divided by the number of ulnar loops to obtain the ridge-count of the average ulnar loop in a series, which in this case is 14.90 (column 2). The average ridge-counts for ulnar loops in a series decreases as the number of ulnar loops increases so that a digit with a low ridge-count would have a greater probability of being associated with eight or nine ulnar loops than with only one or two ulnar loops.

These charts also show the percentage of source sample which is the frequency of persons with the specified number of patterns -- in this case 8.46% of the population has exactly four ulnar loops.

	$\overline{X}$	σ	$\overline{X}$	σ	$+2\sigma$	$+1\sigma$	-1σ	-2σ	N	Source
Description	Mean	Standard Deviation	Mean	Standard Deviation		R A N G E			Sample size	source
Bimanual Pattern Frequency	(population)		(individual)			(population)			(digits)	
Arch	0.34	0.21	0.03	0.02	0.76	0.54	0.14	0.00	2,331	2
Tented Arch	1.67	0.42	0.16	0.04	2.51	2.09	1.25	0.83	11,142	2
Radial Loop	3.88	0.62	0.39	0.06	5.12	4.47	3.29	2.64	25,975	2
Ulnar Loop	61.71	2.51	6.17	0.25	66.76	64.13	59.36	56.72	412,275	2
Whorl	32.39	2.87	3.14	0.29	37.16	34.15	28.69	25.68	216,387	2

MALES

	$\overline{X}$	σ	$\overline{X}$	σ	2σ	$+1\sigma$	-1σ	-2σ	N	source
Description	Mean	Standard Deveiation	Mean	Standard Deviation	-----R A N G E-----				Sample size	source
Right Hand Pattern Frequency	(population)		(individual)		(population)				(digits)	
Arch	0.35	0.13	0.04	0.01	0.61	0.47	0.28	0.09	1,165	2
Tented Arch	1.63	0.29	0.16	0.03	2.21	1.78	1.48	1.05	5,461	2
Radial Loop	4.25	0.25	0.43	0.03	4.75	4.50	4.00	3.75	14,202	2
Ulnar Loop	57.99	1.26	5.80	0.13	60.51	59.25	56.73	55.47	193,733	2
Whorl]	35.77	1.50	3.58	0.15	38.77	37.20	34.27	32.77	119,494	2

MALES

Right Hand Pattern Frequency

Description	$\bar{X}$ Mean	σ Standard Deviation	$\bar{X}$ Mean	σ Standard Devéation	$+2\sigma$	$+1\sigma$	-1σ	-2σ	N Sample size	Source source
					----------	------R A N G E	------	----------		
Left Hand Pattern Frequency	(population)		(individual)			(population)			(digits)	
Arch	0.35	0.13	0.04	0.01	0.61	0.48	0.23	0.09	1,166	2
Tented Arch	1.70	0.28	0.16	0.03	1.98	1.70	1.42	1.14	5,681	2
Radial Loop	3.52	0.40	0.34	0.04	4.32	3.92	3.12	2.72	11,773	2
Ulnar Loop	65.42	1.36	6.54	0.14	68.14	66.78	64.06	62.70	218,542	2
Whorl	29.01	1.45	2.90	0.15	31.91	30.46	27.56	26.11	96,893	2

MALES

Left Hand Pattern Frequency

%

Digit	Arch		Tented Arch		Radial Loop		Ulnar Loop		Whorl	source
I - X	0.32		1.58		3.92		61.25		32.93	1
Right Hand										
I	---		---		0.31		49.53		50.16	1
II	1.59		7.79		17.90		34.48		38.24	1
III	---		---		1.74		77.13		21.13	1
IV	---		---		1.09		45.54		53.37	1
V	---		---		0.26		80.81		18.93	1
Left Hand										
VI	---		---		0.44		61.13		38.43	1
VII	1.65		8.01		15.46		40.07		34.81	1
VIII	---		---		1.60		77.95		20.46	1
IX	---		---		0.31		59.63		40.07	1
X	---		---		0.09		86.23		13.69	1

MALES

Digit		Radial Loop		Ulnar Loop		Whorl		All Patterns		source
I - X		100.0		100.0		100.0		100.0		1
RH I		0.78		8.09		15.23		10.0		1
II		45.68		5.63		11.61		10.0		1
III		4.45		12.59		6.42		10.0		1
IV		2.78		7.43		16.21		10.0		1
V		0.66		13.19		5.75		10.0		1
Σ RH		54.34		46.94		55.22		50.0		1
LH VI		1.13		9.98		11.67		10.0		1
VII		39.45		6.54		10.57		10.0		1
VIII		4.08		12.73		6.21		10.0		1
IX		0.78		9.74		12.17		10.0		1
X		0.22		14.08		4.16		10.0		1
Σ LH		45.66		53.06		44.78		50.00		1

MALES

Digit distribution of patterns--

Description	$\bar{X}$ Mean	σ Standard Deviation	S.E. Standard Error	$+2\sigma$	$+1\sigma$	-1σ	-2σ	N Sample size	% % of source population	Source
				RANGE						
Bimanual TFRC	136.26	36.08	0.14	208.42	172.34	100.18	64.10	66,811	100.0	2
Right Hand TFRC	69.42	18.60	0.07	106.62	88.02	50.82	32.22	66,811	100.0	2
Left Hand TFRC	66.84	18.72	0.07	104.28	85.56	48.12	29.40	66,811	100.0	2
Mean digital ridge-counts										
Bimanual	13.79	5.58	0.01	24.95	19.37	8.21	2.63	160,229	100.0	2
Right Hand	14.08	5.00	0.01	24.08	19.08	9.08	4.08	160,229	100.0	2
Left Hand	13.52	4.90	0.01	23.32	18.42	8.62	3.72	160,229	100.0	2

	$\bar{X}$	σ	S.E.	$+2\sigma$	1σ	-1σ	-2σ	N	%	Source
Description	Mean	Standard Deviation	Standard error	RANGE				sample size	% of source population	Source
Pattern Type								(digits)		
All Patterns BH	13.79	5.58	0.004	24.95	19.37	8.21	2.63	1,602,290	100.00	1
RH	14.08	5.00	0.006	24.08	19.08	9.08	4.08	801,145	100.00	1
LH	13.52	4.90	0.006	23.32	18.42	8.62	3.72	801,145	100.00	1
Radial Loops BH	10.05	6.21	0.025	22.47	16.26	3.84	0.00	62,791	3.92	1
RH	11.01	4.92	0.027	20.85	15.93	6.09	1.17	34,120	4.26	1
LH	8.91	5.10	0.030	19.10	14.01	3.81	0.00	28,671	3.58	1
Ulnar Loops BH	12.94	4.87	0.005	22.68	17.81	8.07	3.20	981,386	61.25	1
RH	12.98	4.89	0.007	22.76	17.87	8.09	3.20	460,560	57.49	1
LH	12.90	4.47	0.006	21.84	17.37	8.43	3.96	520,736	65.00	1
Whorls BH	16.65	4.88	0.006	26.41	21.53	11.77	6.89	527,607	32.93	1
RH	16.90	4.20	0.008	25.30	21.10	12.70	8.50	291,354	36.37	1
LH	16.34	4.11	0.008	24.56	20.45	12.23	8.12	236,253	29.49	1

MALES
Pattern-specific Mean Ridge-counts

	$\bar{X}$	σ	S.E.	+ 2 σ	+ 1 σ	- 1 σ	- 2 σ	N	%	Source
Description	Mean	Standard Deviation	Standard Error	RANGE				Sample size	% of source population	Source
Digit								# (digits)		
RH I	18.40	5.02	0.01	28.44	23.42	13.38	8.36	160,229	100.0	1
II	10.55	5.88	0.01	22.31	16.43	4.67	0.00	160,229	100.0	1
III	12.07	4.51	0.01	21.09	16.58	7.56	3.05	160,229	100.0	1
IV	15.87	5.02	0.01	25.91	20.89	10.85	5.83	160,229	100.0	1
V	13.51	4.56	0.01	22.63	18.07	8.95	4.39	160,229	100.0	1
LH VI	16.08	5.11	0.01	26.30	21.19	10.97	5.86	160,229	100.0	1
VII	10.01	5.64	0.01	21.29	15.65	4.37	0.00	160,229	100.0	1
VIII	12.42	4.64	0.01	21.70	17.06	7.78	3.14	160,229	100.0	1
IX	15.71	4.85	0.01	25.41	20.56	10.86	6.01	160,229	100.0	1
X	13.38	4.26	0.01	21.90	17.64	9.12	4.86	160,229	100.0	1

Digit		Radial Loop		Ulnar Loop		Whorl		All Patterns		source
I - X		10.05		12.94		16.65		13.79		1
Right Hand										
I		16.17		16.75		20.05		18.40		1
II		11.18		10.29		13.07		10.55		1
III		9.56		11.28		15.12		12.07		1
IV		9.76		13.98		17.66		15.87		1
V		8.40		12.92		16.10		13.51		1
Left Hand										
VI		15.28		14.66		18.35		16.08		1
VII		8.98		10.34		12.86		10.01		1
VIII		6.50		11.69		15.87		12.42		1
IX		8.77		14.29		17.87		15.71		1
X		8.56		12.96		16.09		13.38		1

MALES

Digit and Pattern Specific Mean Ridge Counts

Description	$\bar{x}$ Mean	σ Standard Deviation	S.E. Standard Error	+ 2σ	+ 1σ	- 1σ	- 2σ	N Sample size	% % of source	source
				RANGE						
Digit										
I - X	10.05	6.21	0.03	22.47	16.26	3.84	0.00	62,791	3.92	1
I	16.17	5.53	0.25	27.23	21.70	10.64	5.11	490	0.03	1
II	11.18	6.22	0.04	23.62	17.40	4.96	0.00	28,681	17.90	1
III	9.56	5.71	0.11	20.98	15.27	3.85	0.00	2,794	1.74	1
IV	9.76	3.75	0.09	17.26	13.51	6.01	2.26	1,743	1.09	1
V	8.40	3.37	0.17	15.14	11.77	5.03	1.66	412	0.26	1
VI	15.28	5.36	0.21	26.00	20.64	9.92	4.56	712	0.44	1
VII	8.98	6.14	0.04	21.26	15.12	2.84	0.00	24,768	15.46	1
VIII	6.50	5.44	0.11	17.38	11.94	1.06	0.00	2,562	1.60	1
IX	8.77	4.47	0.20	17.71	13.24	4.30	0.00	491	0.31	1
X	8.56	4.08	0.35	16.72	12.64	4.48	0.40	138	0.09	1

MALES
Digit-specific Mean Ridge-counts

	$\bar{X}$		S.E.	+ 2	+ 1	- 1	- 2	N	%	source
DESCRIPTION	MEAN	STANDARD DEVIATION	STANDARD ERROR	-----------------	R A N GE	-----------------		SAMPLE SIZE	% of SOURCE	source
Digit								(digits)		
I - X	12.94	4.87	0.004	22.68	17.81	8.07	3.20	981,386	61.25	1
I	16.75	5.06	0.01	26.87	21.81	11.69	6.63	79,367	49.53	1
II	10.29	4.72	0.02	19.73	15.01	5.57	0.85	55,253	34.48	1
III	11.28	4.24	0.01	19.75	15.52	7.04	2.80	123,580	77.13	1
IV	13.93	4.94	0.01	23.81	18.87	8.99	4.05	72,965	45.54	1
V	12.92	4.47	0.01	21.86	17.39	8.45	3.98	129,485	80.81	1
VI	14.66	4.92	0.01	24.50	19.58	9.74	4.82	97,946	61.13	1
VII	10.34	4.19	0.02	18.72	14.53	6.15	1.96	64,196	40.07	1
VIII	11.69	4.33	0.01	20.35	16.02	7.36	3.03	124,891	77.95	1
IX	14.29	4.69	0.01	23.67	18.98	9.60	4.91	95,541	59.63	1
X	12.96	4.21	0.01	21.38	17.17	8.75	4.54	138,162	86.23	1

MALES
Digit-specific Mean Ridge-counts
Ulnar Loops

	$\bar{X}$	σ	S.E.	+ 2 σ	+ 1 σ	- 1 σ	- 2 σ	N	%	source
Description	Mean	Standard Deviation	Standard Error	R A N G E				Sample size	% of source	source
Digit								(digits)		
I - X	16.65	4.88	0.004	26.41	21.53	11.77	6.89	527,607	32.93	1
I	20.05	4.40	0.01	28.85	24.45	15.65	11.25	80,372	50.16	1
II	13.07	4.27	0.01	21.61	17.34	8.80	4.53	61,274	38.24	1
III	15.12	4.02	0.01	23.16	19.14	11.10	7.08	33,855	21.13	1
IV	17.66	4.35	0.01	26.36	22.01	13.31	8.96	85,521	53.37	1
V	16.10	3.97	0.02	24.04	20.07	12.13	8.16	30,332	18.93	1
VI	18.35	4.57	0.01	27.49	22.92	13.78	9.21	61,571	38.43	1
VII	12.86	4.23	0.01	21.32	17.09	8.63	4.40	55,780	34.81	1
VIII	15.68	4.01	0.02	23.70	19.69	11.67	7.66	32,776	20.46	1
IX	17.87	4.24	0.01	26.35	22.11	13.63	9.39	64,197	40.07	1
X	16.09	3.51	0.03	23.11	19.60	12.58	9.07	21,929	13.69	1

MALES
Digit-specific Mean Ridge-counts
Whorls

%	$\bar{X}$*	$\bar{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	-----R A N	G E-------	sample size		source
number of LR on both hands								(persons)		
0	69.76	---	---	---	---	---	---	46,606		2
1	22.53	10.08	10.08	6.30	0.05	16.38	3.78	15,052		2
2	6.88	9.80	19.59	10.84	0.16	30.43	8.75	4,599		2
3	0.74	9.79	29.38	14.69	0.66	44.07	14.69	494		2
4	0.09	11.69	46.74	20.74	2.75	67.48	26.00	57		2
5	0.005	9.47	47.33	11.79	6.81	59.12	35.54	3		2
6	0.0	---	---	---	---	---	---	0		2
7	0.0	---	---	---	---	---	---	0		2
8	0.0	---	---	---	---	---	---	0		2
9	0.0	---	---	---	---	---	---	0		2
10	0.0	---	---	---	---	---	---	0		2

MALES

Multidigital Summed Pattern Frequencies

	%	$\overline{X}$*	$\overline{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	-----R A N	G E-------	sample size		source
number of LR on right hand								(persons)		
0	79.98	----	----	----	----	-----	----	53,436		2
1	18.82	10.91	10.91	6.16	0.06	17.07	4.75	12,574		2
2	1.16	11.04	22.08	9.42	0.34	31.50	12.66	776		2
3	0.04	11.39	34.17	15.06	3.07	49.23	19.11	24		2
4	0.002	6.00	24.00	0	0	0	0	1		2
5	0.0	----	----	----	----	----	----	0		2

Note; $\overline{X}$ = average wadial loop in a series

MALES

Multidigital Summed Ridge-counts

	%	$\overline{X}$*	$\overline{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	-----R A N	G E-------	sample size		source
Number of LR on left hand								(persons)		
0	83.24	----	----	----	-----	----	----	55,613		2
1	15.92	8.87	8.87	6.15	0.06	15.02	2.72	10,639		2
2	0.81	8.34	16.67	9.97	0.43	26.64	6.70	543		2
3	0.02	13.06	39.19	16.31	4.08	55.50	22.88	16		2
4	0.00	----	----	----	----	----	----	0		2
	Note;	$\overline{X}$* = average radial loop in a series.								

	%	$\overline{X}$*	$\overline{X}$	σ	.E.	+ 1 σ	- 1 σ	N		urce
Description	% of source	see below	cumulative mean	standard deviation	standard error	--------R A	N G E----	sample size		source
Number of loops on both hands	(?)							(persons)		
0	1.45	---	---	---	---	---	---	972		2
1	3.38	16.58	16.58	3.61	0.08	20.19	12.97	2,261		2
2	5.76	15.88	31.75	6.34	0.10	38.09	25.41	3,849		2
3	6.65	15.35	46.05	9.16	0.14	55.21	36.89	4,444		2
4	8.46	14.90	59.59	11.95	0.16	71.54	47.64	5,652		2
5	10.17	14.30	71.83	14.90	0.18	86.73	56.93	6,792		2
6	12.91	13.64	81.83	18.16	0.20	99.99	63.67	8,623		2
7	14.76	12.92	90.46	21.32	0.21	111.78	69.14	9,823		2
8	17.56	12.05	96.43	24.75	0.23	121.18	71.68	11,735		2
9	12.64	11.50	103.50	26.90	0.29	130.40	76.60	8,446		2
10	6.25	11.28	112.77	28.20	0.44	140.97	84.57	4,175		2
		Note: $\overline{X}$*	= ridge-count of average loop in a series.							

MALES

Multidigital Summed Pattern Frequency

	%	$\bar{X}$*	$\bar{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see	Cumulative mean	standard deviation	standard error	------R A N	G E------	sample size		source
Number of LU on right hand								(persons)		
0	5.74	----	-----	----	----	----	----	3,834		2
1	13.54	15.38	15.38	3.99	0.04	19.37	11.38	9.044		2
2	17.99	14.35	28.70	7.13	0.07	35.83	21.57	12,018		2
3	23.86	13.40	40.19	10.33	0.08	50.52	29.86	15,940		2
4	25.51	12.35	49.40	13.35	0.10	62.75	36.05	17,042		2
5	13.37	11.65	58.25	15.82	0.17	74.07	42.42	8,933		2

Note: $\bar{X}$* = average ulnar loop in a series.

	%	$\overline{X}$*	$\overline{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	------R A N G E------		sample size		source
Number of LU on left hand								(persons)		
0	3.33	----	----	----	----	----	----	2,225		2
1	9.72	15.68	15.68	3.81	0.05	19.49	11.87	6,491		2
2	14.00	14.75	29.49	6.85	0.07	36.34	22.64	9,355		2
3	21.96	13.59	40.77	10.32	0.08	51.09	30.45	14,672		2
4	31.45	12.38	49.53	13.57	0.09	63.10	35.96	21,015		2
5	19.54	11.89	59.47	15.27	0.13	74.74	44.20	13,053		2
	Note: $\overline{X}$*	= average ulnar loop in a series.								

MALES

Multidigital Summed Ridge-counts

	%	$\overline{X}$*	$\overline{X}$		S.E.	+ 1	- 1	N		source
Description	% of source	see below	cumulative mean	standard deviation	standard error	----R A N G E----		sample size		source
Number of whorls on both hands								(persons)		
0	19.24	---	---	---	---	---	---	12,857		2
1	14.40	14.60	14.60	5.84	0.06	20.44	8.76	9,[illegible]22		2
2	14.49	15.72	31.43	9.14	0.09	40.57	22.29	9,678		2
3	11.28	15.72	47.16	11.20	0.13	58.36	35.96	7,535		2
4	9.72	15.89	63.54	13.37	0.17	76.91	50.17	6,495		2
5	8.29	16.20	81.01	15.33	0.21	96.34	65.68	5,540		2
6	7.13	16.47	98.81	16.93	0.25	115.74	81.88	4,762		2
7	5.87	16.84	117.91	19.35	0.31	137.26	98.56	3,923		2
8	5.08	17.29	138.35	21.22	0.37	159.76	117.12	3,391		2
9	3.17	17.80	160.18	23.12	0.50	183.30	137.06	2,117		2
10	1.33	18.10	181.10	25.47	0.85	206.57	155.63	891		2
		Note: $\overline{X}$*	= ridge-count of average whorl in a series.							

MALES

	%	$\overline{X}$*	$\overline{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		ource
Description	%	see below	cumulative mean	standard deviation	standard error	-------R-A	N G E-----	sample size		source
Number of whorls on right hand								(persons)		
0	24.83	----	-----	-----	-----	-----	-----	16,586		2
1	24.39	16.30	16.30	5.59	0.04	21.89	10.71	16,295		2
2	19.44	16.19	32.37	7.94	0.07	40.31	24.43	12,985		2
3	14.89	16.50	49.51	9.81	0.10	59.32	39.70	9,948		2
4	11.38	17.03	68.11	11.57	0.13	79.68	56.54	7,600		2
5	5.08	17.65	88.24	13.76	0.24	102.00	74.48	3,397		2
	Note;	$\overline{X}$* = average whorl in a series								

MALES
Multidigital Summed Ridge-counts
Whorls--Right Hand

	%	$\overline{X}$*	$\overline{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	------R A N	G E------	sample size		source
Number of whorls on left hand								(persons)		
0	34.62	----	-----	-----	----	----	----	23,129		2
1	24.57	15.17	15.17	5.27	0.04	20.44	9.90	16,416		2
2	16.88	15.67	31.13	7.47	0.07	38.60	23.66	11,276		2
3	12.12	16.22	48.65	9.55	0.11	58.20	39.10	8.095		2
4	8.73	16.97	67.89	11.90	0.16	79.79	55.99	5,835		2
5	3.08	17.33	86.63	14.10	0.31	100.73	72.53	2,060		2
	Note; $\overline{X}$*	=	average whorl in a series.							

MALES
Multidigital Summed Ridge-counts

Description	$\overline{X}$ Mean	σ Standard deviation	$\overline{X}$ Mean	σ standard deviation	$+2\sigma$ RANGE	$+1\sigma$	-1σ	-2σ	N sample size	source
Bimanual Pattern Frequency	(population)		(individual)			(population)			(digits)	
Arch	0.24	0.17	0.02	0.02	0.58	0.41	0.07	0.00	208	2
Tented Arch	1.10	0.35	0.11	0.04	1.80	1.45	0.75	0.40	1,107	2
Radial Loop	2.93	0.57	0.29	0.06	4.07	3.50	2.36	1.79	2,938	2
Ulnar Loop	65.04	2.55	6.50	0.26	70.14	67.59	62.49	59.94	65,474	2
Whorl	30.69	2.75	3.07	0.28	36.19	33.44	27.94	25.19	30,892	2

FEMALES

Bimanual Pattern Frequency

Description	$\bar{X}$ Mean	Standard Deviation	$\bar{X}$ Mean	Standard Error	+ 2	+ 1	- 1	- 2	N Sample size	source
Right Hand Patt. Freq.	(population)		(individual)		(population)				(digits)	
Arch	0.23	0.11	0.02	0.01	0.45	0.34	0.12	0.01	111	2
Tented Arch	0.96	0.21	0.10	0.02	1.38	1.17	0.75	0.54	482	2
Radial Loop	2.58	0.34	0.26	0.03	3.26	2.92	2.24	1.90	1,297	2
Ulnar Loop	64.98	1.40	6.50	0.14	67.78	66.38	63.58	62.18	32,706	2
Whorl	31.26	1.47	3.13	0.15	34.20	32.73	29.79	28.32	15,734	2

FEMALES

Description	$\overline{X}$ Mean	σ Standard Deviation	$\overline{X}$ Mean	σ Standard Error	$+ 2 \sigma$	$+ 1 \sigma$ RANGE	$- 1 \sigma$	$- 2 \sigma$	N sample size	source
Left Hand Patt. Freq.	(population)		(individual)			(population)			(digits)	
Arch	0.26	0.11	0.03	0.01	0.48	0.37	0.15	0.04	129	2
Tented Arch	1.24	0.24	0.12	0.02	1.78	1.48	1.00	00.76	625	2
Radial Loop	3.28	0.38	0.33	0.04	4.04	3.66	2.90	2.52	1,591	2
Ulnar Loop	65.32	1.38	6.53	0.14	68.08	66.70	63.94	62.56	32,876	2
Whorl	30.12	1.48	3.01	0.15	33.08	31.60	28.64	27.16	15,156	2

Digit	Arch		Tented Arch		Radial Loop		Ulnar Loop		Whorl	source
I - X	0.22		0.98		2.98		64.72		31.11	1
Right Hand										
I	---		---		0.12		57.16		42.72	1
II	1.01		4.40		12.02		42.93		39.63	1
III	---		---		0.28		82.59		17.13	1
IV	---		---		0.40		53.26		46.34	1
V	---		---		0.09		86.46		13.45	1
Left Hand										
VI	---		---		0.24		60.57		39.18	1
VII	1.15		5.43		15.26		40.05		38.11	1
VIII	---		---		0.95		77.93		21.11	1
IX	---		---		0.33		59.78		39.89	1
X	---		---		0.08		86.44		13.48	1

FEMALES

Digit		Radial Loop		Ulnar Loop		Whorl		All Patterns	1	source
I - X		100.00		100.00		100.00		100.00		1
RH I		0.40		8.83		13.73		10.00		1
II		40.37		6.63		12.74		10.00		1
III		0.95		12.76		5.51		10.00		1
IV		1.34		8.24		14.90		10.00		1
V		0.31		13.36		4.32		10.00		1
Σ R H		43.37		49.82		51.20		10.00		1
LH VI		0.81		9.36		12.60		10.00		1
VII		51.24		6.19		12.25		10.00		1
VIII		3.19		12.04		6.79		10.00		1
IX		1.11		9.24		12.82		10.00		1
X		0.27		13.36		4.33		10.00		1
Σ L H		56.63		50.18		48.80		50.00		1

FEMALES

Digit distribution of patterns

$\overline{X}$		σ	S.E.	+ 2 σ	+ 1 σ	- 1 σ	- 2 σ	N	%	source
Description	Mean	Standard Deviation	Standard Error	------------------	------R A N G E-----		----------	Sample size	% of source	source
Bimanual TFRC	131.86	35.54	0.35	202.94	167.40	96.32	60.78	10,066	100.0	2
Right Hand TFRC	67.80	17.95	0.18	103.70	85.75	49.85	31.90	10,066	100.0	2
Left Hand TFRC	64.06	18.75	0.19	101.56	82.81	45.31	26.56	10,066	100.0	2
Bimanual Mean Digital Ridge Ct.	13.32	5.26	0.03	23.84	18.58	8.06	2.80	31,040	100.0	1
Right Hand	13.96	4.78	0.03	23.52	18.74	9.18	4.40	31,040	100.0	1
Left Hand	12.92	4.84	0.03	22.60	17.76	8.08	3.24	31,040	100.0	1

FEMALES

TFRC VALUES

Description	$\bar{X}$ Mean	σ Standard Deviation	S.E. Standard Error	+ 2 σ	+ 1 σ	- 1 σ	- 2 σ	N Sample size	% % of source	source source
				R A N G E						
Pattern Type								(digits)		
All Patterns BH	13.32	5.26	0.01	23.84	18.58	8.06	2.50	310,400	100.00	1
RH	13.96	4.78	0.01	23.52	18.74	9.18	4.40	155,200	100.00	1
LH	12.92	4.84	0.01	22.60	17.76	8.08	3.24	155,200	100.00	1
Radial Loop BH	10.00	6.25	0.07	22.50	16.25	3.75	0.00	9,245	2.98	1
RH	10.71	4.64	0.07	19.99	15.35	6.07	1.43	4,010	2.58	1
LH	9.45	4.46	0.07	18.37	13.91	4.99	0.53	5,235	3.37	1
Ulnar Loop BH	12.43	4.71	0.01	21.85	17.14	7.72	3.01	200,881	64.72	1
RH	12.73	4.50	0.01	21.79	17.29	8.29	3.79	100,072	64.48	1
LH	12.15	4.43	0.01	20.90	16.52	7.66	3.18	100,809	64.95	1
Whorl BH	16.02	4.72	0.01	25.46	20.74	11.30	6.58	96,551	31.11	1
RH	16.47	4.08	0.01	24.30	20.22	12.06	7.98	49,438	31.85	1
LH	15.54	4.15	0.01	23.76	19.61	11.31	7.16	47,113	30.36	1

FEMALES

	$\overline{X}$	σ	S.E.	+ 2 σ	+ 1 σ	- 1 σ	- 2 σ	N	%	source
Description	Mean	Standard Deviation	Standard Error	R A N G E				Sample	% of source	source
Digit								(digits)		
RH I	17.00	4.86	0.03	26.72	21.86	12.14	7.28	31,040	100.0	1
II	11.06	5.31	0.03	21.68	16.37	5.75	0.44	31,040	100.0	1
III	12.09	4.22	0.03	20.53	16.31	7.87	3.65	31,040	100.0	1
IV	15.70	4.94	0.03	25.58	20.64	10.76	5.82	31,040	100.0	1
V	12.81	4.56	0.03	21.93	17.37	8.25	3.68	31,040	100.0	1
LH VI	14.65	4.92	0.03	24.49	19.57	9.73	4.81	31,040	100.0	1
VII	10.14	5.27	0.03	20.68	15.41	4.87	0.00	31,040	100.0	1
VIII	11.97	4.54	0.03	21.05	16.51	7.43	2.89	31,040	100.0	1
IX	15.26	5.03	0.03	25.32	20.29	10.23	5.20	31,040	100.0	1
X	12.56	4.44	0.03	21.44	17.00	8.12	3.68	31,040	100.0	1

FEMALES

Digit		Radial Loop		Ulnar Loop		Whorl		All Patterns		Source
I - X		10.00		12.43		16.02		13.32		1
Right Hand										
I		14.27		15.55		18.95		17.00		1
II		10.88		10.51		13.22		11.06		1
III		6.00		11.46		15.25		12.09		1
IV		8.68		14.05		17.66		15.70		1
V		6.90		12.38		15.66		12.81		1
Left Hand										
VI		14.00		13.26		16.82		14.65		1
VII		9.72		9.80		12.43		10.14		1
VIII		4.86		11.20		15.12		11.97		1
IX		7.50		13.79		17.51		15.26		1
X		6.80		12.17		15.43		12.56		1

FEMALES

Digit and Pattern-specific Mean Ridge Counts

	$\bar{X}$	σ	S.E.	+ 2 σ	+ 1 σ	- 1 σ	- 2 σ	N	%	source
Description	Mean	Standard Deviation	Standard Error	R A N G E				Sample size	% of source	source
Digit								(digits)		
I - X	10.00	6.25	0.07	22.50	16.25	3.75	0.00	9,245	2.98	1
I	14.27	5.78	0.95	25.83	20.05	8.49	2.71	37	0.12	1
II	10.88	6.25	0.10	23.38	17.13	4.63	0.00	3,732	12.02	1
III	6.00	3.76	0.40	13.52	9.76	2.24	0.00	88	0.28	1
IV	8.68	3.09	0.28	14.86	11.77	5.59	2.50	124	0.40	1
V	6.90	3.44	0.67	13.78	10.34	3.46	0.02	29	0.09	1
VI	14.00	4.57	0.53	23.14	18.57	9.43	4.86	75	0.24	1
VII	9.76	6.28	0.09	22.32	16.04	3.48	0.00	4,737	15.26	1
VIII	4.86	4.22	0.25	13.30	9.08	0.64	0.00	295	0.95	1
IX	7.50	4.33	0.43	16.16	11.83	3.17	0.00	103	0.33	1
X	6.80	2.90	0.58	12.60	9.70	3.90	1.00	25	0.08	1

FEMALES

	$\bar{X}$	σ	S.E.	$+2\sigma$	$+1\sigma$	-1σ	-2σ	N	%	source
Description	Mean	Standard Deviation	Standard Error	RANGE				Sample size	% of source	source
Digit								(digits)		
I - X	12.43	4.71	0.01	21.85	17.14	7.72	3.01	200,881	64.72	1
I	15.55	4.81	0.03	25.17	20.36	10.74	5.93	17,742	57.16	1
II	10.51	4.40	0.03	19.31	14.91	6.11	1.71	13,326	42.93	1
III	11.46	3.98	0.02	19.42	15.44	7.48	3.50	25,635	82.59	1
IV	14.05	4.81	0.03	23.67	18.86	9.24	4.43	16,533	53.26	1
V	12.38	4.48	0.03	21.34	16.86	7.90	3.42	26,836	86.46	1
VI	13.26	4.67	0.03	22.60	17.93	8.59	3.92	18,802	60.57	1
VII	9.80	4.03	0.03	17.86	13.83	5.77	1.74	12,430	40.05	1
VIII	11.20	4.25	0.03	19.70	15.45	6.95	2.70	24,191	77.93	1
IX	13.79	4.83	0.03	23.45	18.62	8.96	4.13	18,555	59.73	1
X	12.17	4.37	0.03	20.91	16.54	7.80	3.43	26,831	86.44	1

FEMALES
Digit=specific Mean Ridge-counts
Ulnar Loops

Description	$\bar{X}$ Mean	σ Standard Deviation	S.E. Standard Error	+ 2 σ	+ 1 σ	- 1 σ	- 2 σ	N Sample size	% % of source	source
				RANGE						
Digit								(digits)		
I - X	16.02	4.72	0.01	25.46	20.74	11.30	6.58	96,551	31.11	1
I	18.95	4.19	0.03	27.33	23.14	14.76	10.57	13,261	42.72	1
II	13.22	4.07	0.03	21.36	17.29	9.15	5.08	12,302	39.63	1
III	15.25	3.85	0.02	22.95	19.10	11.40	7.55	5,317	17.13	1
IV	17.66	4.30	0.02	26.26	21.96	13.36	9.06	14,383	46.34	1
V	15.66	4.01	0.06	23.68	19.67	11.65	7.64	4,175	13.45	1
VI	16.82	4.48	0.03	25.78	21.30	12.34	7.86	12,163	39.18	1
VII	12.43	4.11	0.03	20.65	16.54	8.32	4.21	11,830	38.11	1
VIII	15.12	3.97	0.05	23.06	19.09	11.15	7.18	6,554	21.11	1
IX	17.51	4.44	0.03	26.39	21.95	13.07	8.63	12,382	39.89	1
X	15.43	3.76	0.06	22.95	19.19	11.67	7.91	4,184	13.41	1

FEMALES

Digit-specific Mean Ridge counts

	%	$\bar{X}$*	$\bar{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		sour
Description	%	see below	cumulative mean	standard deviation	standard error	------R A N G E------		sample size		source
Number of LR on both hands								(persons)		
0	76.21	---	---	---	---	---	---	7,671		2
1	18.69	10.17	10.17	6.42	0.15	16.59	3.75	1,881		2
2	4.76	9.76	19.53	11.03	0.50	30.56	8.50	479		2
3	0.32	8.18	24.53	12.40	2.19	36.93	12.13	32		2
4	0.03	4.58	18.33	0.94	0.54	19.27	17.39	3		2
5	0.0	---	---	---	---	---	---	0		2
6	0.0	---	---	---	---	---	---	0		2
7	0.0	---	---	---	---	---	---	0		2
8	0.0	---	---	---	---	---	---	0		2
9	0.0	---	---	---	---	---	---	0		2
10	0.0	---	---	---	---	---	---	0		2

Description	%	$\bar{X}$*	$\bar{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	------R A N	G E------	sample size		source
Number of LR on right hand								(persons)		
0	87.41	---	---	---	---	---	---	8.799		2
1	12.29	10.83	10.83	6.31	0.18	17.14	4.52	1,237		2
2	0.30	8.67	17.37	7.69	1.40	25.06	9.68	30		2
3	0.0	---	---	---	---	---	---	0		2
4	0.0	---	---	---	---	---	---	0		2
5	0.0	---	---	---	---	---	---	0		2
	Note: $\bar{X}$*=	average radial loop in a series.								

FEMALES

Multidigital Summed Ridge-counts

	%	$\overline{X}$*	$\overline{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	------R A	N G E-----	sample size		source
Number of LR on left hand								(persons)		
0	84.19	---	---	---	---	---	---	8,475		2
1	15.22	9.53	9.53	6.28	0.16	15.81	3.25	1,532		2
2	0.59	6.86	13.71	9.02	1.17	22.73	4.69	59		2
3	0.0	---	---	---	---	---	---	0		2
4	0.0	---	---	---	---	---	---	0		2
5	0.0	---	---	---	---	---	---	0		2
	Note; $\overline{X}$* = average radial loop in a series.									

FEMALES

Multidigital Summed ridge-counts

	%	$\overline{X}$*	$\overline{\overline{X}}$	σ	S.E.	+ 1 σ	− 1 σ	N		source
Description	% of source	see below	cumulative mean	standard deviation	standard error	------R A	N G E------	sample size		source
Number of loops on both hands								(persons)		
0	1.20	---	---	---	---	---	---	120		2
1	2.91	16.08	16.08	3.59	0.21	19.67	12.49	293		2
2	5.51	15.51	31.02	6.01	0.26	37.03	25.01	555		2
3	6.09	14.85	44.56	8.72	0.35	53.28	35.84	613		2
4	6.90	14.65	58.61	11.25	0.43	69.86	47.36	695		2
5	8.69	14.31	71.57	13.98	0.47	85.55	57.59	875		2
6	12.39	13.74	82.42	17.72	0.50	100.14	64.70	1,247		2
7	12.47	12.78	89.46	20.31	0.57	109.77	69.15	1,255		2
8	18.23	11.74	93.88	23.99	0.56	117.87	69.89	1,835		2
9	16.39	11.13	100.16	25.72	0.63	125.88	74.44	1,650		2
10	9.22	10.88	108.78	27.41	0.90	136.19	81.37	928		2
		Note: $\overline{X}$* = ridge-count of average loop in a series.								

%	$\bar{X}$*	$\bar{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	------R A N	G E------	sample size		source
Number of LU on right hand								(persons)		
0	3.58	---	---	---	---	---	---	360		2
1	10.45	15.20	15.20	3.78	0.12	18.98	11.42	1,052		2
2	15.08	14.56	29.12	6.28	0.16	35.40	22.84	1,518		2
3	20.67	13.55	40.64	9.75	0.21	50.39	30.89	2,081		2
4	28.81	12.29	49.15	12.67	0.24	61.82	36.48	2,900		2
5	21.41	11.52	57.60	15.08	0.32	72.68	42.52	2,155		2
	Note; $\bar{X}$* = average ulnar loop in a series.									

FEMALES
Multidigital Summed Ridge-counts
Ulnar loops--right hand

Description	%	$\overline{X}$* see below	$\overline{X}$ cumulative mean	σ standard deviation	S.E. standard error	+ 1 σ	- 1 σ	N sample size		source
						RANGE				
								(persons)		
Number of LU on left hand										
0	3.54	---	---	---	---	---	---	356		2
1	10.46	14.78	14.78	3.82	0.12	18.60	10.96	1,053		2
2	13.49	14.30	28.60	6.74	0.18	35.34	21.86	1,358		2
3	20.82	13.14	39.43	9.96	0.22	49.39	29.47	2,096		2
4	31.75	11.64	46.57	13.16	0.23	59.73	33.41	3,196		2
5	19.94	10.97	54.83	15.28	0.34	70.11	39.55	2,007		2

Note: $\overline{X}$* = average ulnar loop in a series.

FEMALES

Multidigital Summed Ridge-counts

%	$\bar{X}$*	$\bar{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
Description	% of source	see below	cumulative mman	standard deviation	standard error	-------R A	N G E------	sample size		source
Number of whorls on both hands								(persons)		
0	24.20	---	---	---	---	----	----	2,435		2
1	13.10	13.60	13.60	5.32	0.15	18.92	8.28	1,310		2
2	12.79	14.85	29.69	8.07	0.22	37.76	21.62	1,287		2
3	10.61	14.99	44.97	10.78	0.33	55.75	34.19	1,068		2
4	10.66	15.25	61.01	13.07	0.40	74.08	47.94	1,073		2
5	7.61	15.87	79.37	14.98	0.54	94.35	64.39	766		2
6	6.32	15.89	95.33	15.97	0.63	111.30	79.36	636		2
7	5.69	16.41	114.89	18.70	0.78	133.59	96.19	573		2
8	5.20	16.91	135.29	21.21	0.93	156.50	114.08	523		2
9	2.77	17.17	154.54	24.14	1.45	178.68	130.40	279		2
10	1.15	17.69	176.88	27.70	2.57	204.58	149.18	116		2
		Note: $\bar{X}$* = ridge-count of average whorl in a series								

FEMALES

	%	$\bar{X}$*	$\bar{X}$	σ	S.E	+1σ	-1σ	N		source
Description	%	see below	cumulative mean	standard deviation	standard error	------R A N G E------		sample size		source
Number of whorls on right hand								(person)		
0	32.14	---	---	---	----	---	---	3,235		2
1	22.88	15.61	15.61	5.07	0.11	20.68	10.54	2,303		2
2	18.07	15.77	31.54	7.45	0.17	38.99	24.09	1,819		2
3	13.75	16.35	49.05	8.93	0.24	57.98	40.12	1,384		2
4	9.78	16.79	67.15	10.97	0.35	78.12	56.18	984		2
5	3.39	17.48	87.40	13.96	0.76	101.36	73.44	341		2
	Note; $\bar{X}$*=	average whorl in a series.								

FEMALES

Multidigital Summed Ridge-counts

Description	%	$\bar{X}$*	$\bar{X}$	σ	S.E.	+ 1 σ	- 1 σ	N		source
	%	see below	cumulative mean	standard deviation	standard error	--------R A	N G E-----	sample size		source
Number of whorls on left hand								(persons)		
0	34.53	---	---	---	---	---	---	3,476		2
1	22.98	14.21	14.21	4.95	0.10	19.16	9.26	2,313		2
2	16.76	14.71	29.42	7.53	0.18	36.95	21.89	1,686		2
3	12.49	15.60	46.80	9.76	0.28	56.56	37.04	1,257		2
4	9.59	16.28	65.12	11.82	0.38	76.94	53.30	965		2
5	3.66	16.61	83.06	14.85	0.77	97.91	68.21	368		2
	Note; $\bar{X}$ *	= average who-rl in a series.								

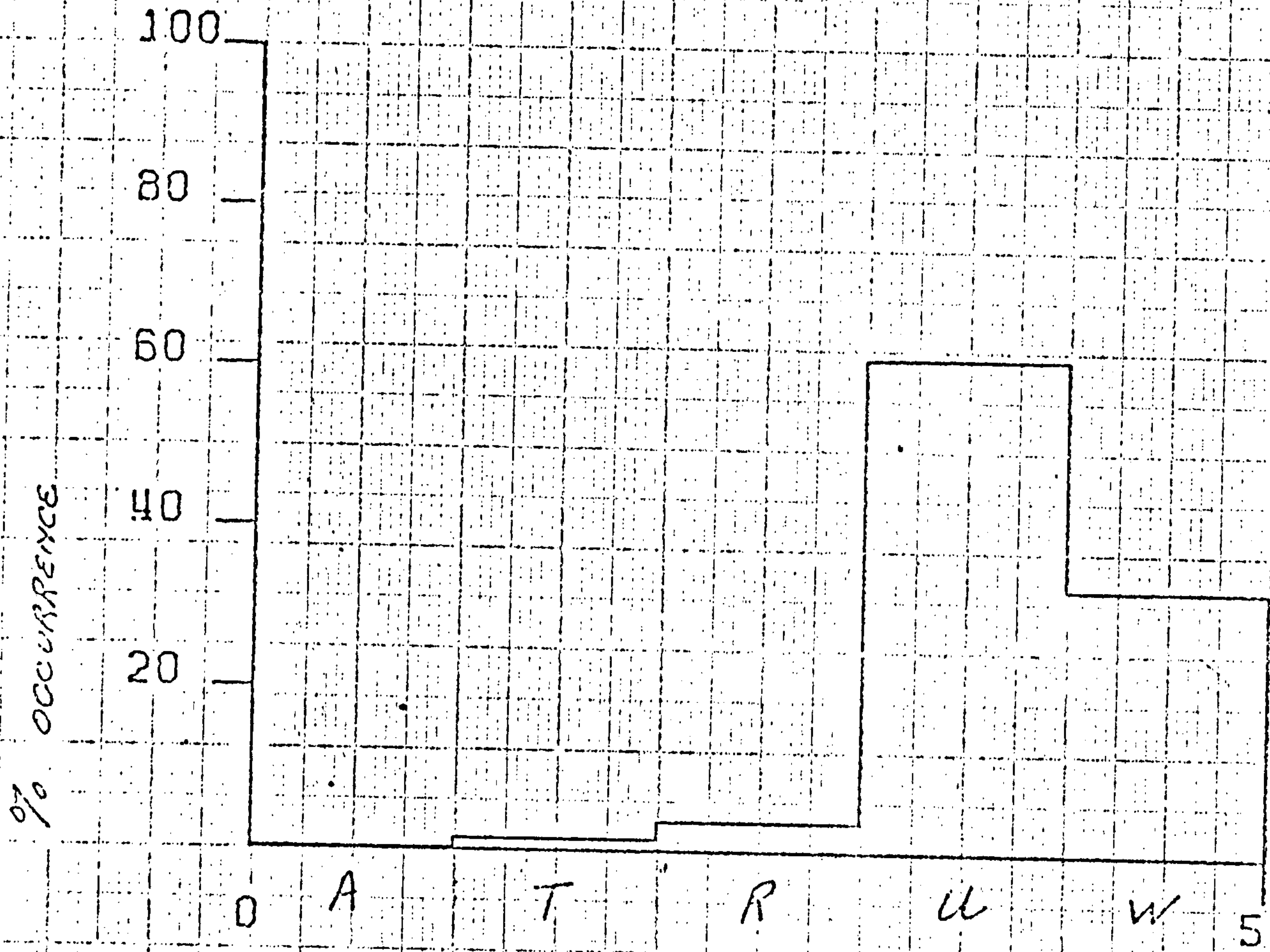
FEMALES

Multidigital Summed Ridge-counts

CHART INDEX

Chart Number	Description	Statistics Page Number	Row/Column
1 - 58	MALES	1 - 21	
59 - 108	FEMALES	22 - 33	
1	BIMANUAL PATTERN FREQUENCY (MALES)	1	
2	RADIAL LOOP FREQUENCY, DIGITS I-X	4	3
3	ULNAR LOOP FREQUENCY, DIGITS I-X	4	4
4	WHORL FREQUENCY, DIGITS I-X	4	5
5	RADIAL LOOP FREQUENCY, DIGITS I-V (M&F)	4	3/ 2-6
6	RADIAL LOOP FREQUENCY, DIGITS VI-X (M&F)	4	3/ 7-11
7	ULNAR LOOP FREQUENCY, DIGITS I-V (M&F)	4	4/ 2-6
8	ULNAR LOOP FREQUENCY, DIGITS VI-X (M&F)	4	4/ 7-11
9	WHORL FREQUENCY, DIGITS I-V (M&F)	4	5/ 2-6
10	WHORL FREQUENCY, DIGITS VI-X (M&F)	4	5/ 7-11
11	TFRC--BIMANUAL	6	1
12	TFRC--RIGHT HAND	6	2
13	TFRC--LEFT HAND	6	3
14	MEAN RIDGE COUNT, ALL PATTERNS, ALL DIGITS	7	1
15	MEAN RIDGE COUNT, RADIAL LOOPS, ALL DIGITS	7	4
16	MEAN RIDGE COUNT, ULNAR LOOPS, ALL DIGITS	7	7

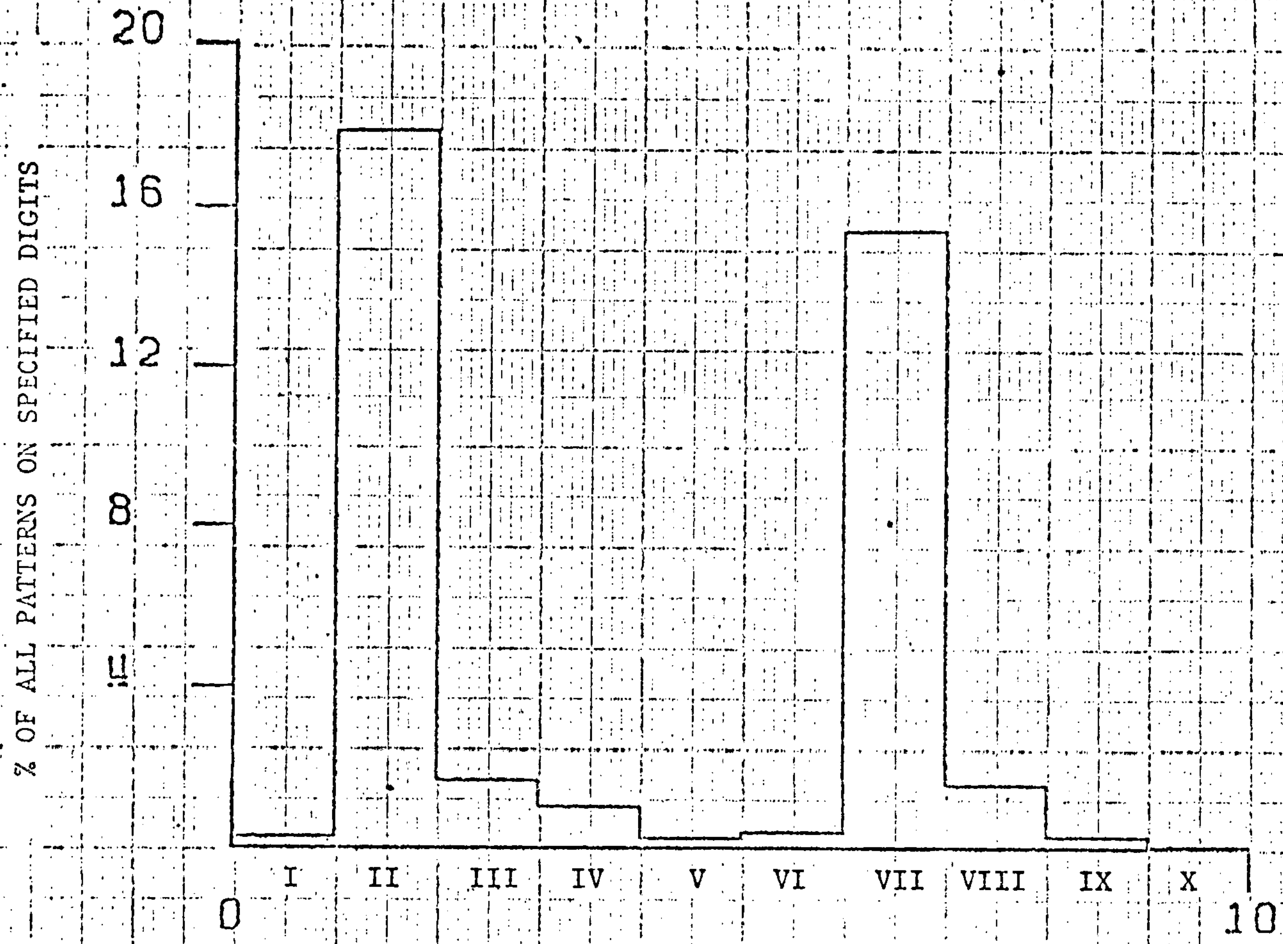
Chart Number	Description	Statistic Page Number	[illegible]o. Column
17	MEAN RIDGE COUNT, WHORLS, ALL DIGITS	7	10
18 - 27	MEAN RIDGE COUNT, ALL PATTERNS, DIGITS I- X	8	1 - 10
28 - 37	MEAN RIDGE COUNT, RADIAL LOOPS, DIGITS I- X	10	2 - 11
38 - 47	MEAN RIDGE COUNT, ULNAR LOOPS, DIGITS I-X	11	2 - 11
48 - 57	MEAN RIDGE COUNT, WHORLS, DIGITS I-X	12	2 - 11
58	BIMANUAL PATTERN FREQUENCY (FEMALES)	22	
59	RADIAL LOOP FREQUENCY, DIGITS I-X	25	3
60	ULNAR LOOP FREQUENCY, DIGITS I-X	25	4
61	WHORL FREQUENCY, DIGITS I-X	25	5
62	TFRC--BIMANUAL	27	1
63	TFRC--RIGHT HAND	27	2
64	TFRC--LEFT HAND	27	3
65	MEAN RIDGE COUNT, ALL PATTERNS, ALL DIGITS	28	1
66	MEAN RIDGE COUNT, RADIAL LOOPS, ALL DIGITS	28	4
67	MEAN RIDGE COUNT, ULNAR LOOPS, ALL DIGITS	28	7
68	MEAN RIDGE COUNT, WHORLS, ALL DIGITS	28	10
69 - 78	MEAN RIDGE COUNTS, ALL PATTERNS, DIGITS I - X	29	1 -10
79 - 88	MEAN RIDGE COUNTS, RADIAL LOOPS, DIGITS I - X	31	2 - 11
89 - 98	MEAN RIDGE COUNTS, ULNAR LOOPS, DIGITS I - X	32	2 - 11
99 - 108	MEAN RIDGE COUNTS, WHORLS, DIGITS I- X	33	2 - 11



PD-18 MALES COMBINED DIGITS

CHART # 2

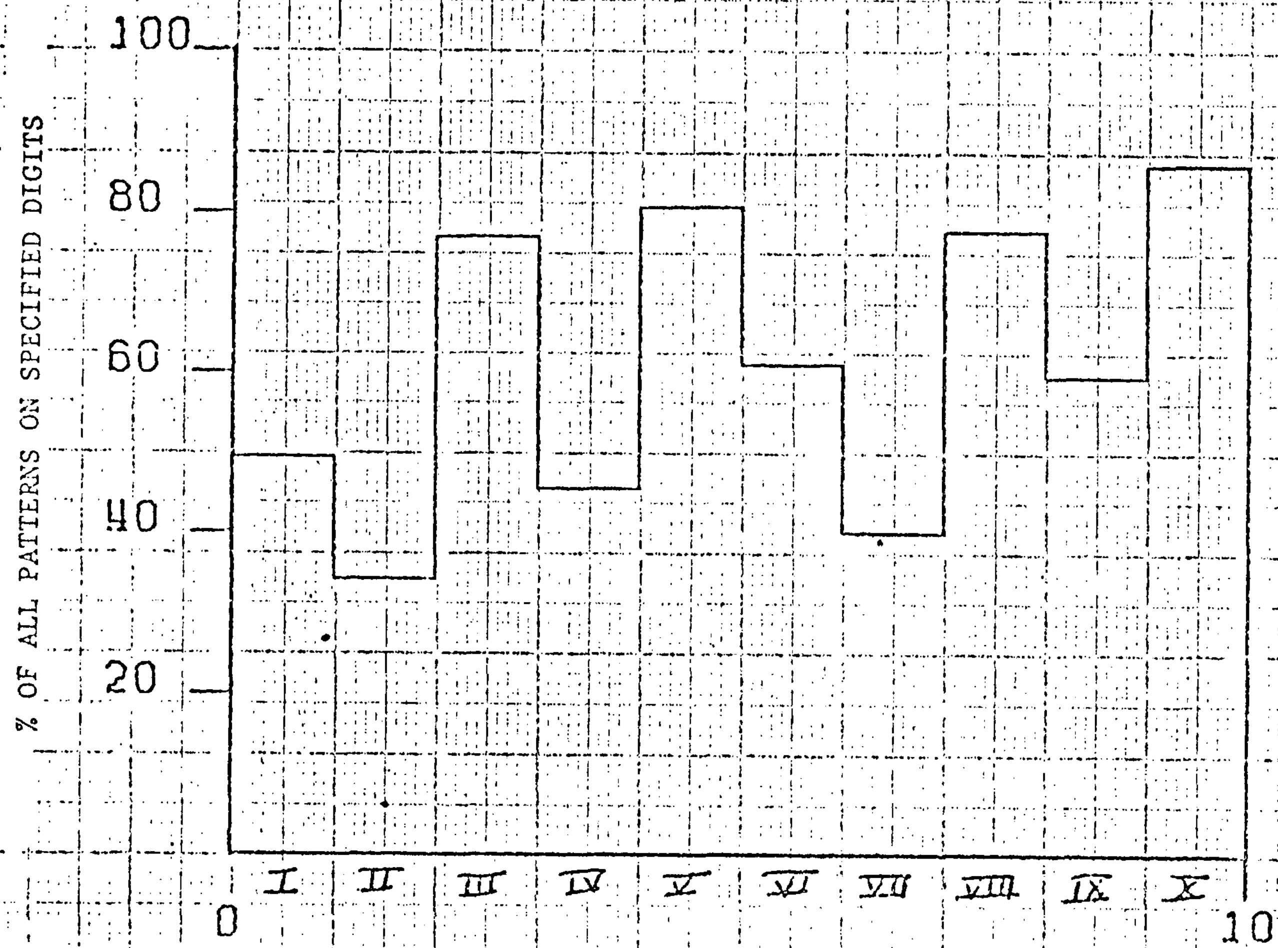
STAT. PAGE 4, ROW 3



PD-5C MALES RADIAL LOOPS DIGITS I-X

CHART # 3

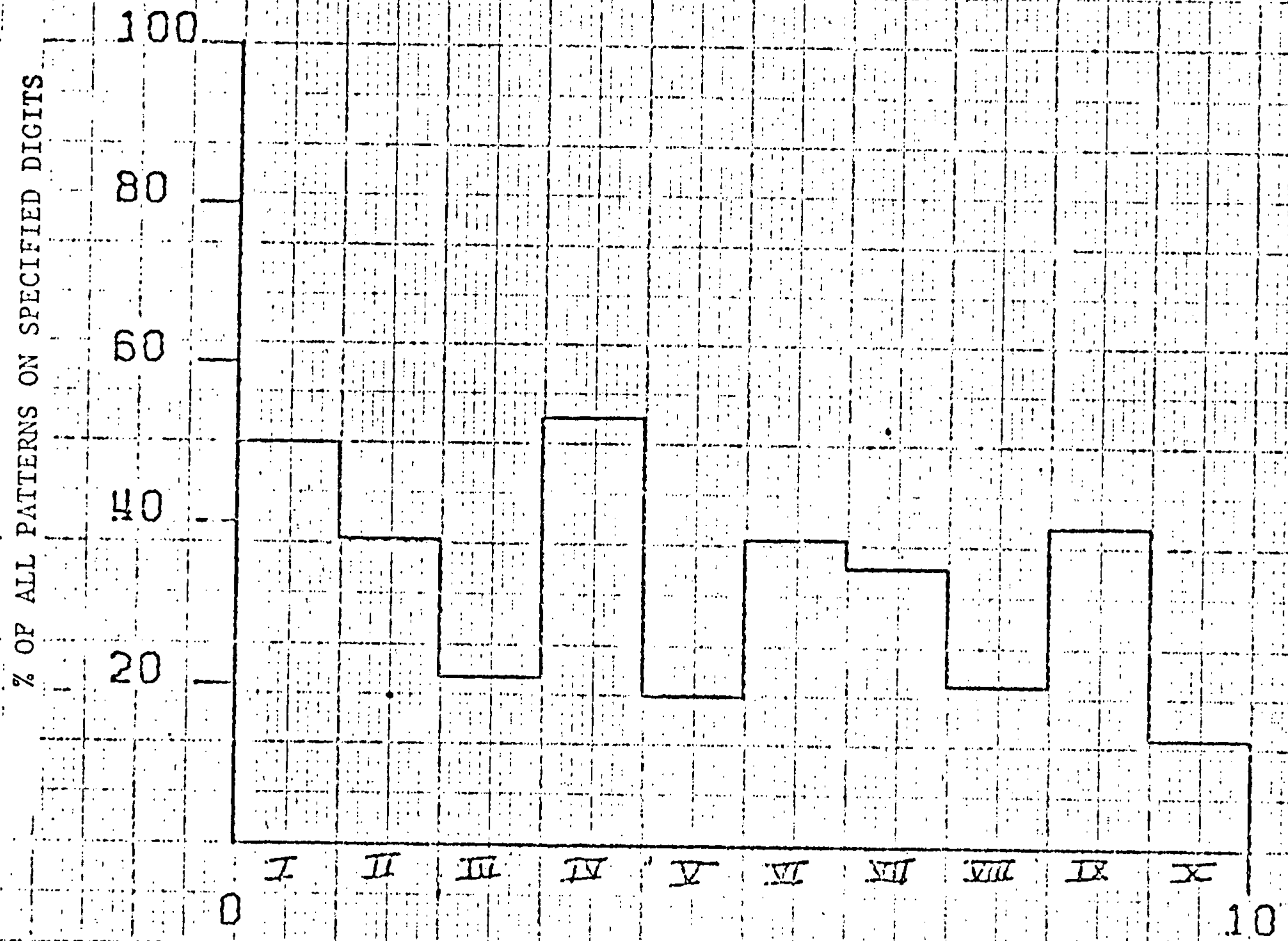
STAT. PAGE 4, ROW 4



PD-50 MALES ULNAR LOOPS DIGITS I-X

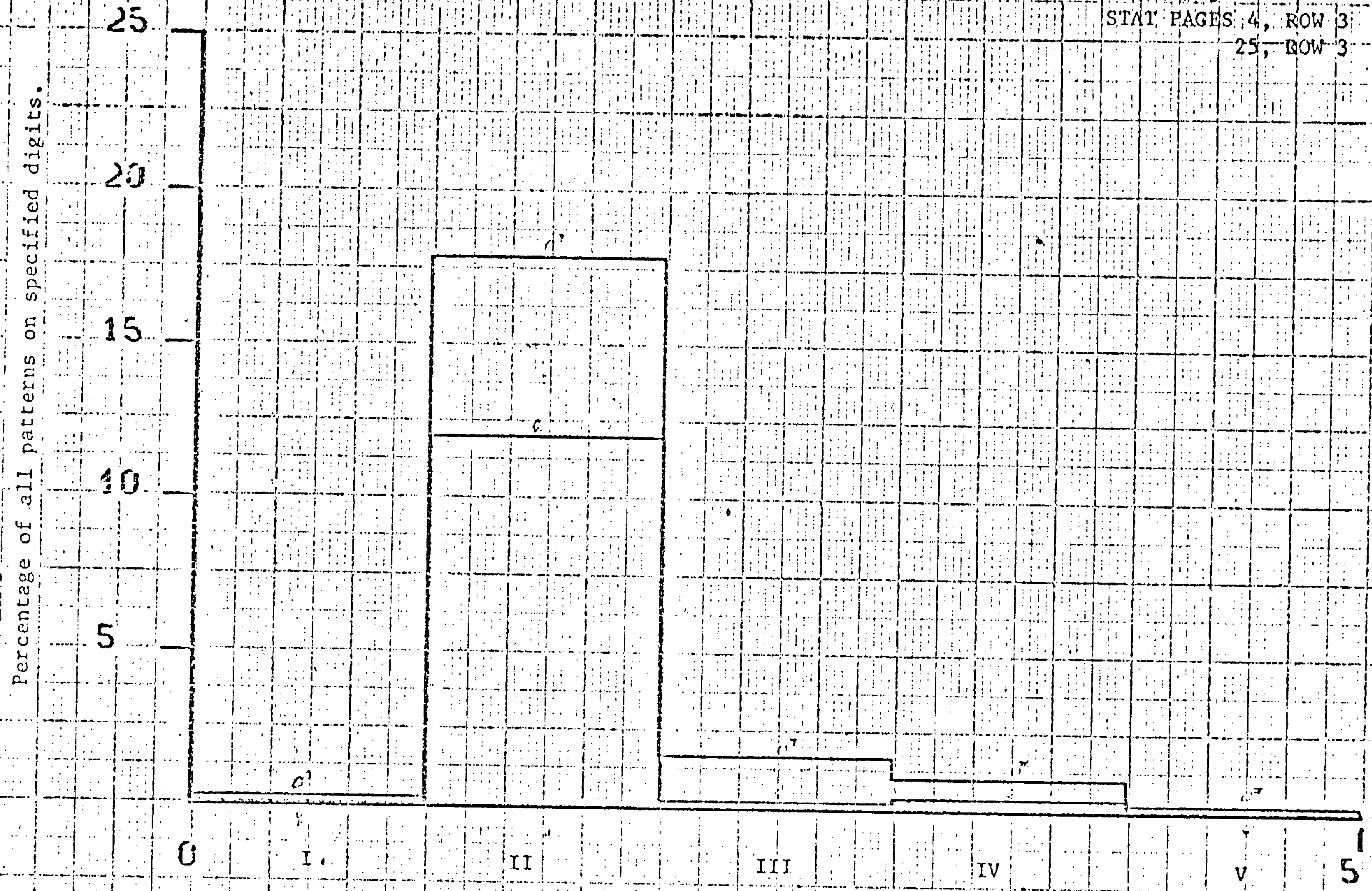
CHART # 4

STAT. PAGE 4, ROW 5



PD-5E MALES WHORL FREQS I-X

CHART # 5
STAT PAGES 4, ROW 3
25, ROW 3



RADIAL LOOPS RH MALES=BLACK FEMALES=RED

CHART # 6

STAT PAGES 4, ROW 3
25, ROW 3

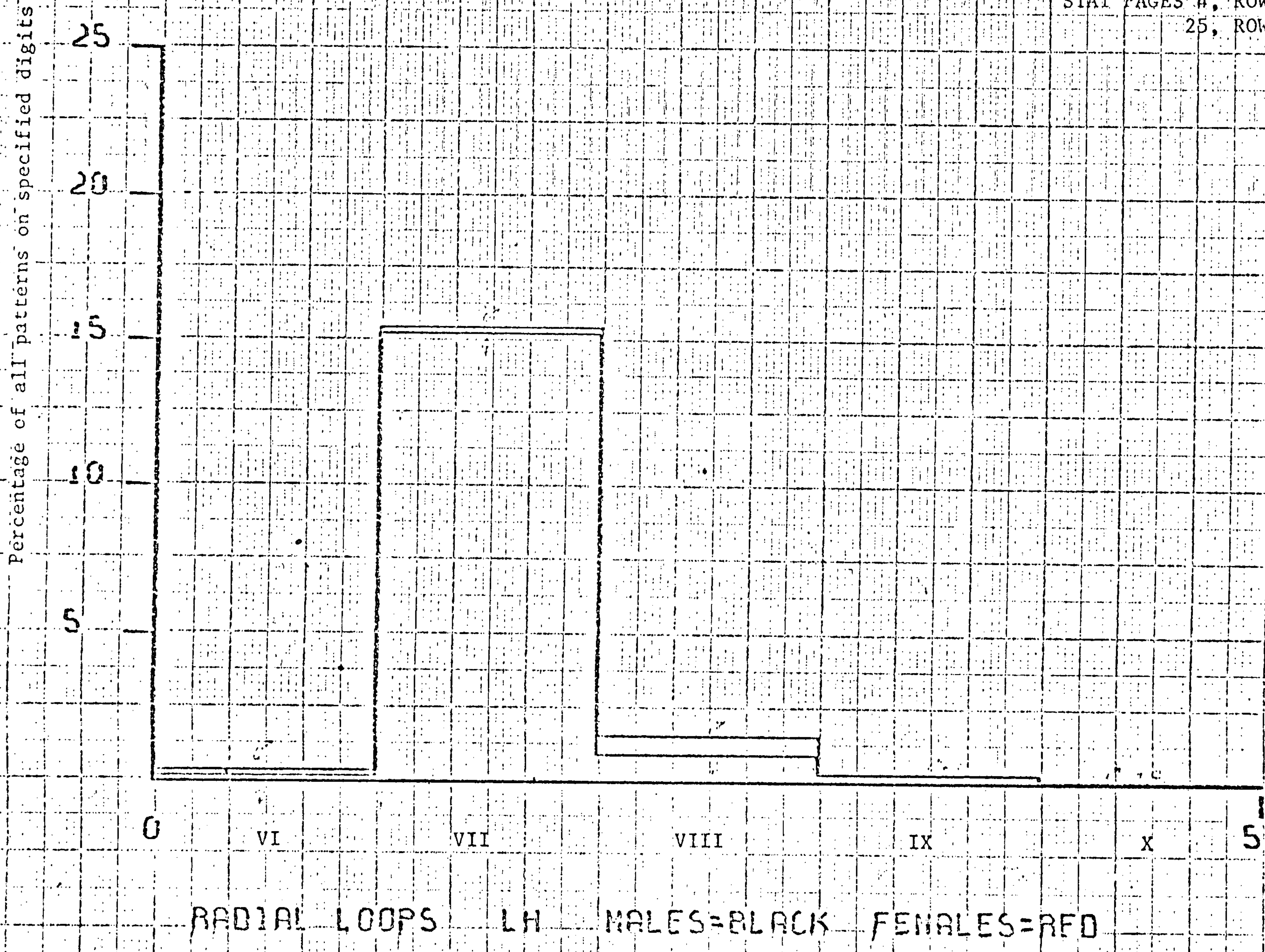
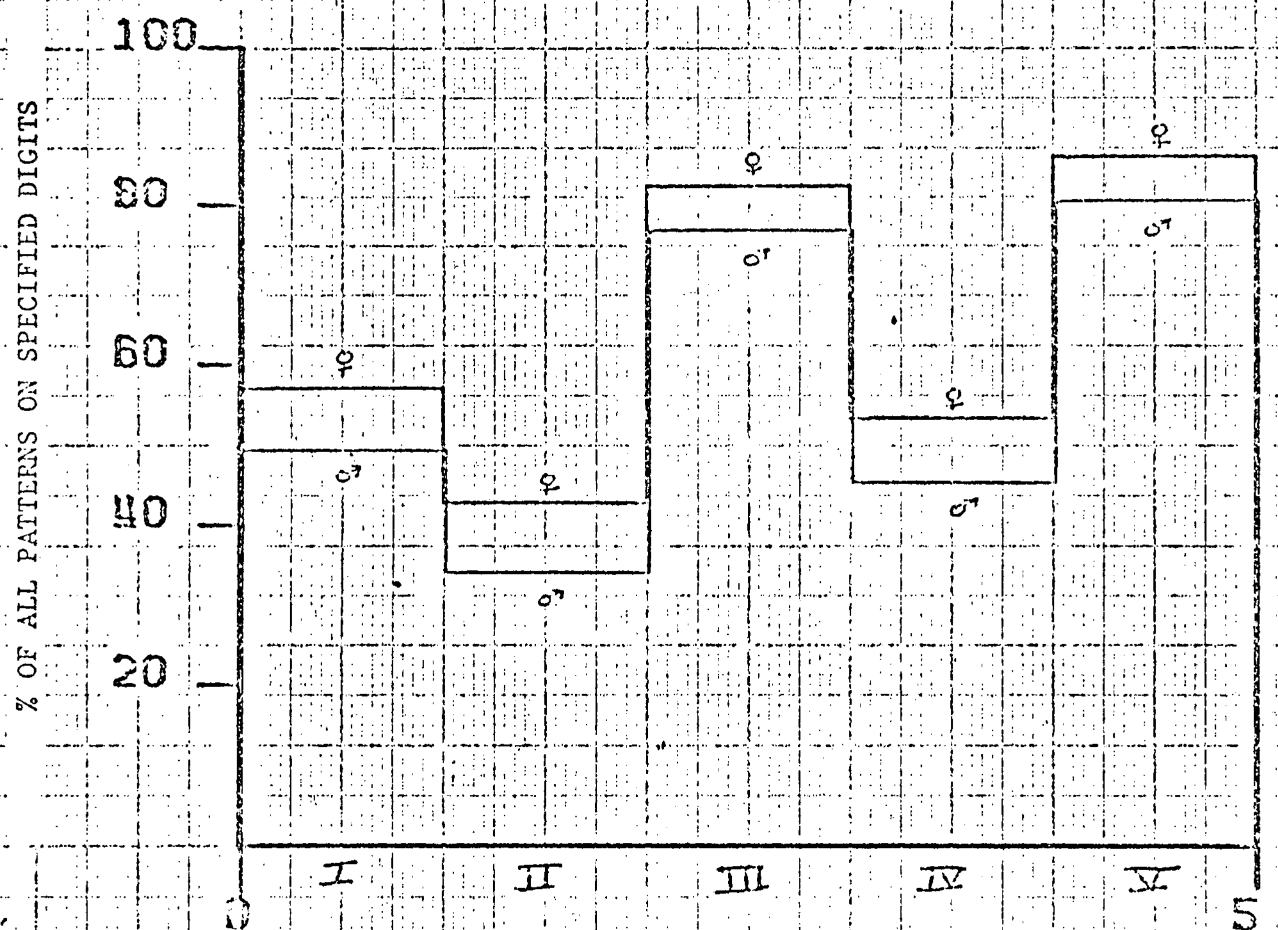


CHART # 7

STAT PAGES 4, ROW 4
25, ROW 4

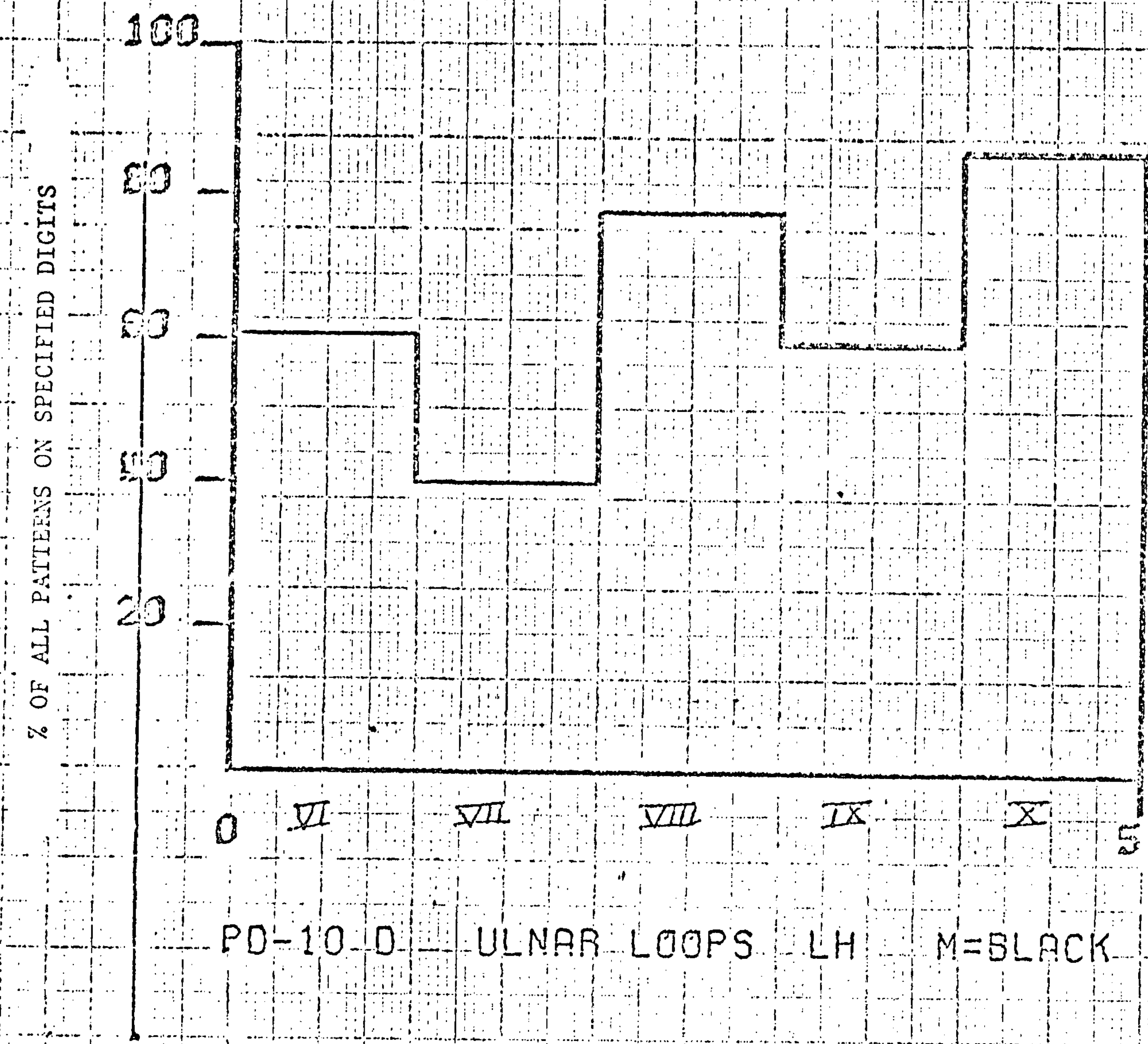


PO-SE ULNAR LOOPS RH M=BLACK ♂ F=RED ♀

NOTE: MALE AND FEMALE GRAPHS
COTERMINOUS AT ALL POINTS

CHART # 8

STAT PAGES 4, ROW 4
25, ROW 4



PD-10 D ULNAR LOOPS LH M=BLACK F=RED1

CHART # 9

STAT PAGES 4, ROW 5
25, ROW 5

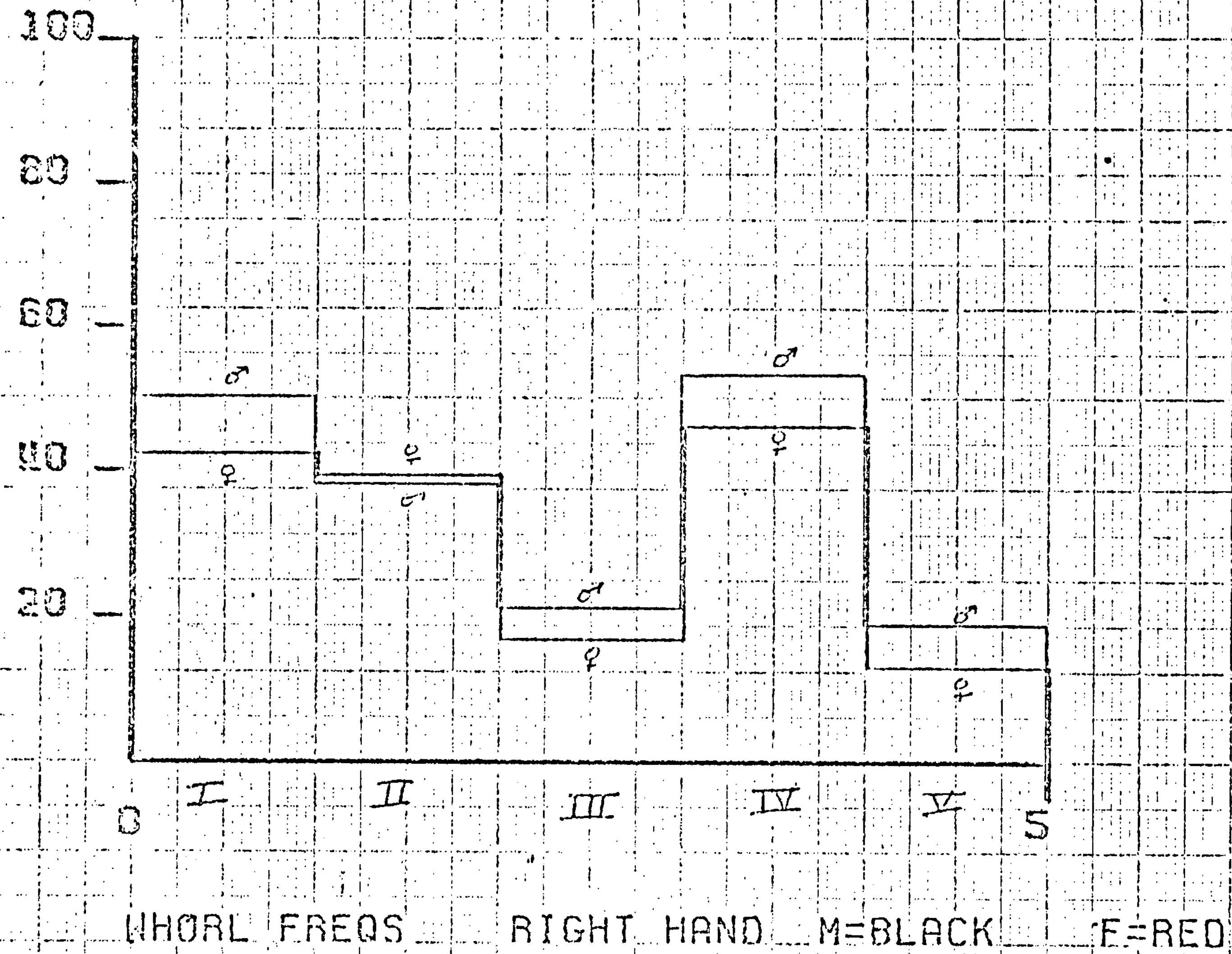
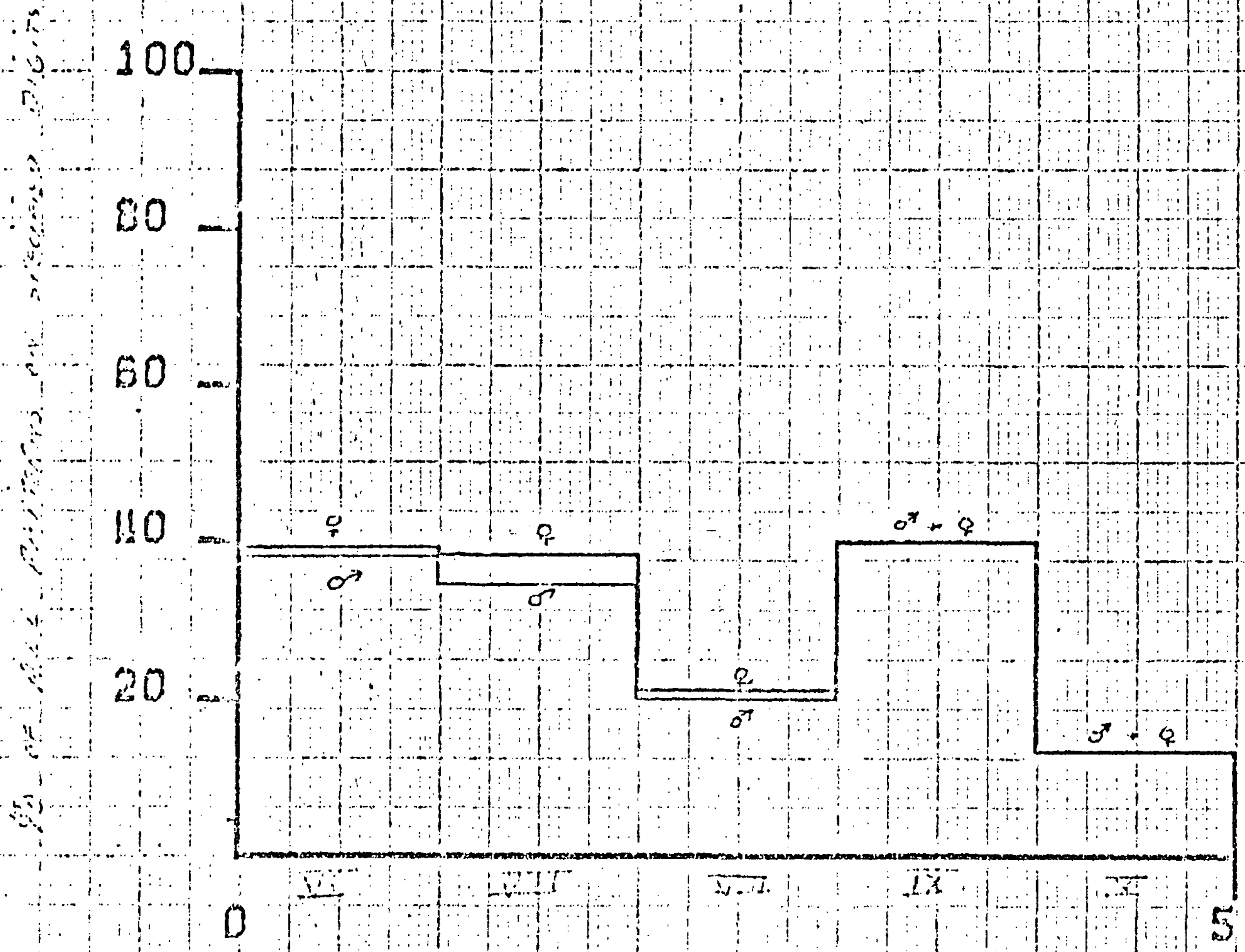


CHART # 10

STAT PAGE 4, ROW 5
25, ROW 5



PD-9E WHORL FREQS LEFT HAND M=BLACK F=RED

Description	Chart Number	Statistics Page Number	Row Column
MEAN RIDGE COUNT, WHORLS, ALL DIGITS	17	7	10
MEAN RIDGE COUNT, ALL PATTERNS, DIGITS I-X	18 - 27	8	1 - 10
MEAN RIDGE COUNT, RADIAL LOOPS, DIGITS I-X	28 - 37	10	2 - 11
MEAN RIDGE COUNT, ULNAR LOOPS, DIGITS I-X	38 - 47	11	2 - 11
MEAN RIDGE COUNT, WHORLS, DIGITS I-X	48 - 57	12	2 - 11
BIMANUAL PATTERN FREQUENCY (FEMALES)	58	22	
RADIAL LOOP FREQUENCY, DIGITS I-X	59	25	3
ULNAR LOOP FREQUENCY, DIGITS I-X	60	25	4
WHORL FREQUENCY, DIGITS I-X	61	25	5
TFRC--BIMANUAL	62	27	1
TFRC--RIGHT HAND	63	27	2
TFRC--LEFT HAND	64	27	3
MEAN RIDGE COUNT, ALL PATTERNS, ALL DIGITS	65	28	1
MEAN RIDGE COUNT, RADIAL LOOPS, ALL DIGITS	66	28	4
MEAN RIDGE COUNT, ULNAR LOOPS, ALL DIGITS	67	28	7
MEAN RIDGE COUNT, WHORLS, ALL DIGITS	68	28	10
MEAN RIDGE COUNTS, ALL PATTERNS, DIGITS I-X	69 - 78	29	1 - 10
MEAN RIDGE COUNTS, RADIAL LOOPS, DIGITS I-X	79 - 88	31	2 - 11
MEAN RIDGE COUNTS, ULNAR LOOPS, DIGITS I-X	89 - 98	32	2 - 11
MEAN RIDGE COUNTS, WHORLS, DIGITS I-X	99 - 108	33	2 - 11

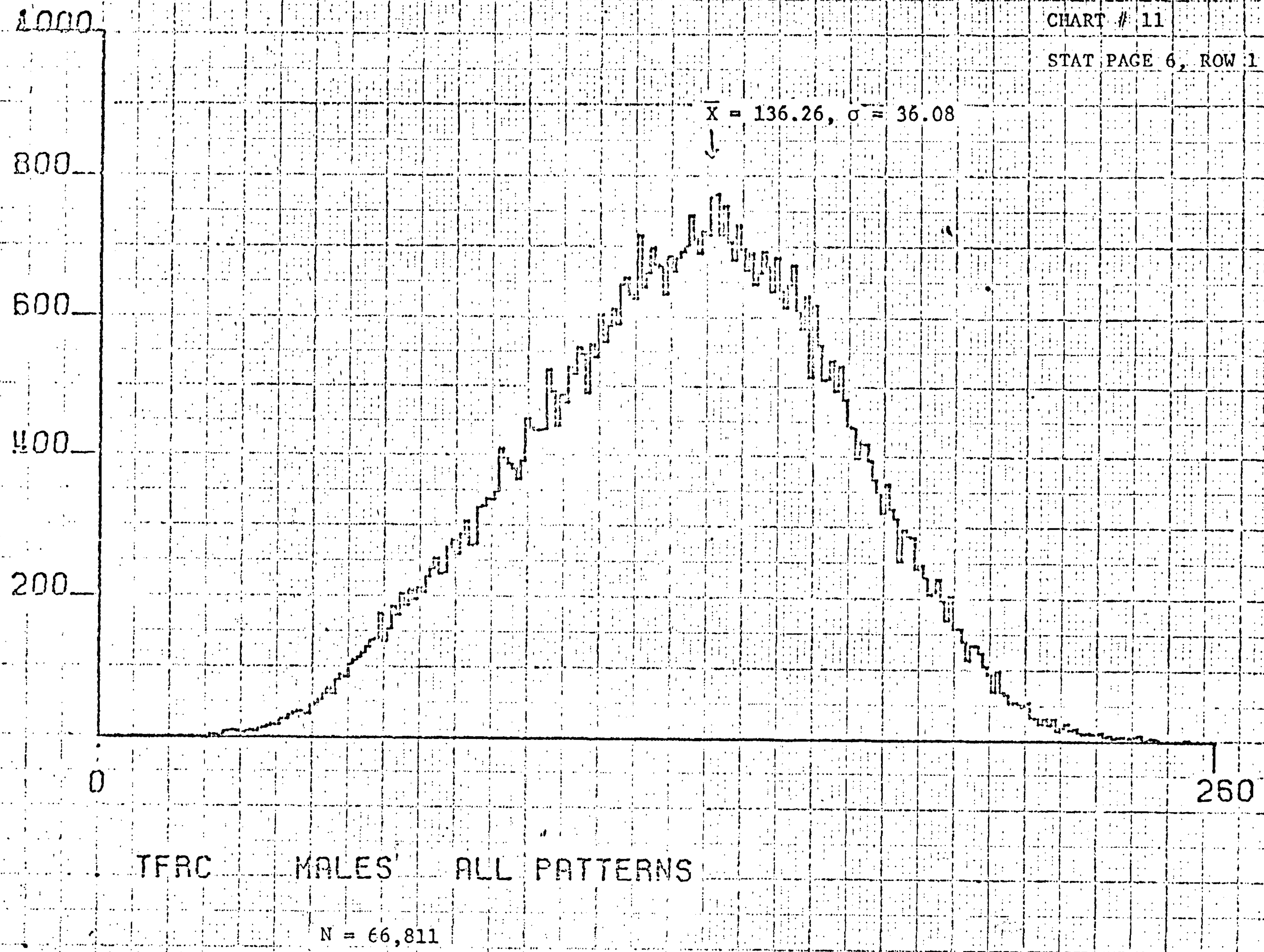
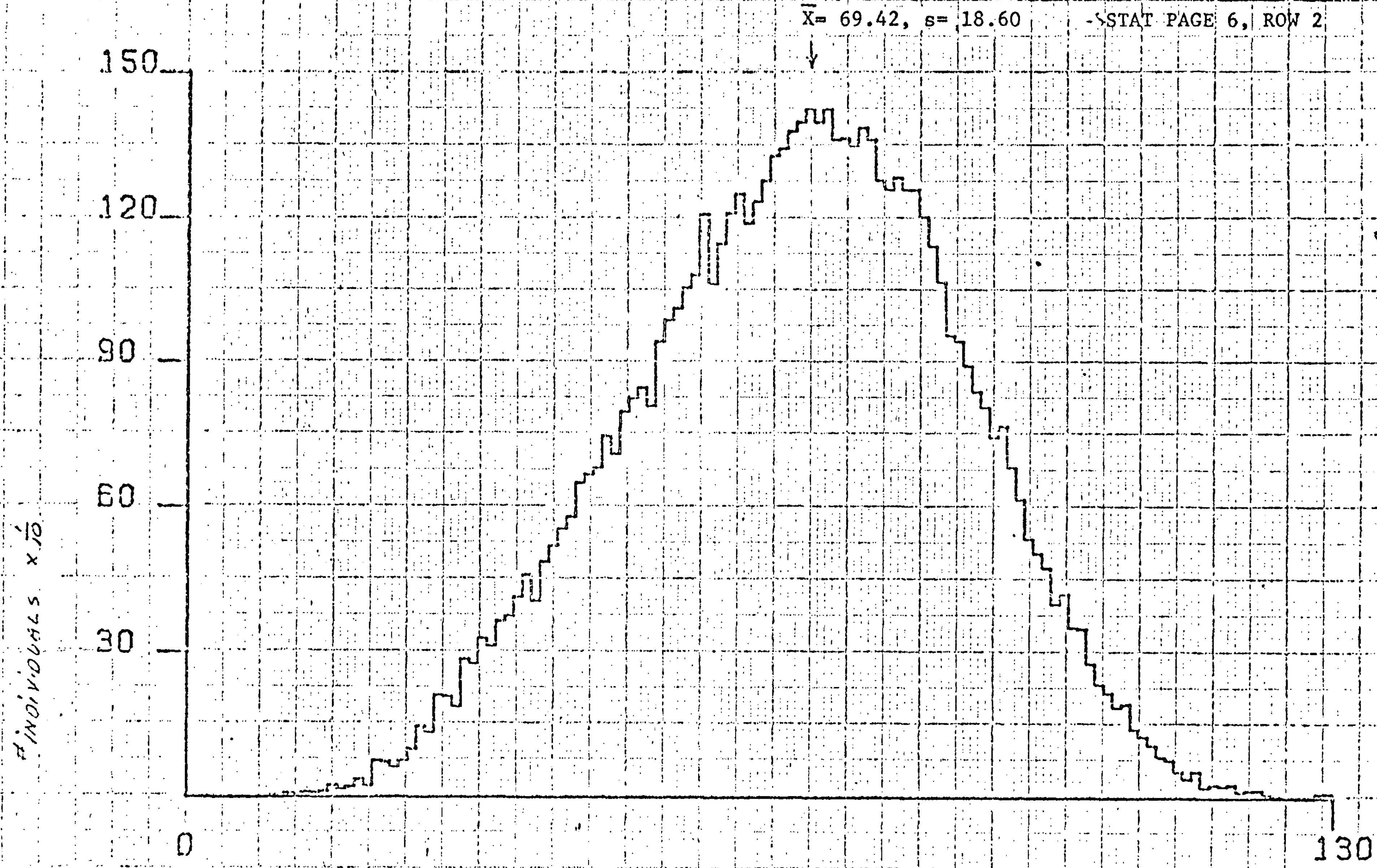


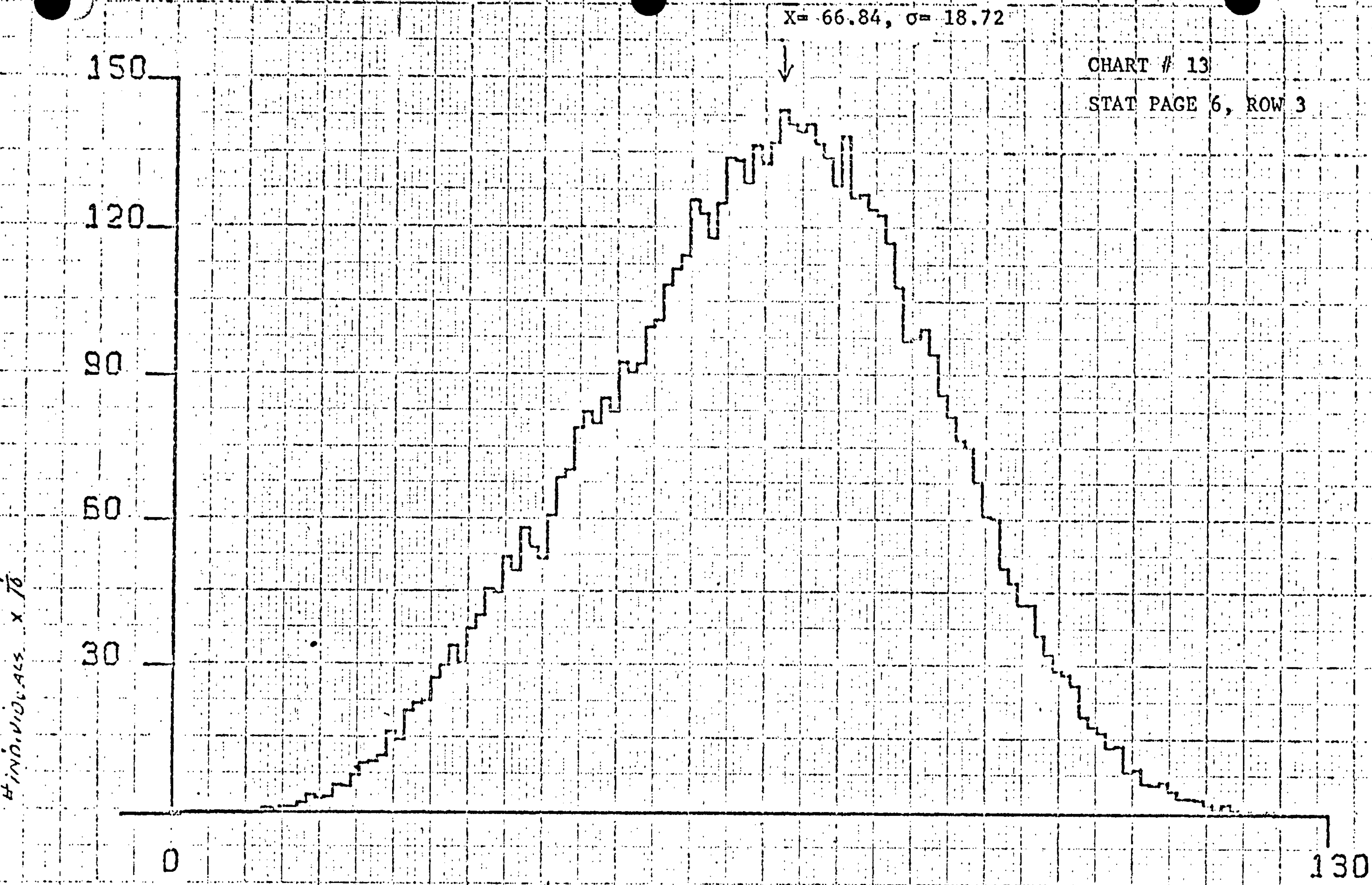
CHART # 11
STAT PAGE 6, ROW 1
$\bar{X}$ = 136.26, σ = 36.08
1000
800
600
400
200
0
260
TFRC MALES' ALL PATTERNS
N = 66,811

CHART # 12



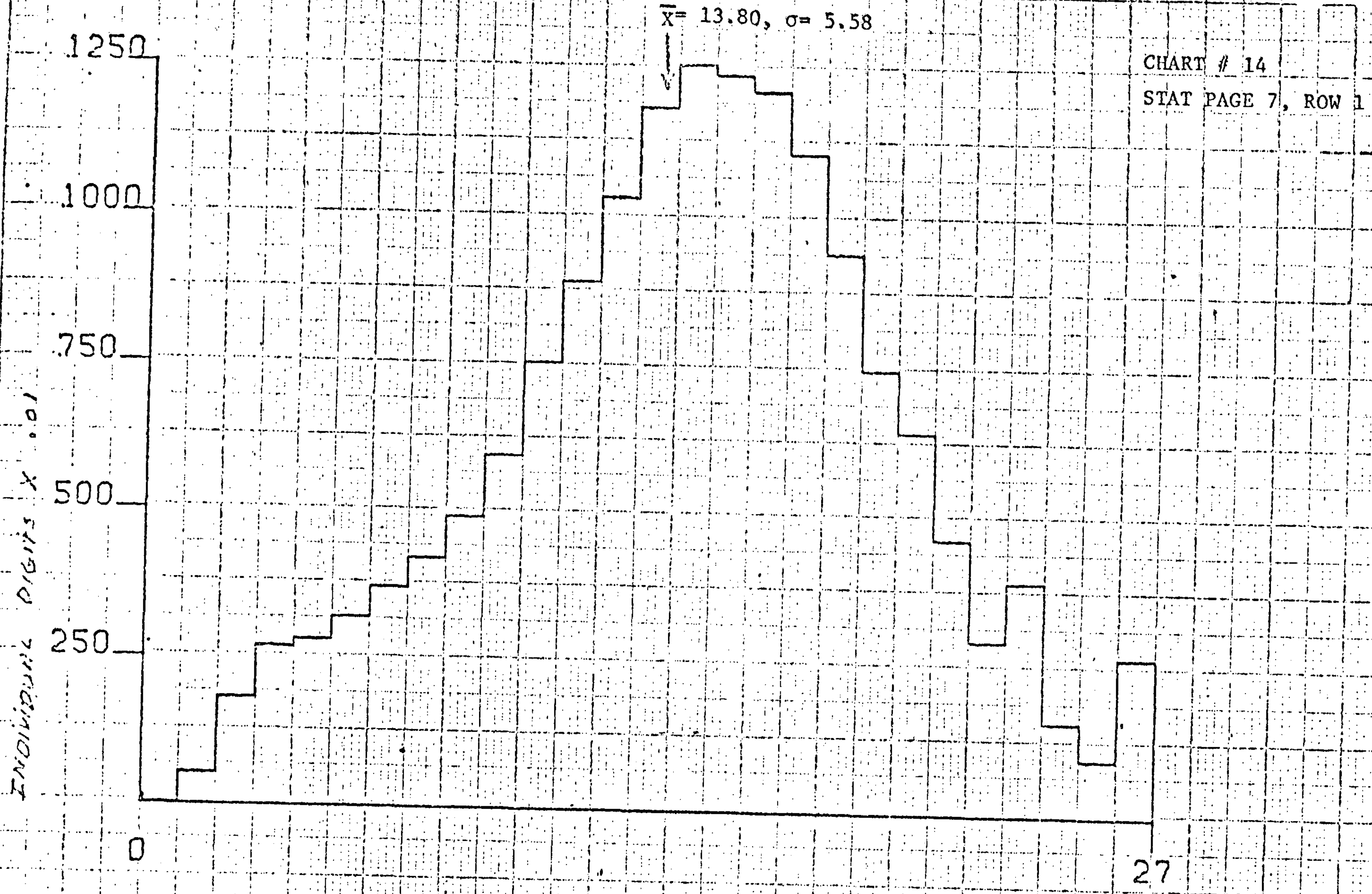
TFRC MALES RIGHT HAND ALL PATTERNS

N= 66,811 persons



TFRC MALES LEFT HAND ALL PATTERNS

N= 66,811 persons

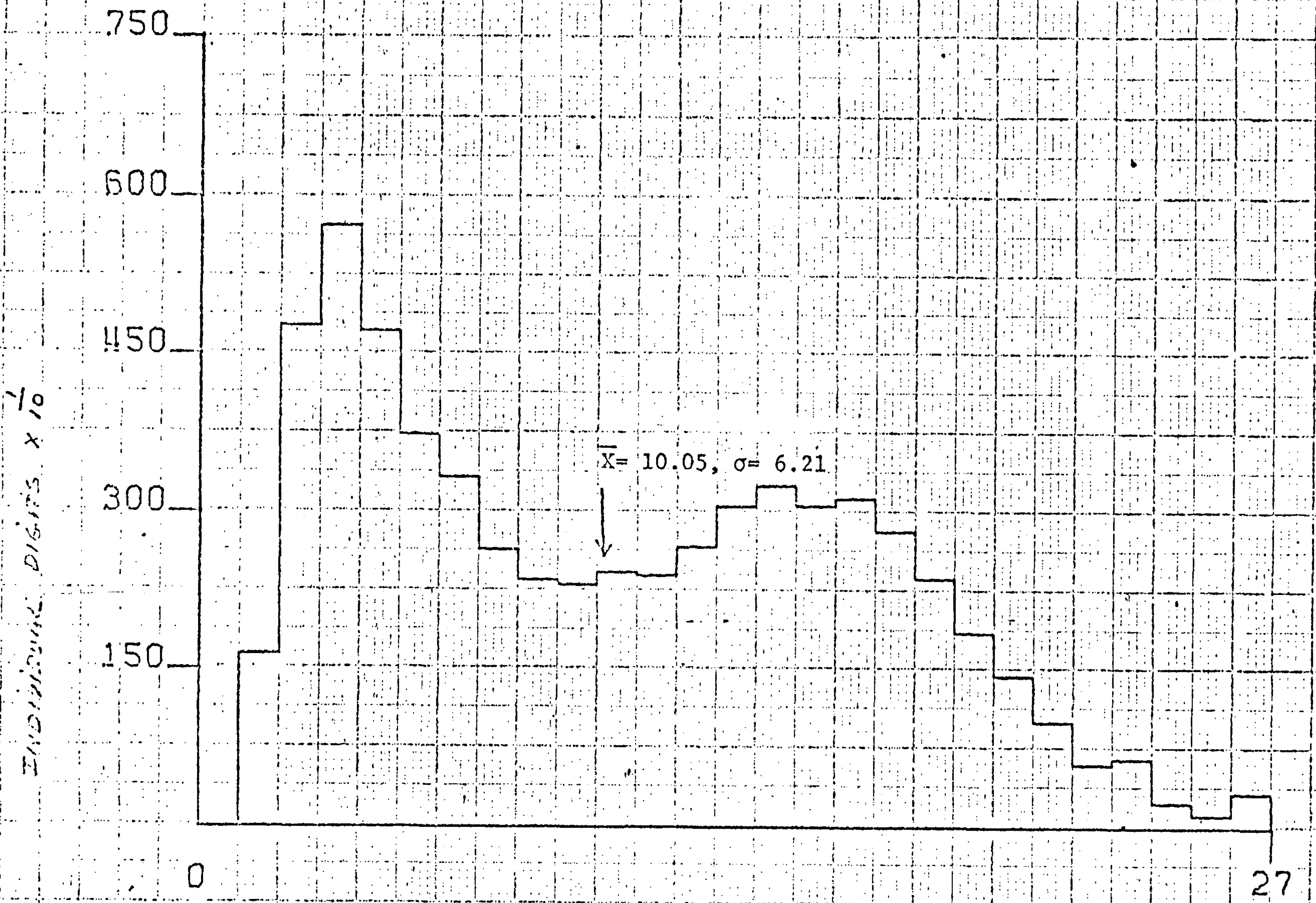


DD-1 MALES TOTAL PATTERN ALL DIGITS

N= 1,602,290 digits

CHART # 15

STAT PAGE 7, ROW 4



MALES RADIAL LOOPS ALL DIGITS

N= 62,791 digits

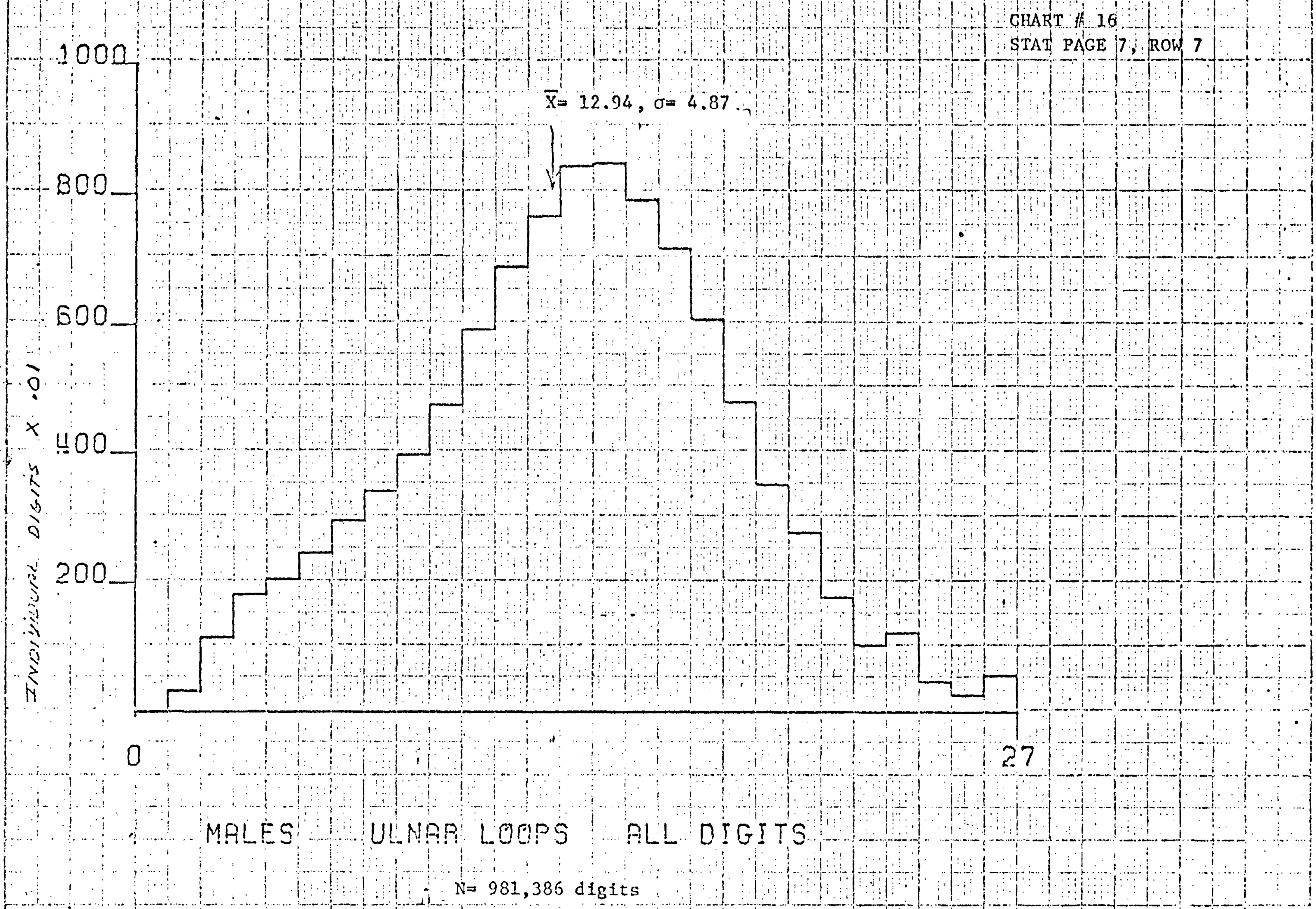


CHART # 16
STAT PAGE 7, ROW 7
X̄= 12.94 , σ= 4.87
1000
800
600
400
200
INDIVIDUAL DIGITS X .01
0
27
MALES ULNAR LOOPS ALL DIGITS
N= 981,386 digits

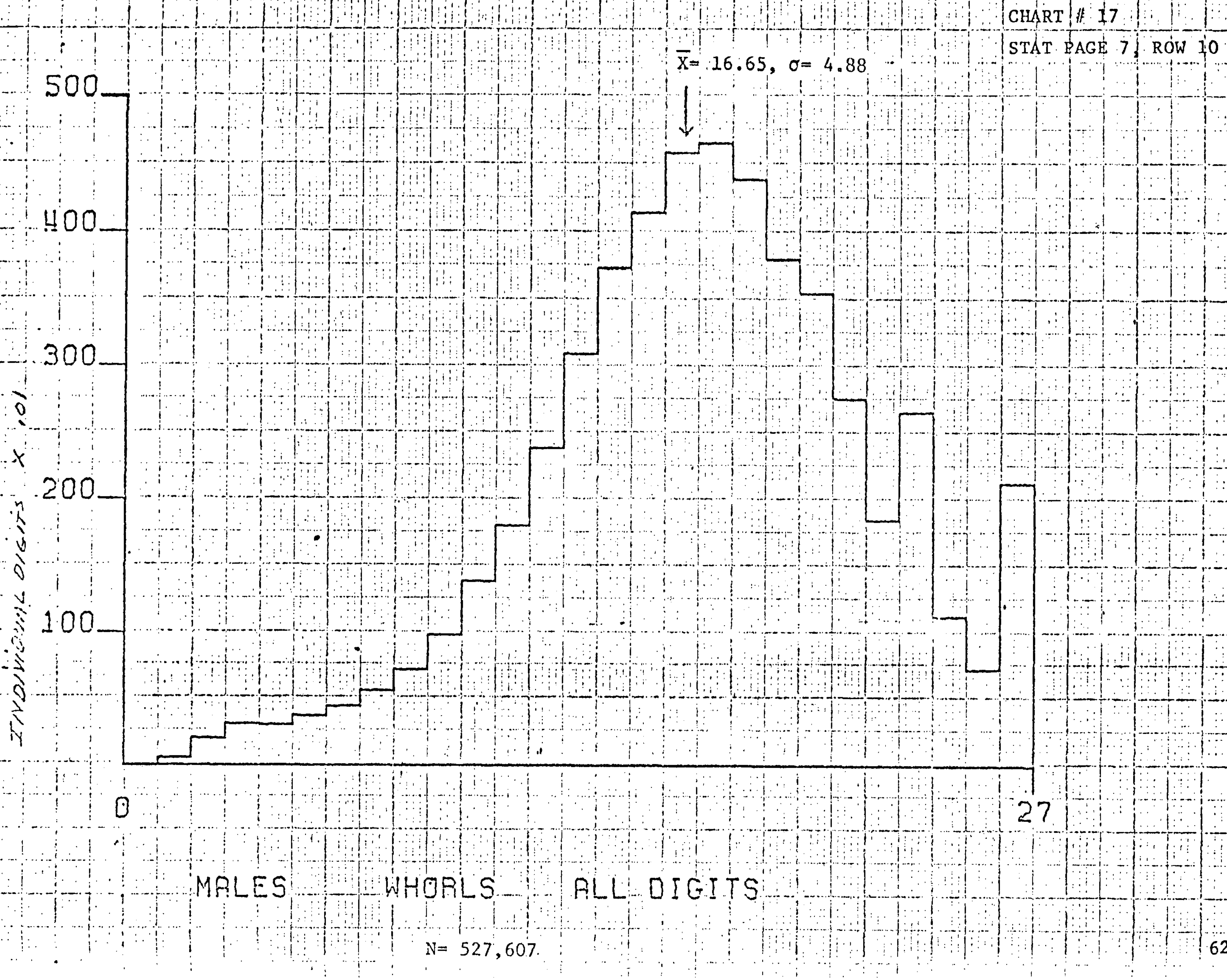


CHART # 17
STAT PAGE 7, ROW 10
X̄= 16.65, σ= 4.88
500
400
300
200
100
INDIVIDUAL DIGITS X .01
0
27
MALES WHORLS ALL DIGITS
N= 527,607

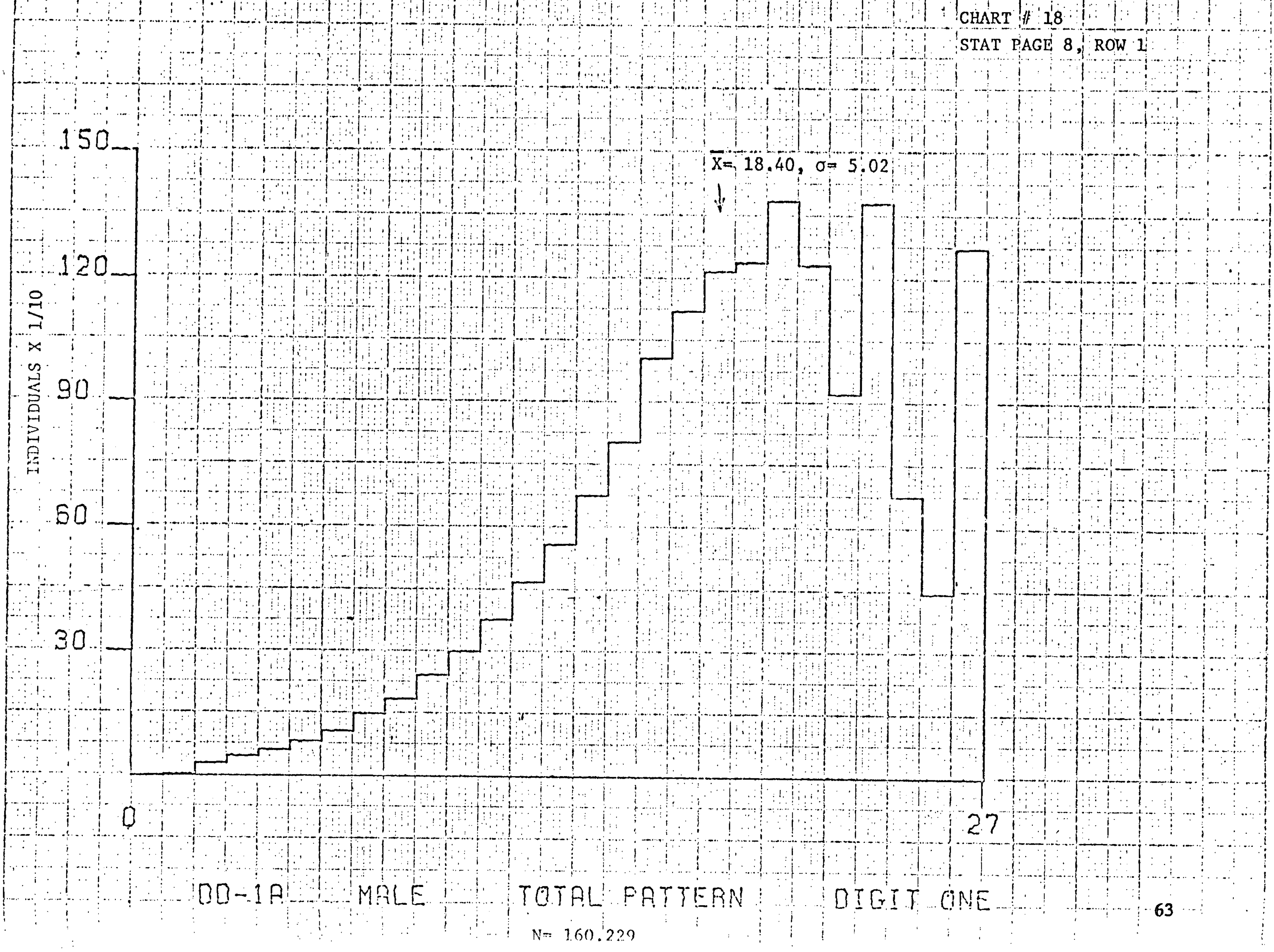
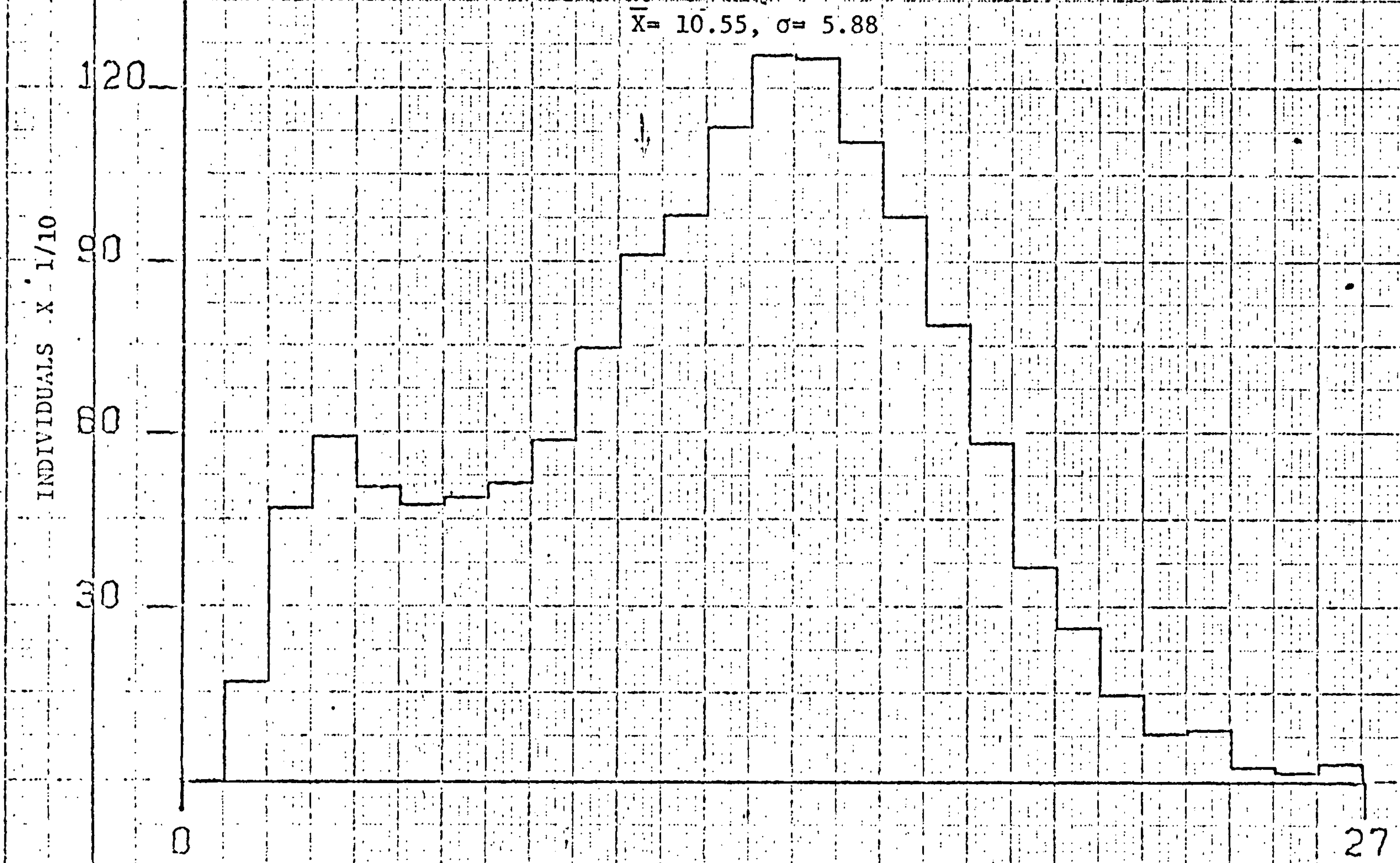


CHART # 18
STAT PAGE 8, ROW 1
X= 18.40, σ= 5.02
150
120
90
60
30
0
27
INDIVIDUALS X 1/10
DD-1A MALE TOTAL PATTERN DIGIT ONE
N= 160,229



DD-1B MALES TOTAL PATTERNS DIGIT TWO

N= 160,229

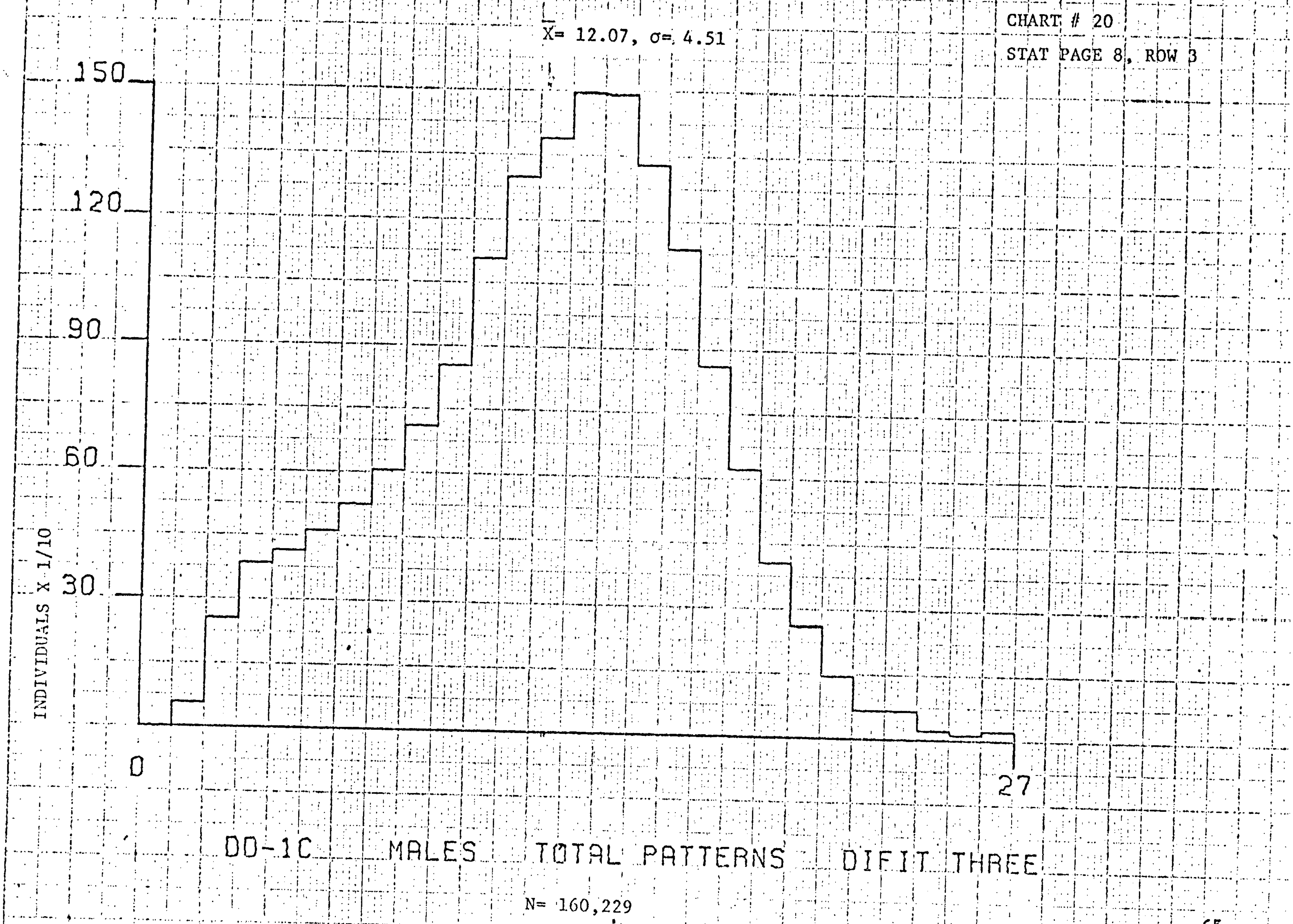
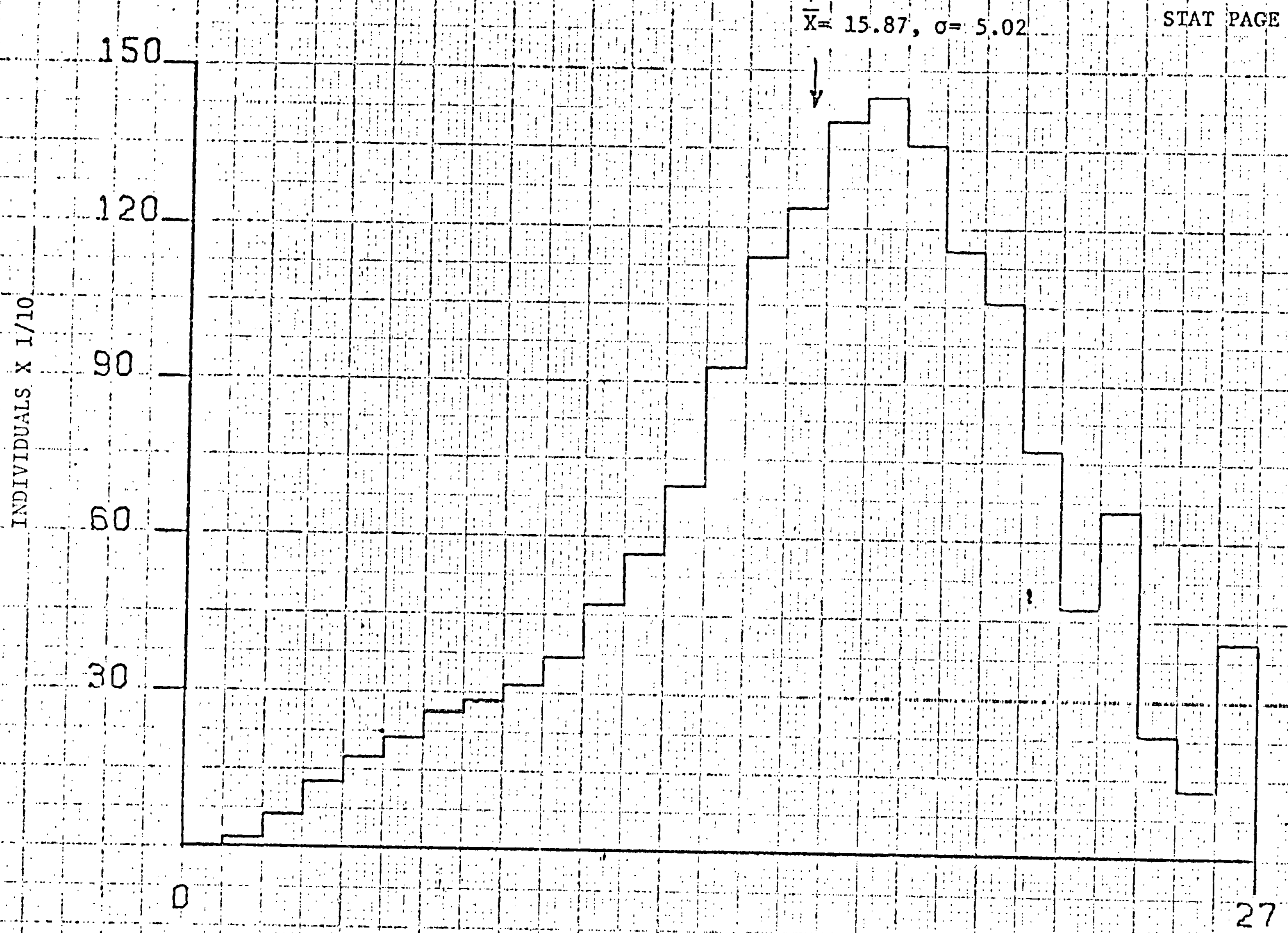


CHART # 20
STAT PAGE 8, ROW 3
X̄= 12.07, σ= 4.51
150
120
90
60
30
INDIVIDUALS X 1/10
0
27
DD-1C MALES TOTAL PATTERNS DIFIT THREE
N= 160,229

CHART # 21

STAT PAGE 8, ROW 4



DD-10 MALES TOTAL PATTERNS DOFOT FOUR

N= 160,229

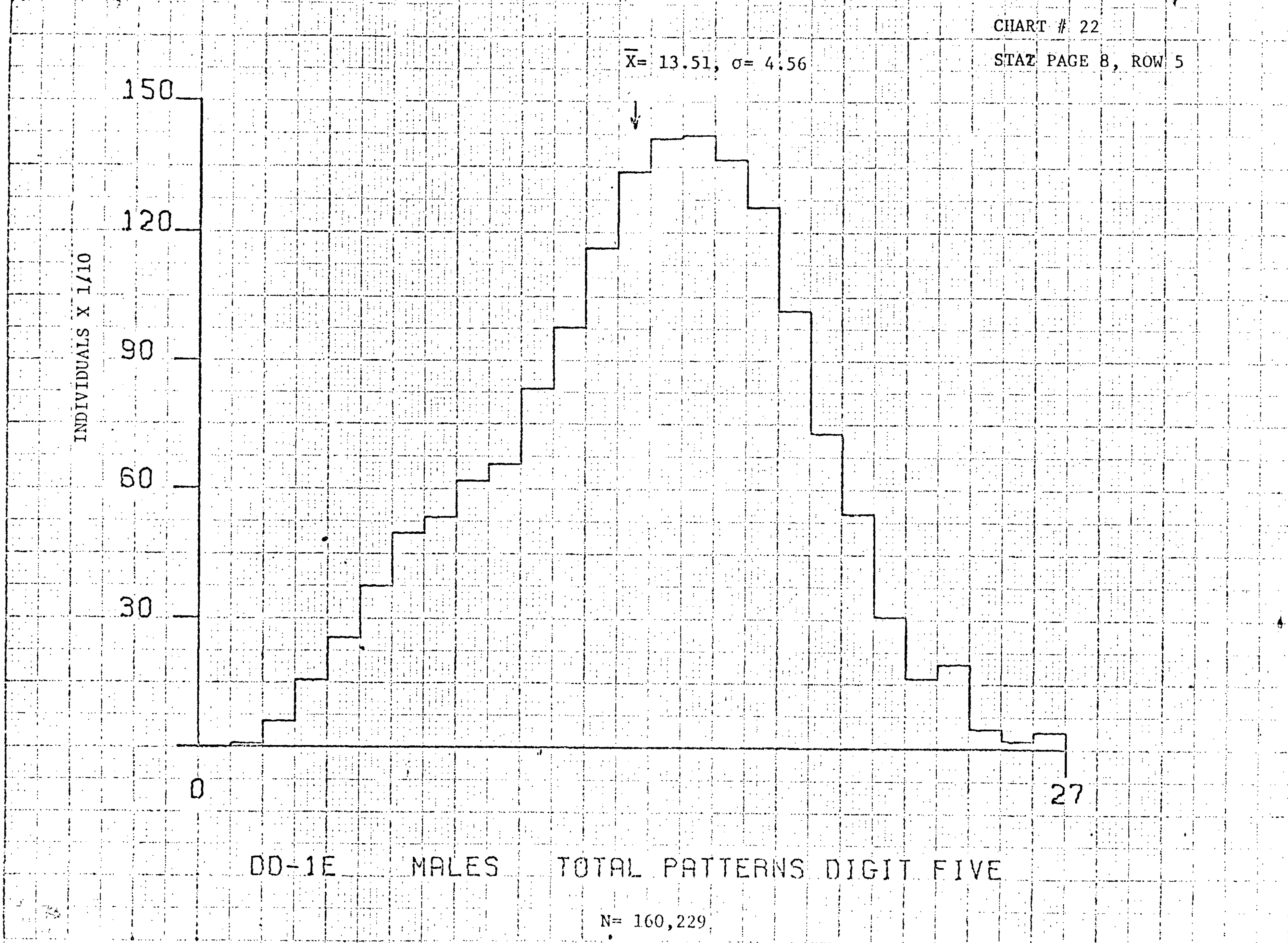


CHART # 22
STAT PAGE 8, ROW 5
X̄= 13.51, σ= 4.56
150
120
90
60
30
INDIVIDUALS X 1/10
0
27
DD-1E MALES TOTAL PATTERNS DIGIT FIVE
N= 160,229

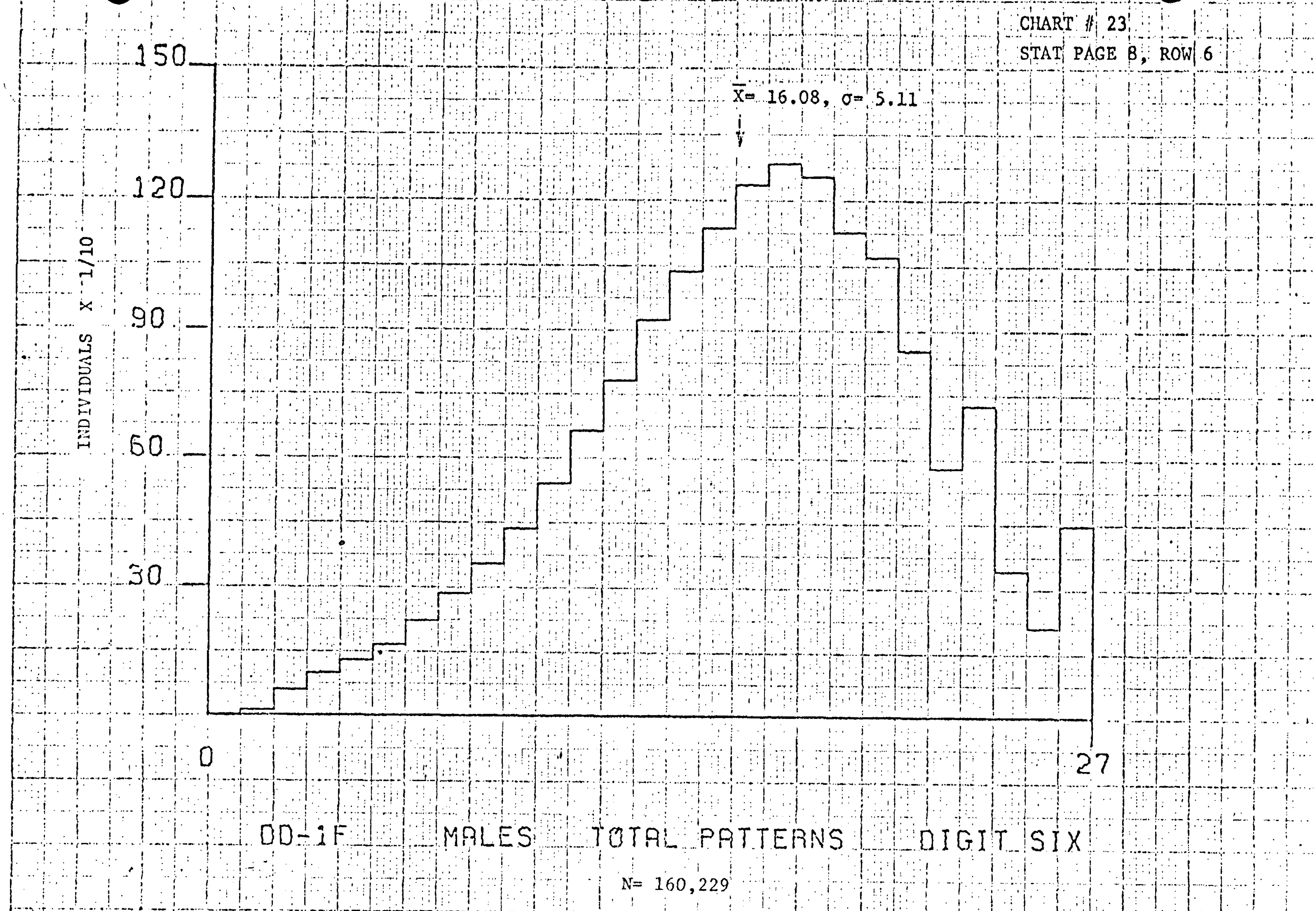
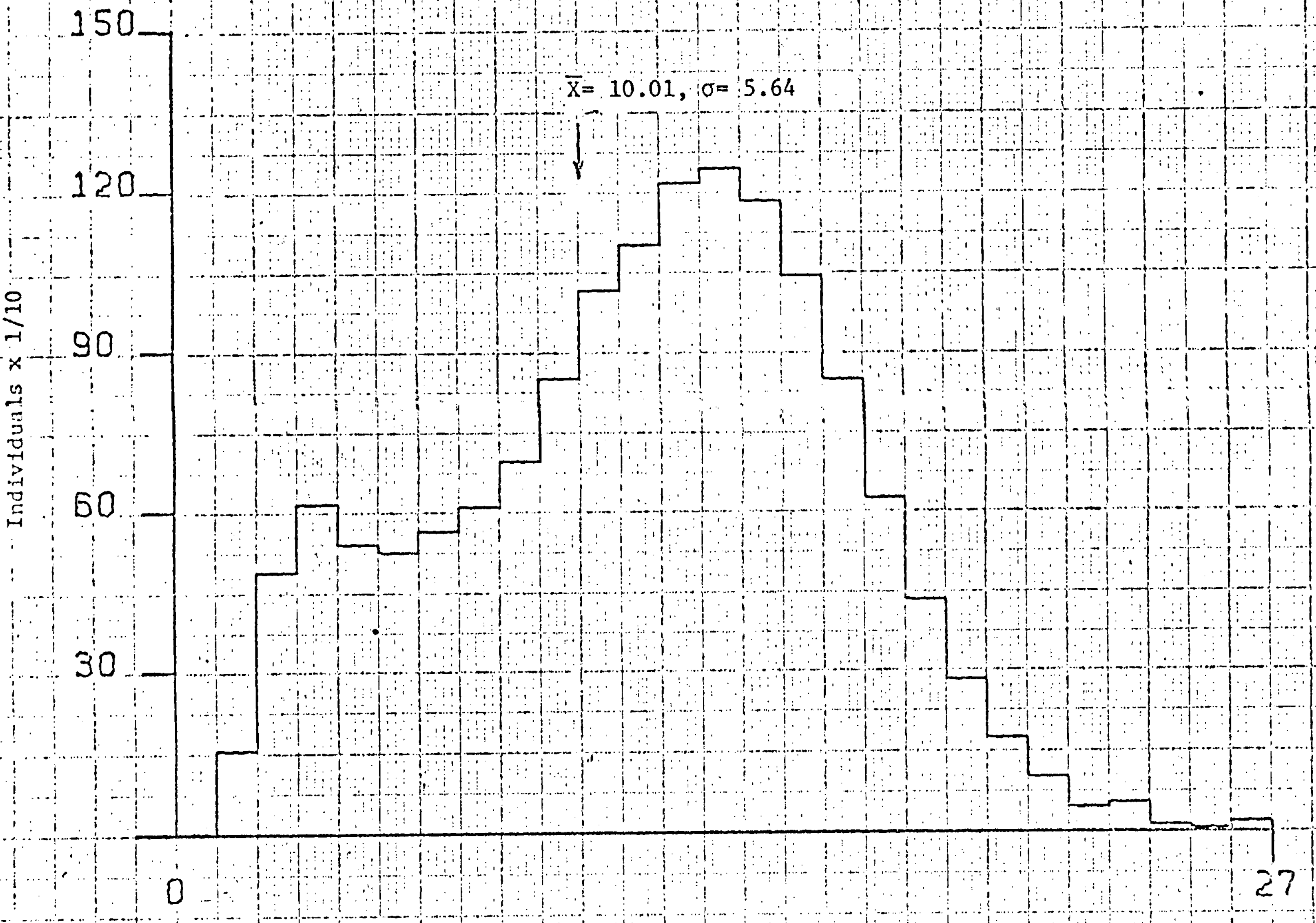
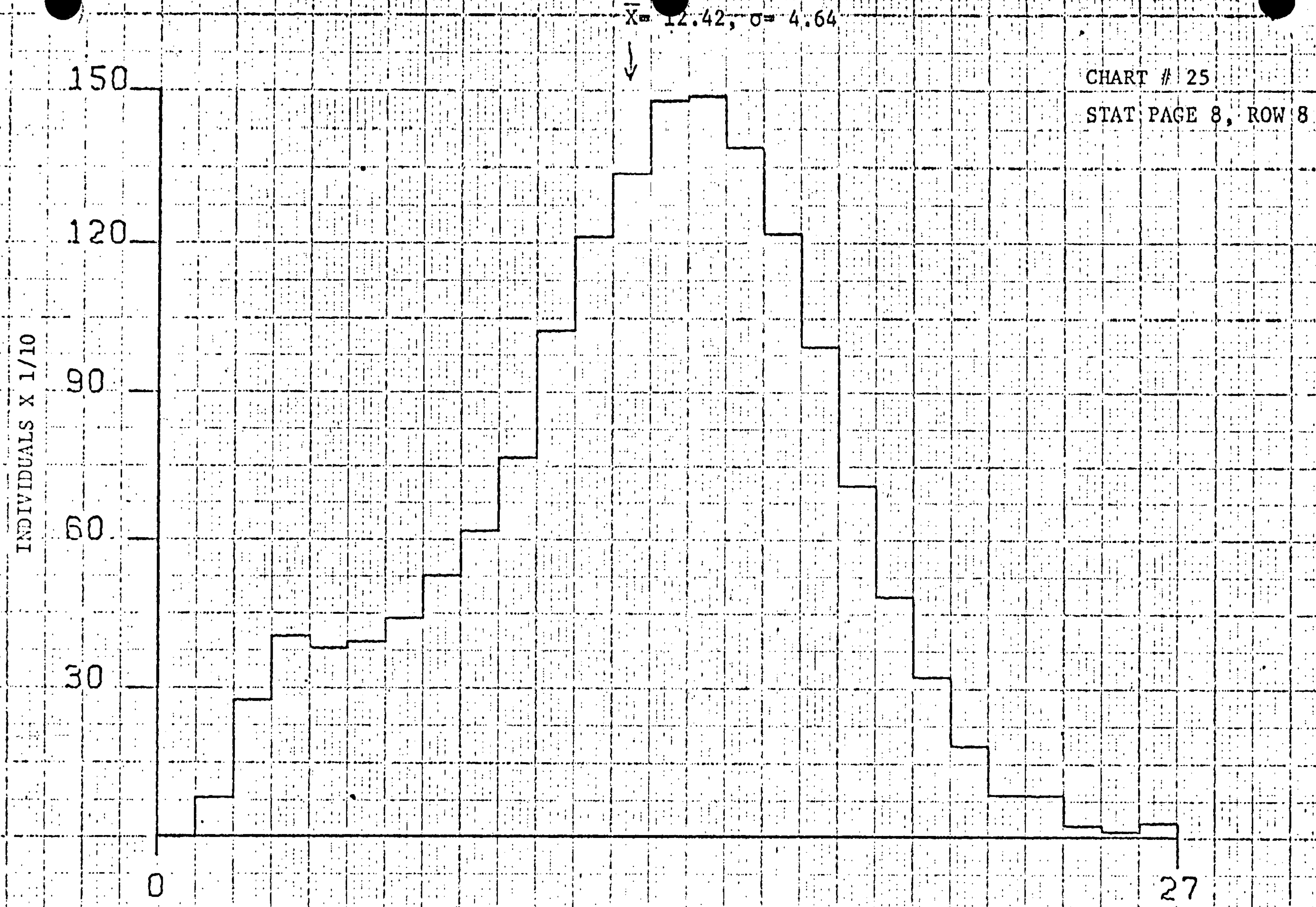


CHART # 23
STAT PAGE 8, ROW 6
X̄= 16.08, σ= 5.11
150
120
90
60
30
INDIVIDUALS X 1/10
0
27
OD-1F MALES TØTAL PATTERNS DIGIT SIX
N= 160,229

CHART # 24
STAT PAGE 8, ROW 7



DD-1G MALES TOTAL PATTERNS DIGIT SEVEN

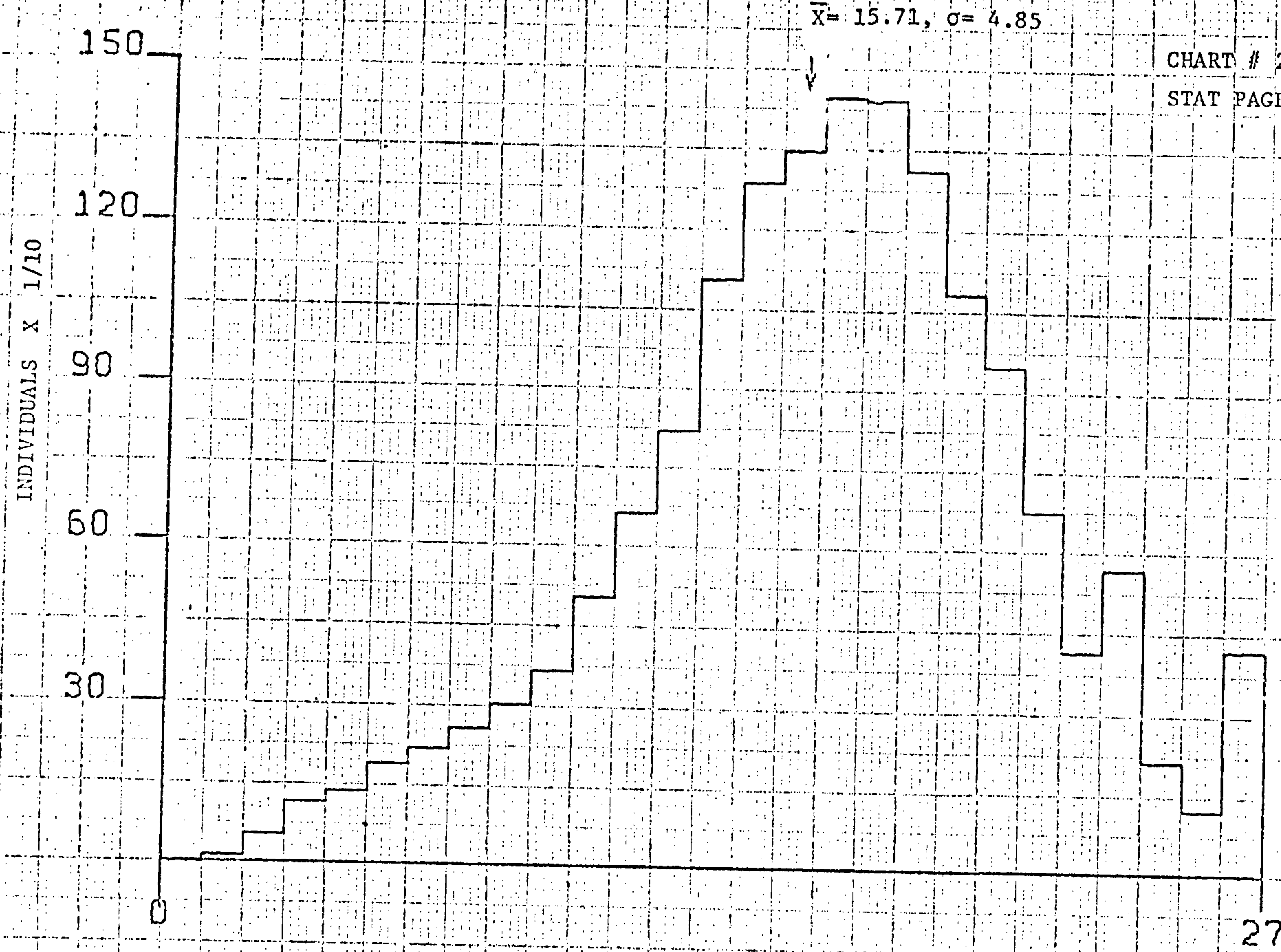


DD-1H MALES TOTAL PATTERNS DIGIT EIGHT

N= 160,229

CHART # 26

STAT PAGE 8, ROW 9



DD-1I MALES TOTAL PATTERNS DIGIT NINE

N= 160,229

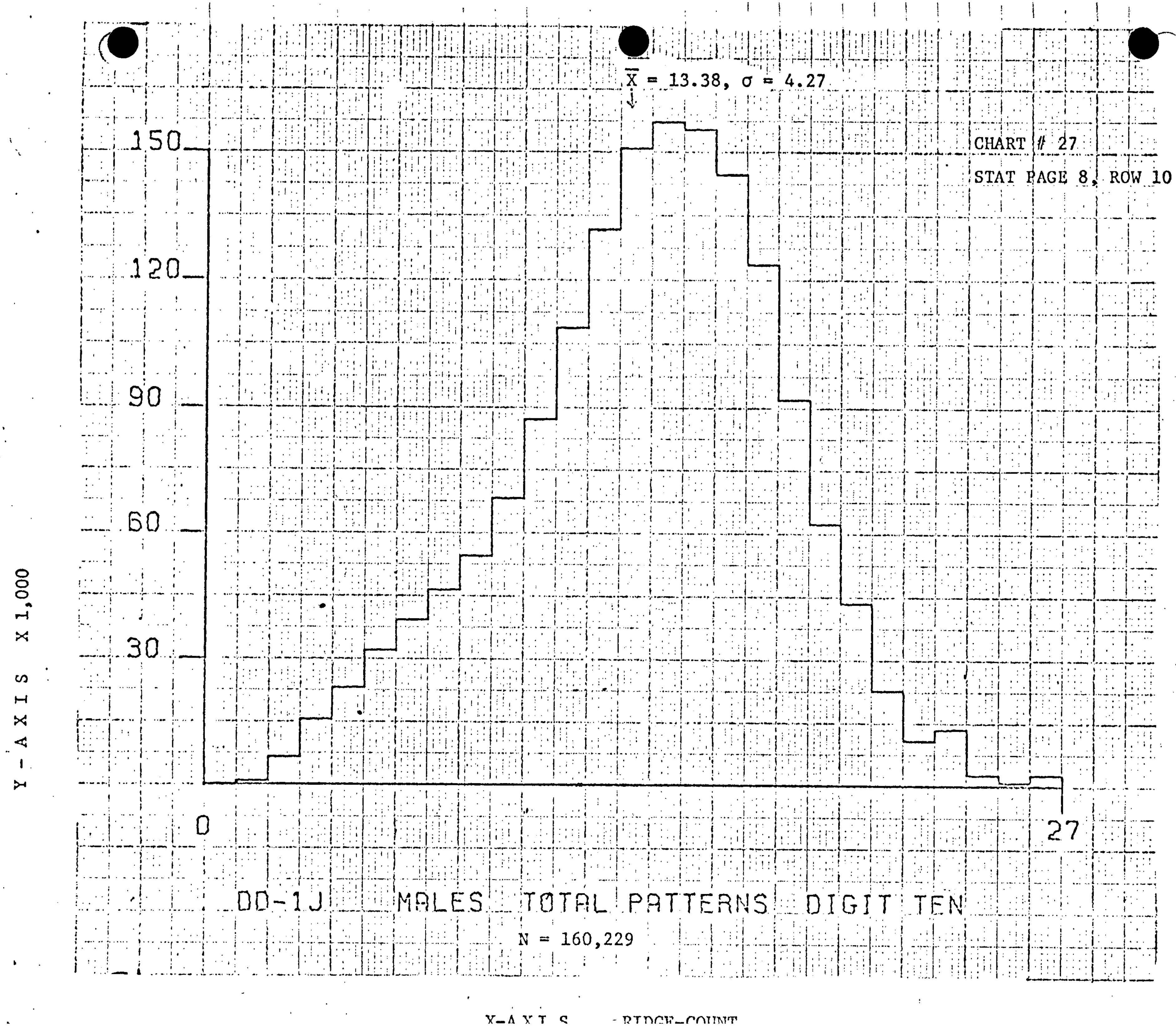
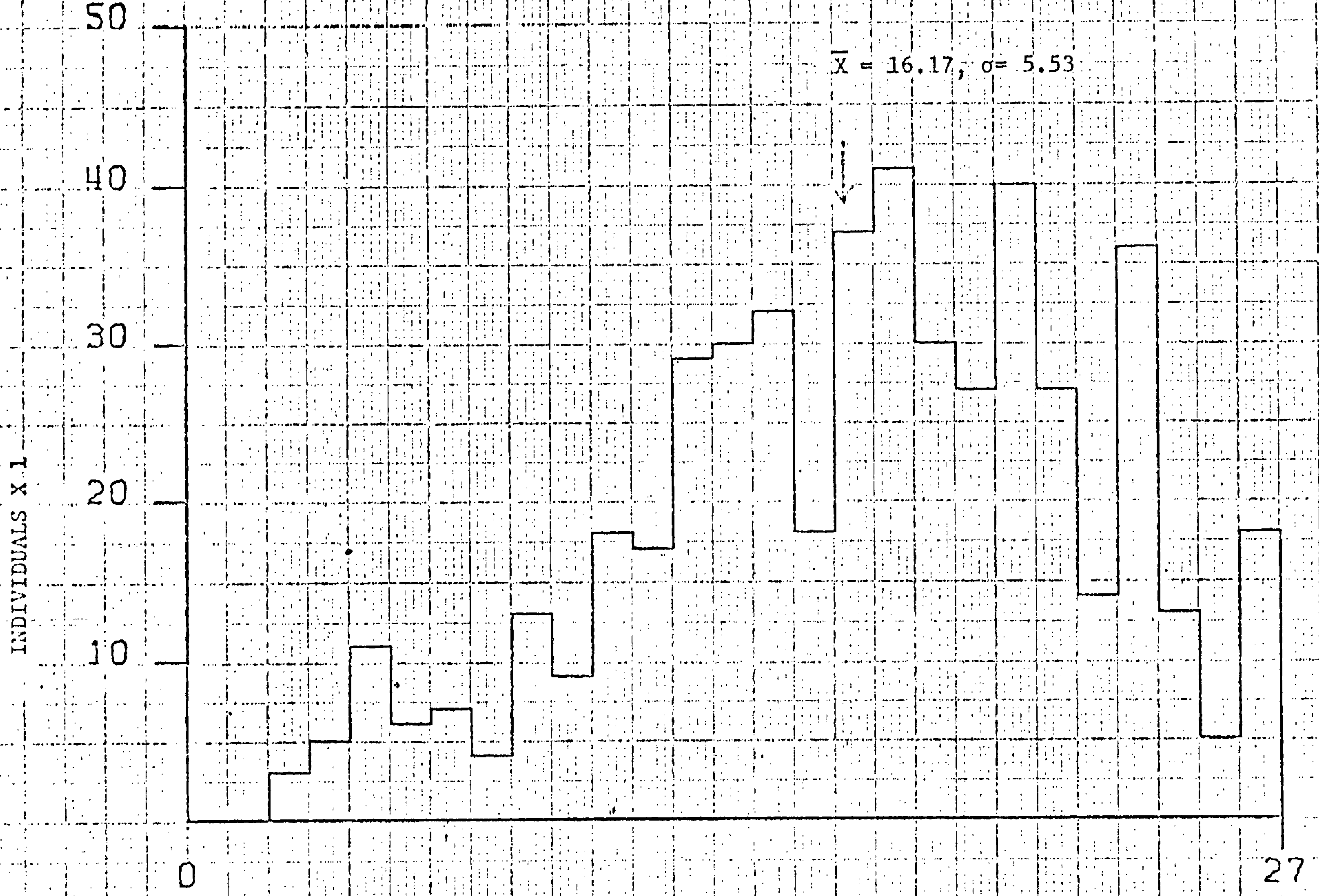

X̄ = 13.38, σ = 4.27
CHART # 27
STAT PAGE 8, ROW 10
150
120
90
60
30
0
27
Y - A X I S   X 1,000
DD-1J MALES TOTAL PATTERNS DIGIT TEN
N = 160,229
X-A X I S   RIDGE-COUNT

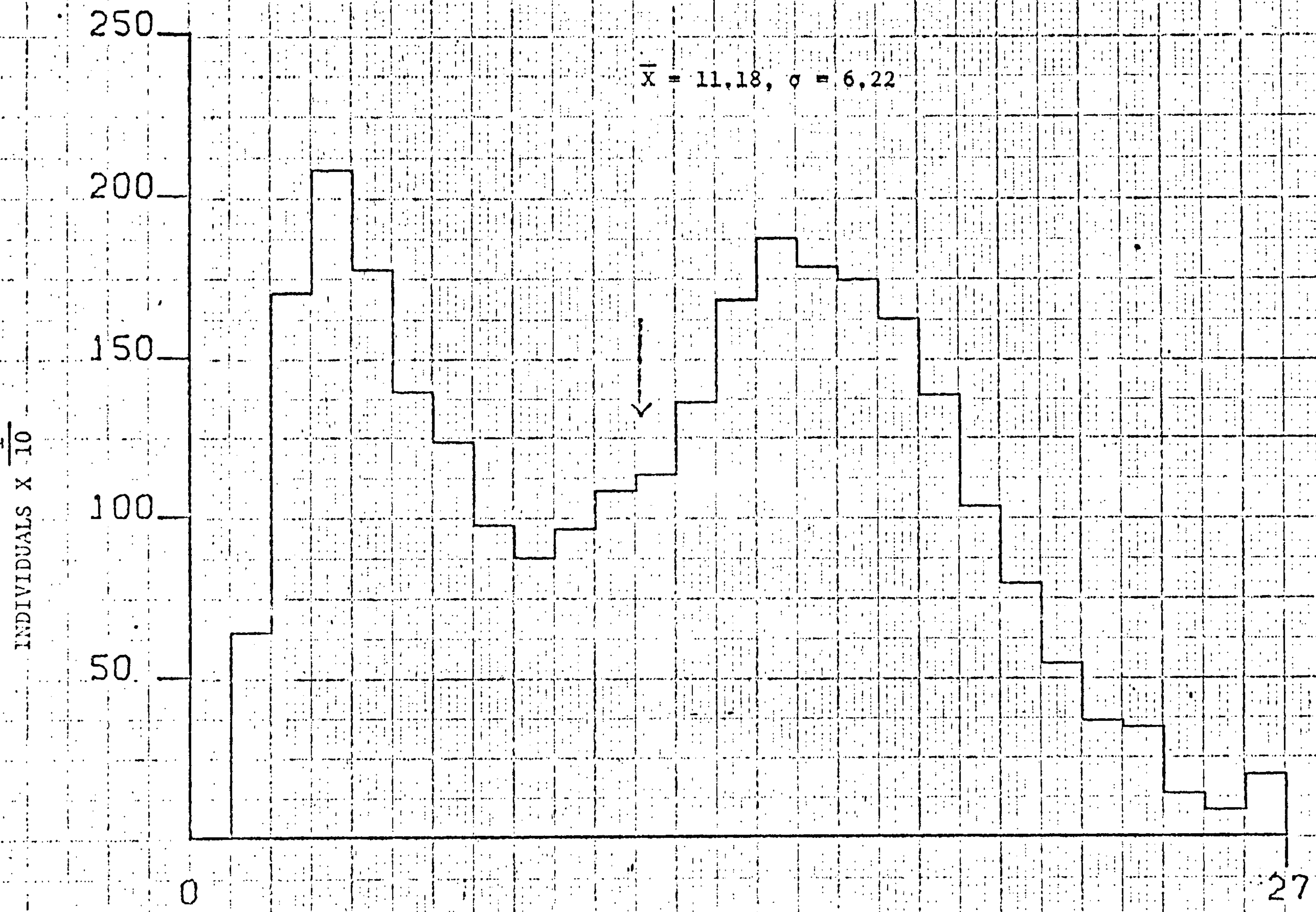
CHART # 28

STAT PAGE 10, ROW 2



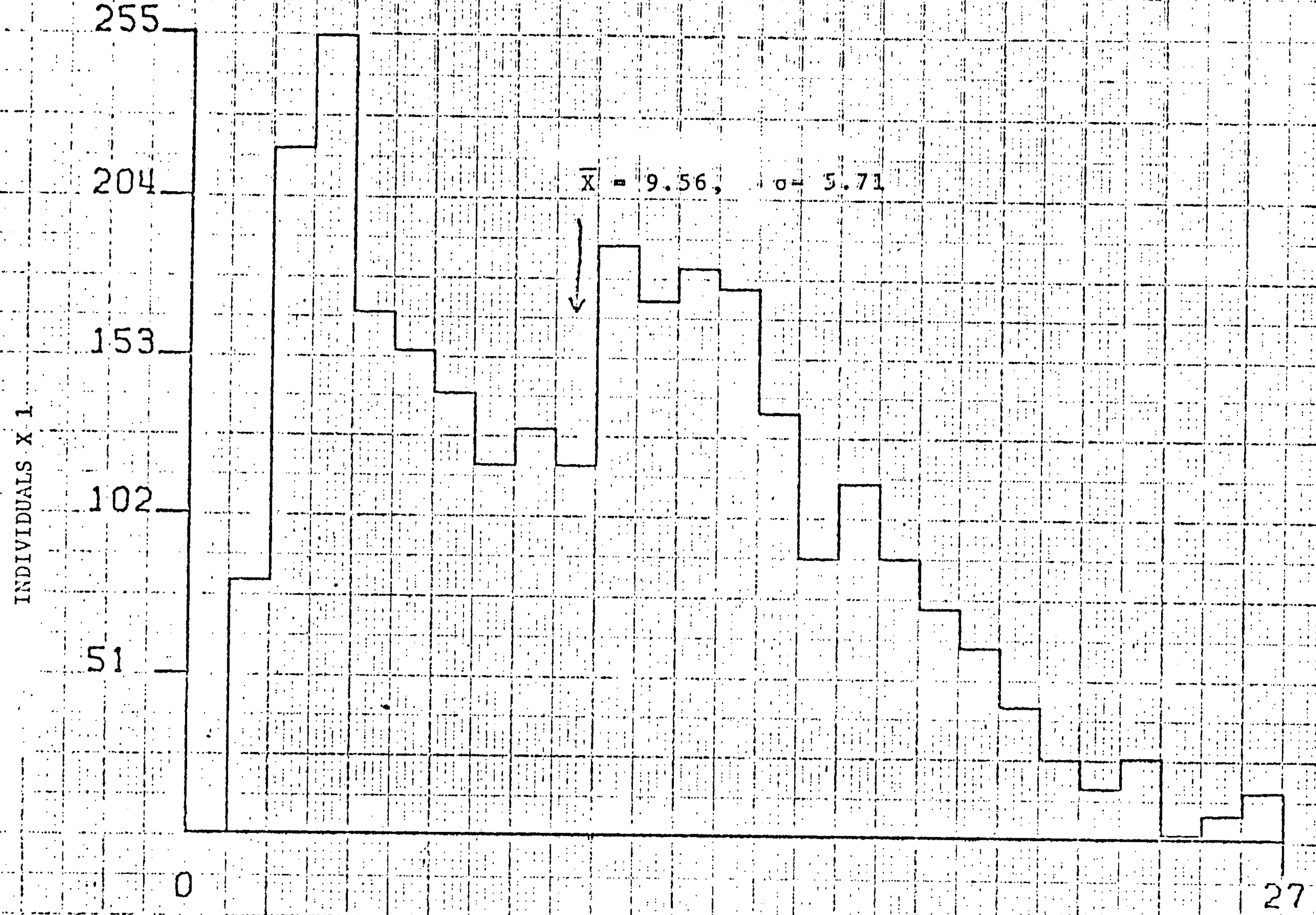
MALES RADIAL LOOPS DIGIT ONE

CHART # 29
STAT PAGE 10, ROW 3



MALES RADIAL LOOPS DIGIT TWO

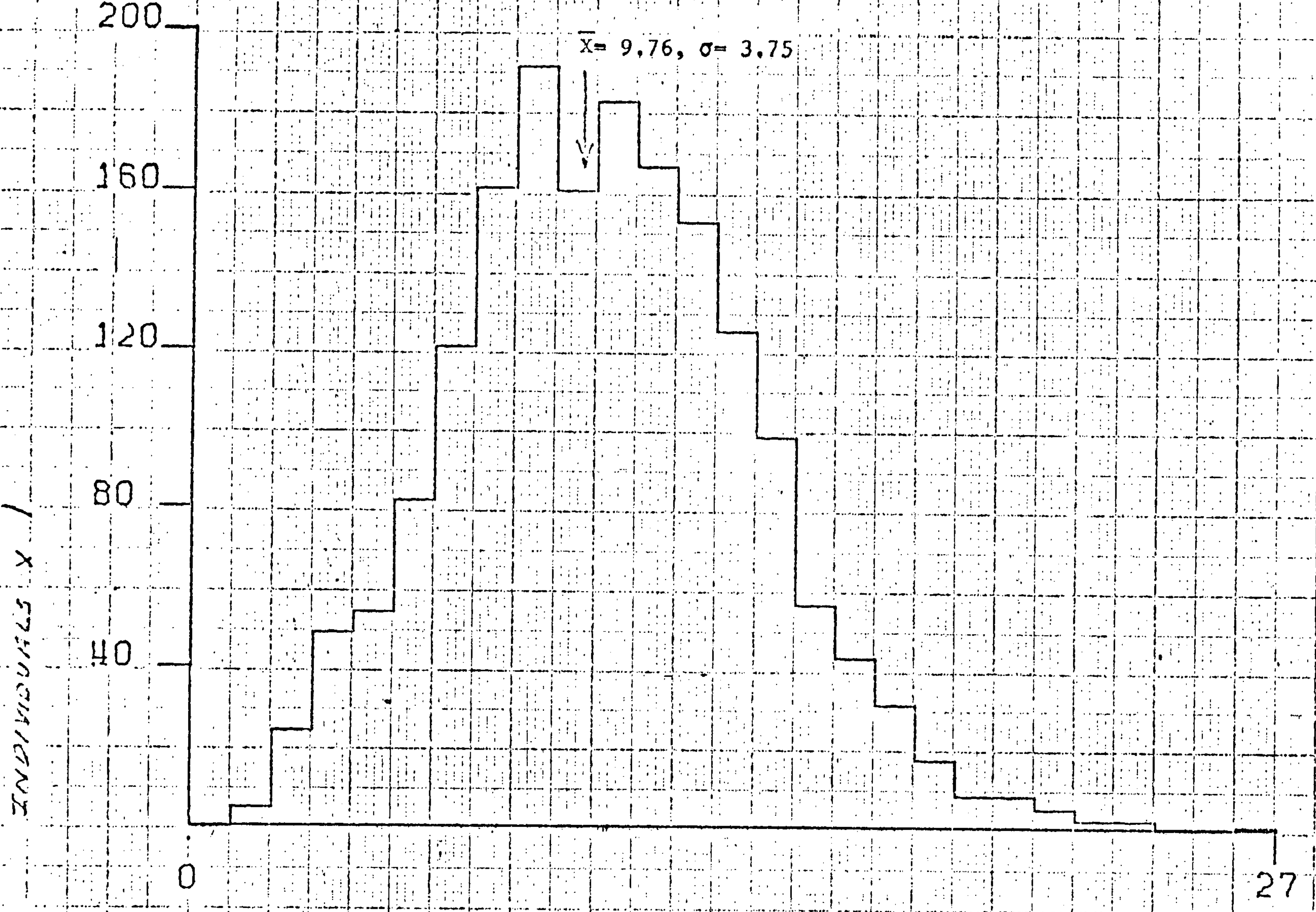
N = 28,681



MALES RADIAL LOOPS DIGIT THREE

N = 2,794

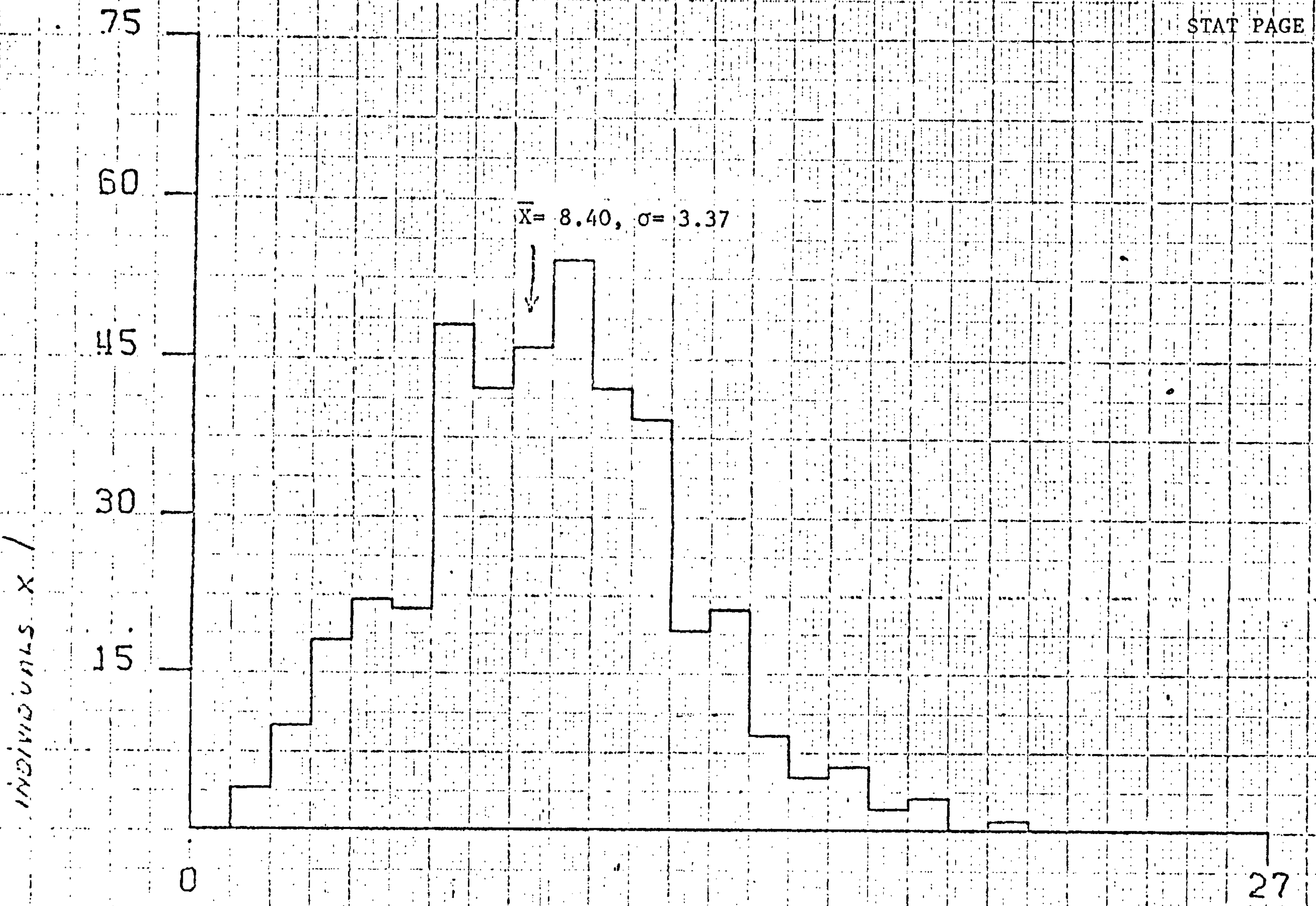
CHART # 31
STAT PAGE 10, ROW 5



MALES RADIAL LOOPS DIGIT FOUR

N= 1,743

CHART # 32
STAT PAGE 10, ROW 6



MALES RADIAL LOOPS DIGIT FIVE

N=412

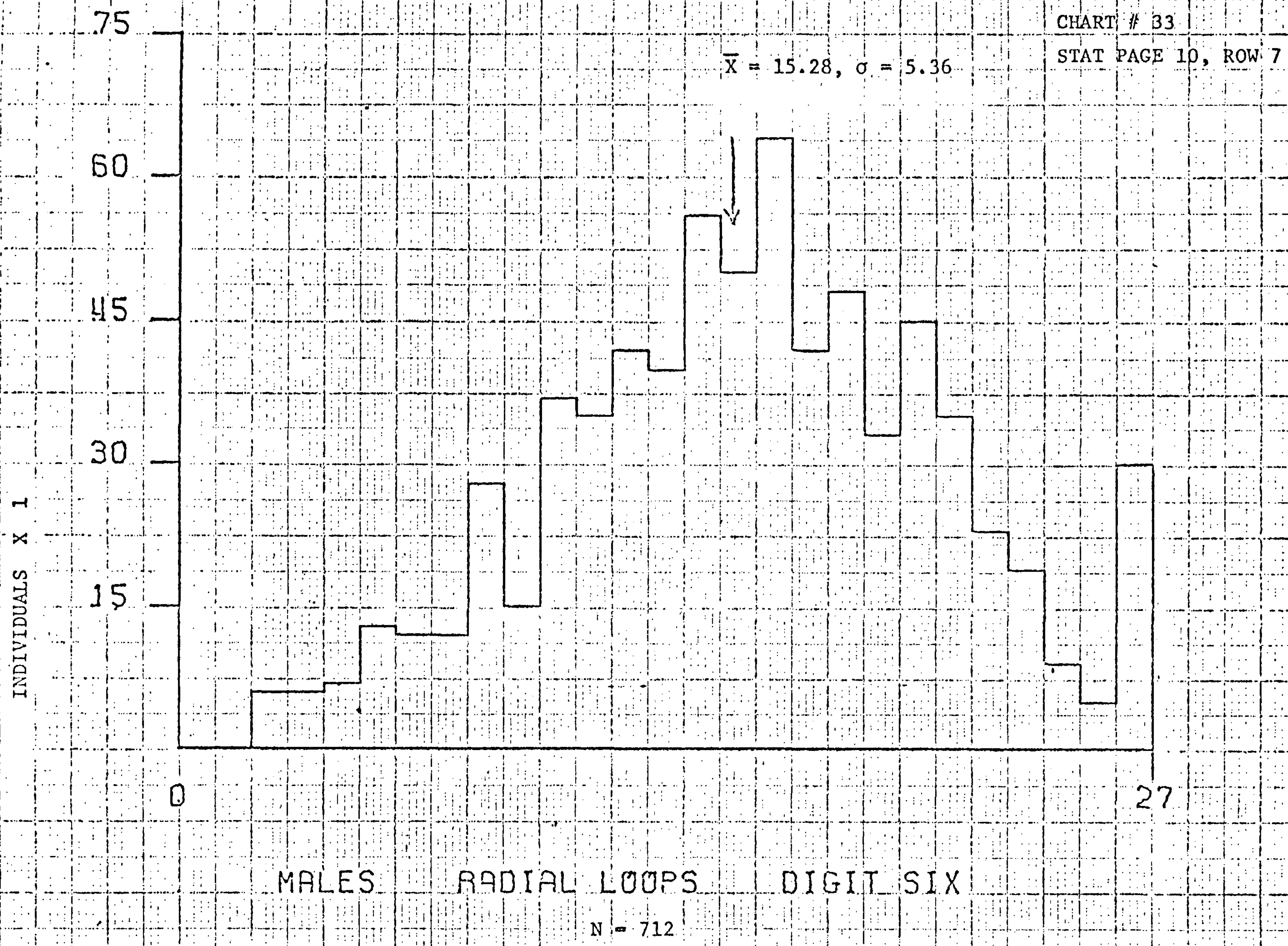


CHART # 33
STAT PAGE 10, ROW 7
X̄ = 15.28, σ = 5.36
75
60
45
30
15
INDIVIDUALS X 1
0
27
MALES RADIAL LOOPS DIGIT SIX
N = 712

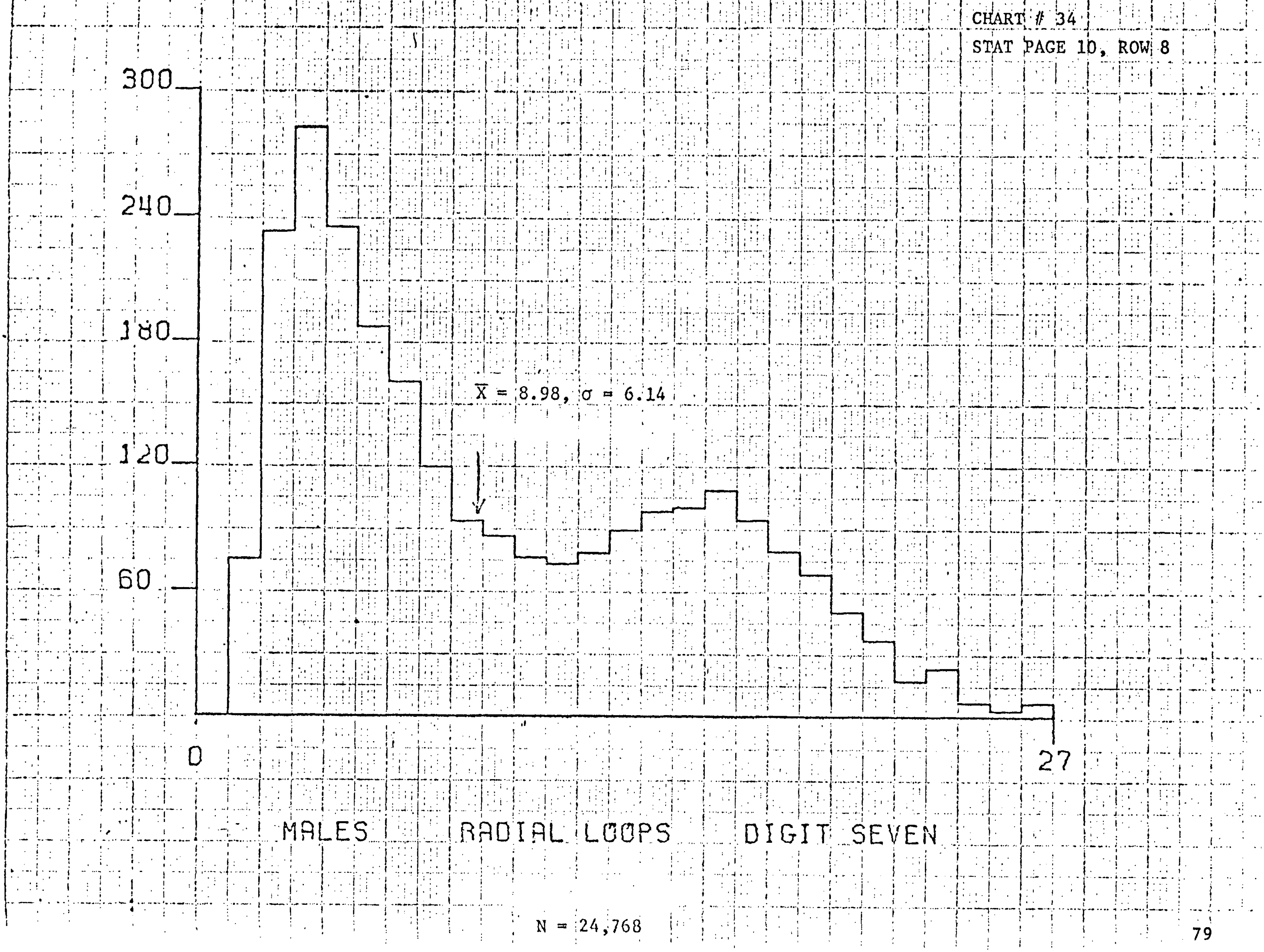
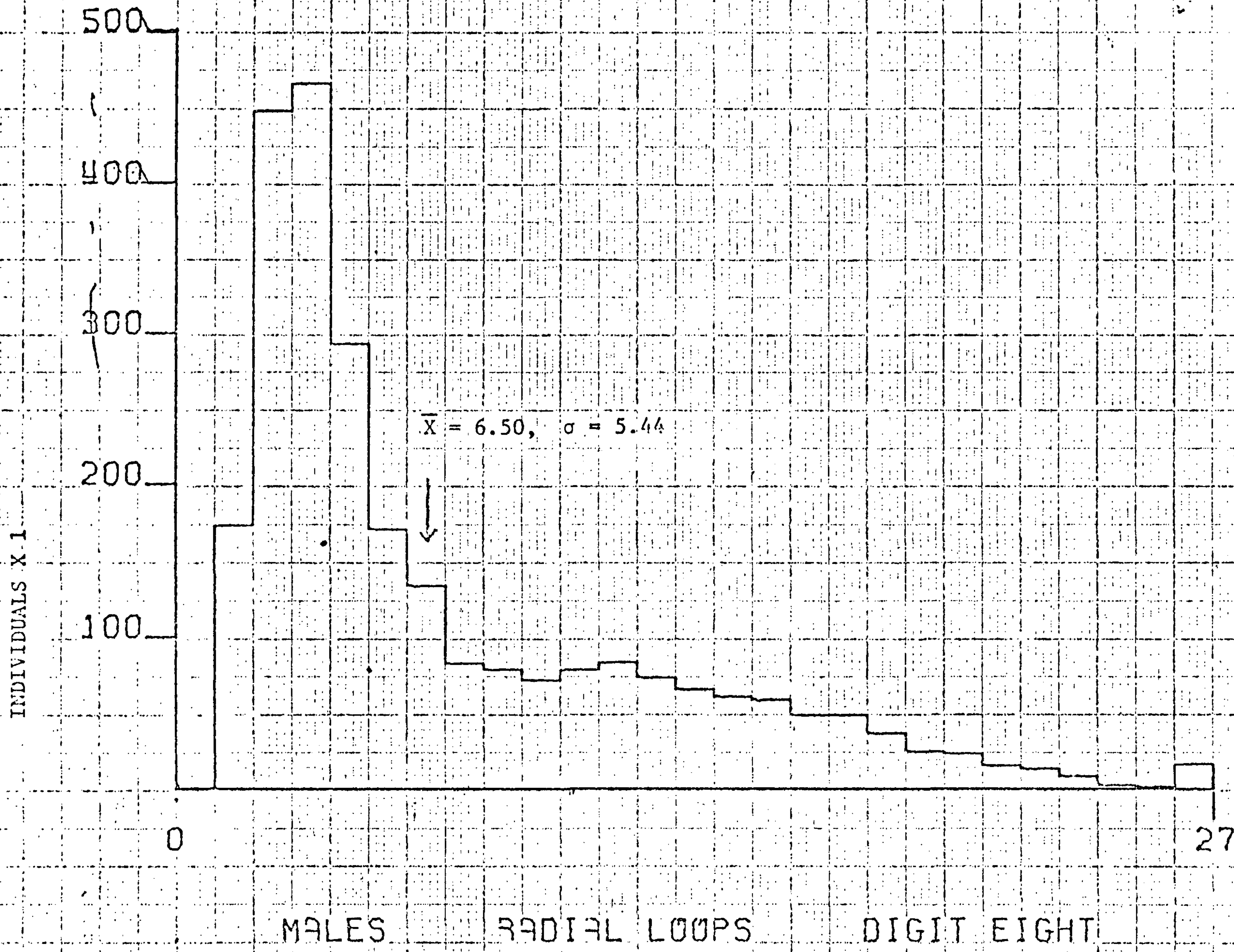


CHART # 34
STAT PAGE 10, ROW 8
300
240
180
120
60
0
27
X̄ = 8.98, σ = 6.14
MALES
RADIAL LOOPS
DIGIT SEVEN
N = 24,768

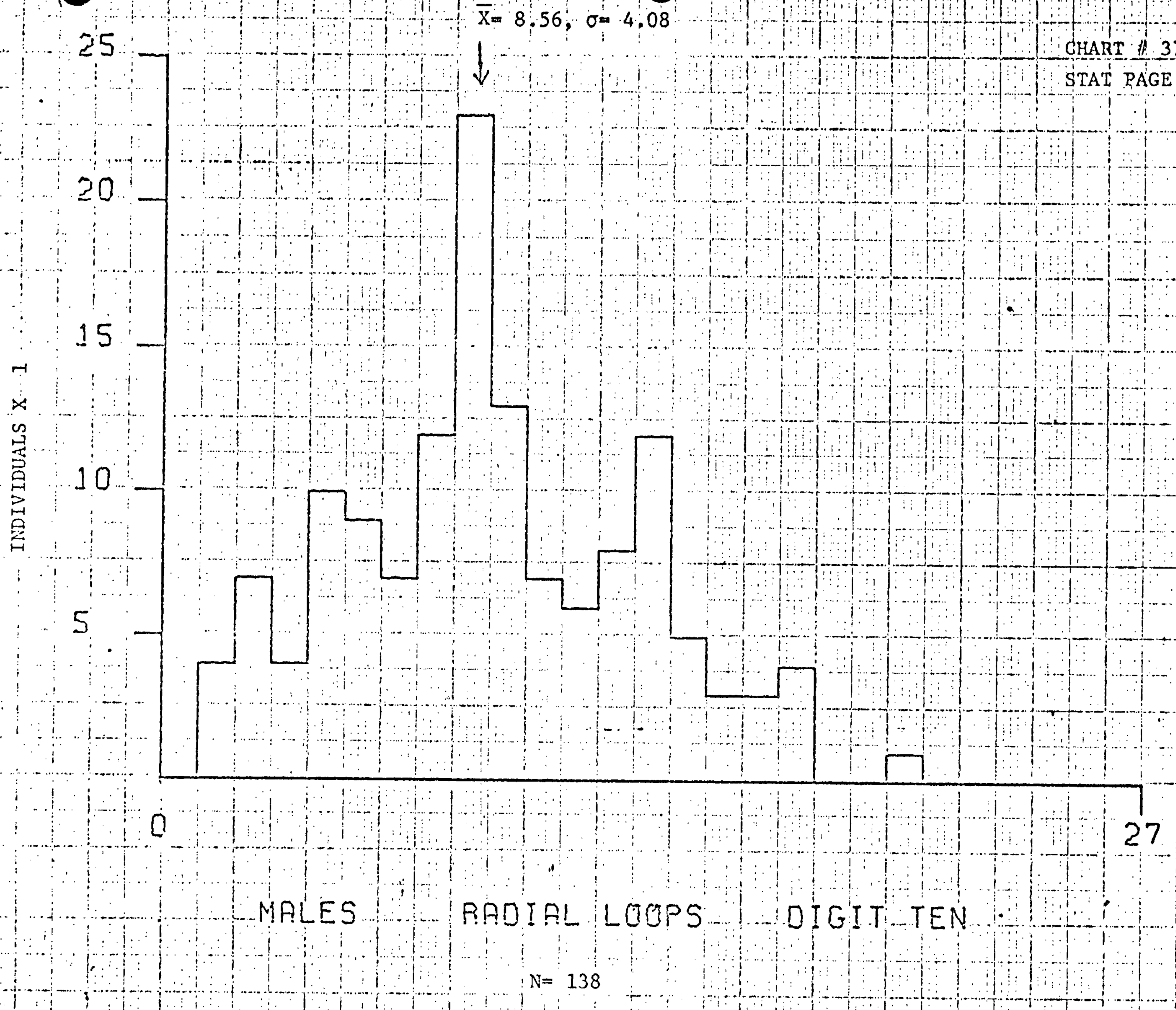
CHART # 35

STAT PAGE 10, ROW 9



N = 2,562


X̄= 8.77, σ= 4.47
CHART # 36
STAT PAGE 10, ROW 10
INDIVIDUALS X 1
50
40
30
20
10
0
27
MALES
RADIAL LOOPS
DIGIT NINE
N= 491


X̄= 8.56, σ= 4.08
25
20
15
10
5
INDIVIDUALS X 1
0
27
MALES RADIAL LOOPS DIGIT TEN
N= 138

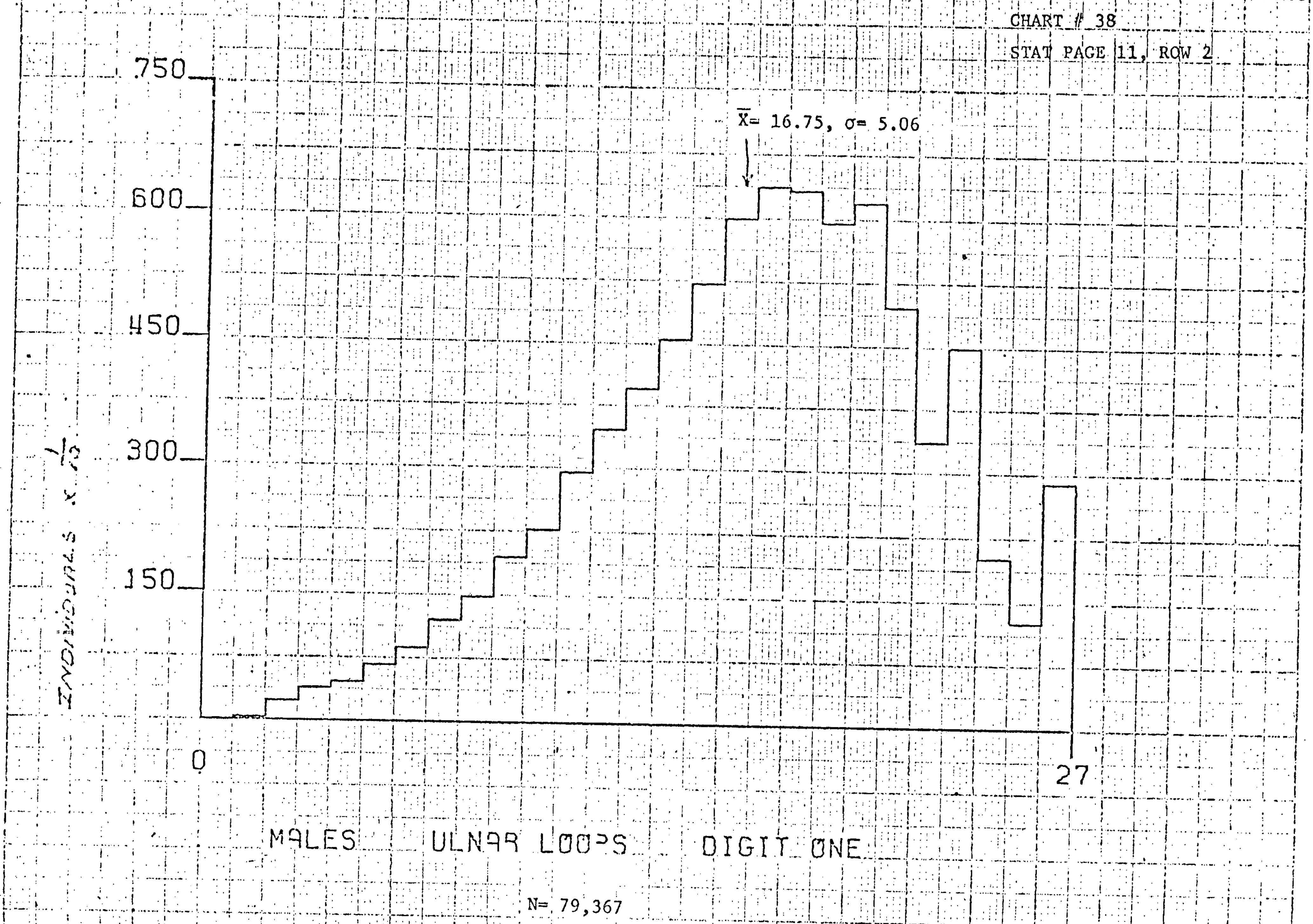


CHART # 38
STAT PAGE 11, ROW 2
$\overline{X}$= 16.75, σ= 5.06
750
600
450
300
150
0
27
MALES ULNAR LOOPS DIGIT ONE
N= 79,367

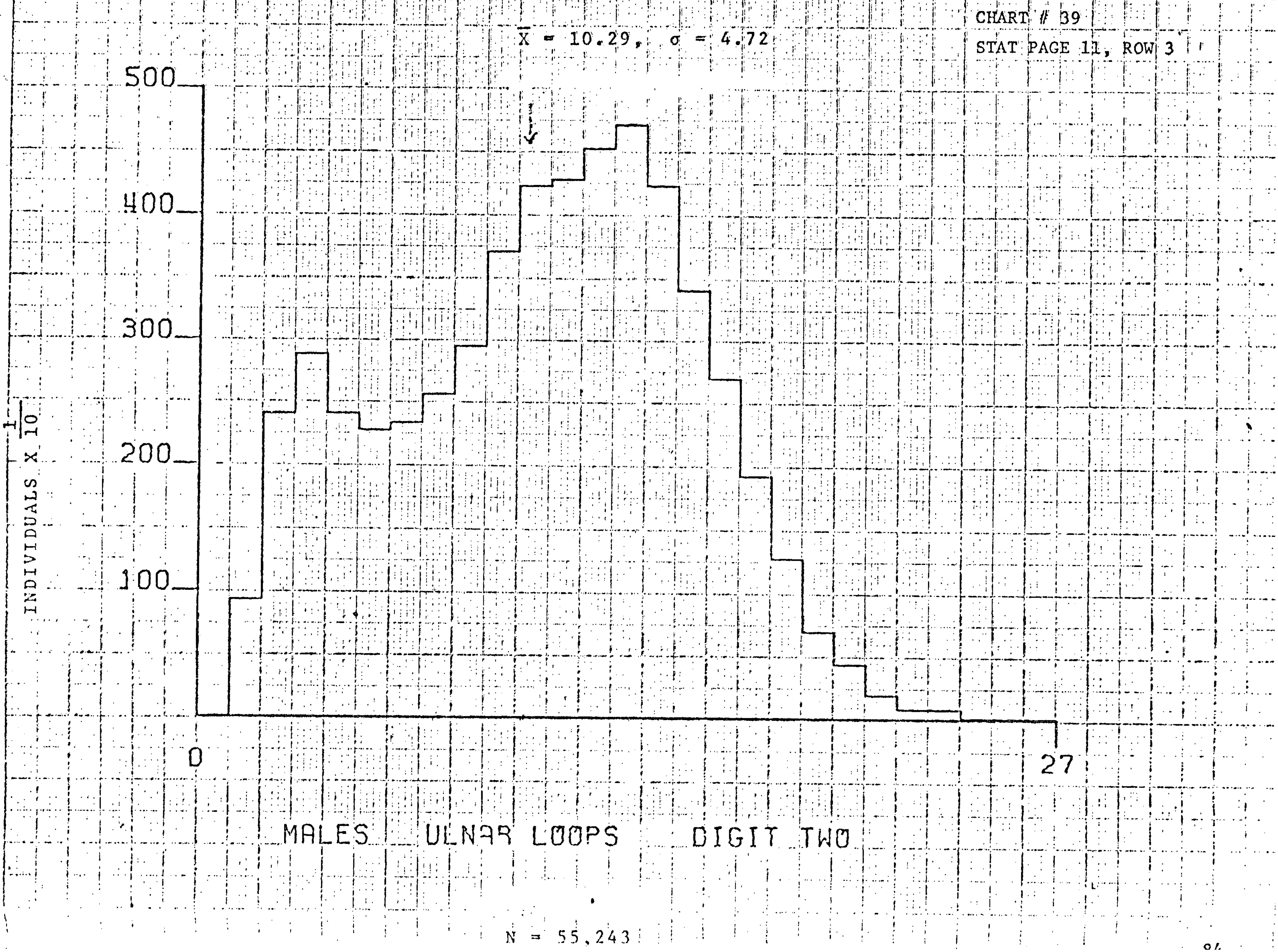
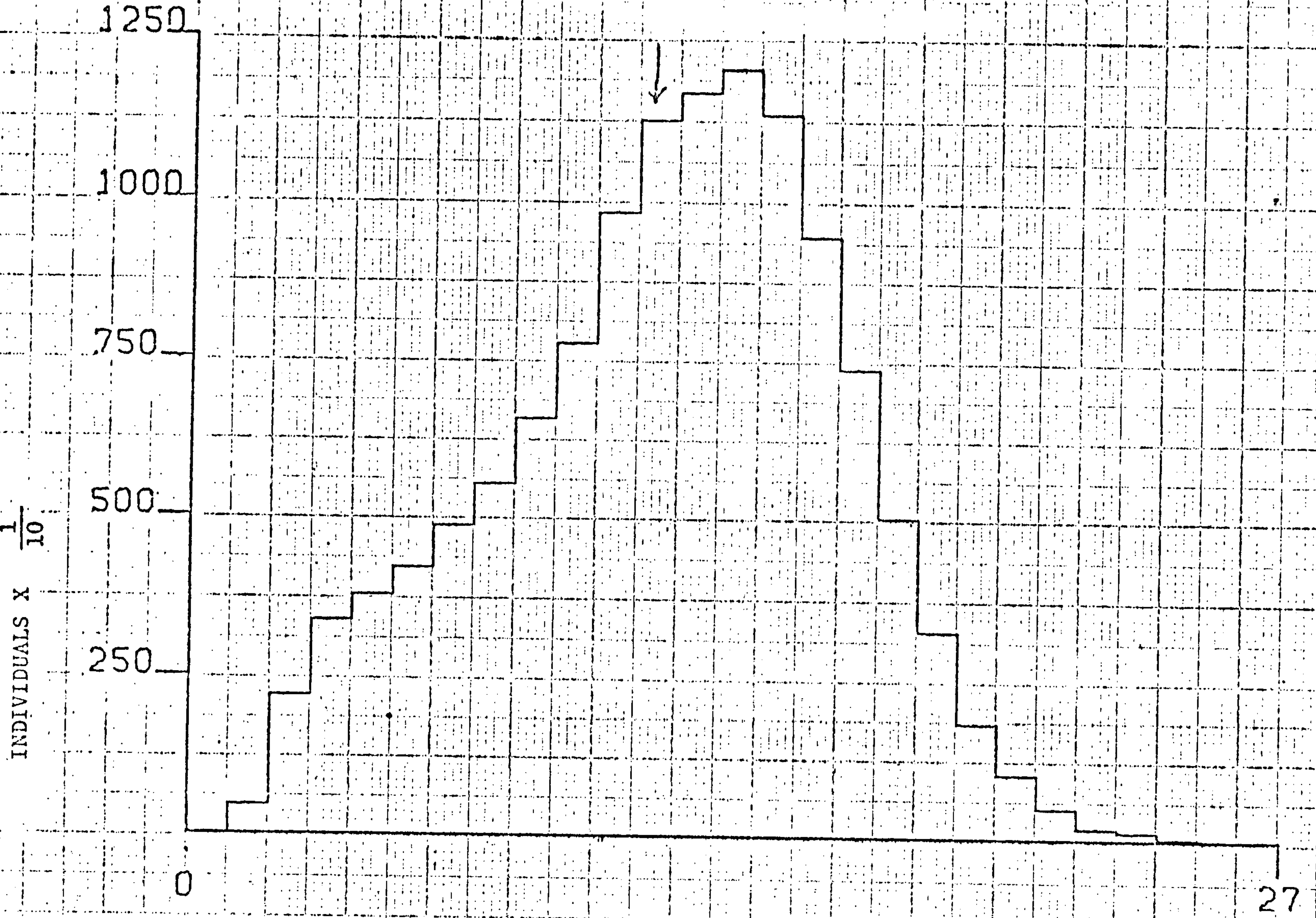


CHART # 39
STAT PAGE 11, ROW 3
X̄ = 10.29, σ = 4.72
500
400
300
200
100
INDIVIDUALS X 1/10
0
27
MALES ULNAR LOOPS DIGIT TWO
N = 55,243

CHART # 40

STAT PAGE 11, ROW 4

$\bar{X}$ = 11.29, σ = 4.24

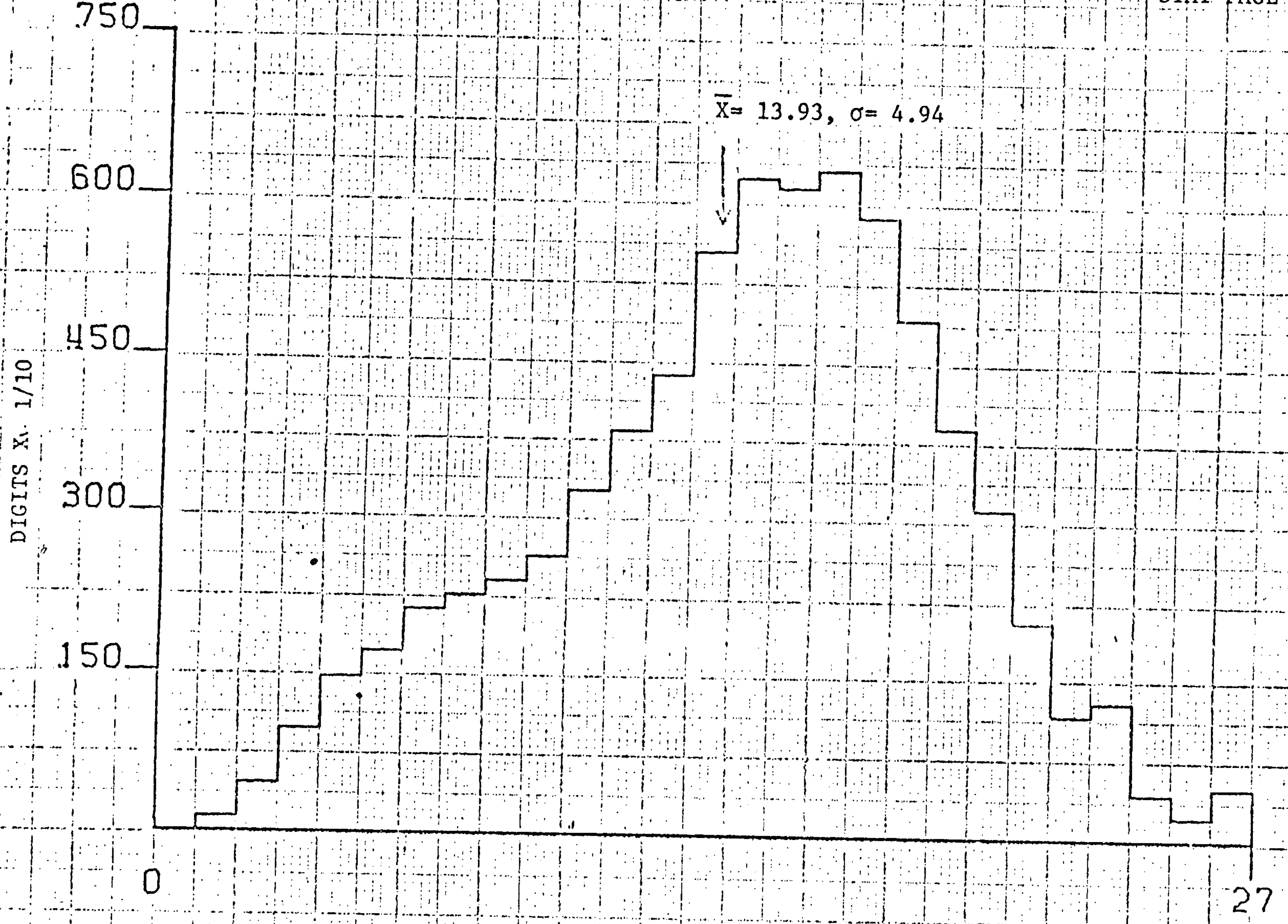


MALES ULNAR LOOPS DIGIT THREE

N = 123,580

CHART # 41

STAT PAGE 11, ROW 5



MALES ULNAR LOOPS DIGIT FØUR

N= 72,965

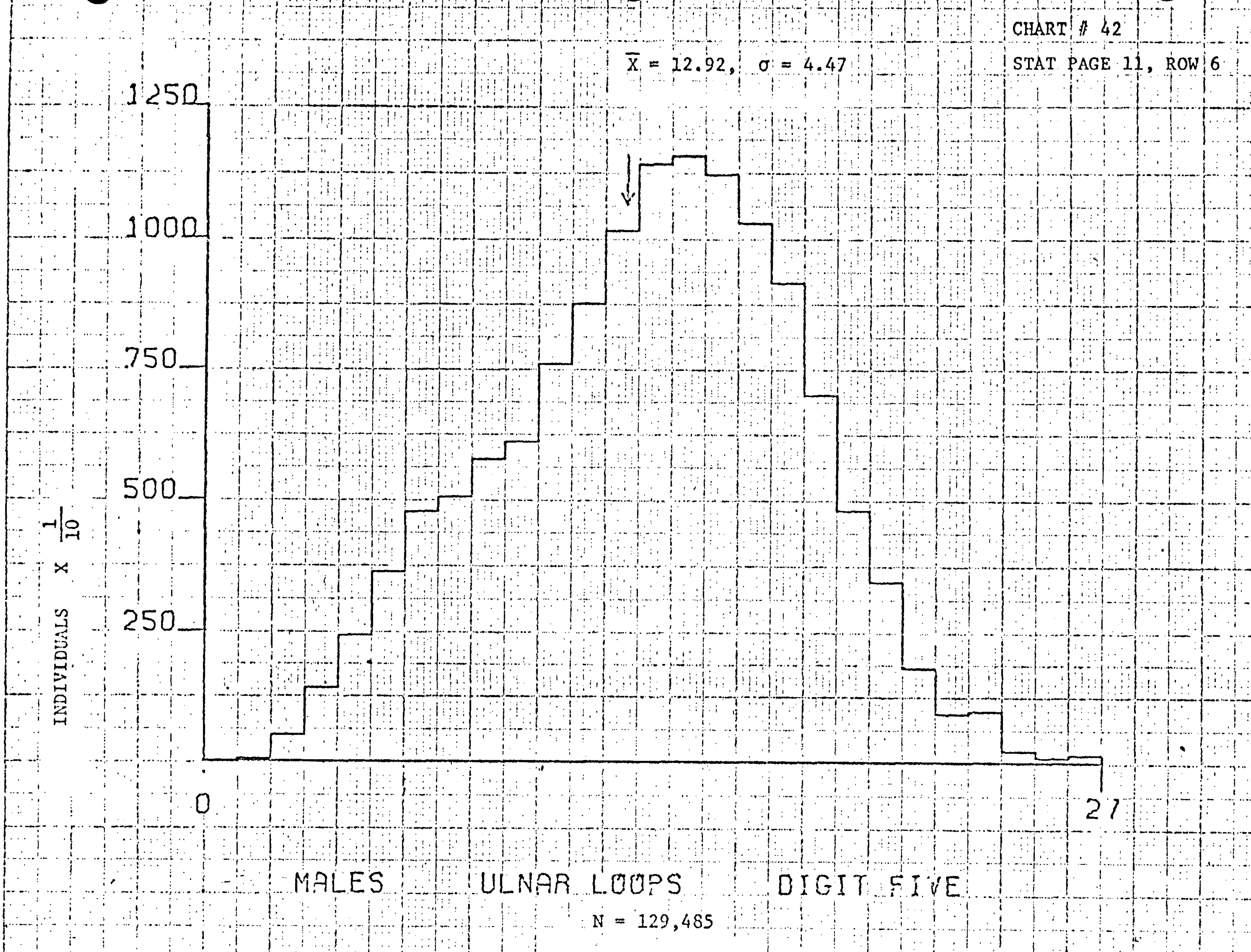


CHART # 42
STAT PAGE 11, ROW 6
$\overline{X}$ = 12.92, σ = 4.47
1250
1000
750
500
250
0
27
INDIVIDUALS x $\frac{1}{10}$
MALES ULNAR LOOPS DIGIT FIVE
N = 129,485

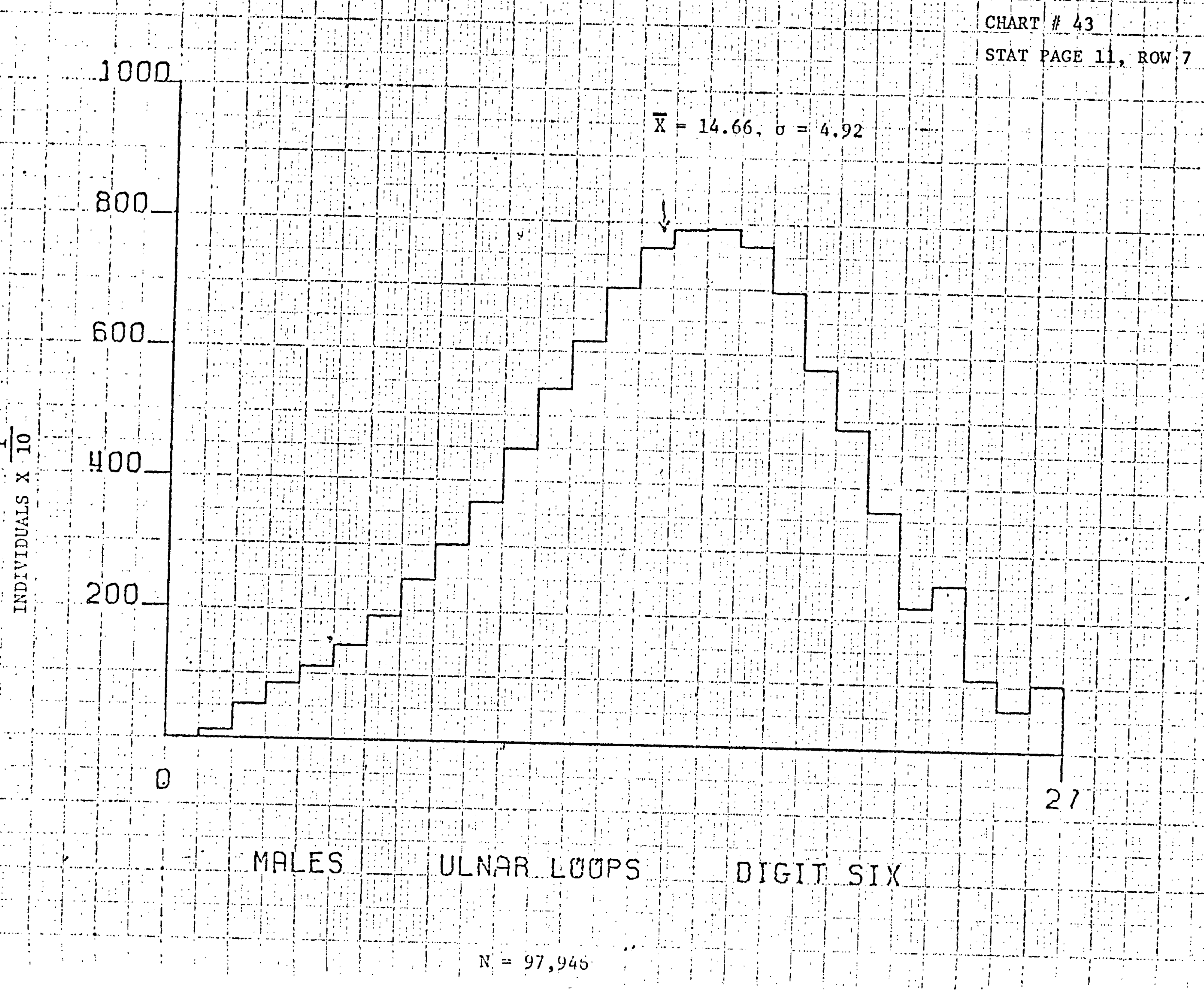
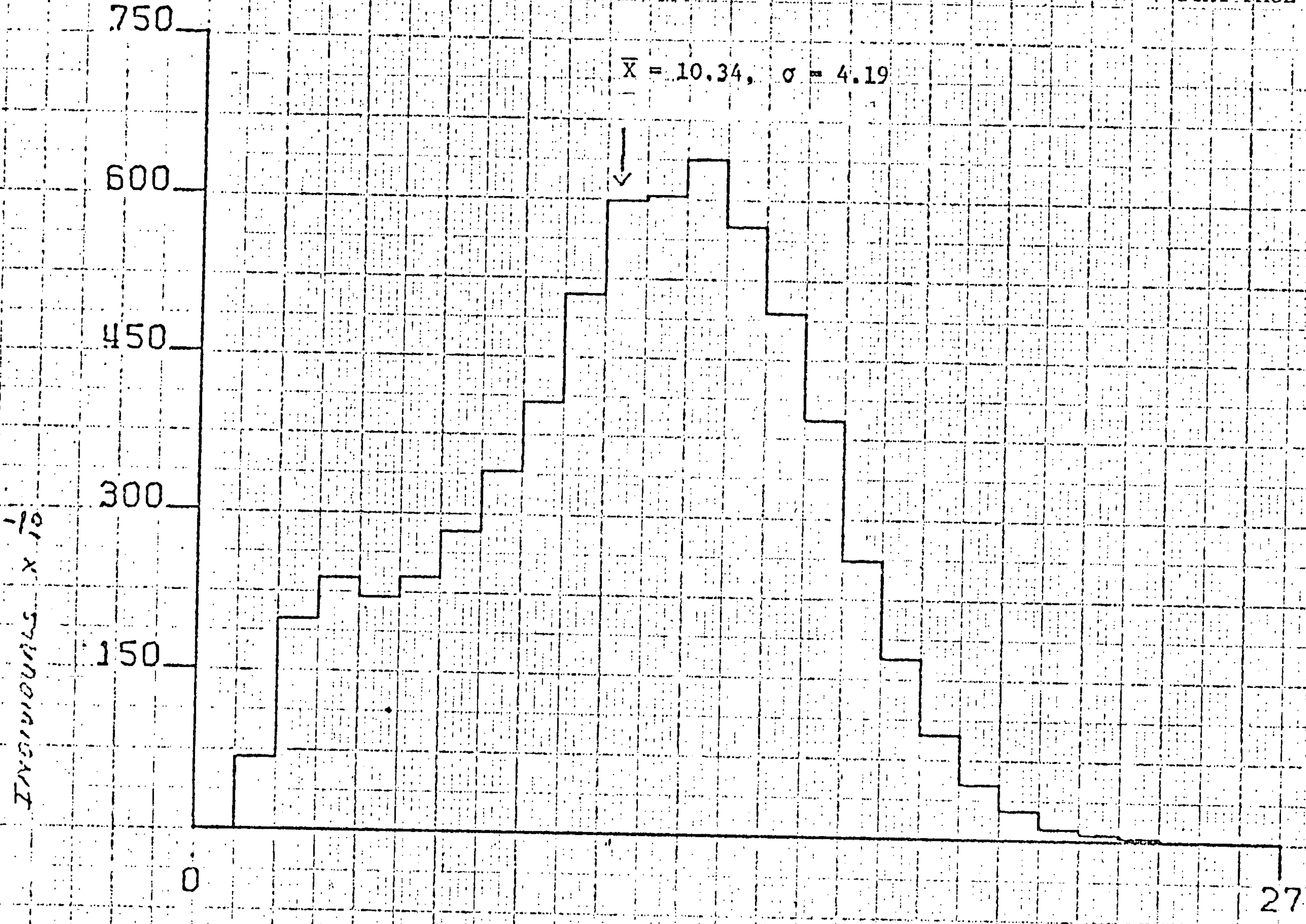


CHART # 43
STAT PAGE 11, ROW 7
$\overline{X}$ = 14.66, σ = 4.92
1000
800
600
400
200
0
27
INDIVIDUALS X $\frac{1}{10}$
MALES
ULNAR LOOPS
DIGIT SIX
N = 97,946

CHART # 44

STAT PAGE 11, ROW 8

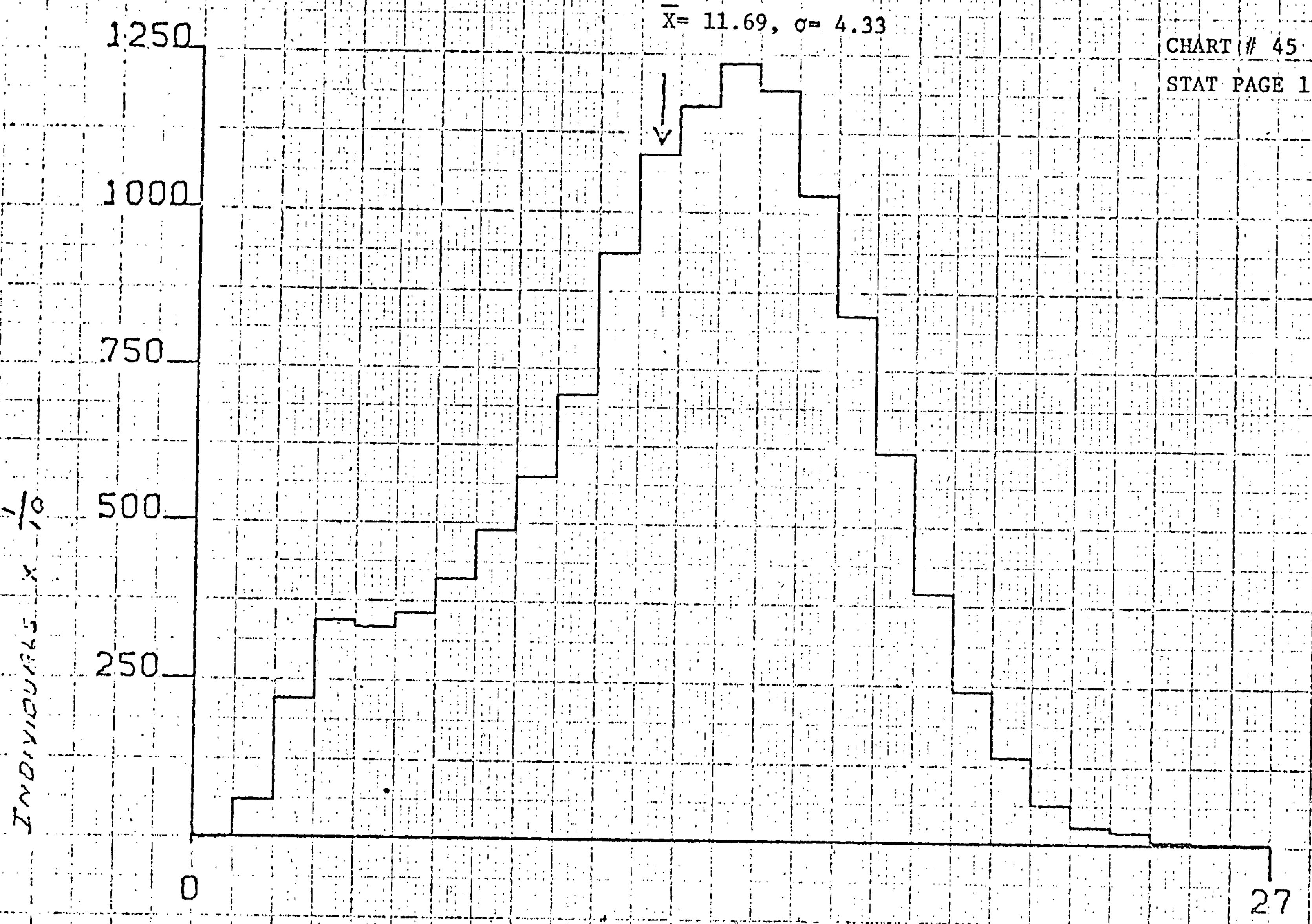


MALES ULNAR LOOPS DIGIT SEVEN

N = 64, 196

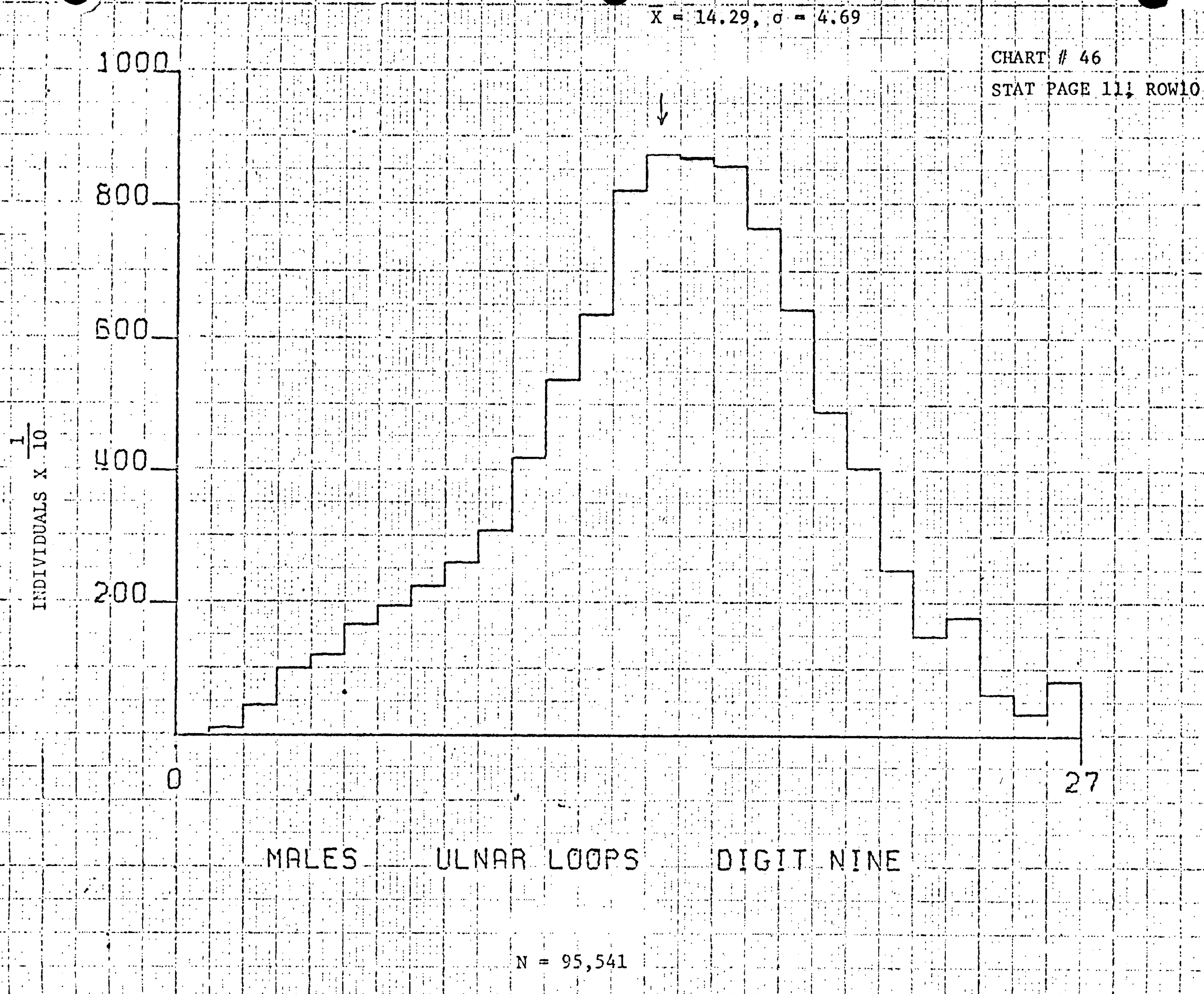
CHART # 45

STAT PAGE 11, ROW 9



MALES ULNAR LOOPS DIGIT EIGHT

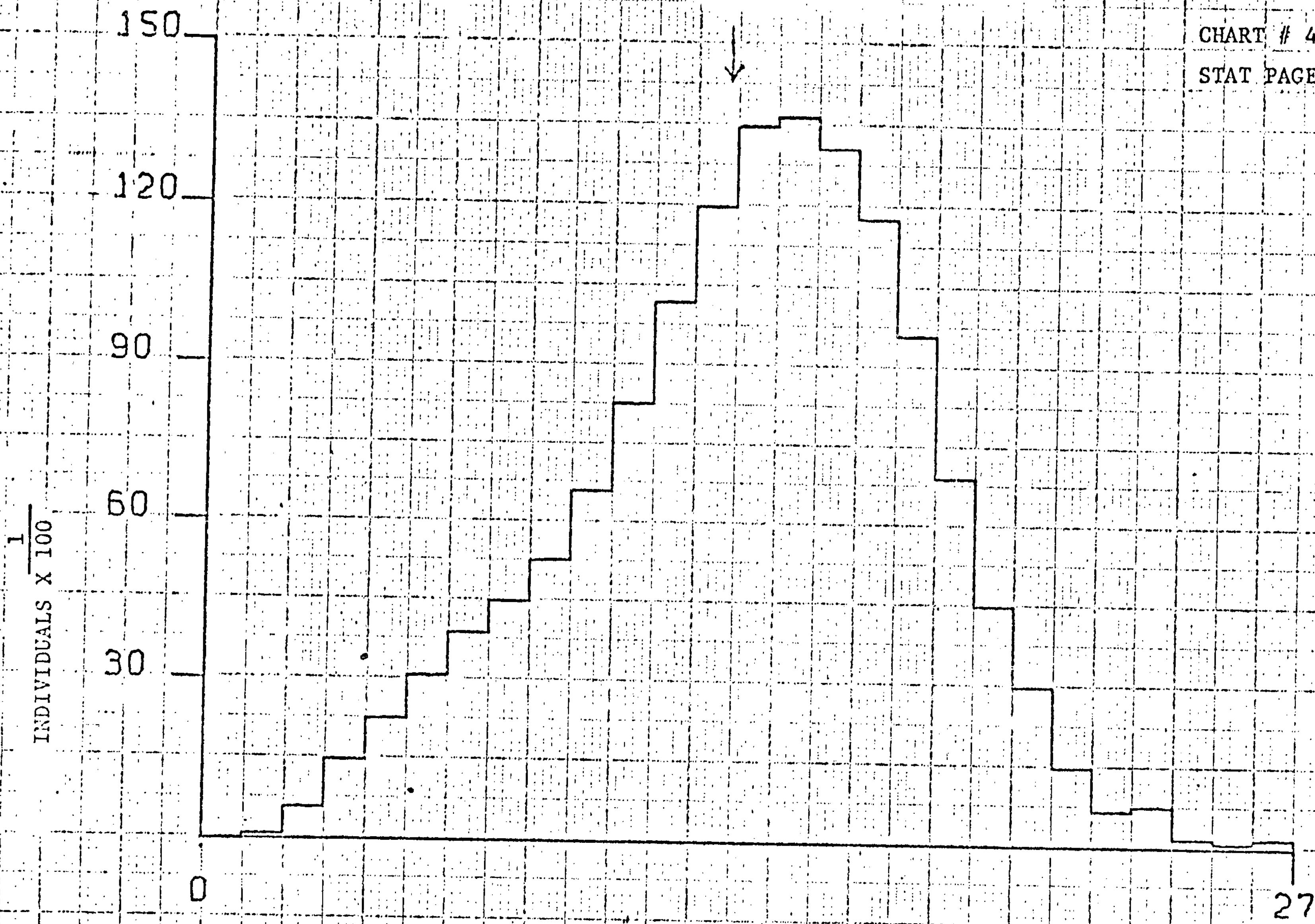
N= 124,891 digits


X = 14.29, σ = 4.69
CHART # 46
STAT PAGE 11, ROW10
1000
800
600
400
200
INDIVIDUALS X 1/10
0
27
MALES ULNAR LOOPS DIGIT NINE
N = 95,541

$\bar{X}$ = 12.96, σ = 4.21

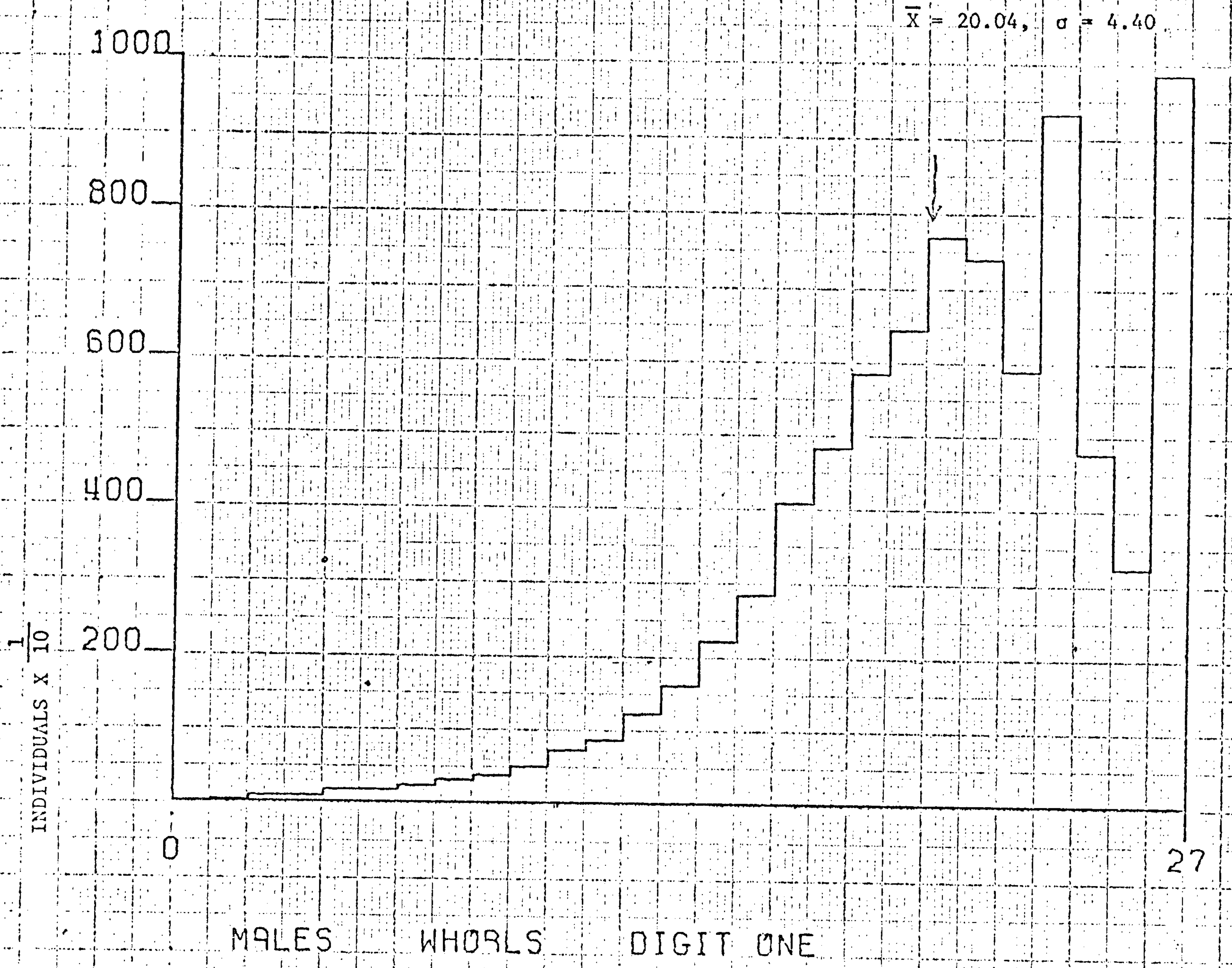
CHART # 47

STAT PAGE 11, ROW 11



MALES ULNAR LOOPS DIGIT TEN

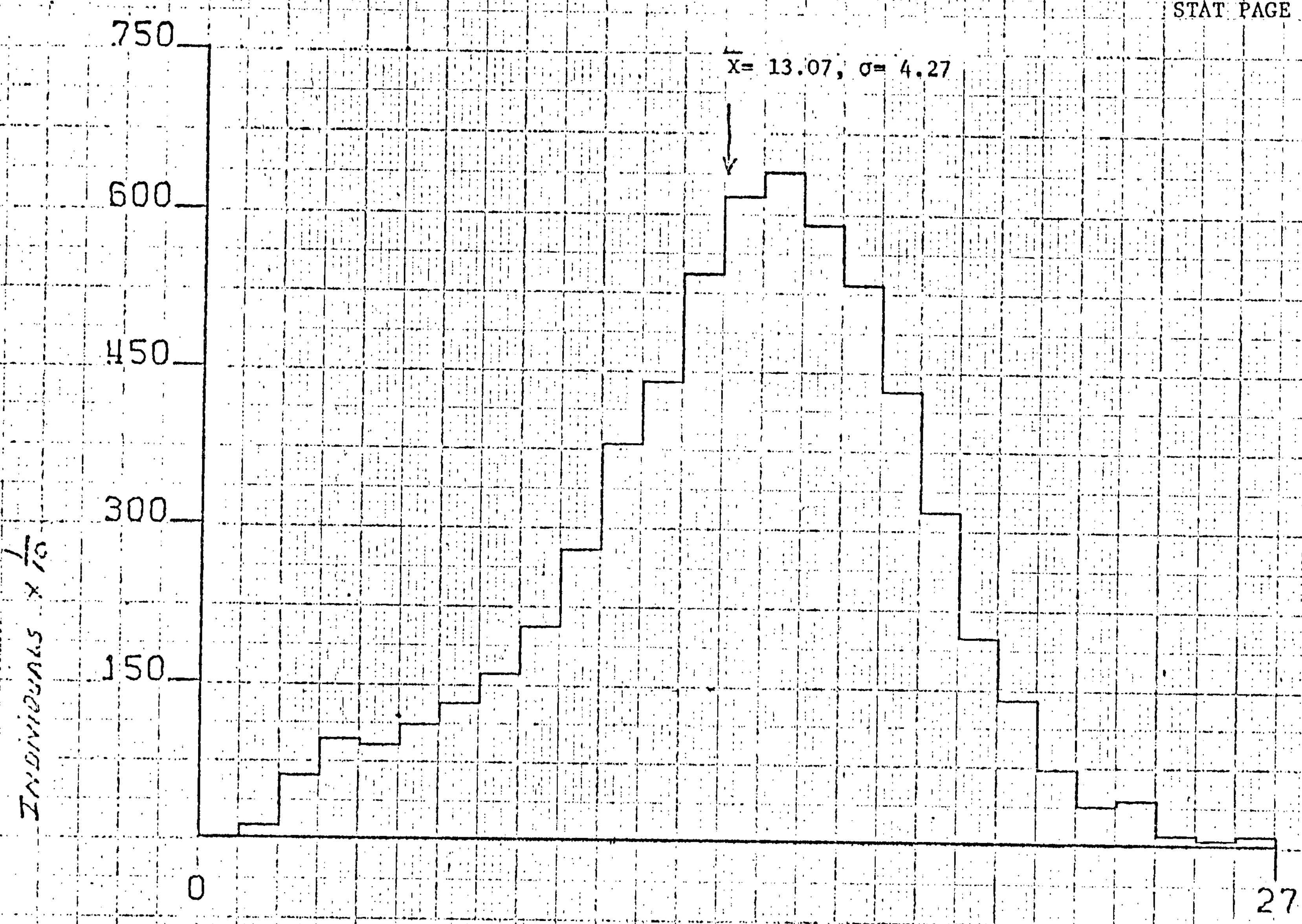
N = 138,162


$\overline{X}$ = 20.04, σ = 4.40
1000
800
600
400
200
INDIVIDUALS X 1/10
0
27
MALES WHORLS DIGIT ONE

N = 80,372

CHART # 49

STAT PAGE 12, ROW 3



MALES WHORLS DIGIT TWO

N= 61,274

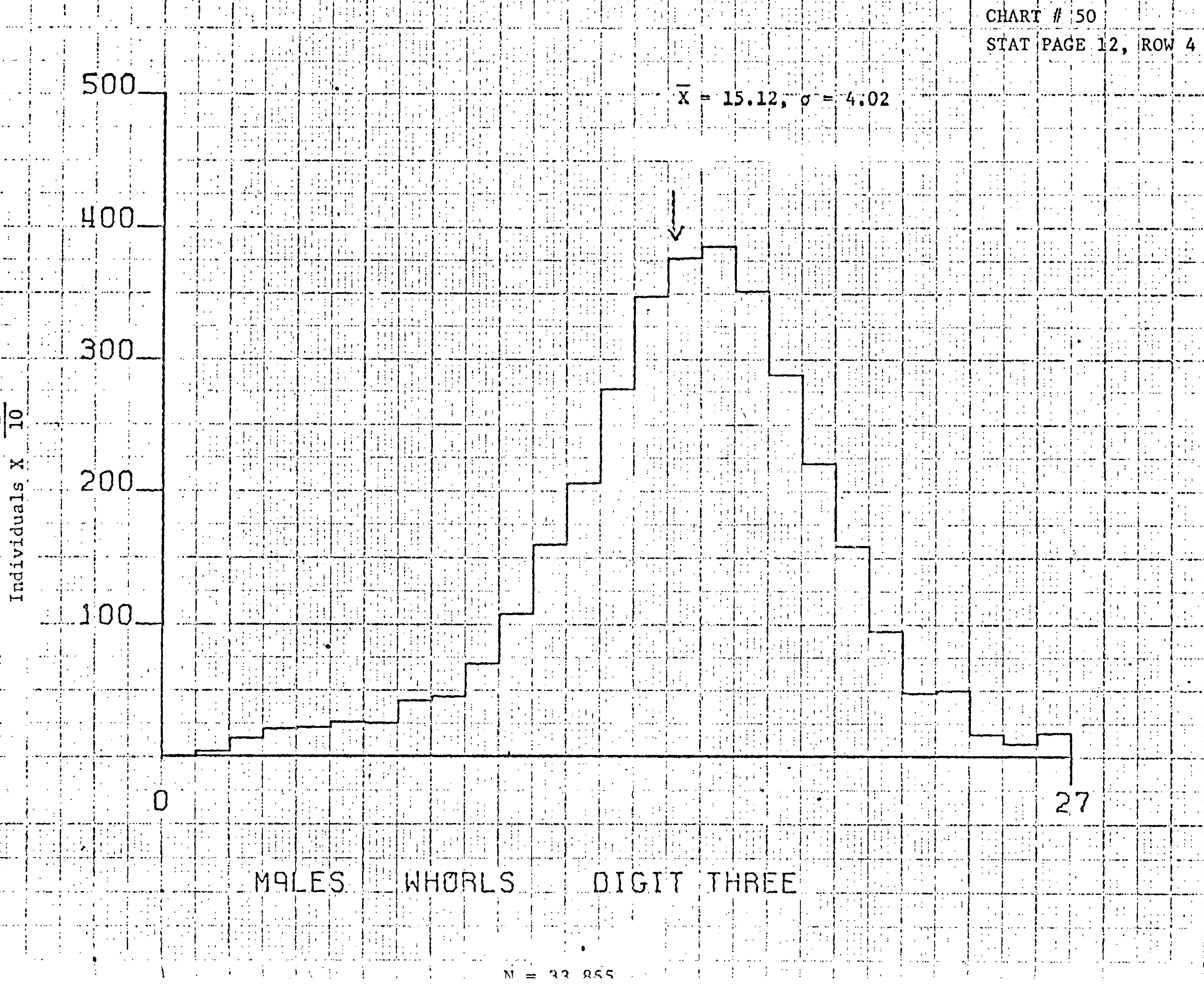
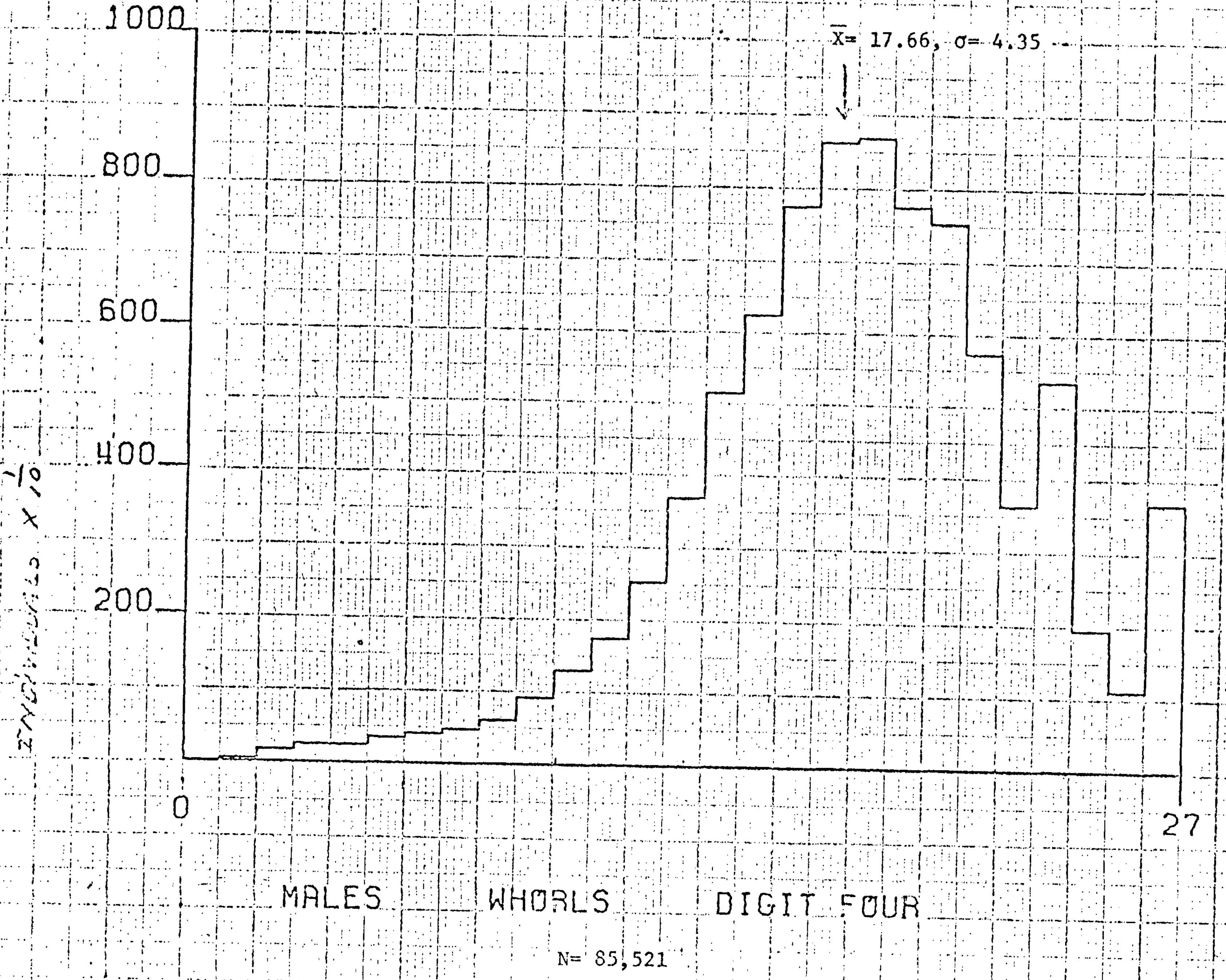


CHART # 50
STAT PAGE 12, ROW 4
$\overline{X}$ = 15.12, σ = 4.02
500
400
300
200
100
0
27
Individuals X 1/10
MALES WHORLS DIGIT THREE
N = 33,855

CHART # 51

STAT PAGE 12, ROW 5



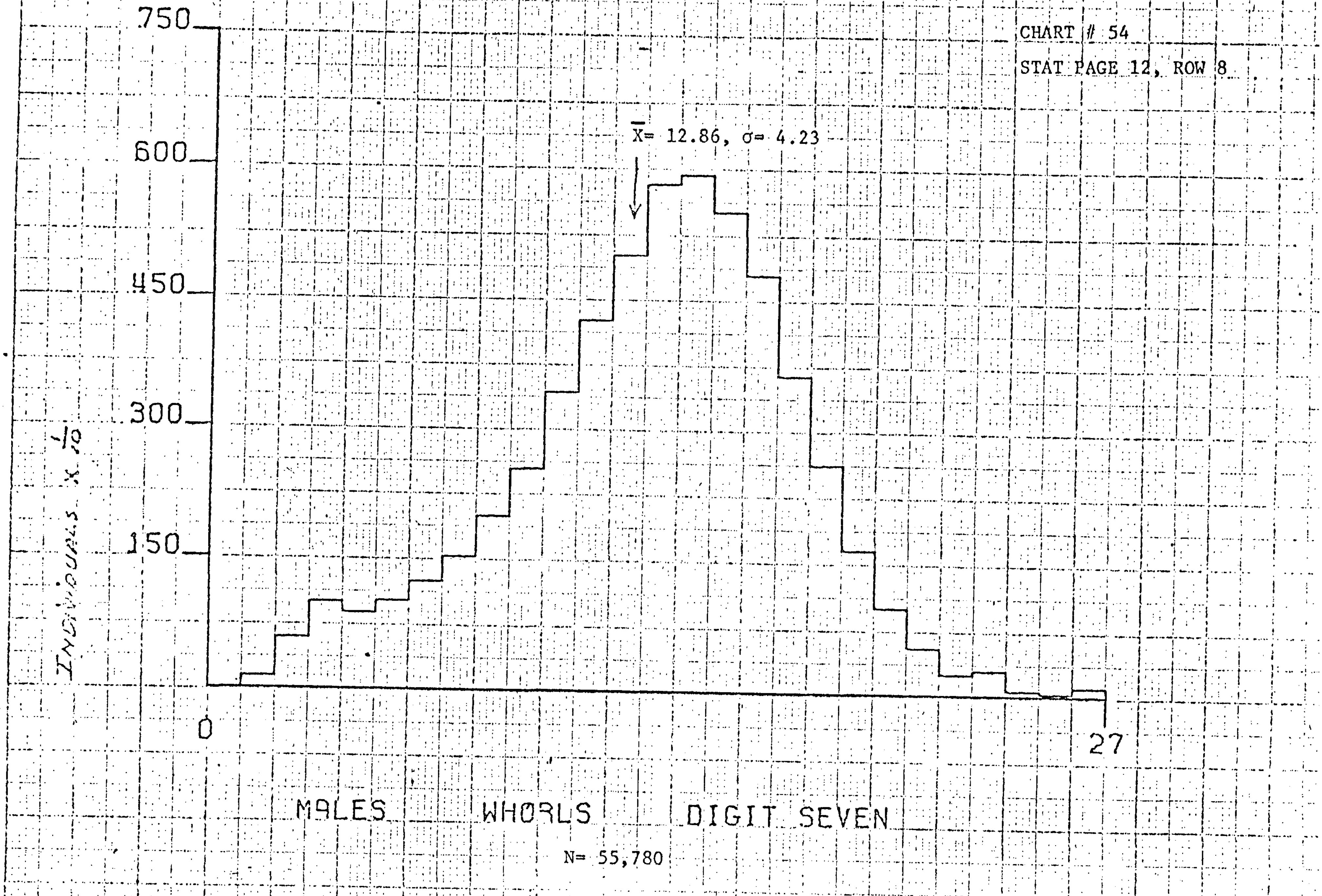
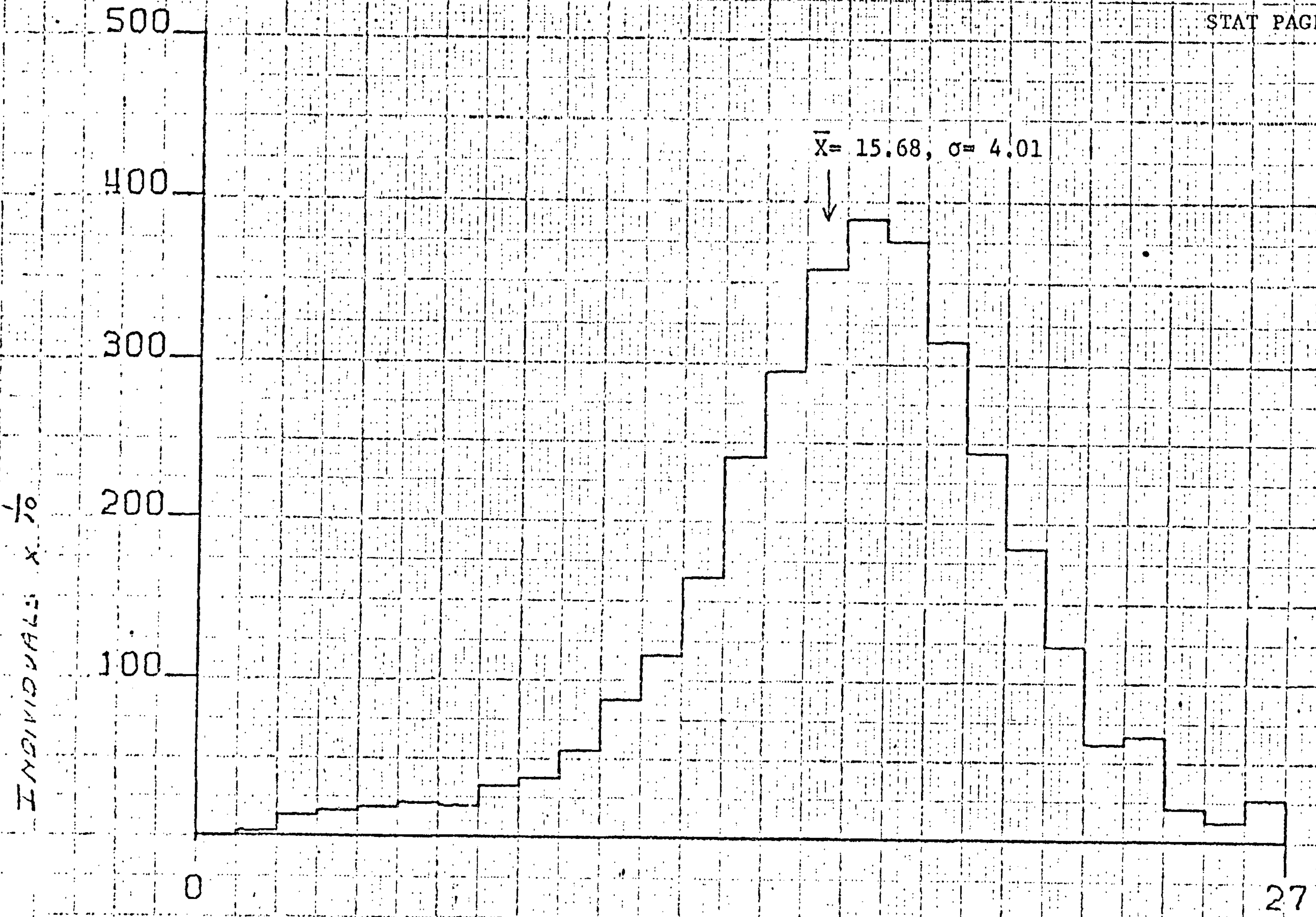


CHART # 54
STAT PAGE 12, ROW 8
X̄= 12.86, σ= 4.23
750
600
450
300
150
0
27
INDIVIDUALS X 1/10
MALES WHORLS DIGIT SEVEN
N= 55,780

CHART # 55

STAT PAGE 12, ROW 9

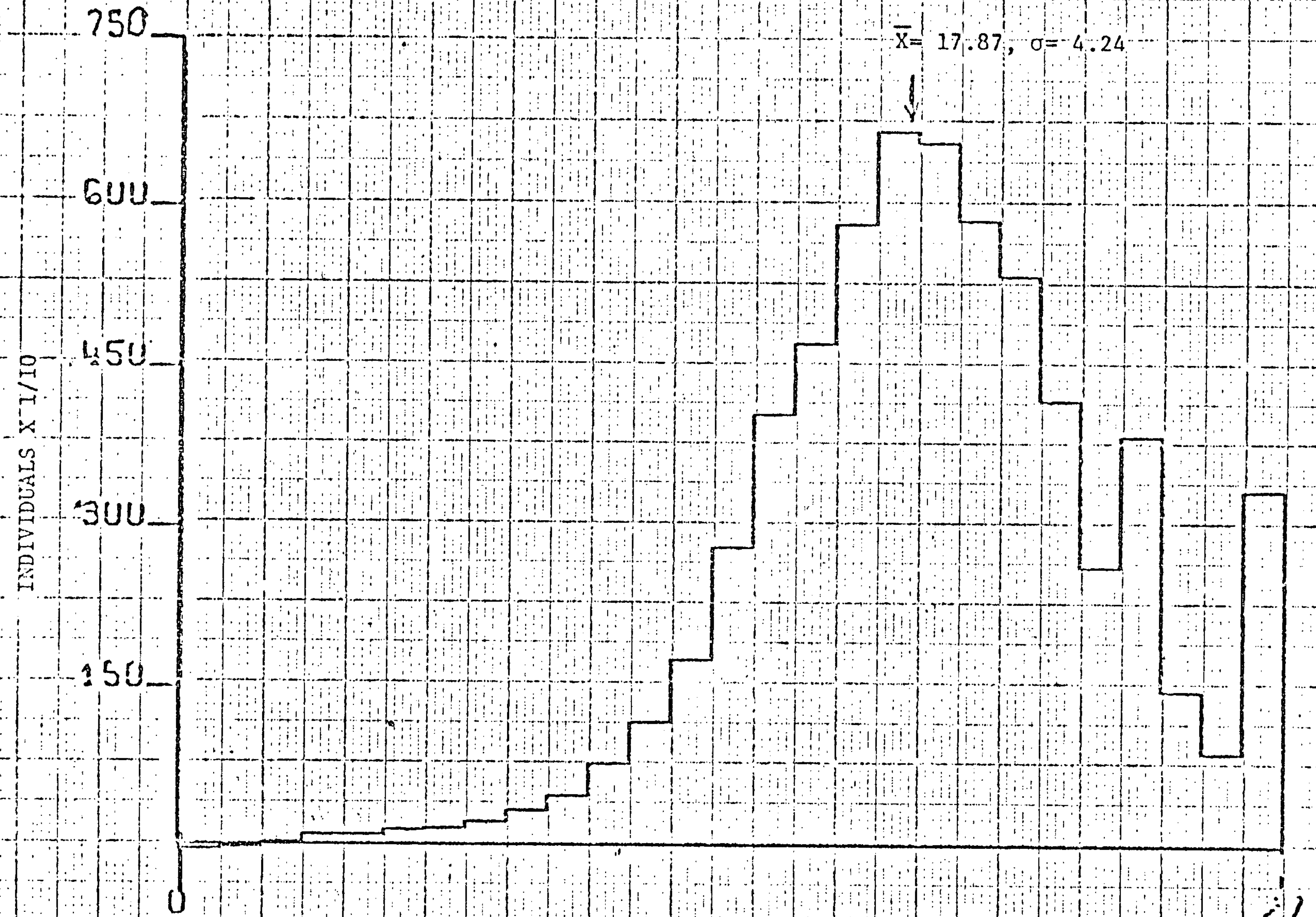


MALES WHORLS DIGIT EIGHT

N= 32,776

CHART # 56

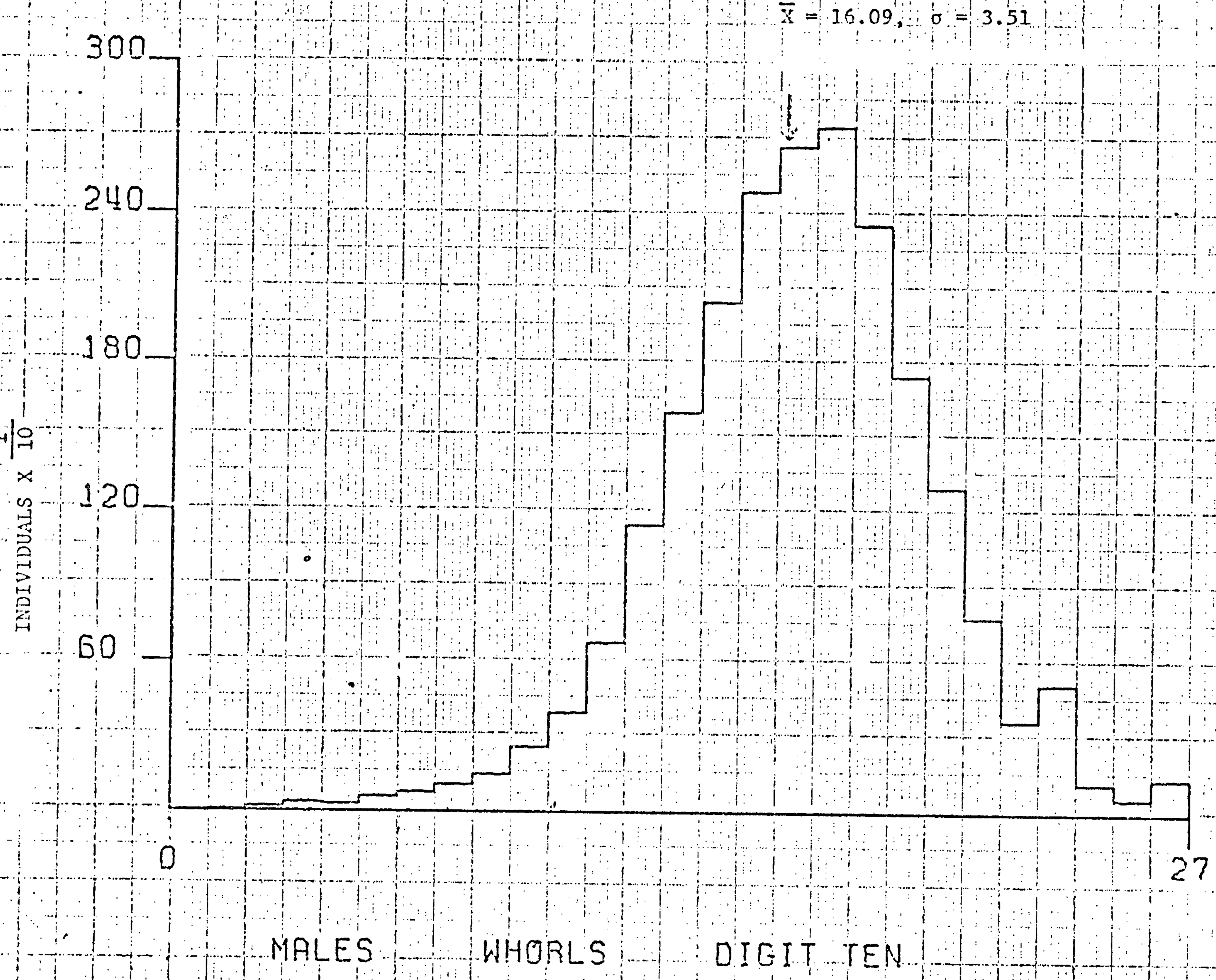
STAT PAGE 12, ROW 10



MALES WHORLS DIGIT NINE N=64,197

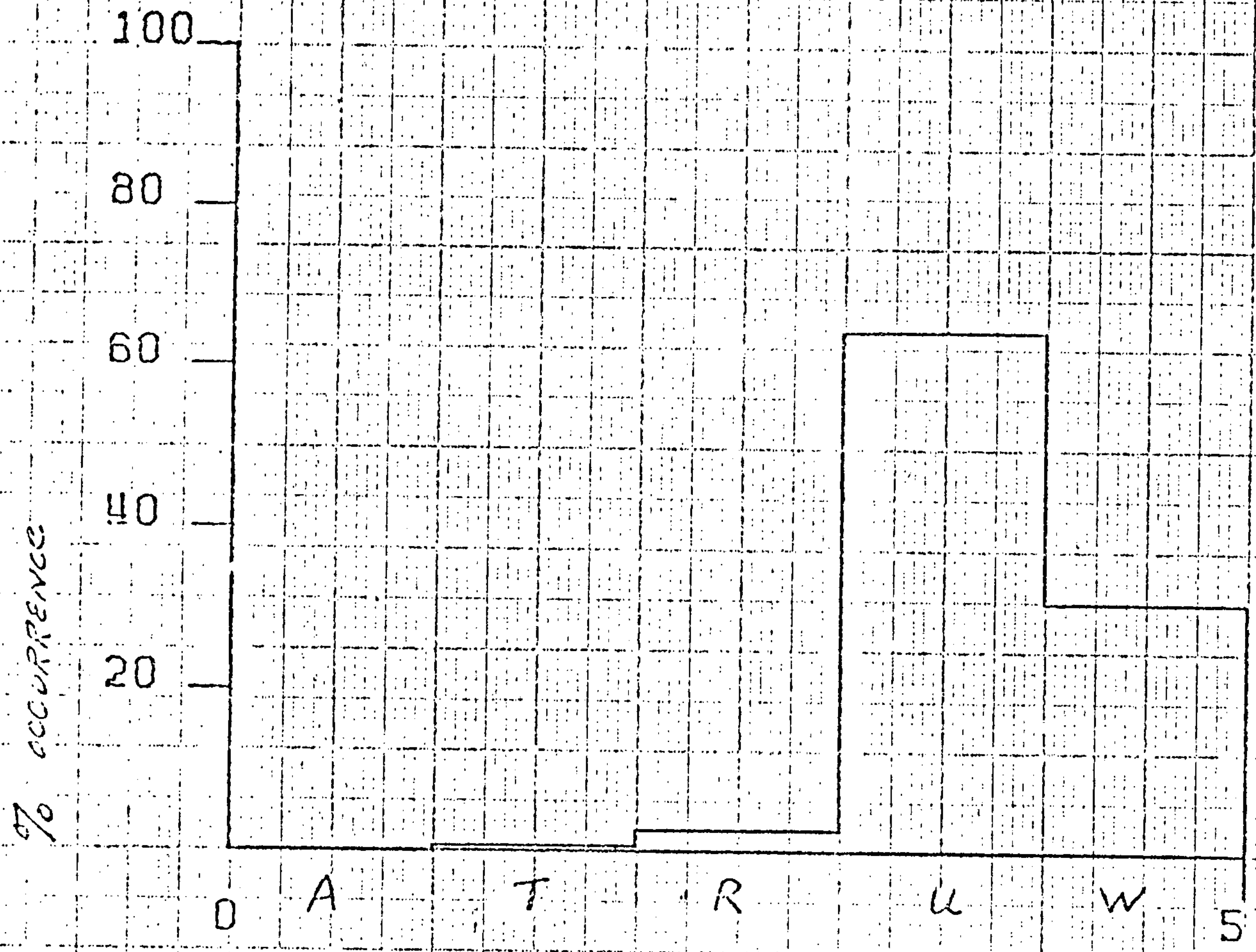
CHART # 57

STAT PAGE 12, ROW 11



N = 21,929

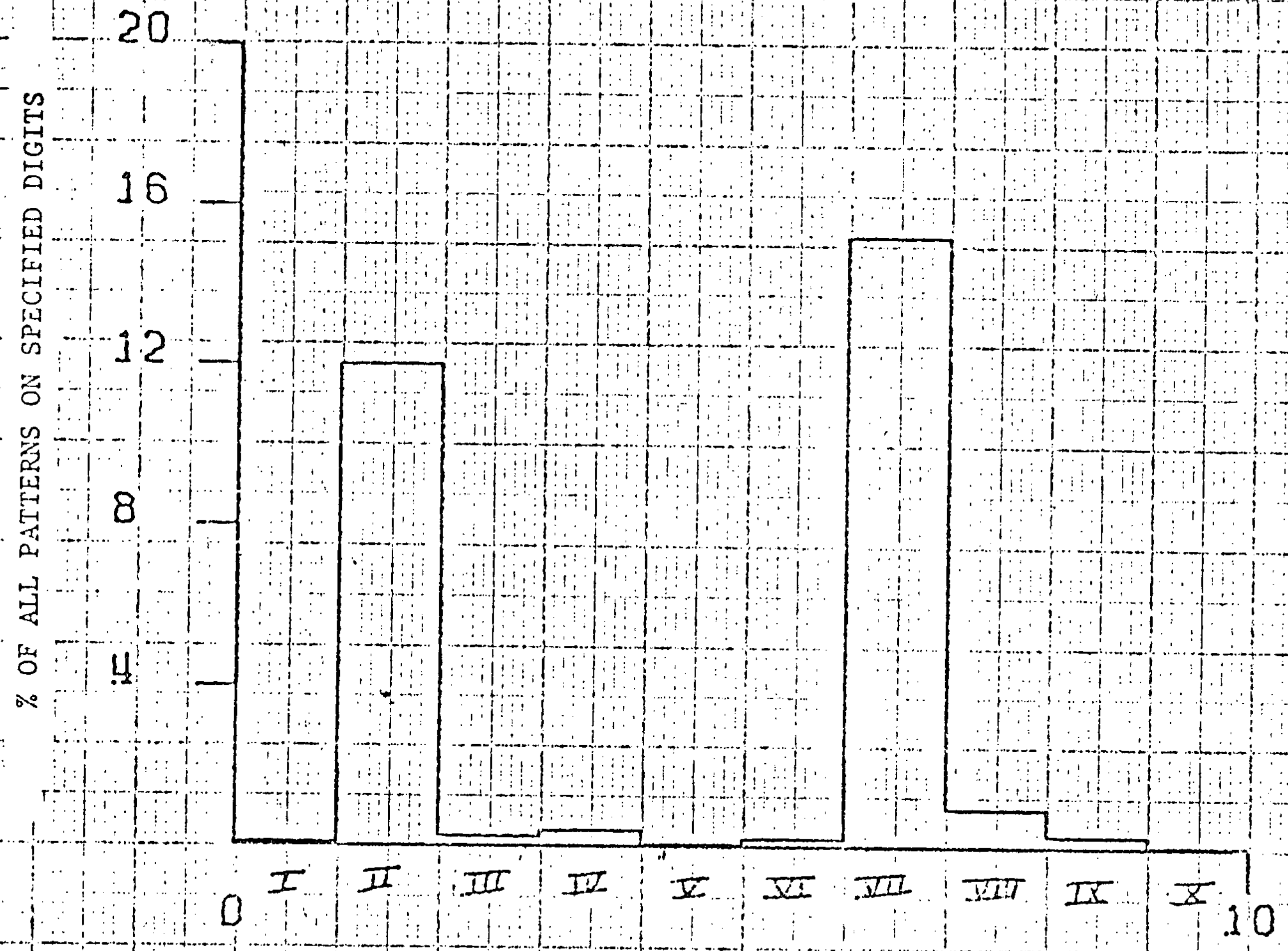
CHART # 58
STAT PAGE 22



PD-1C FEMALES COMBINED DIGITS

CHART # 59

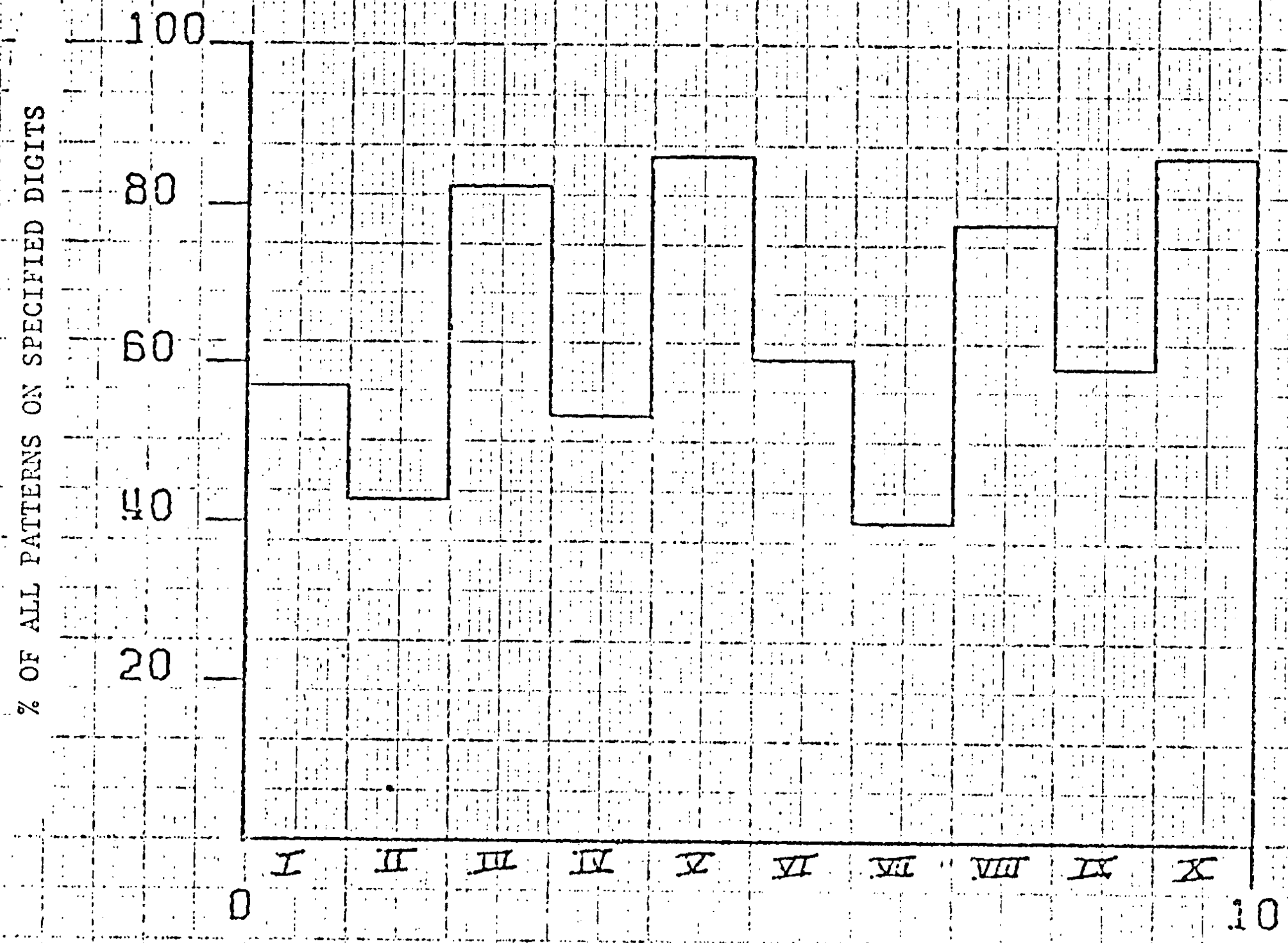
STAT PAGE 25, COL. 3



PD-7C FEMALES RADIAL LOOPS I-X

CHART # 60

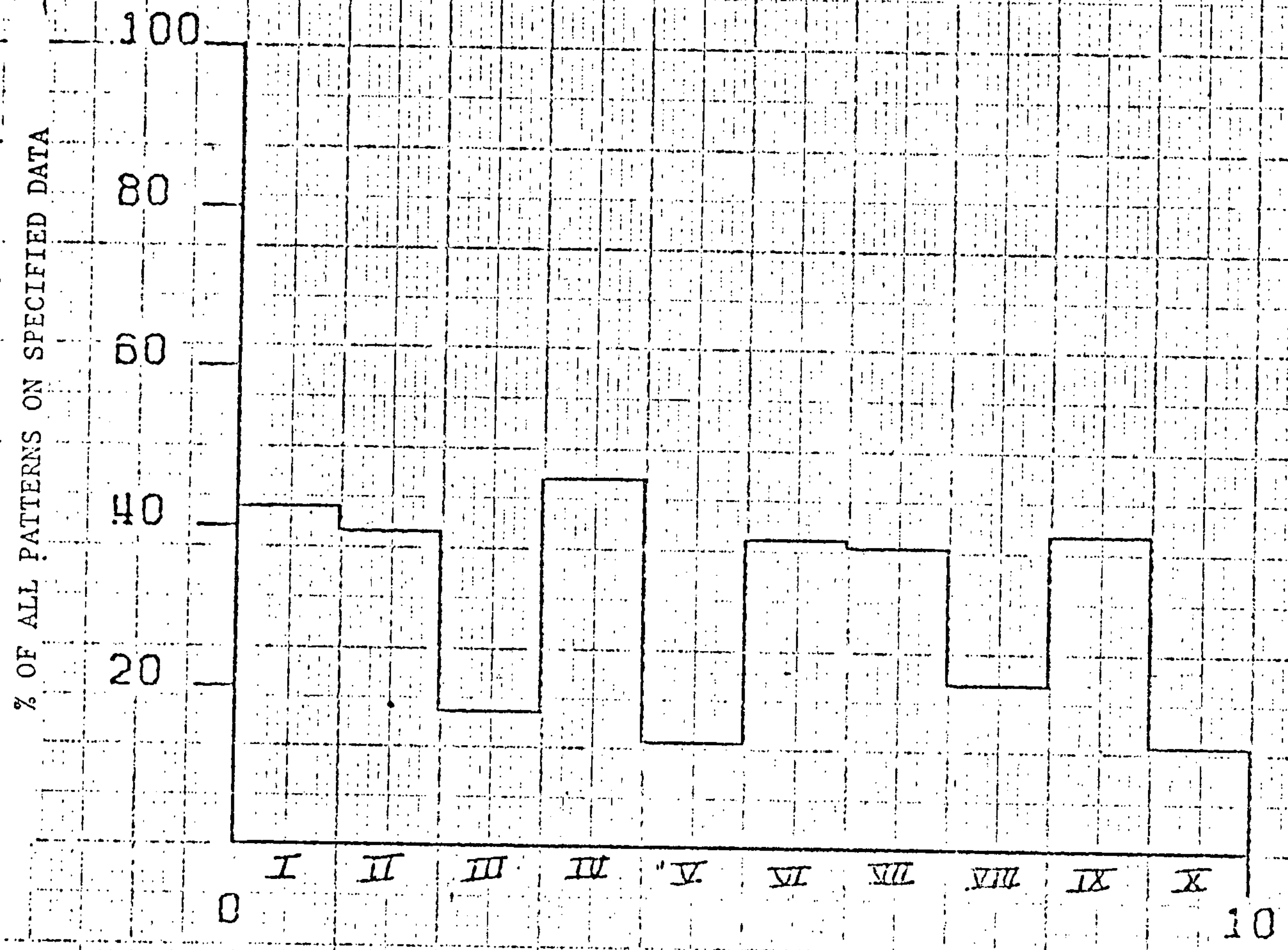
STAT PAGE 25, COL. 4



PD-70 FEMALES ULNAR LOOPS I-X

CHART # 61

STAT PAGE 25, COL. 5



PD-7E FEMALES WHORL FREQS I-X

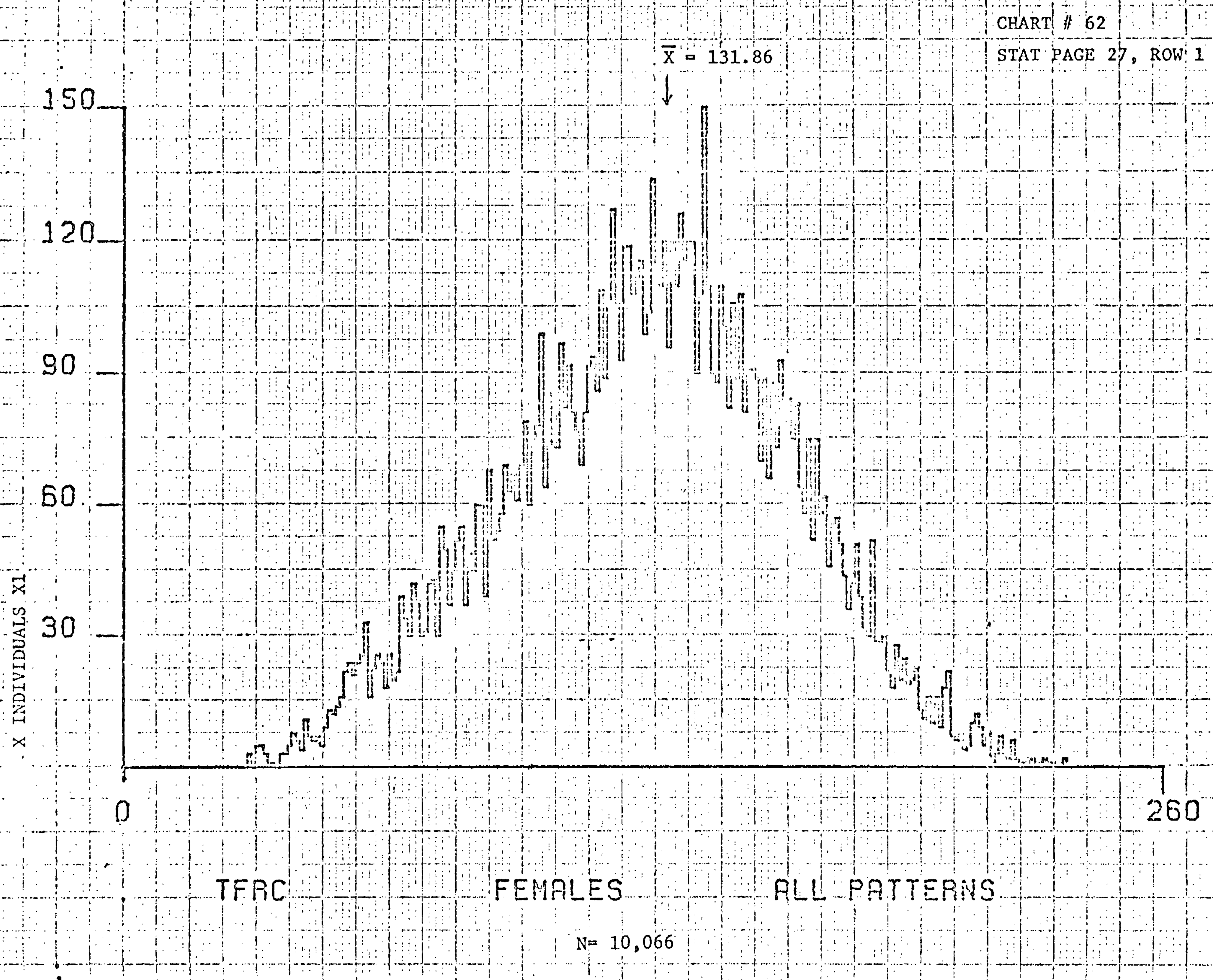
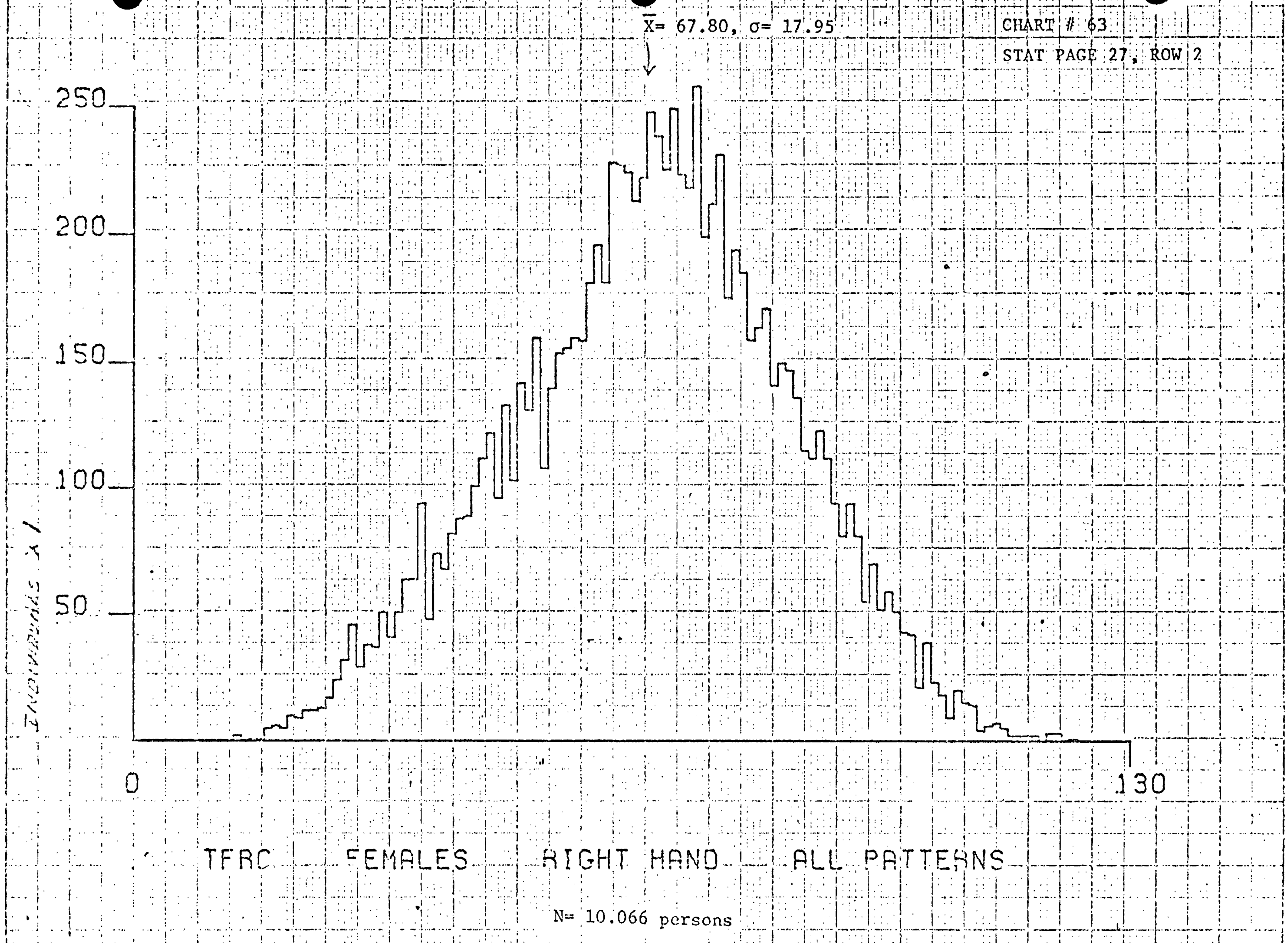


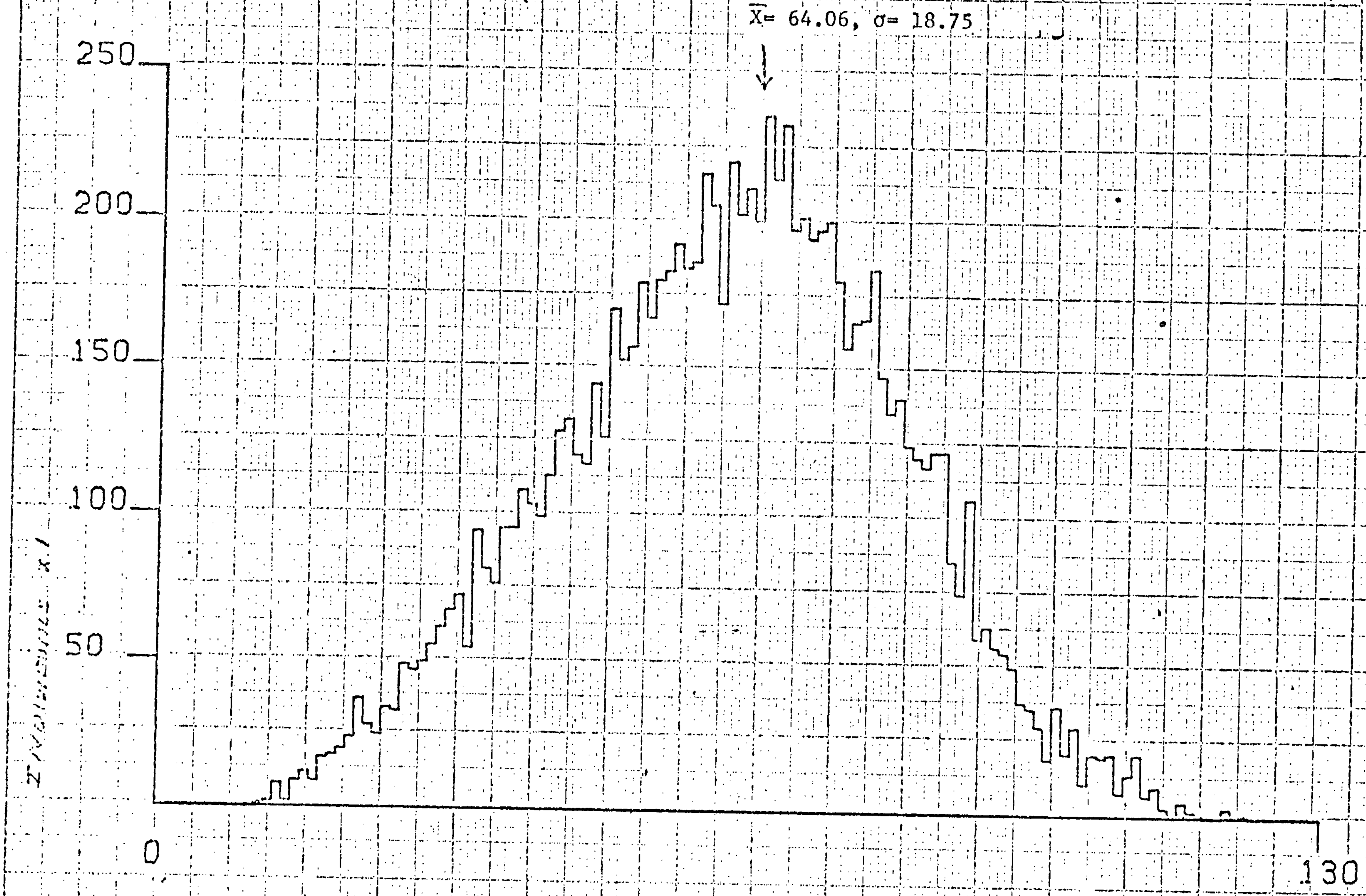
CHART # 62
STAT PAGE 27, ROW 1
$\overline{X}$ = 131.86
150
120
90
60
30
X INDIVIDUALS X1
0
260
TFRC
FEMALES
ALL PATTERNS
N= 10,066



$\overline{X}$= 67.80, σ= 17.95
CHART # 63
STAT PAGE 27, ROW 2
250
200
150
100
50
0
130
TFRC FEMALES RIGHT HAND ALL PATTERNS
N= 10.066 persons

CHART # 64

STAT PAGE 27, ROW 3

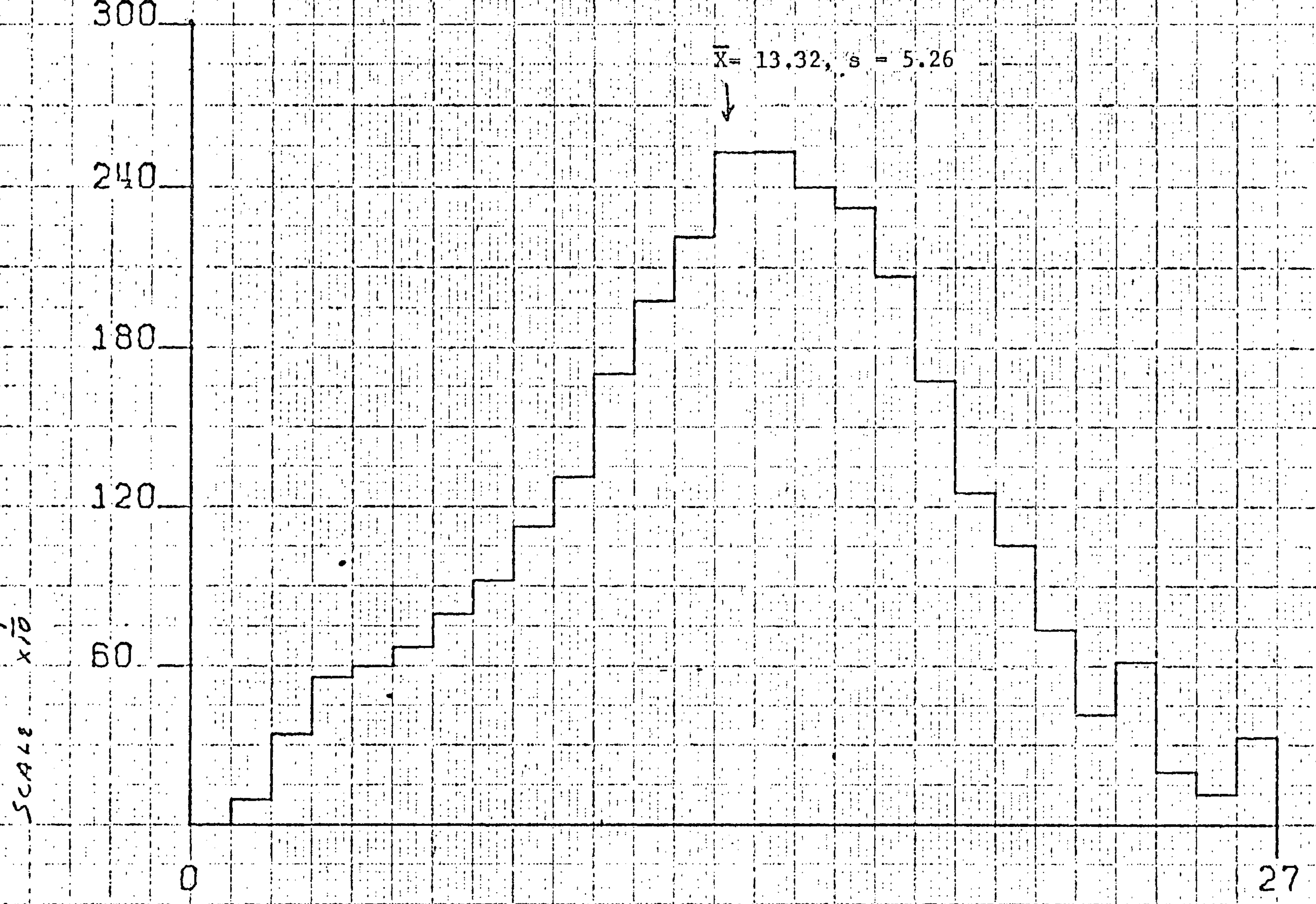


TFRC FEMALES LEFT HAND ALL PATTERNS

N= 10,006 persons

CHART # 65

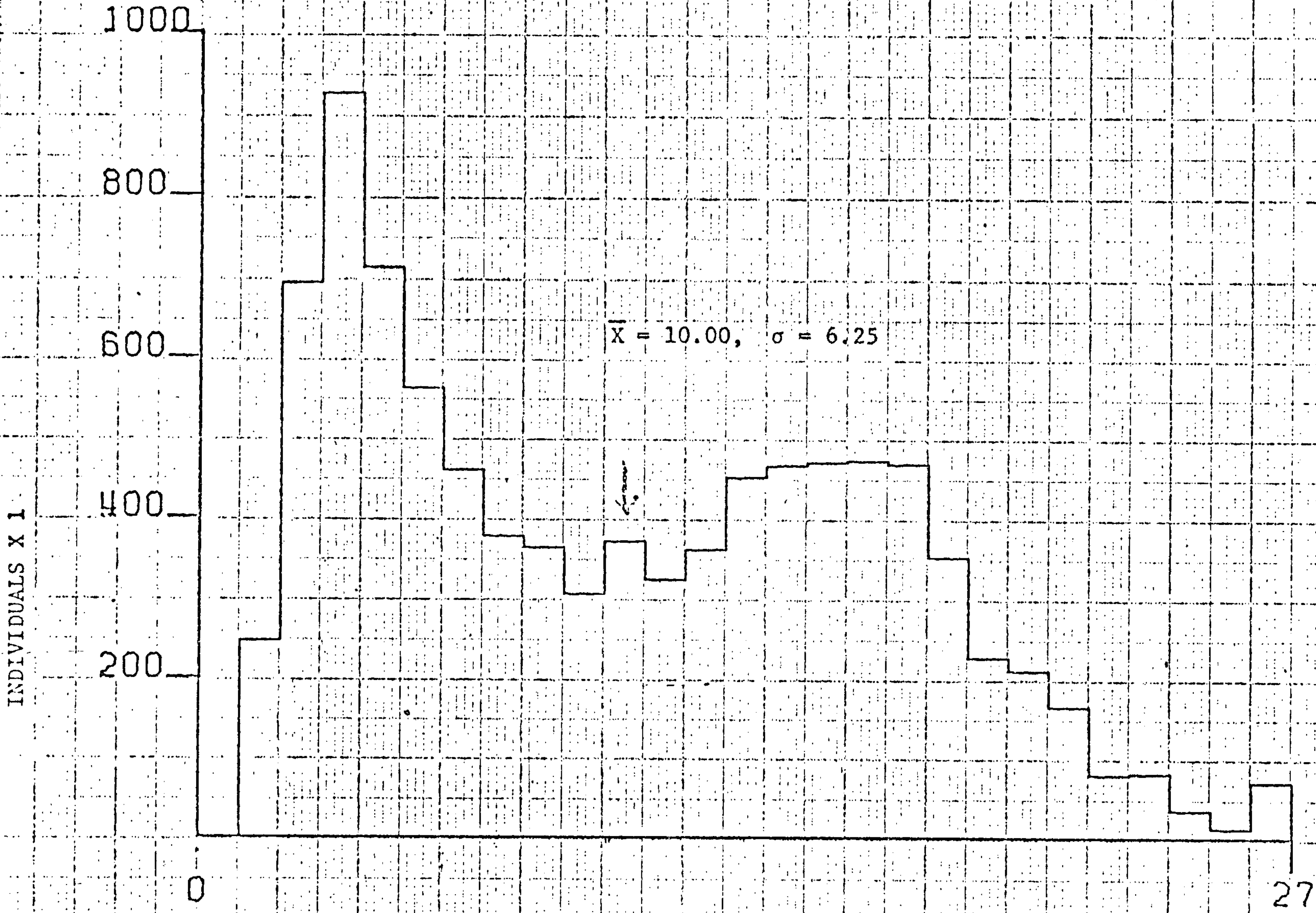
STAT PAGE 28, ROW 1



DD-2A FEMALES ALL PATTERNS ALL DIGITS

N= 310,400 digits

CHART # 66
STAT PAGE 28, ROW 4



FEMALES RADIAL LOOPS ALL DIGITS

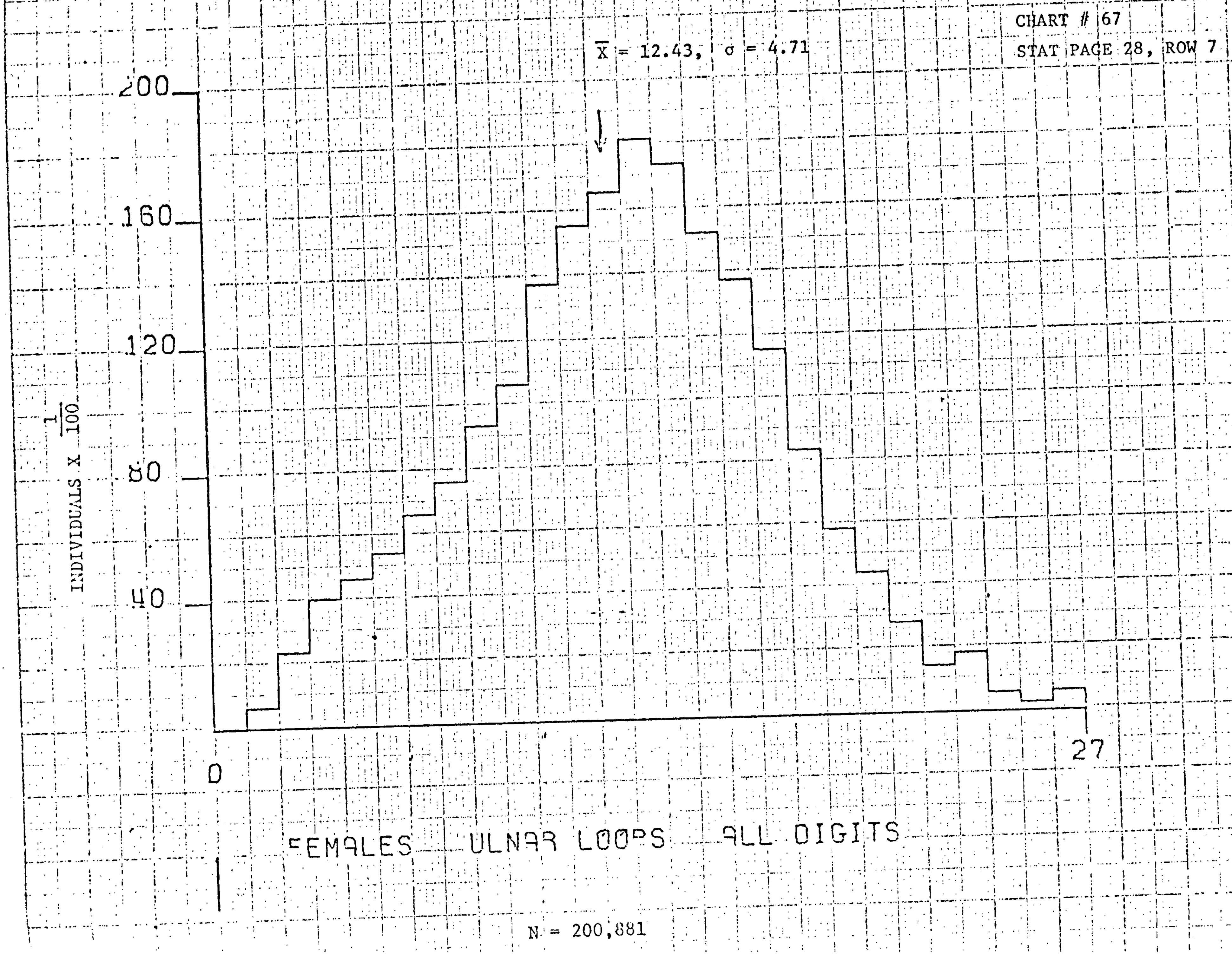
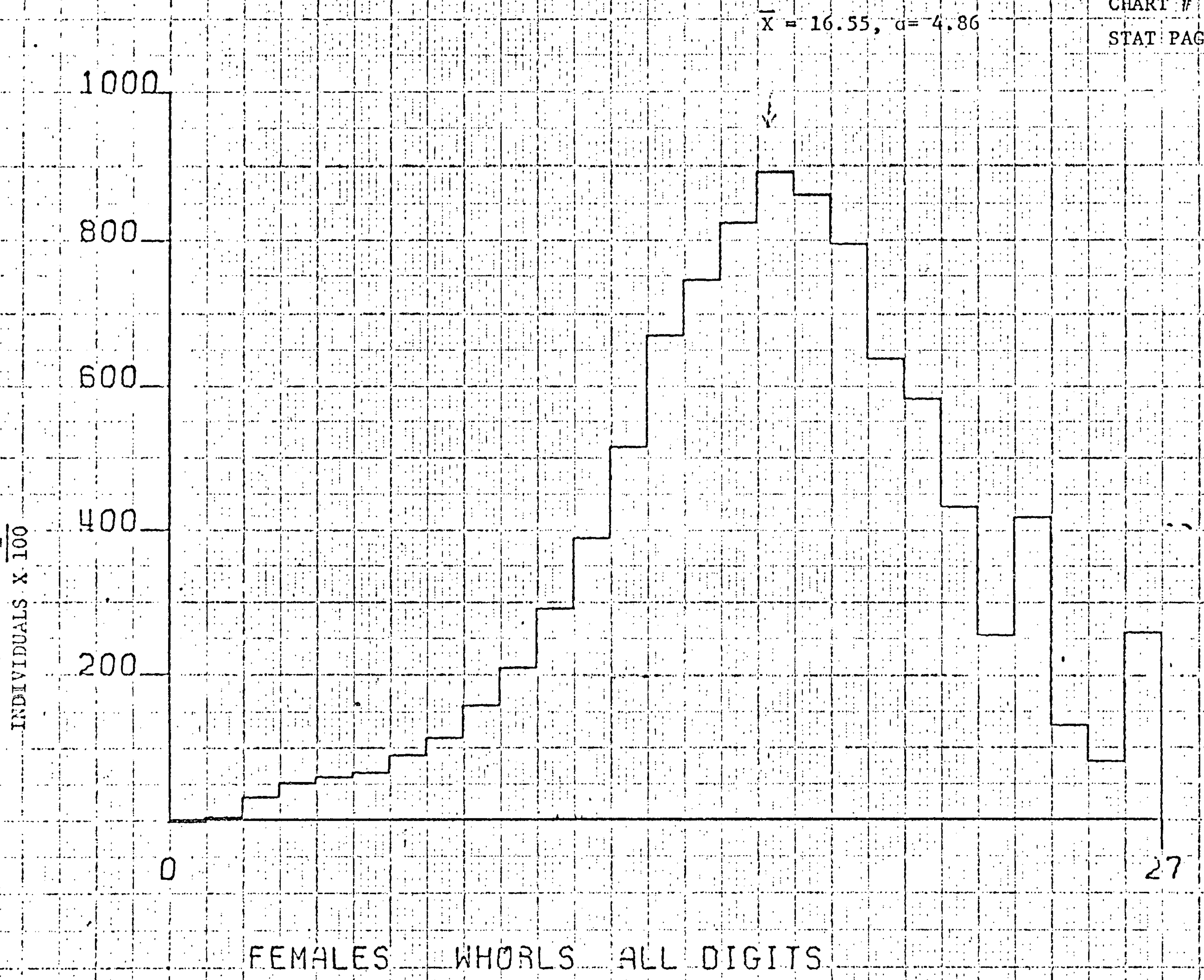


CHART # 67
STAT PAGE 28, ROW 7
$\overline{X}$ = 12.43, σ = 4.71
200
160
120
80
40
0
27
INDIVIDUALS X $\frac{1}{100}$
FEMALES ULNAR LOOPS ALL DIGITS
N = 200,881

Page 111 is missing

CHART # 68

STAT PAGE 28, ROW 10



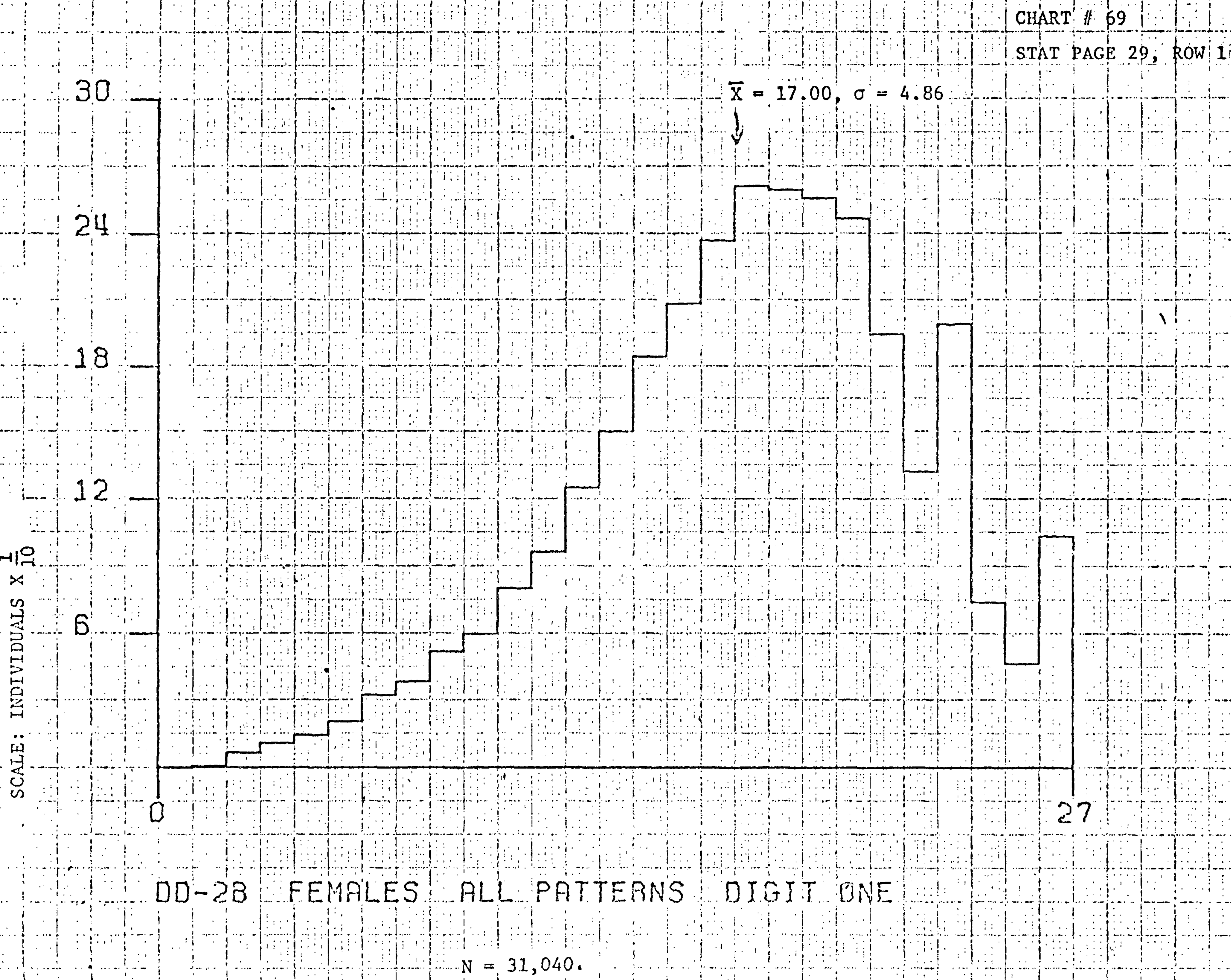
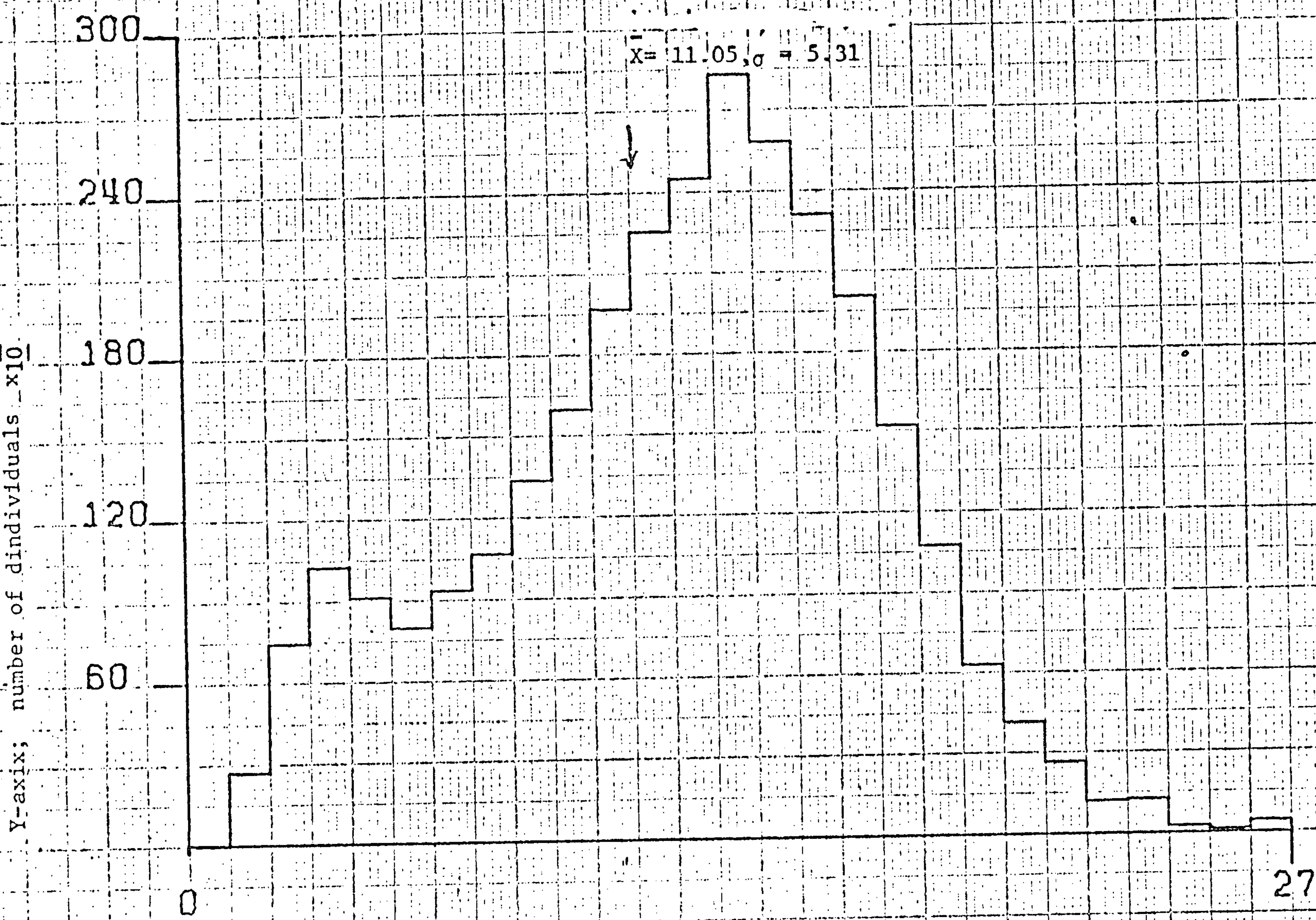


CHART # 69
STAT PAGE 29, ROW 1
$\overline{X}$ = 17.00, σ = 4.86
30
24
18
12
6
SCALE: INDIVIDUALS X $\frac{1}{10}$
0
27
DD-28 FEMALES ALL PATTERNS DIGIT ONE
N = 31,040.

CHART # 70

STAT PAGE # 29, ROW 2



DD-2C FEMALES ALL PATTERNS DIGIT TWO

N = 31,040

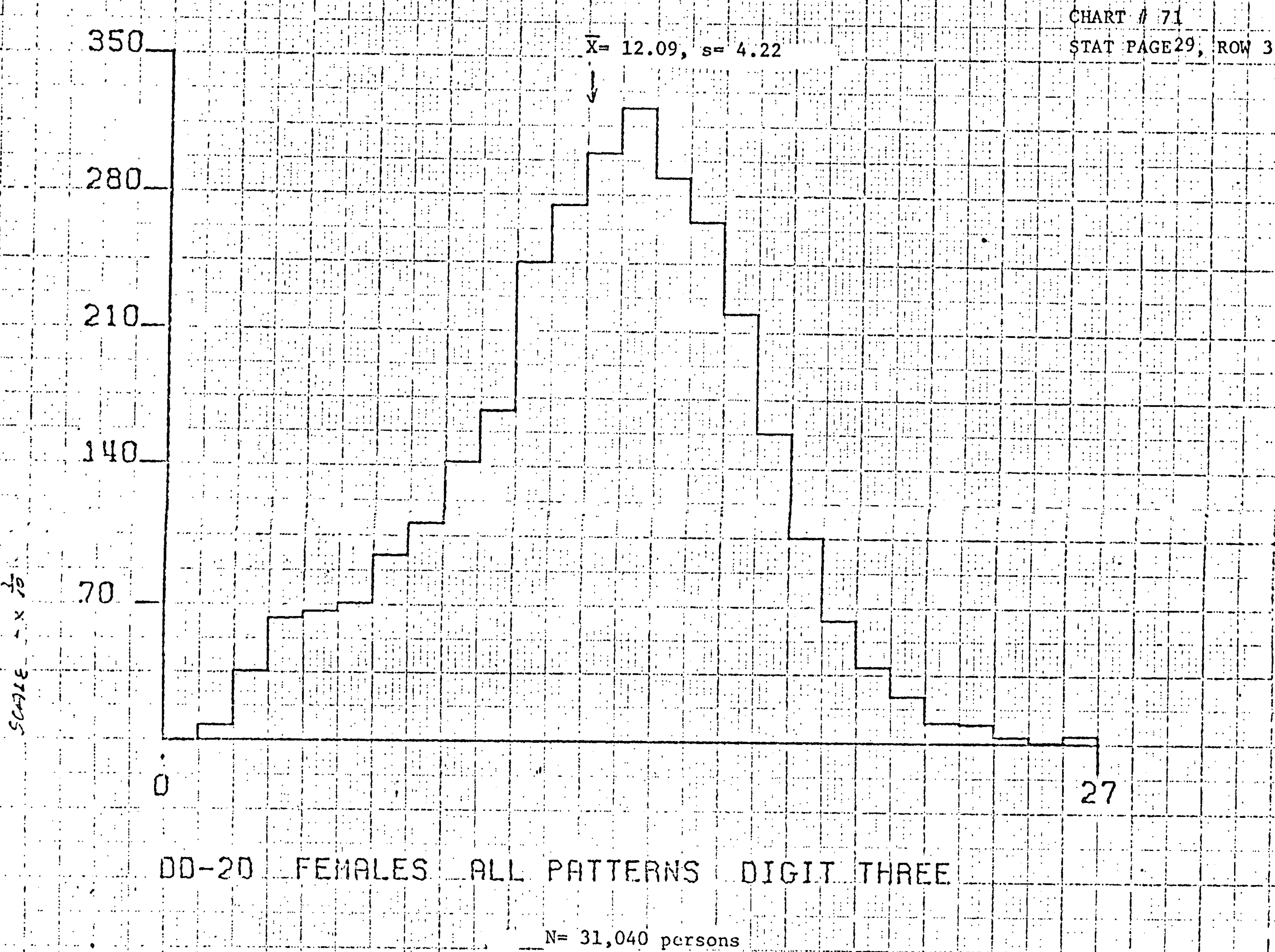
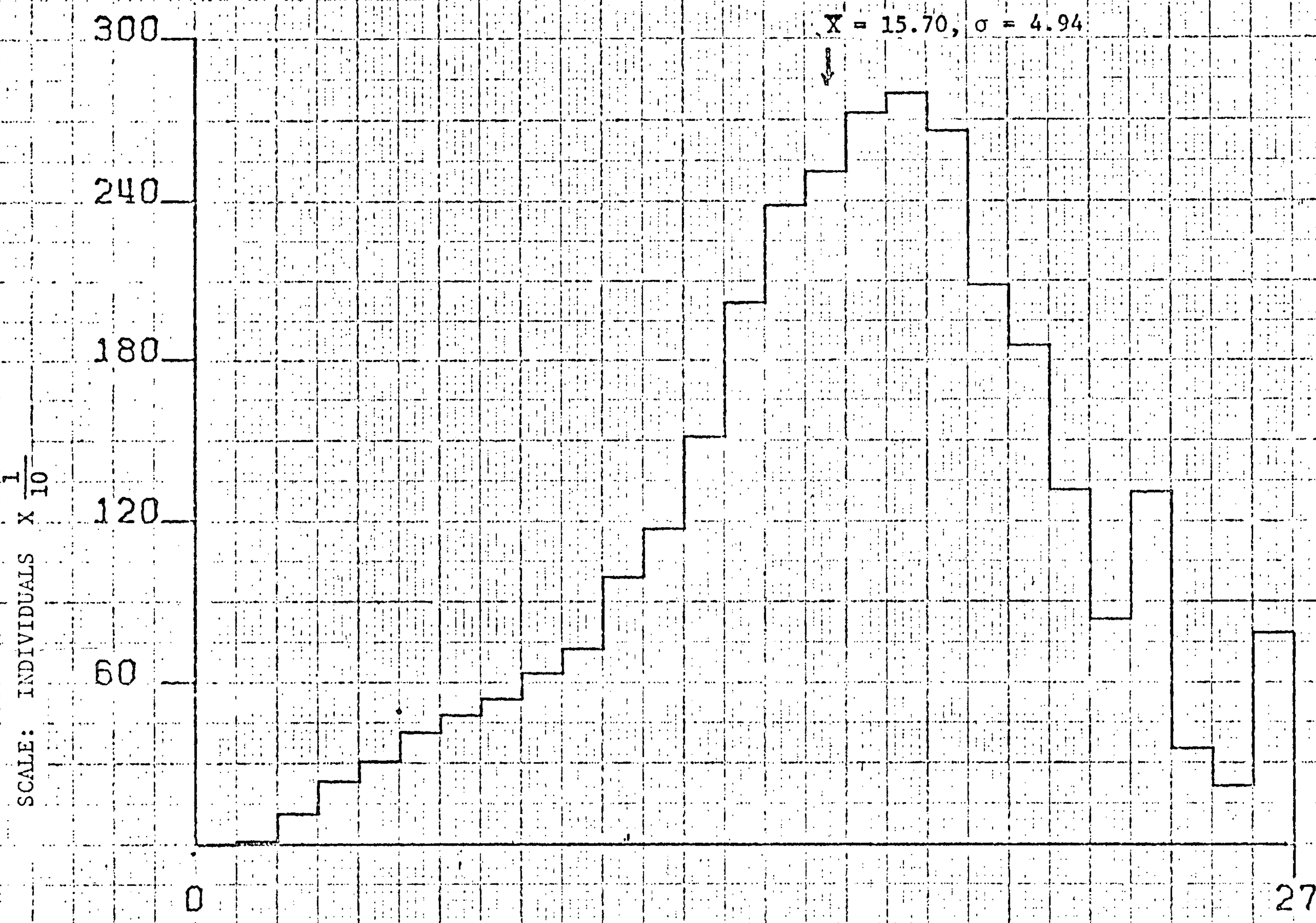


CHART # 71
STAT PAGE 29, ROW 3
X̄= 12.09, s= 4.22
350
280
210
140
70
SCALE - x 1/10
0
27
DD-20 FEMALES ALL PATTERNS DIGIT THREE
N= 31,040 persons

CIART # 72
STAT PAGE29, ROW 4

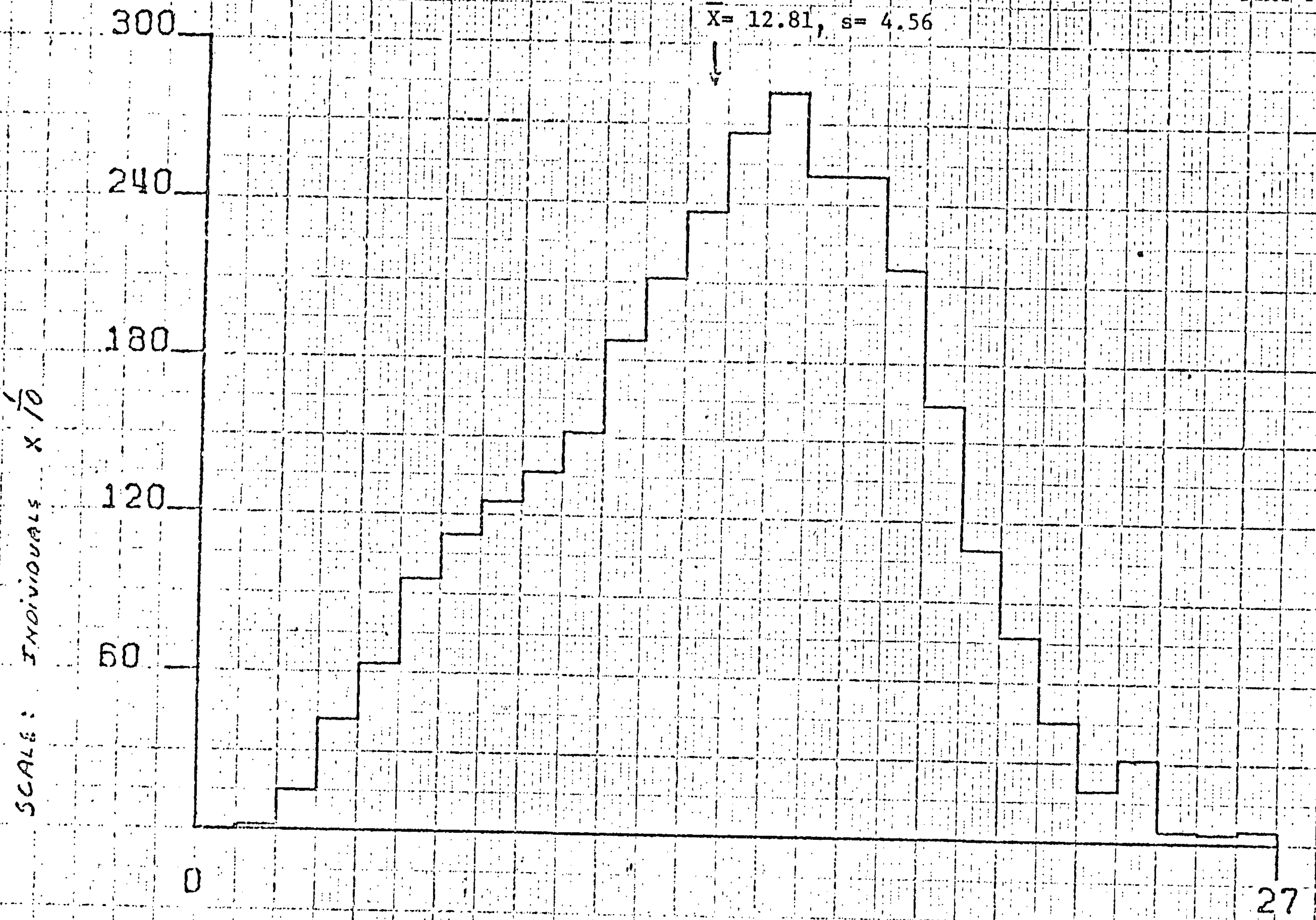


DD-2E FEMALES ALL PATTERNS DIGIT FOUR

N = 31;040

CHART # 73

STAT PAGE 29, ROW 5

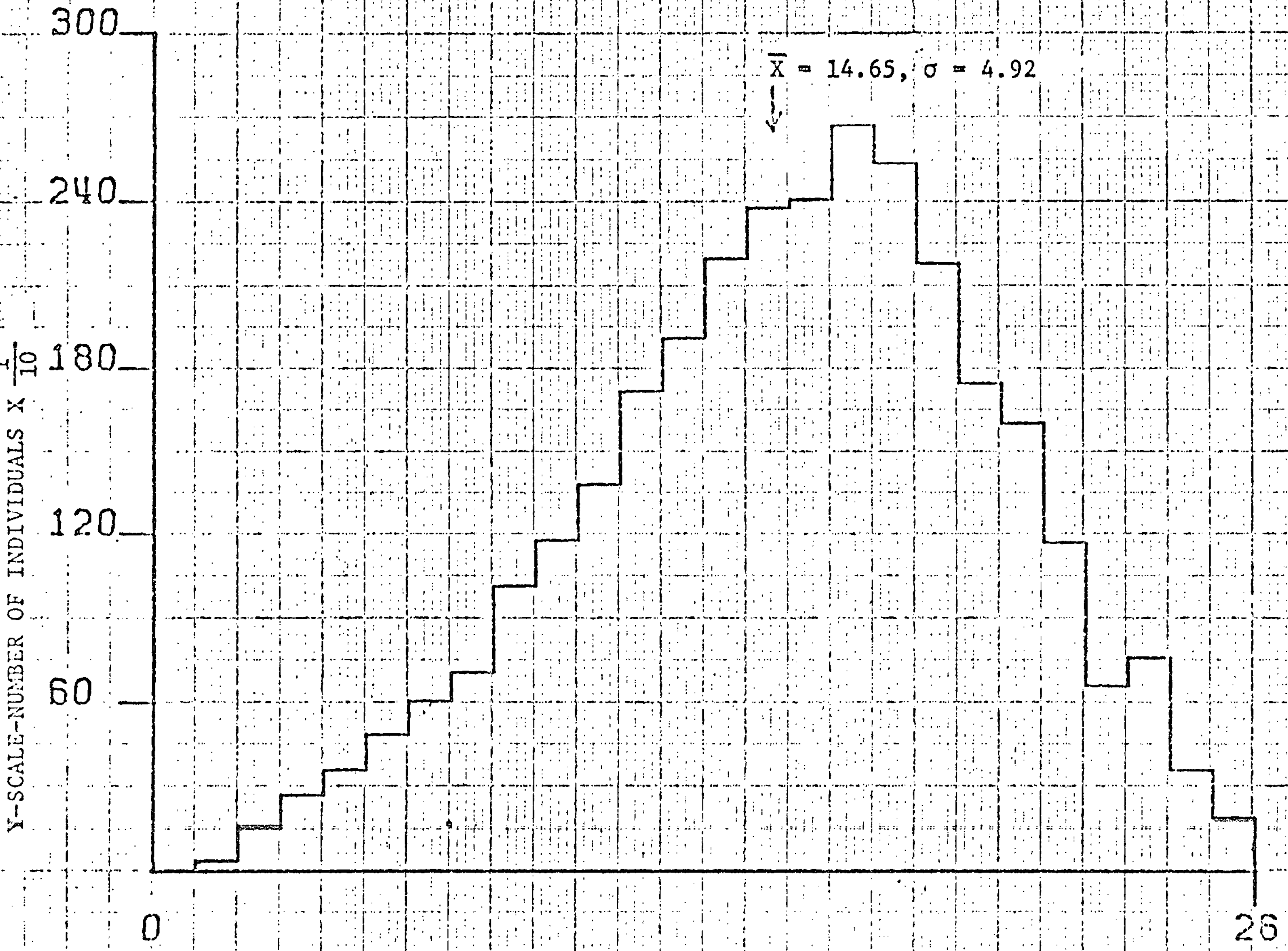


DD-2F FEMALES ALL PATTERNS DIGIT FIVE

N= 31,040 persons

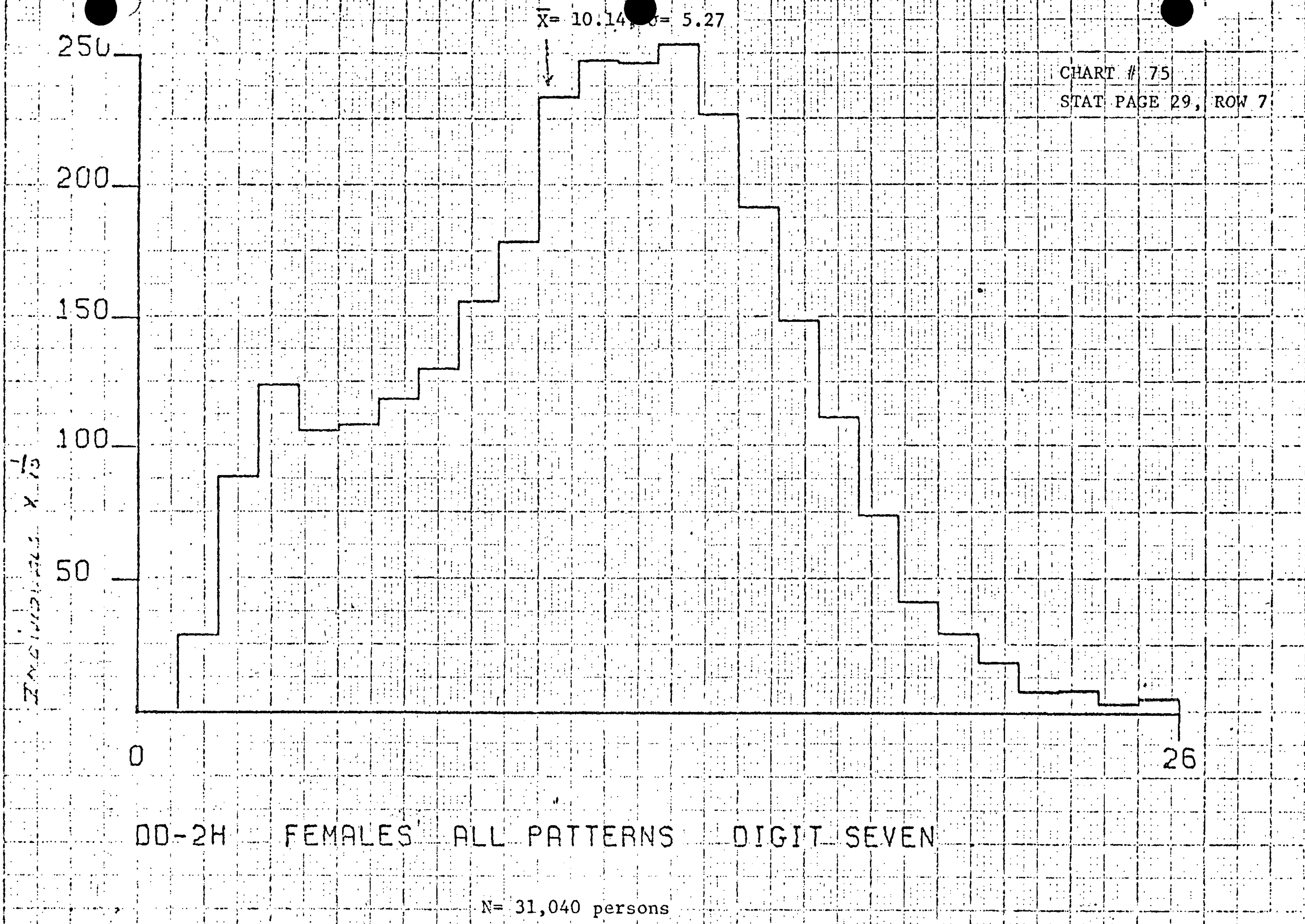
CHART # 74

STAT PAGE 29, ROW 6



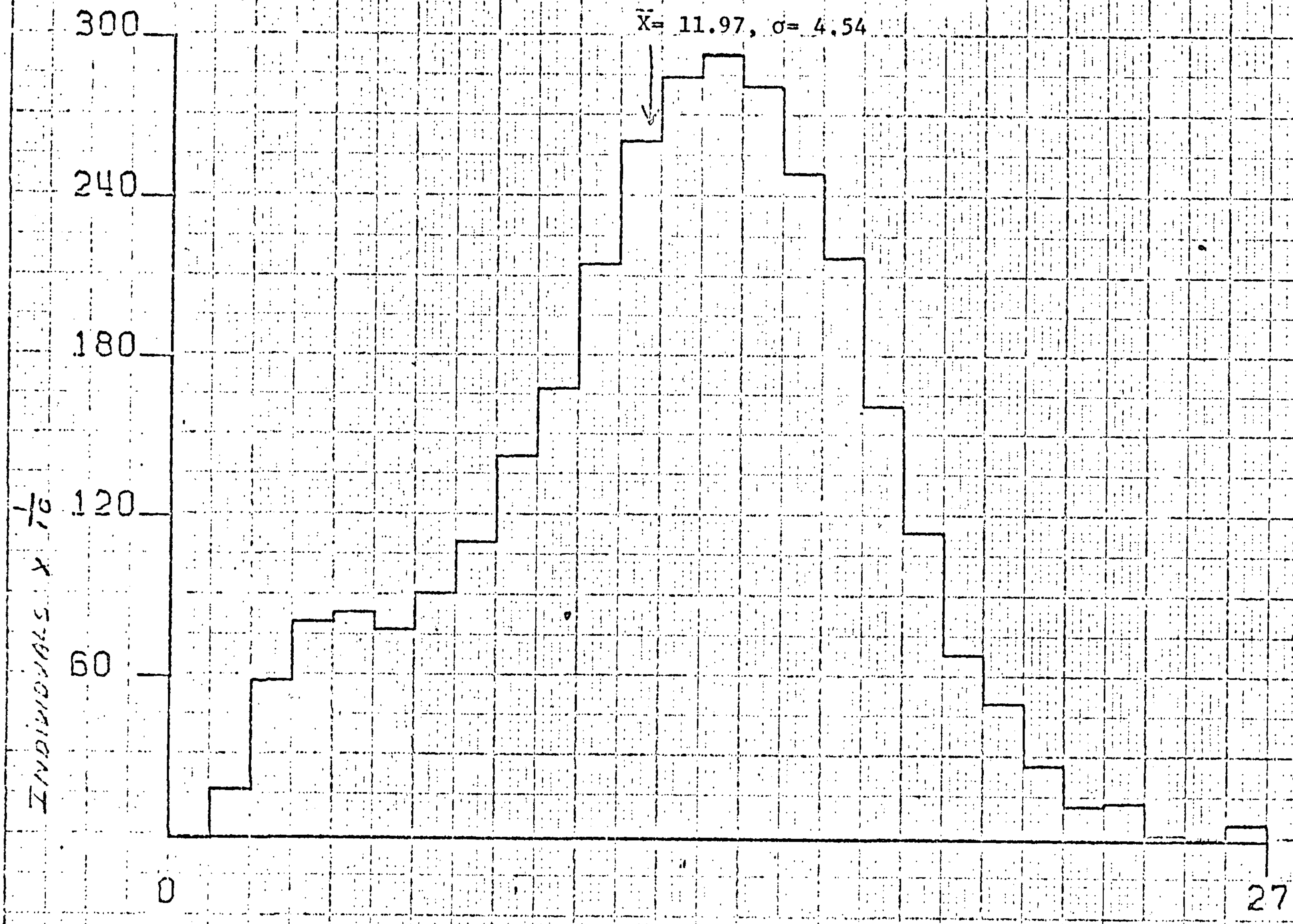
DD-2G FEMALES ALL PATTERNS DIGIT SIX

N = 31,040



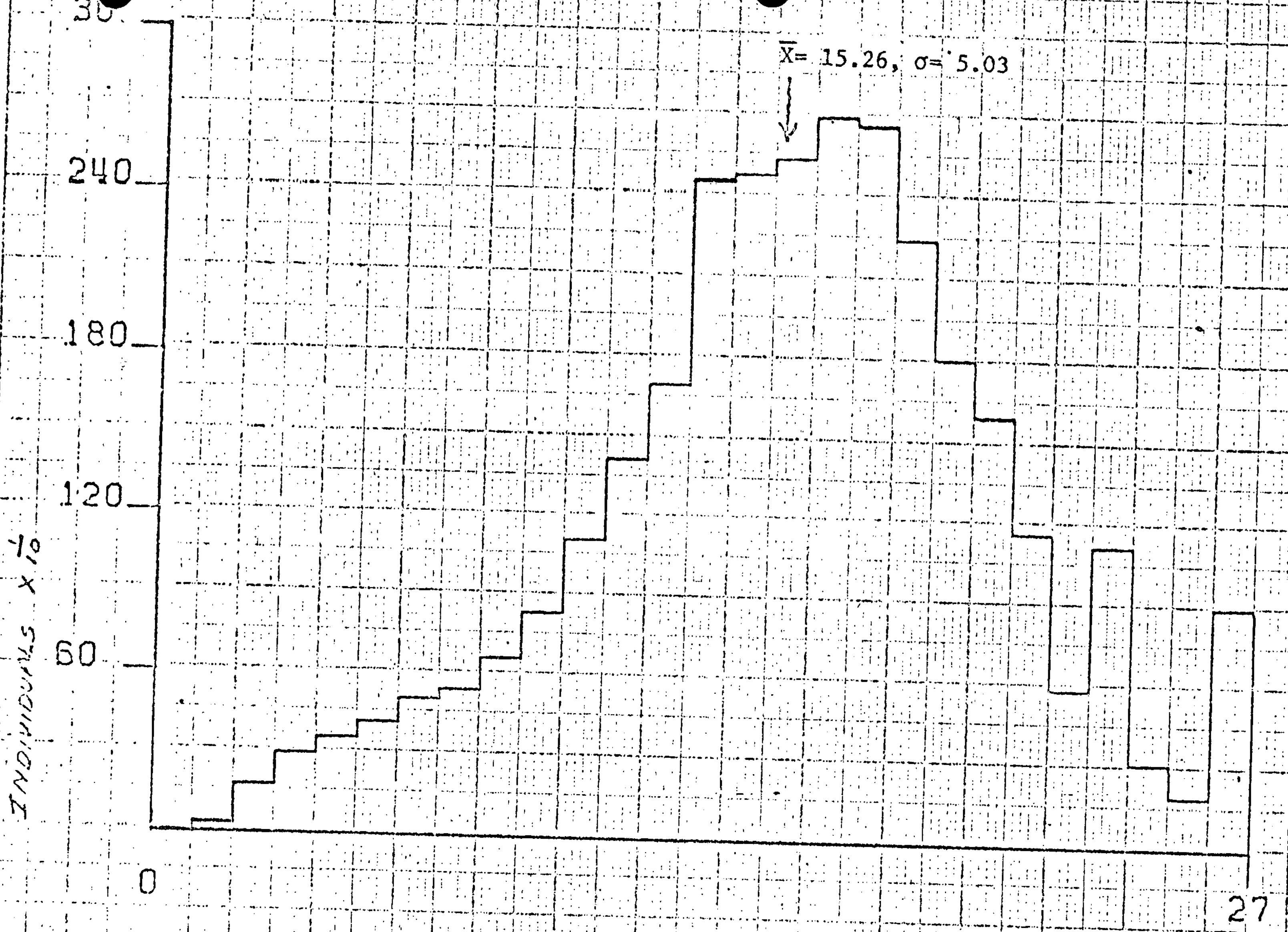
$\overline{X}$= 10.14, σ= 5.27
CHART # 75
STAT PAGE 29, ROW 7
250
200
150
100
50
0
26
DD-2H FEMALES ALL PATTERNS DIGIT SEVEN
N= 31,040 persons

CHART # 76
STAT PAGE 29, ROW 8



DD-21 FEMALES ALL PATTERNS DIGIT EIGHT

N= 31,040

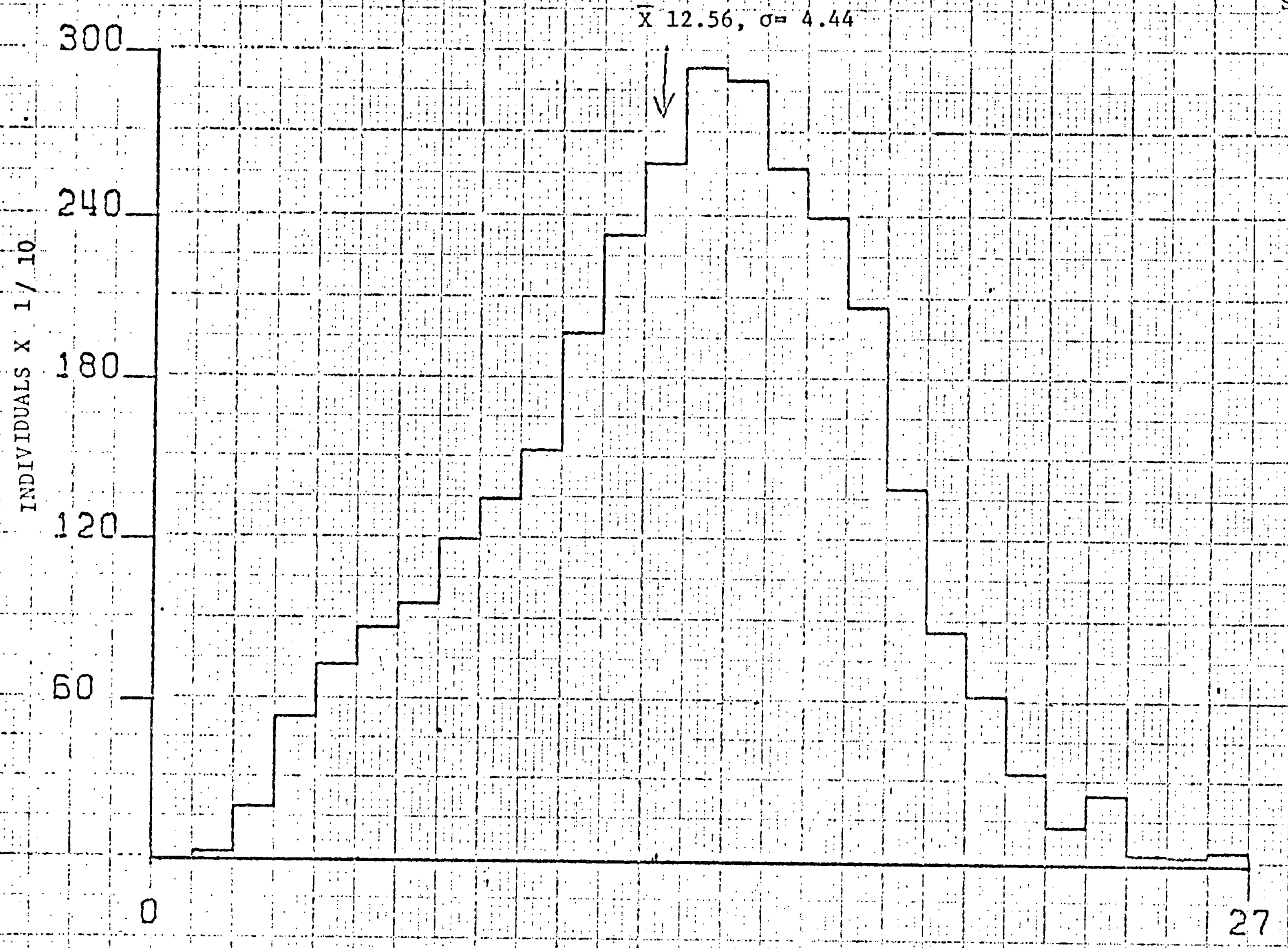


DD-2J FEMALES ALL PATTERNS DIGIT NINE

N= 31,040

CHART # 78

STAT PAGE 29, ROW 10

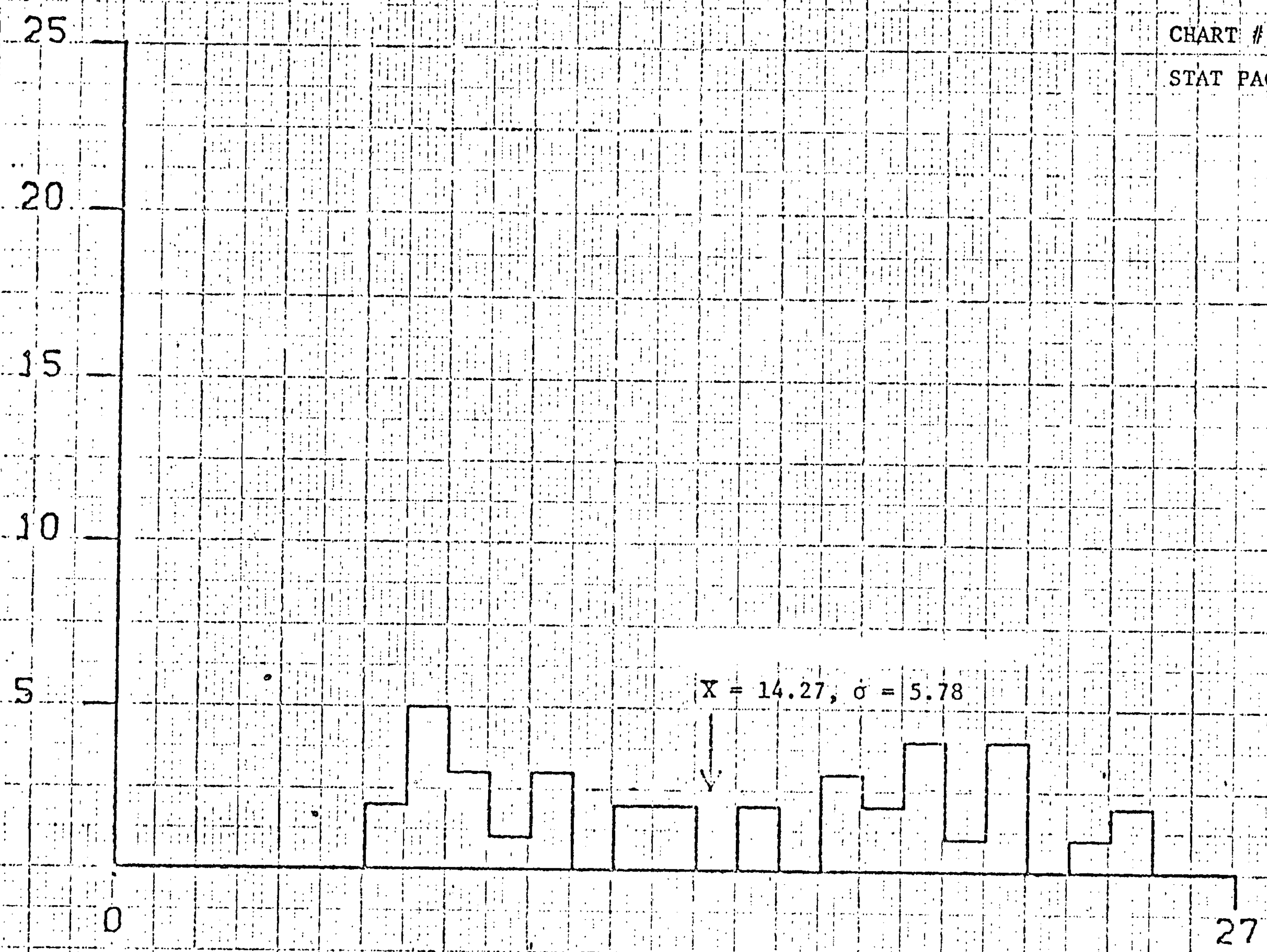


DD-2K FEMALES ALL PATTERNS DIGIT TEN

N= 31,040

CHART # 79

STAT PAGE 31, ROW 2



FEMALES RADIAL LOOPS DIGIT ONE N= 37

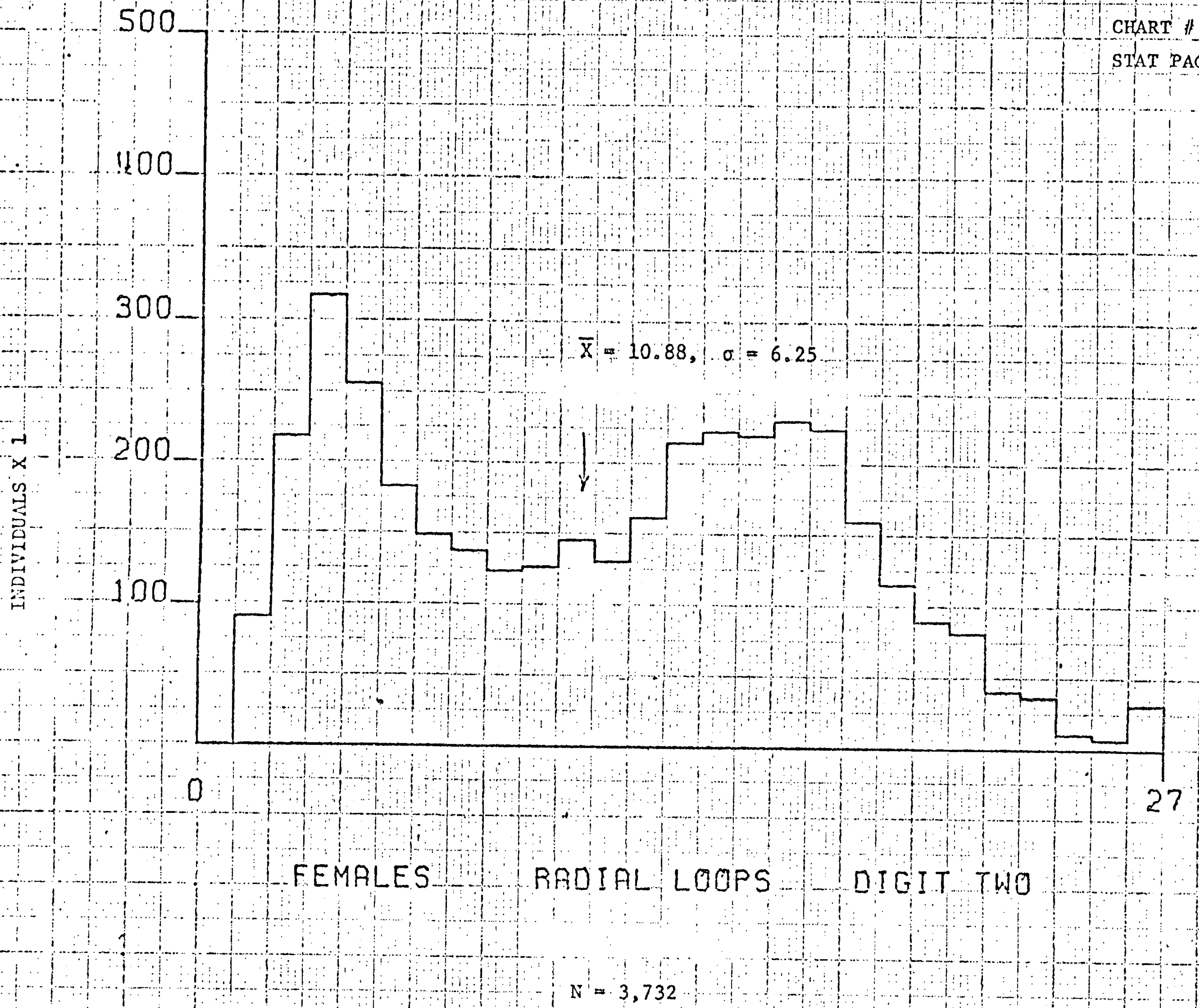
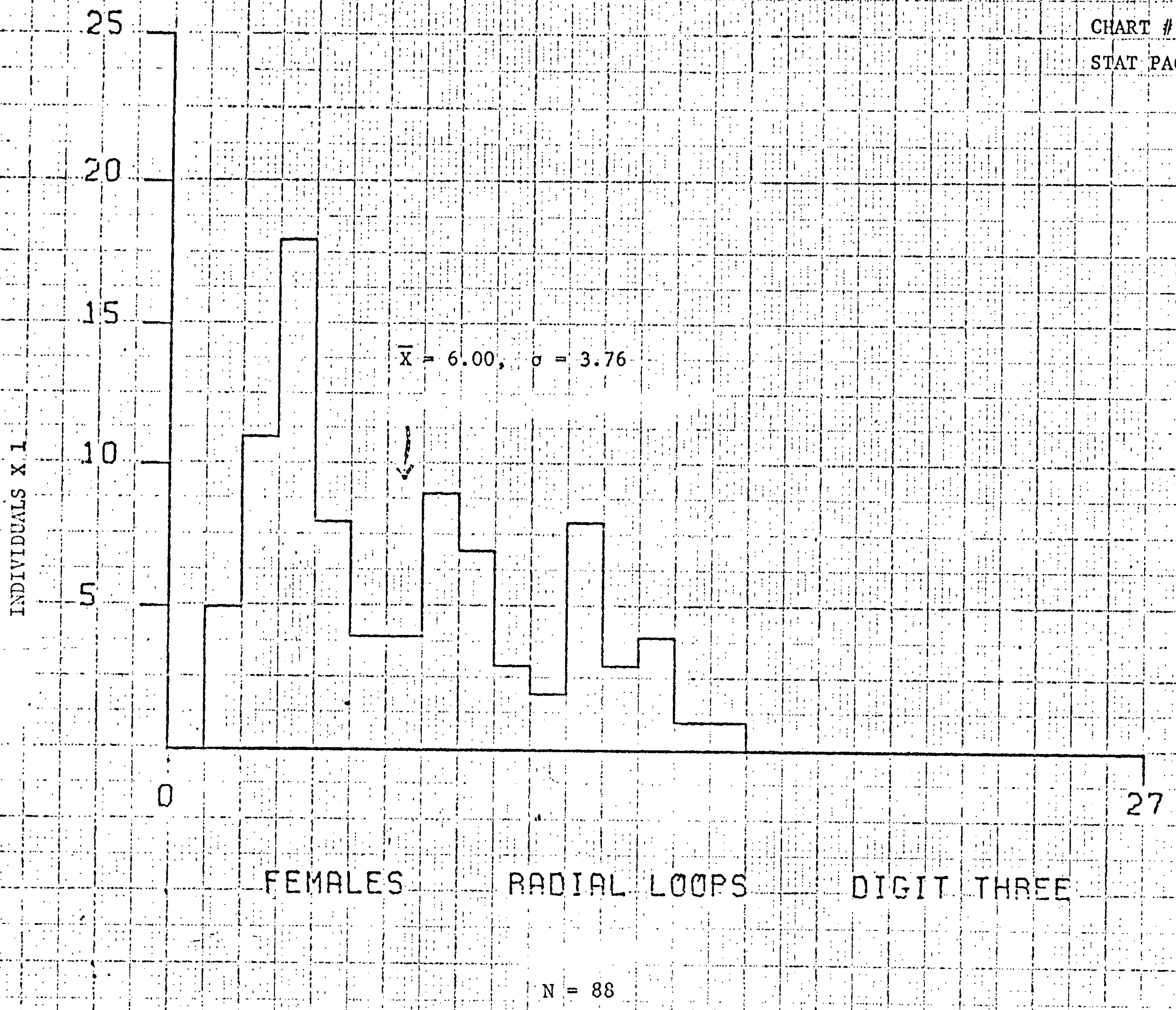

500
400
300
200
100
INDIVIDUALS X 1
$\overline{X}$ = 10.88, σ = 6.25
0
27
FEMALES RADIAL LOOPS DIGIT TWO
N = 3,732

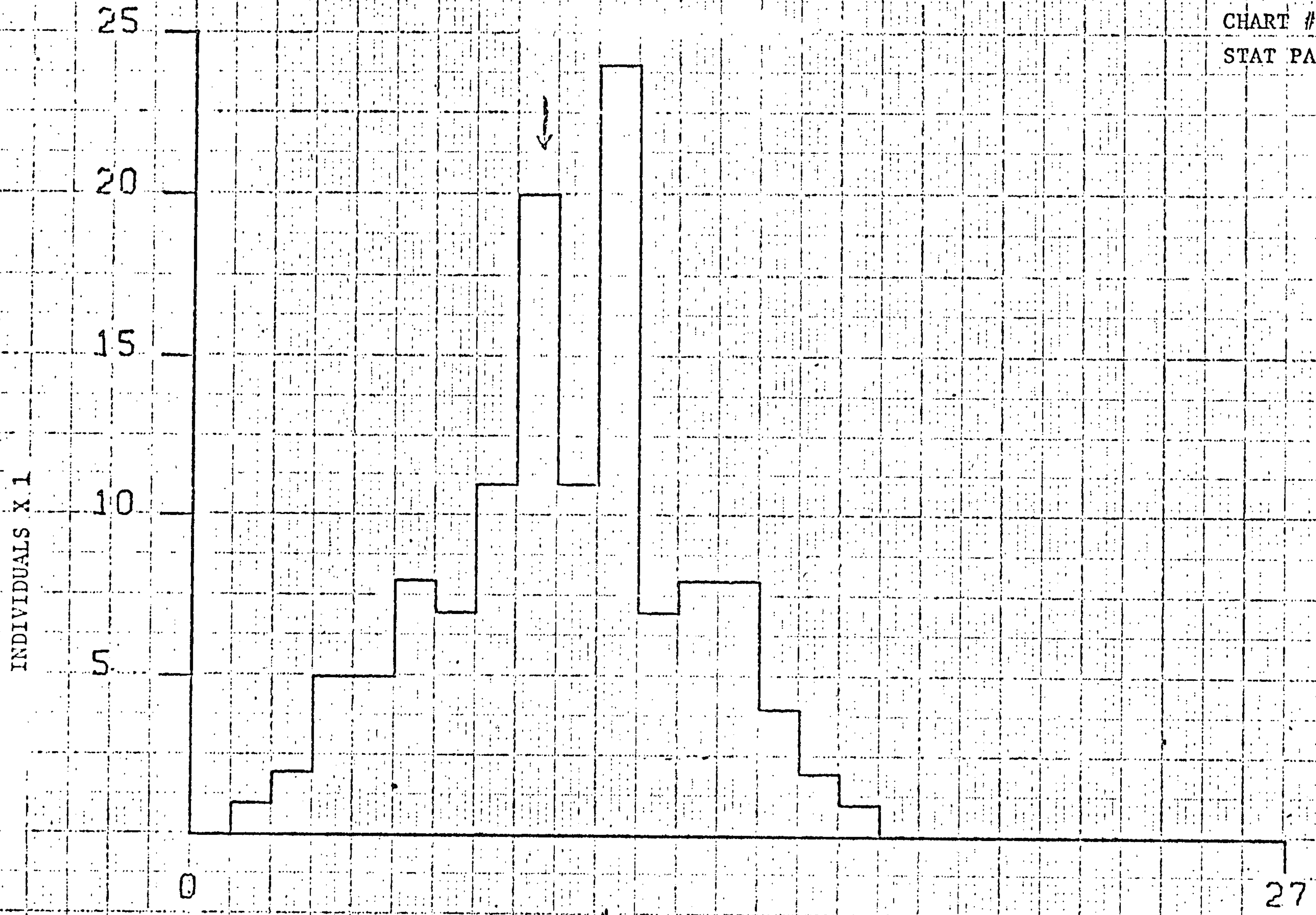
CHART # 81

STAT PAGE 31, ROW 4



$\overline{X}$ = 8.69, σ = 3.09

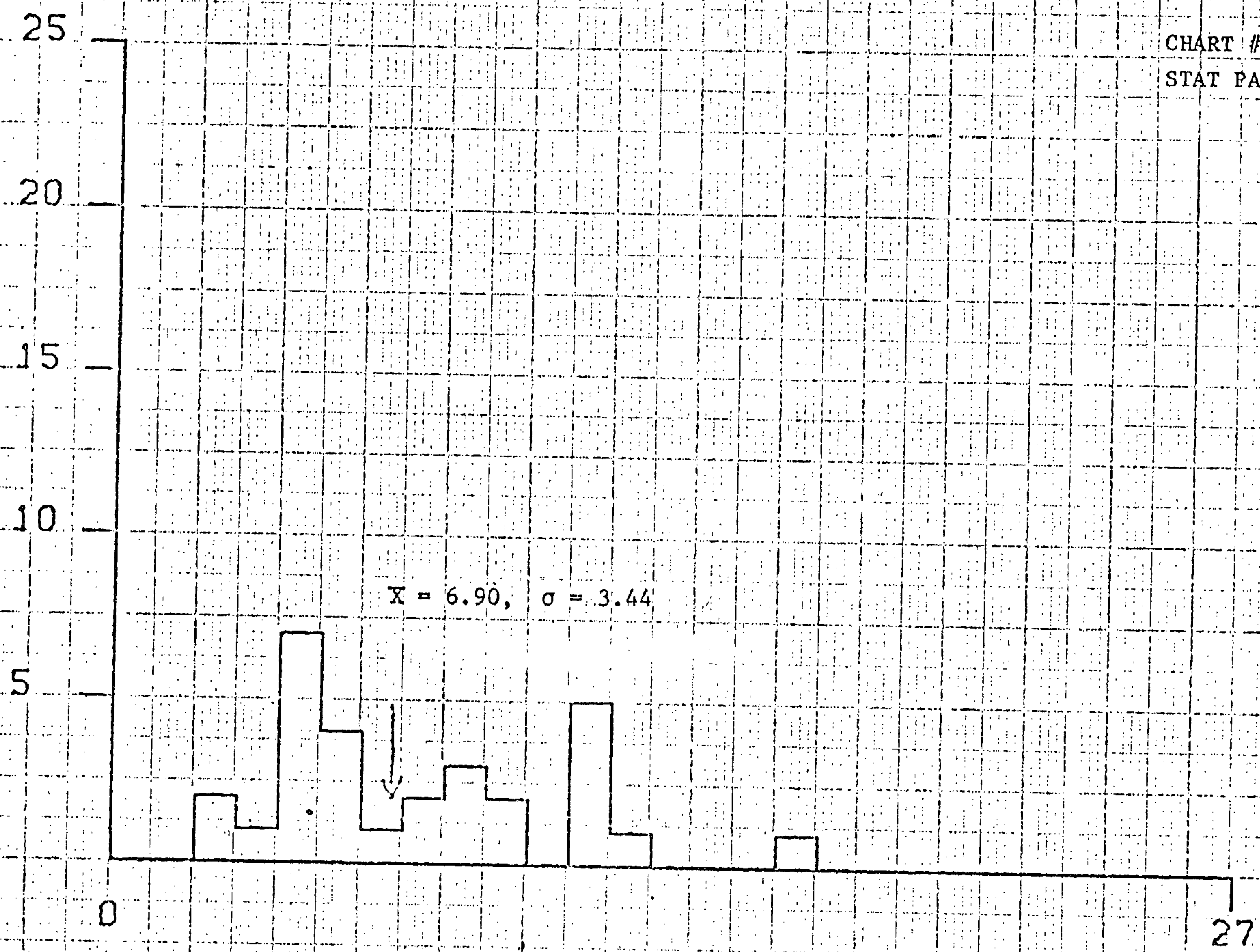
CHART # 82
STAT PAGE 31, ROW5



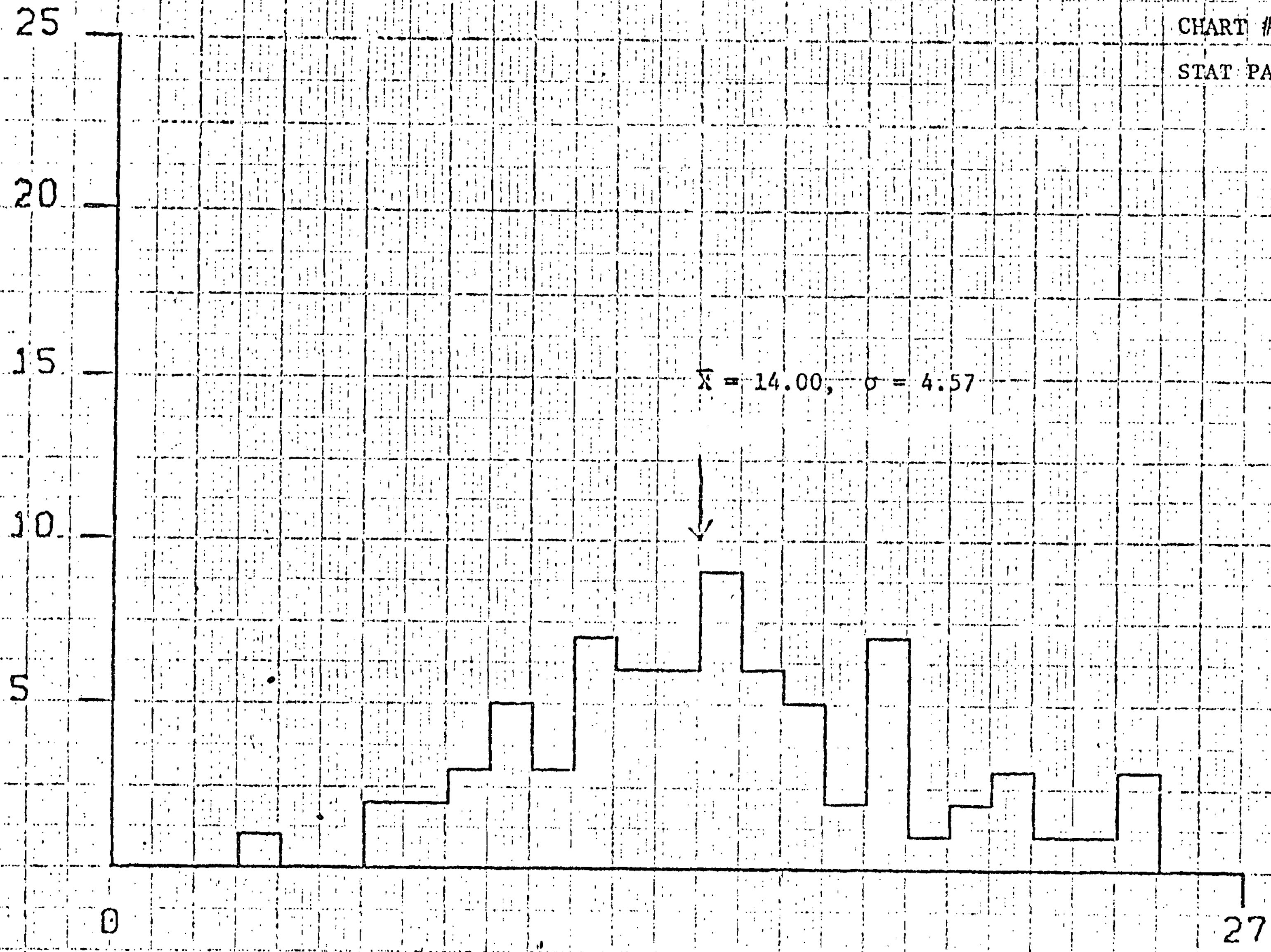
FEMALES RADIAL LOOPS DIGIT FOUR

N = 124

CHART # 83
STAT PAGE 31, ROW 6



FEMALES RADIAL LOOPS DIGIT FIVE N= 29



FEMALES RADIAL LOOPS DIGIT SIX N=75

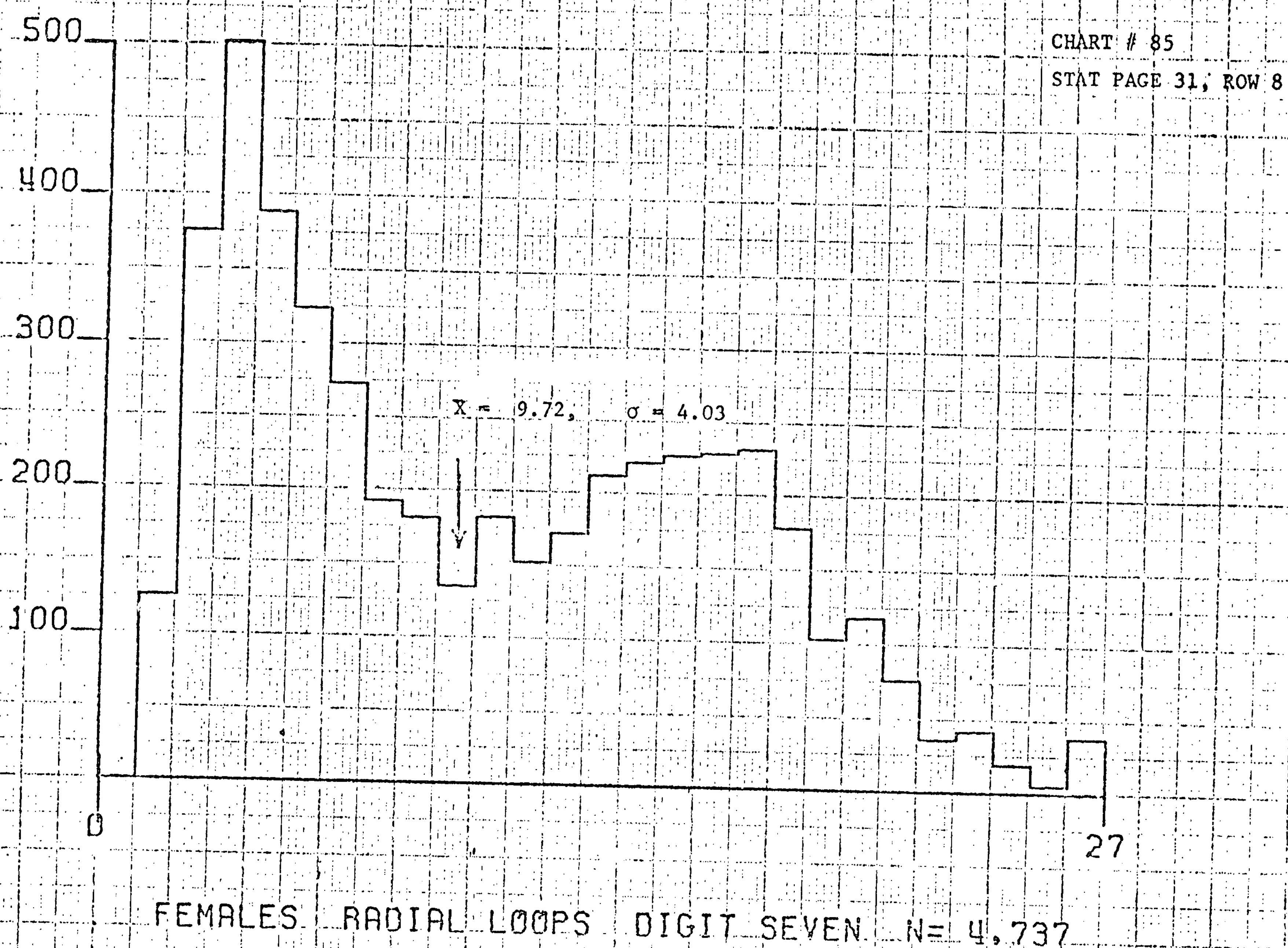
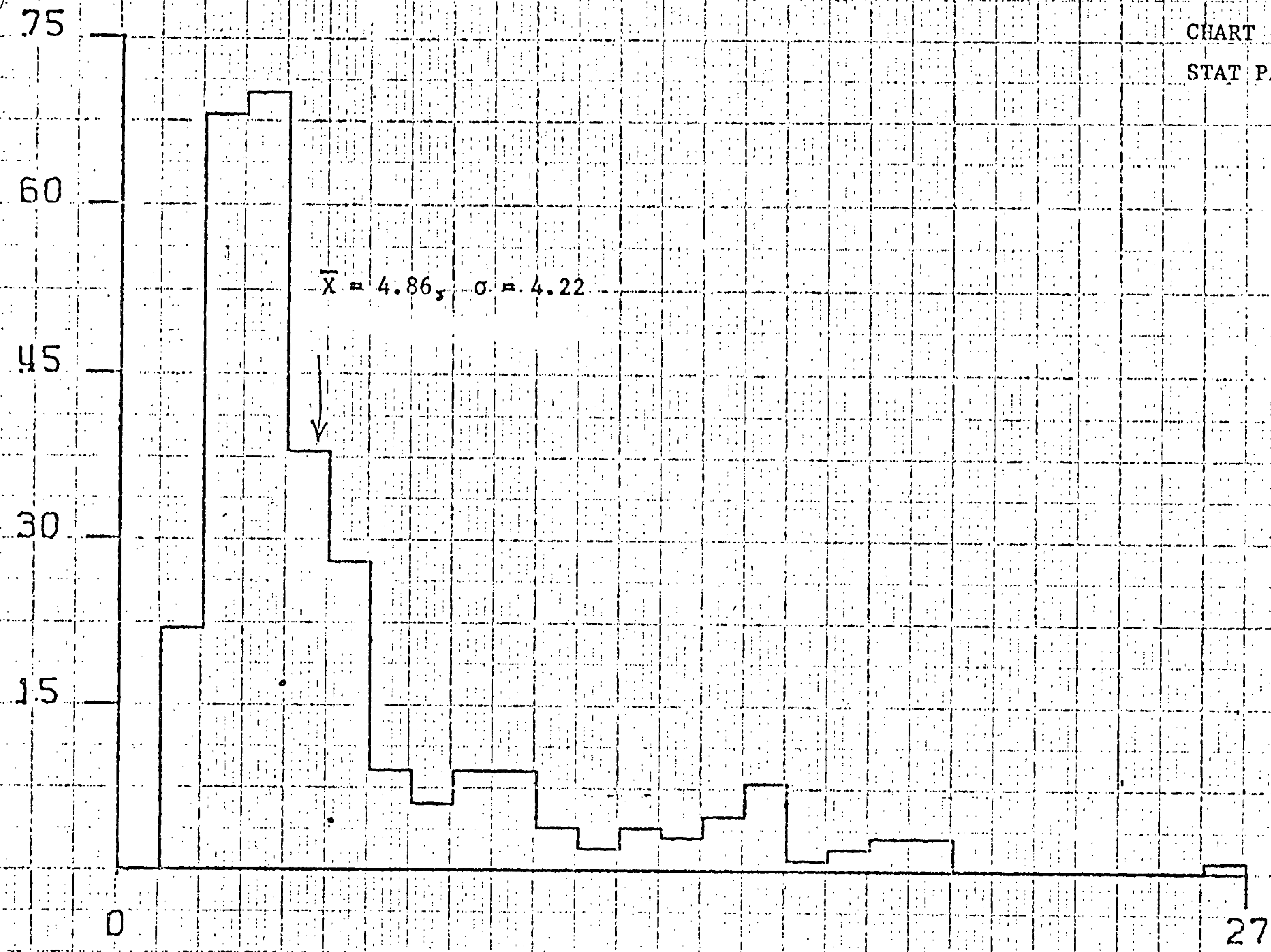


CHART # 85
STAT PAGE 31, ROW 8
500
400
300
200
100
0
27
X = 9.72, σ = 4.03
FEMALES RADIAL LOOPS DIGIT SEVEN N= 4,737

CHART # 86

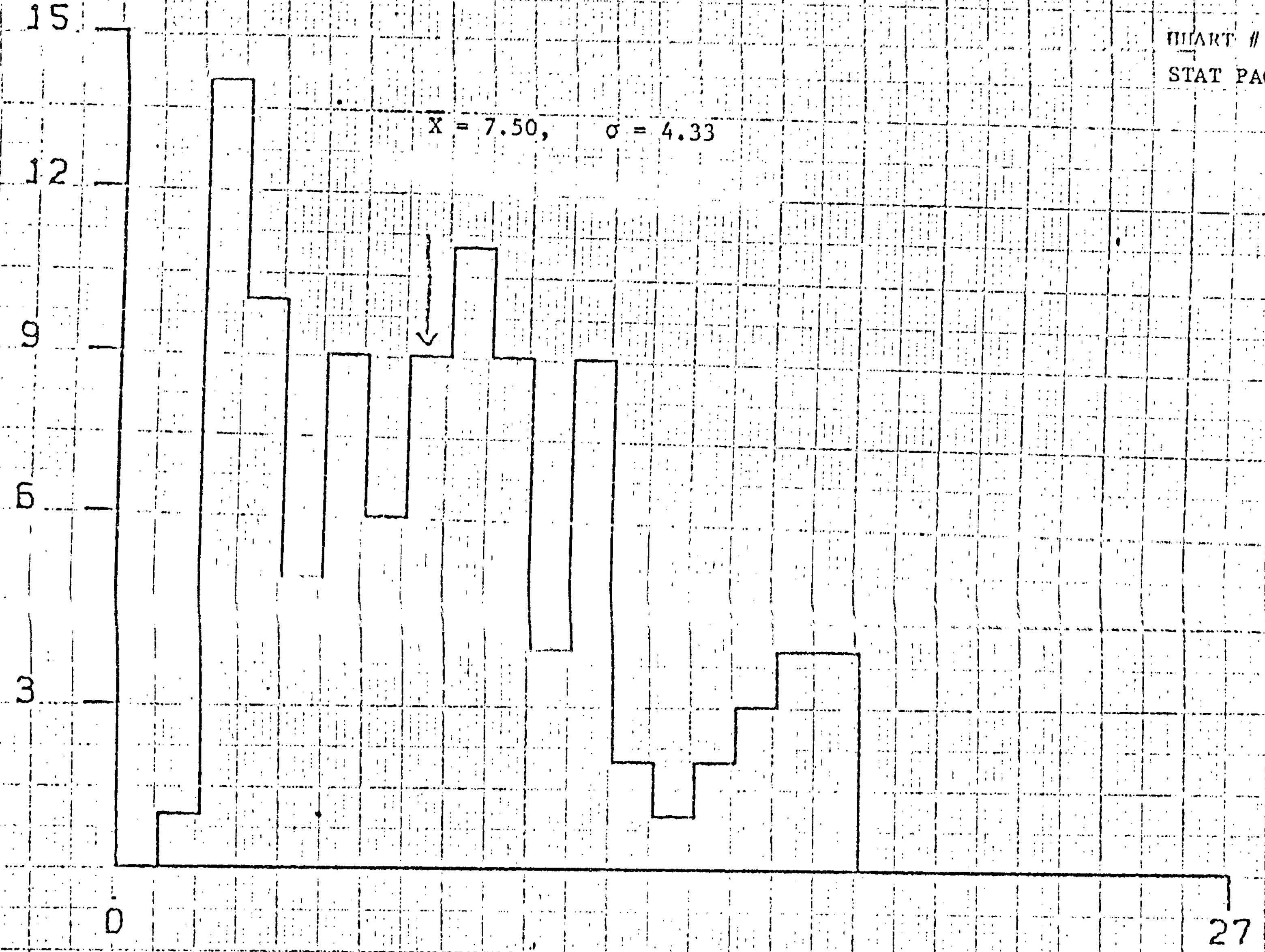
STAT PAGE 31, ROW 9



FEMALES RADIAL LOOPS DIGIT EIGHT N= 295

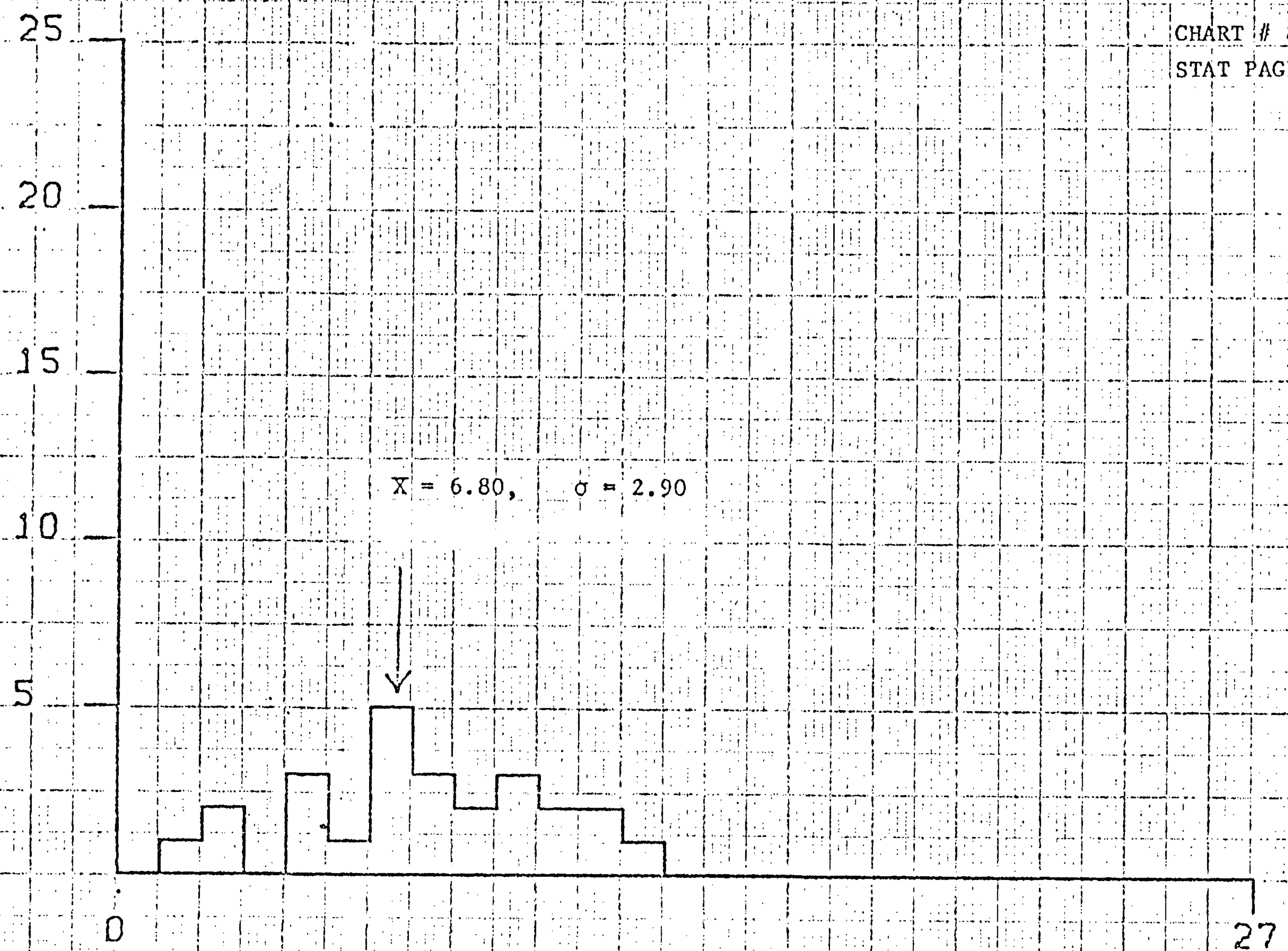
CHART # 87

STAT PAGE 31, ROW 10

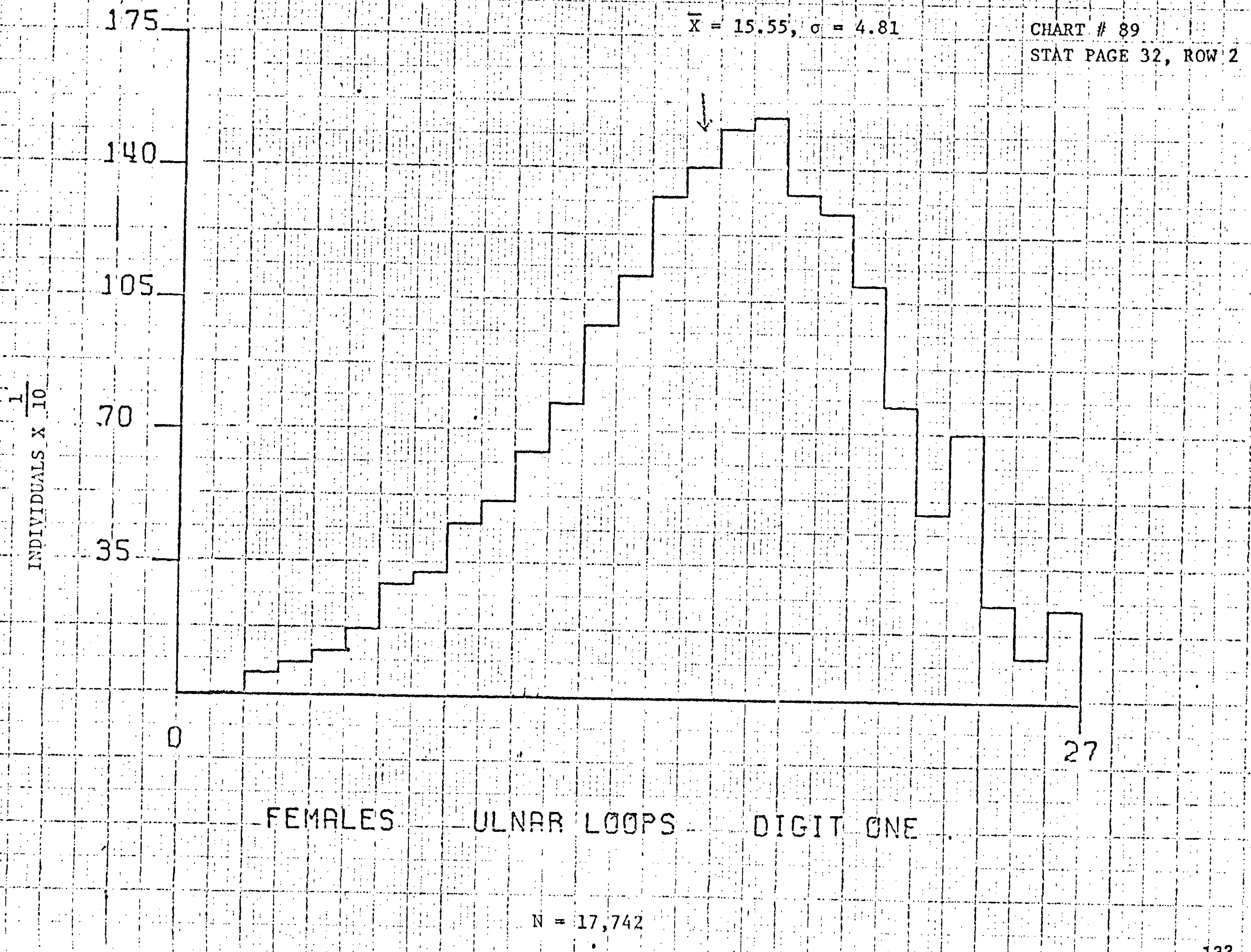


FEMALES RADIAL LOOPS DIGIT NINE N= 103

CHART # 88
STAT PAGE 31, ROW 11

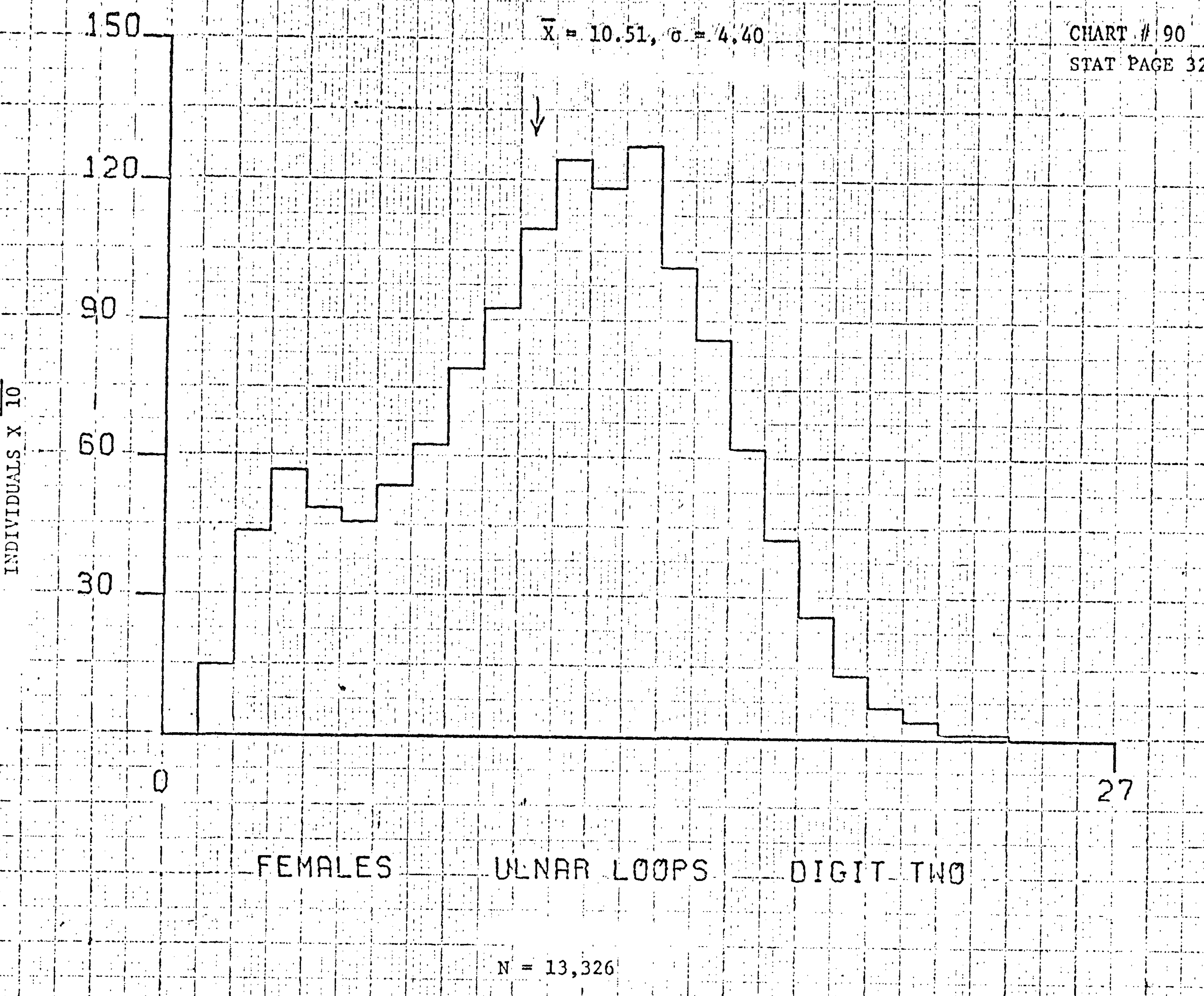


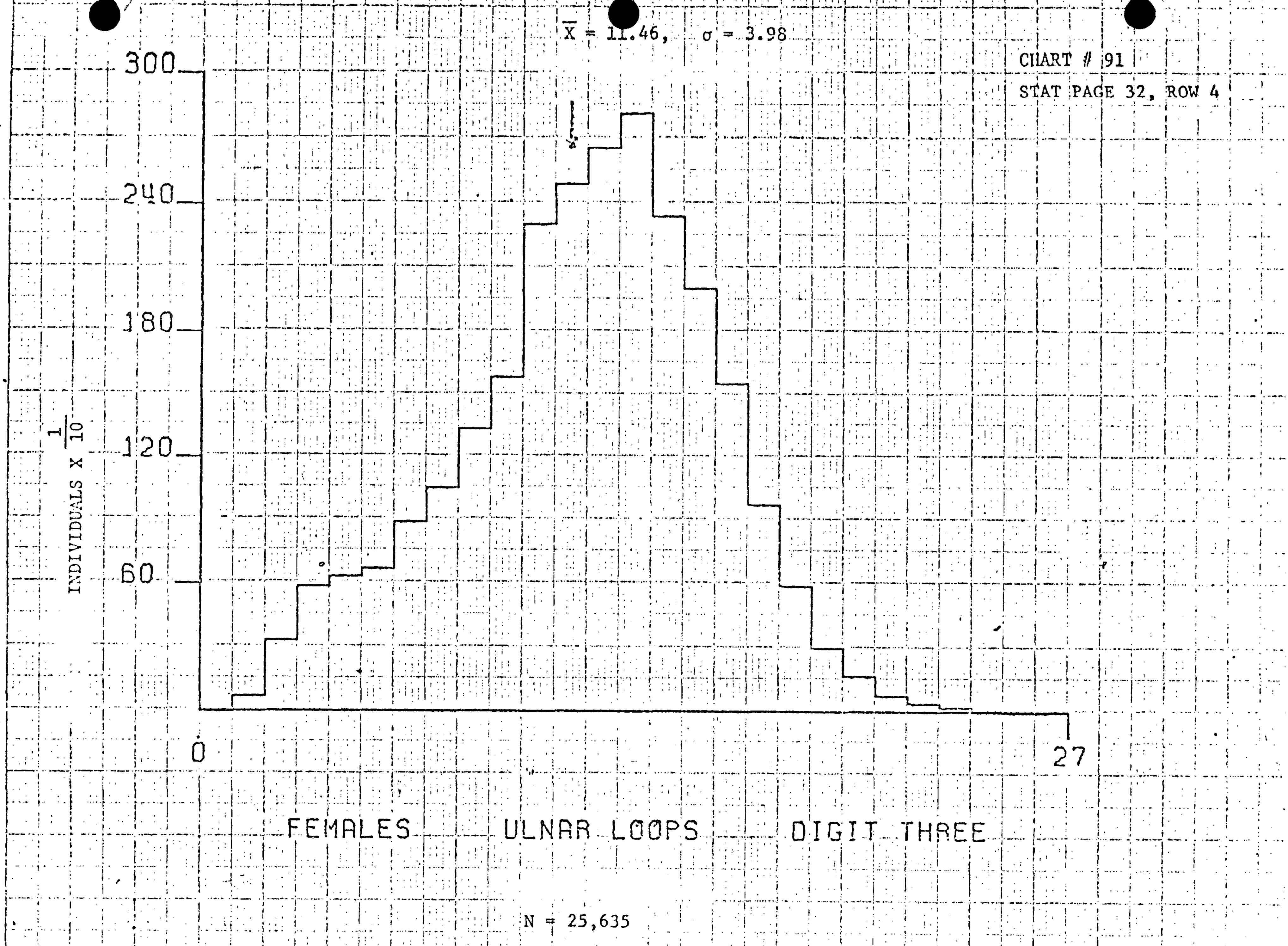
FEMALES RADIAL LOOPS DIGIT TEN N=25

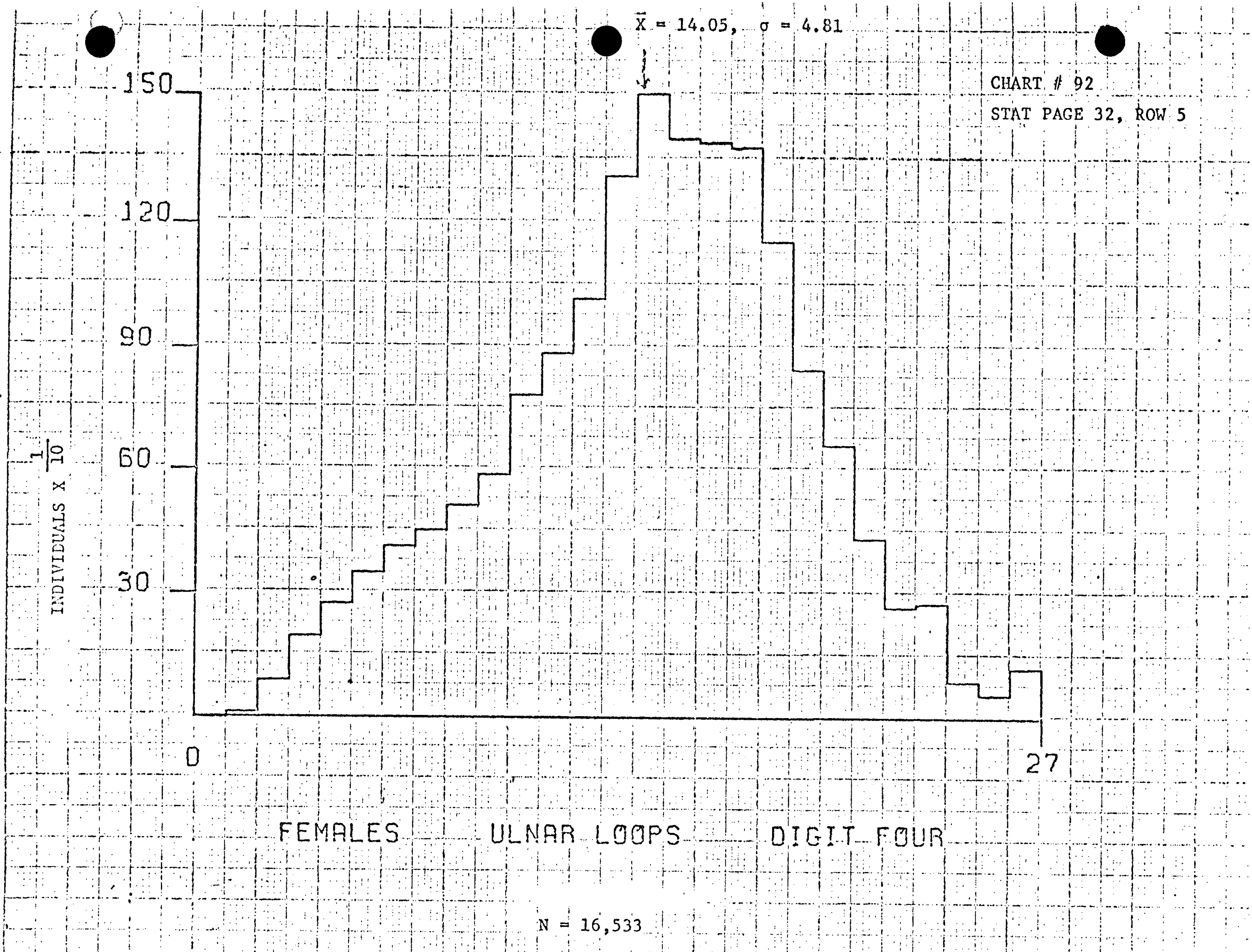


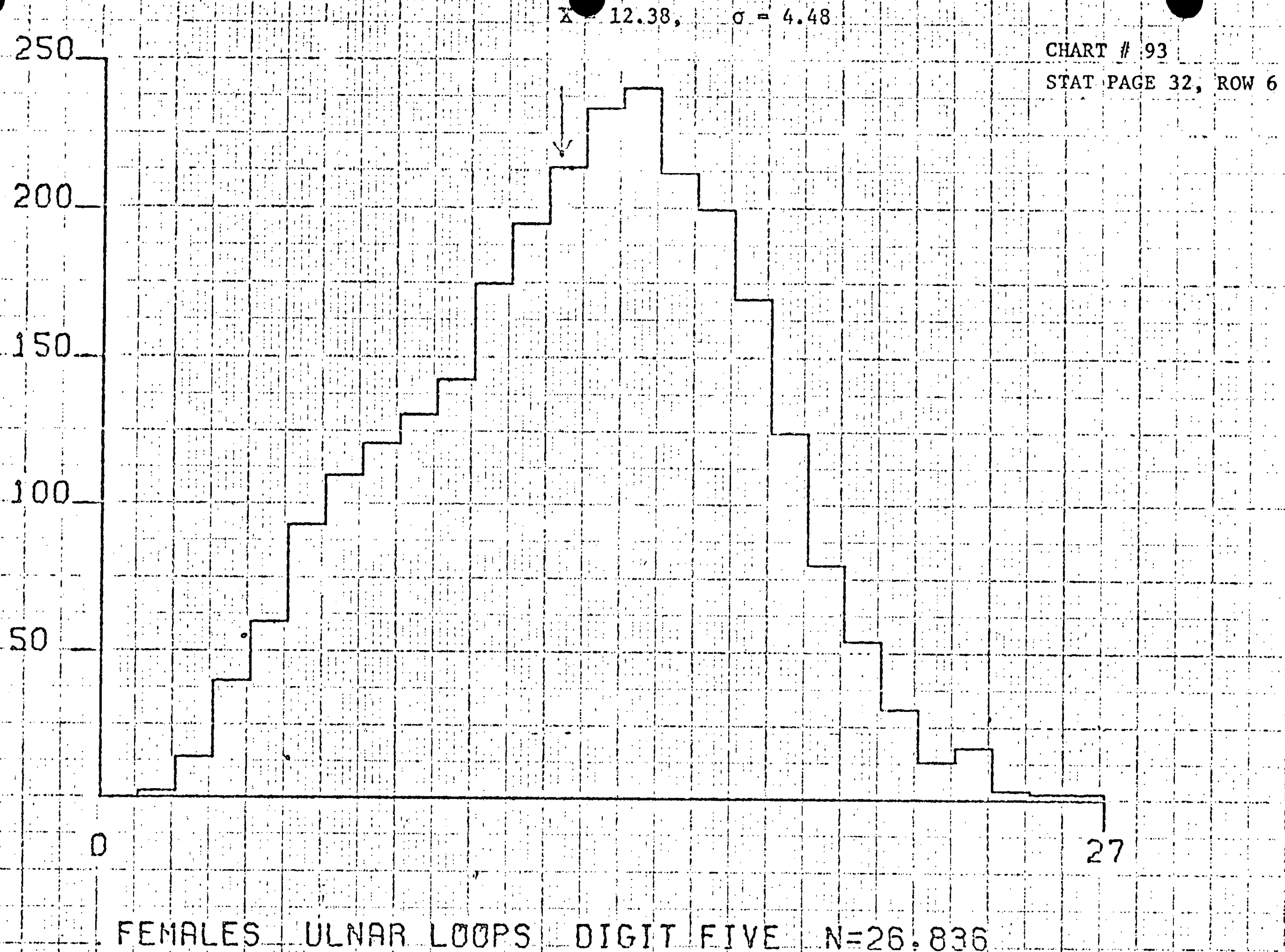
X̄ = 15.55, σ = 4.81
CHART # 89
STAT PAGE 32, ROW 2
175
140
105
70
35
INDIVIDUALS X 1/10
0
27
FEMALES ULNAR LOOPS DIGIT ONE
N = 17,742

CHART # 90
STAT PAGE 32. ROW 3




$\overline{X}$ = 11.46, σ = 3.98
CHART # 91
STAT PAGE 32, ROW 4
300
240
180
120
60
INDIVIDUALS x 1/10
0
27
FEMALES ULNAR LOOPS DIGIT THREE
N = 25,635


$\bar{X}$ = 14.05, σ = 4.81
CHART # 92
STAT PAGE 32, ROW 5
150
120
90
60
30
INDIVIDUALS X $\frac{1}{10}$
0
27
FEMALES ULNAR LOOPS DIGIT FOUR
N = 16,533



x̄ = 12.38, σ = 4.48
CHART # 93
STAT PAGE 32, ROW 6
250
200
150
100
50
0
27
FEMALES ULNAR LOOPS DIGIT FIVE N=26,836

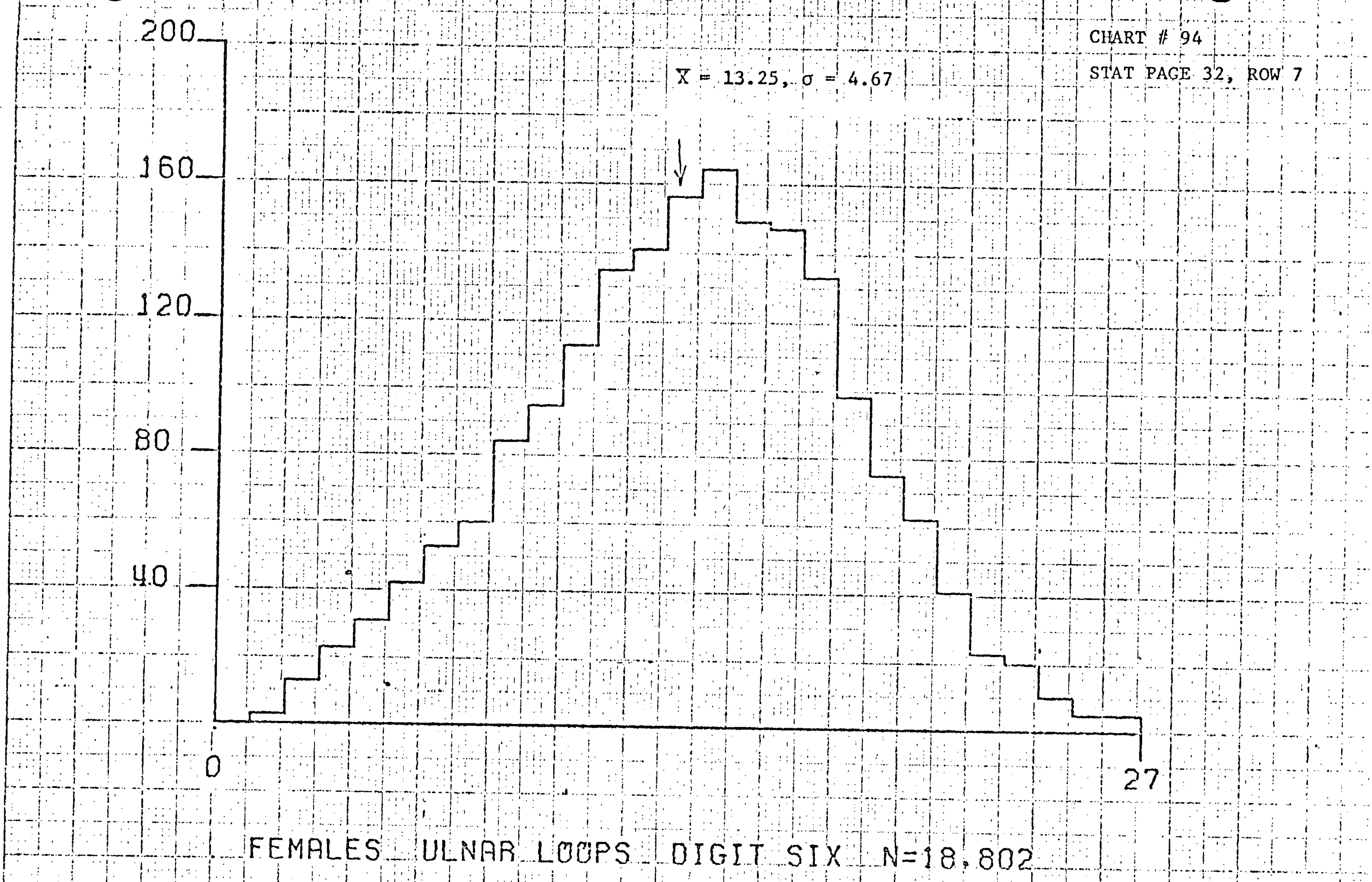
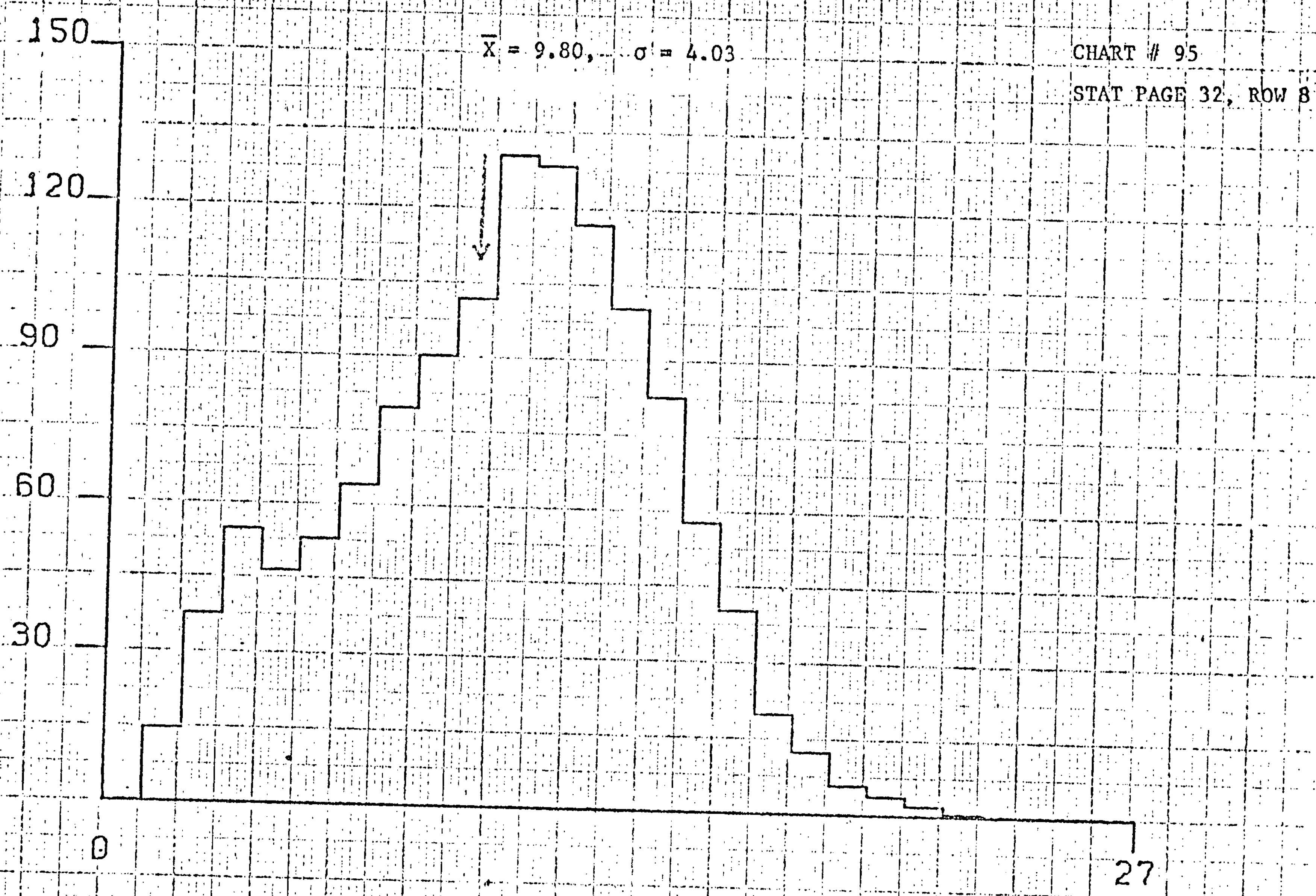


CHART # 94
STAT PAGE 32, ROW 7
$\overline{X}$ = 13.25, σ = 4.67
200
160
120
80
40
0
27
FEMALES ULNAR LOOPS DIGIT SIX N=18,802

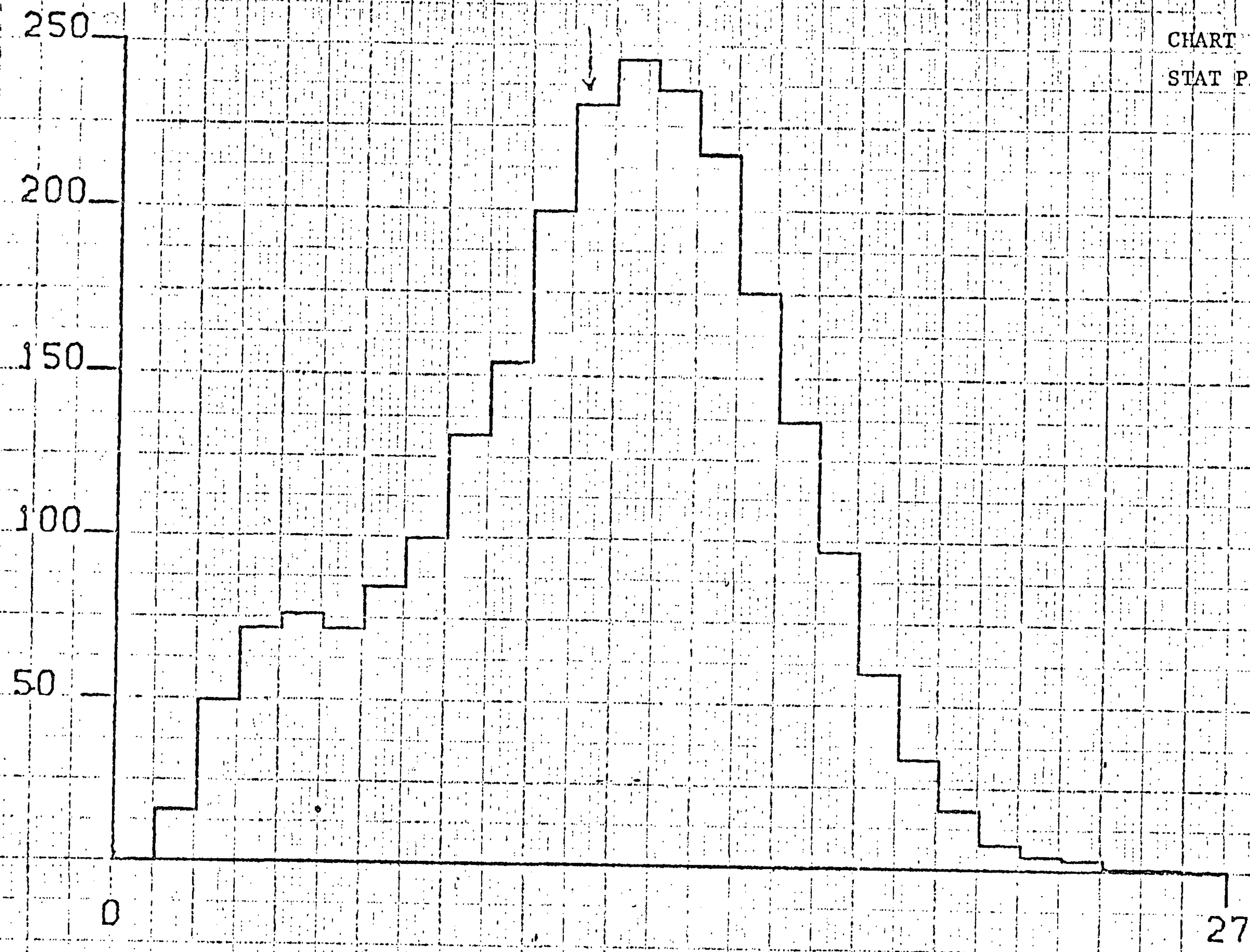


FEMALES ULNAR LOOPS DIGIT SEVEN N=12,430

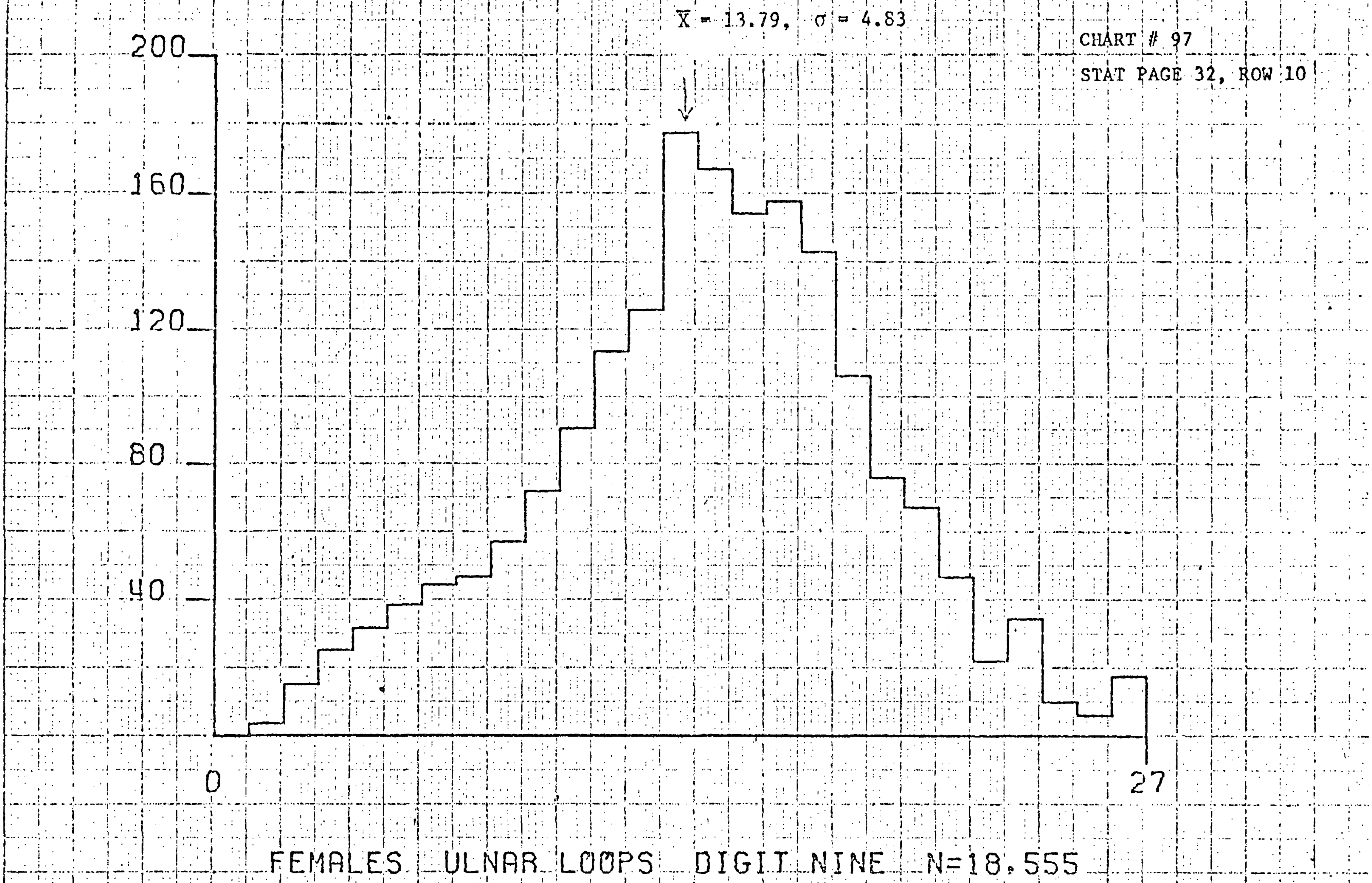
$\bar{X}$ = [illegible]20, σ = 4.25

CHART # 96

STAT PAGE 32, ROW 9



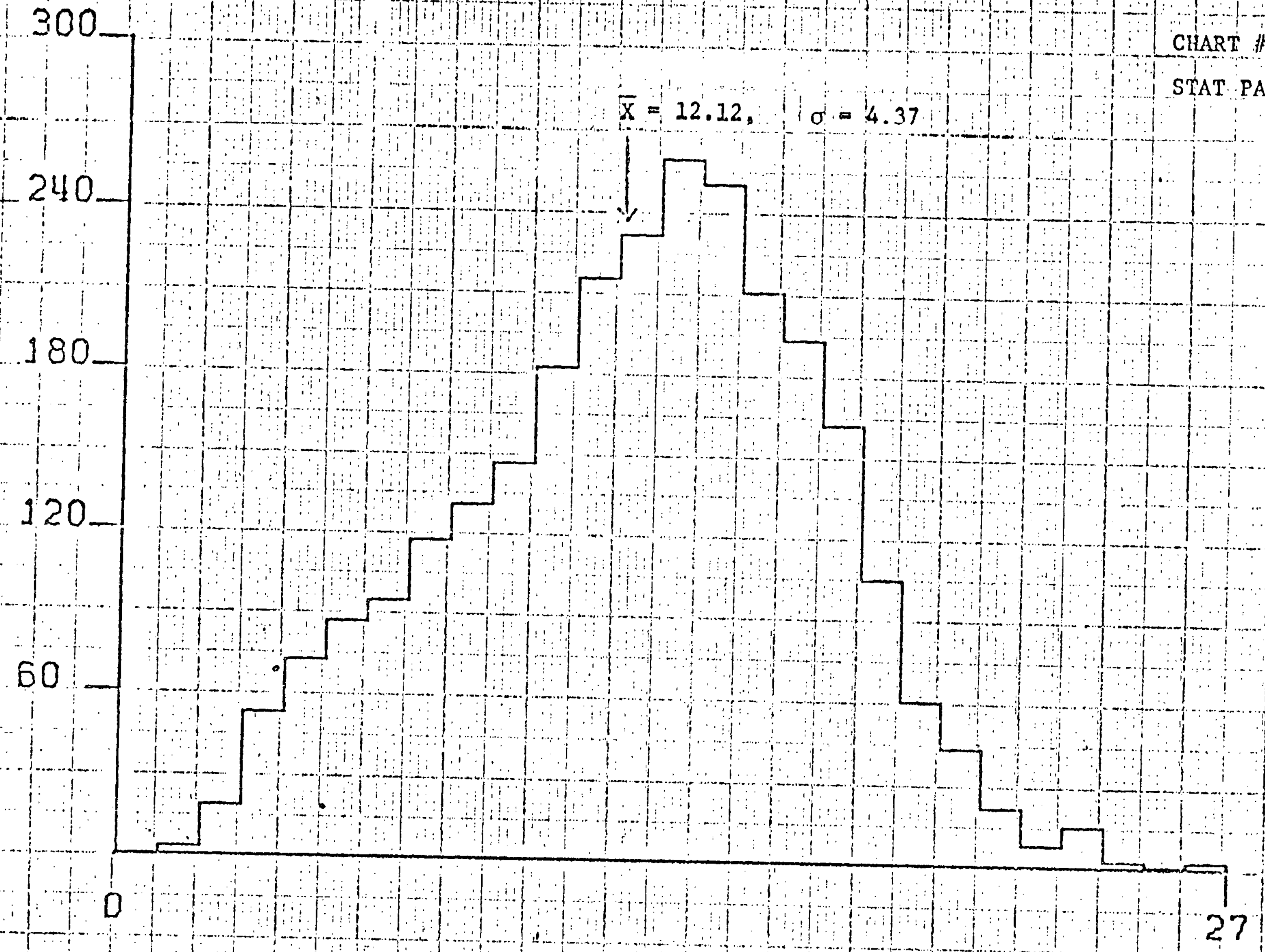
FEMALES ULNAR LOOPS DIGIT EIGHT N=24,191



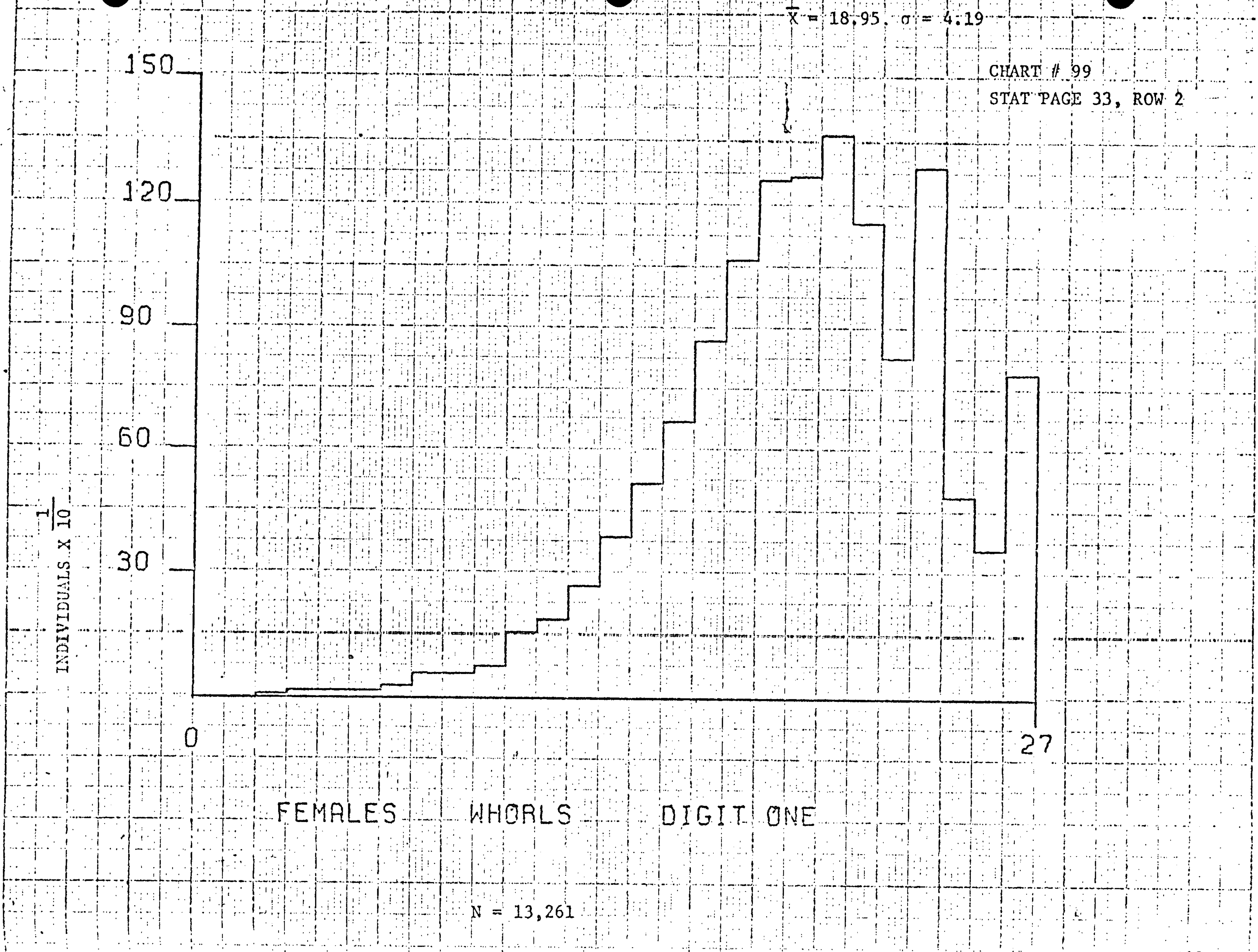
X̄ = 13.79, σ = 4.83
CHART # 97
STAT PAGE 32, ROW 10
200
160
120
80
40
0
27
FEMALES ULNAR LOOPS DIGIT NINE N=18,555

CHART # 98

STAT PAGE 32, ROW 11



FEMALE ULNAR LOOPS DIGIT TEN N=26.831

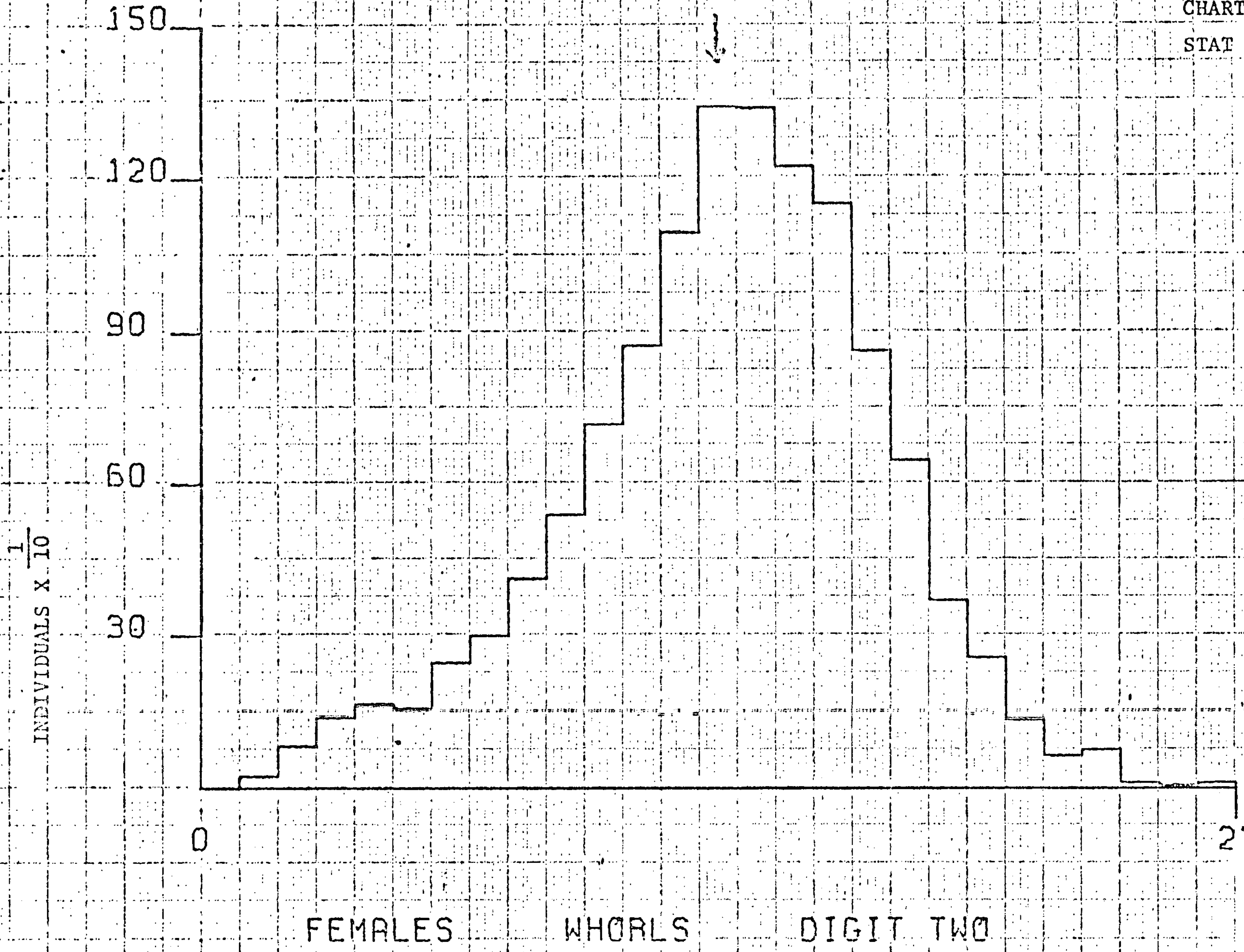


$\bar{X}$ = 18.95, σ = 4.19
CHART # 99
STAT PAGE 33, ROW 2
150
120
90
60
30
INDIVIDUALS X $\frac{1}{10}$
0
27
FEMALES WHORLS DIGIT ONE
N = 13,261

= 13.22, σ = 4.07

CHART # 100

STAT PAGE 33, ROW 3



N = 12,302

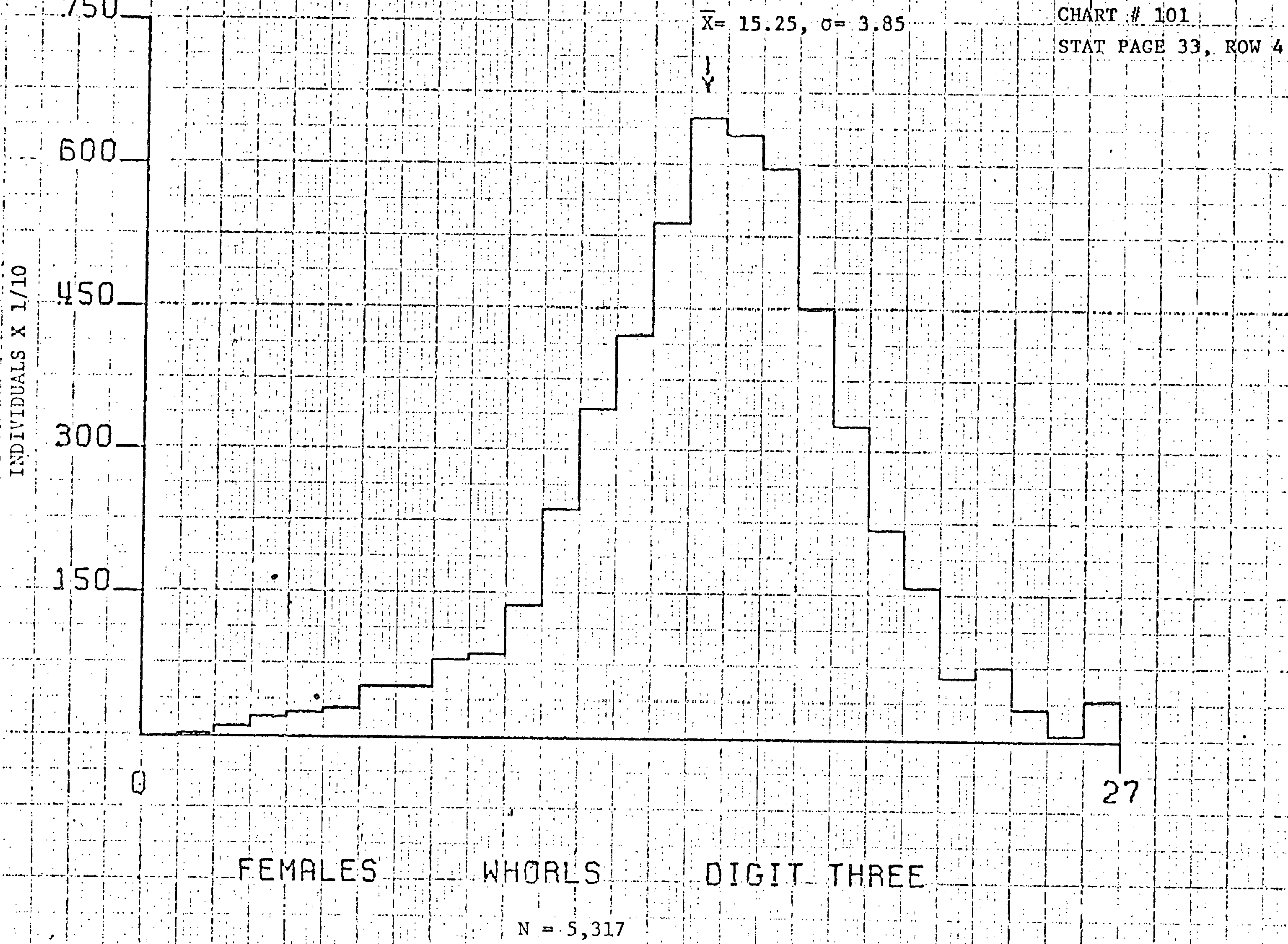
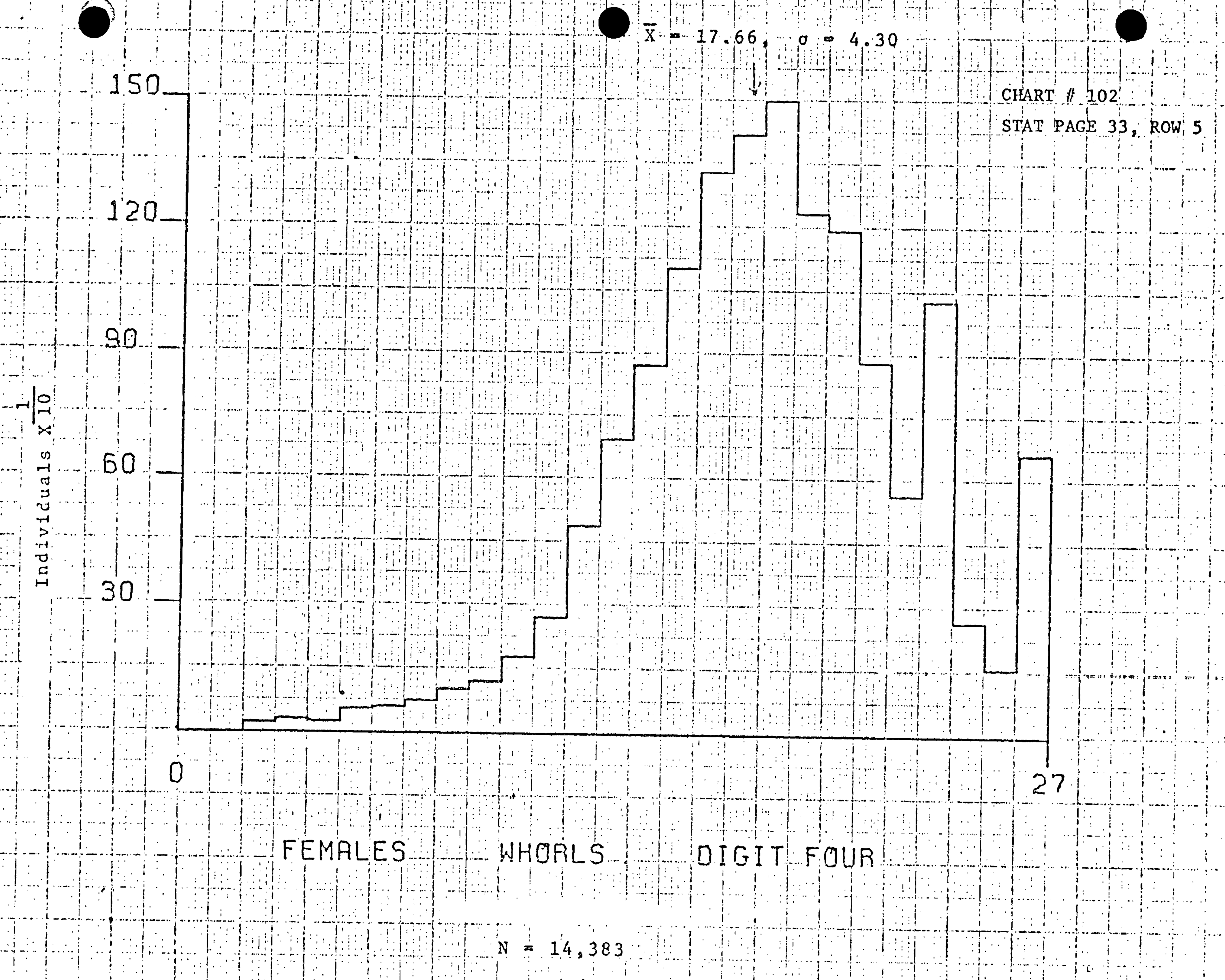


CHART # 101
STAT PAGE 33, ROW 4
$\bar{X}$= 15.25, σ= 3.85
INDIVIDUALS X 1/10
750
600
450
300
150
0
27
FEMALES WHORLS DIGIT THREE
N = 5,317



$\overline{X}$ = 17.66, σ = 4.30
CHART # 102
STAT PAGE 33, ROW 5
150
120
90
60
30
Individuals $\frac{1}{X\,10}$
0
27
FEMALES WHORLS DIGIT FOUR
N = 14,383

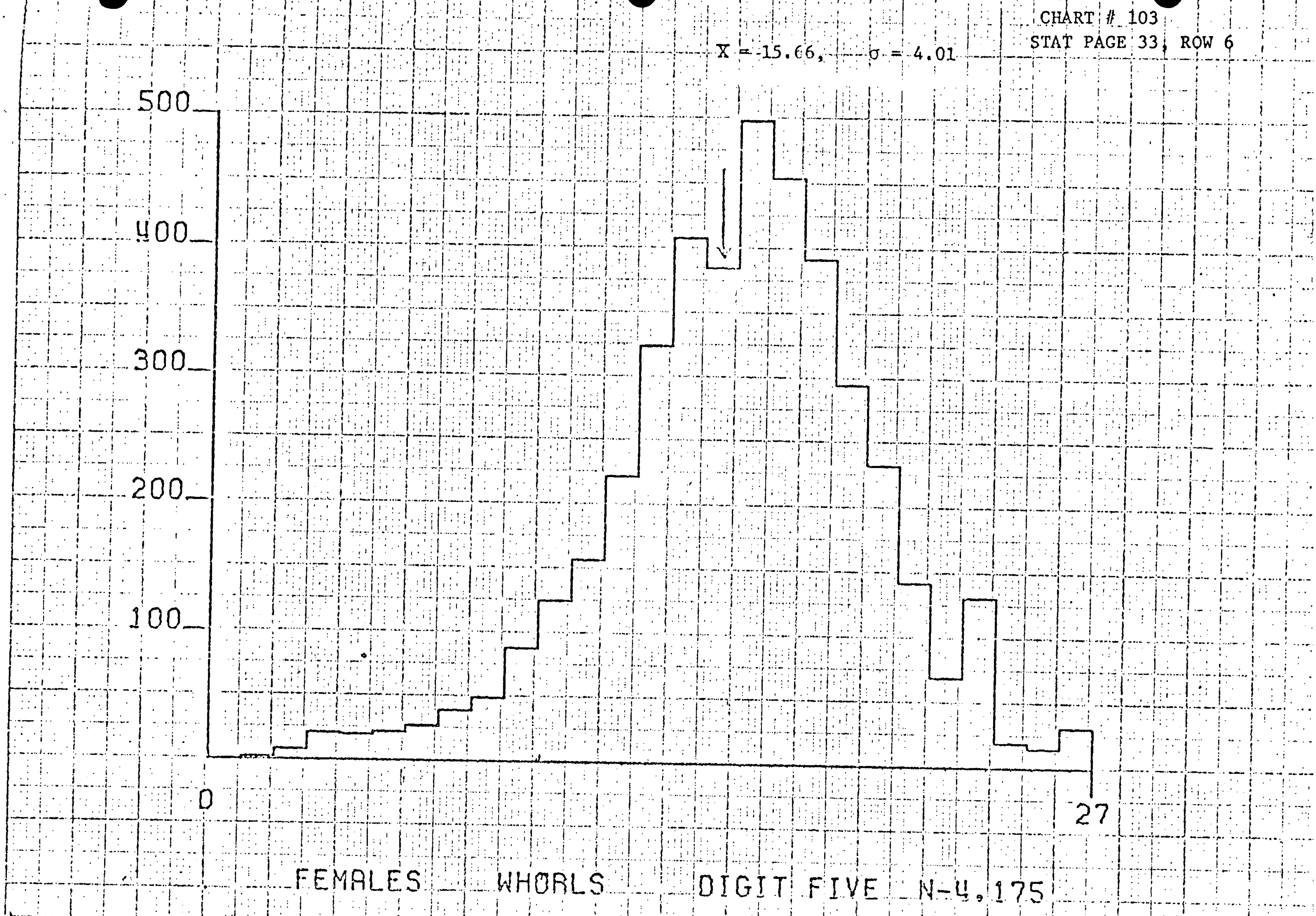


CHART # 103
STAT PAGE 33, ROW 6
X = 15.66, σ = 4.01
500
400
300
200
100
0
27
FEMALES WHORLS DIGIT FIVE N-4,175

CHART # 104

STAT PAGE 33, ROW 7

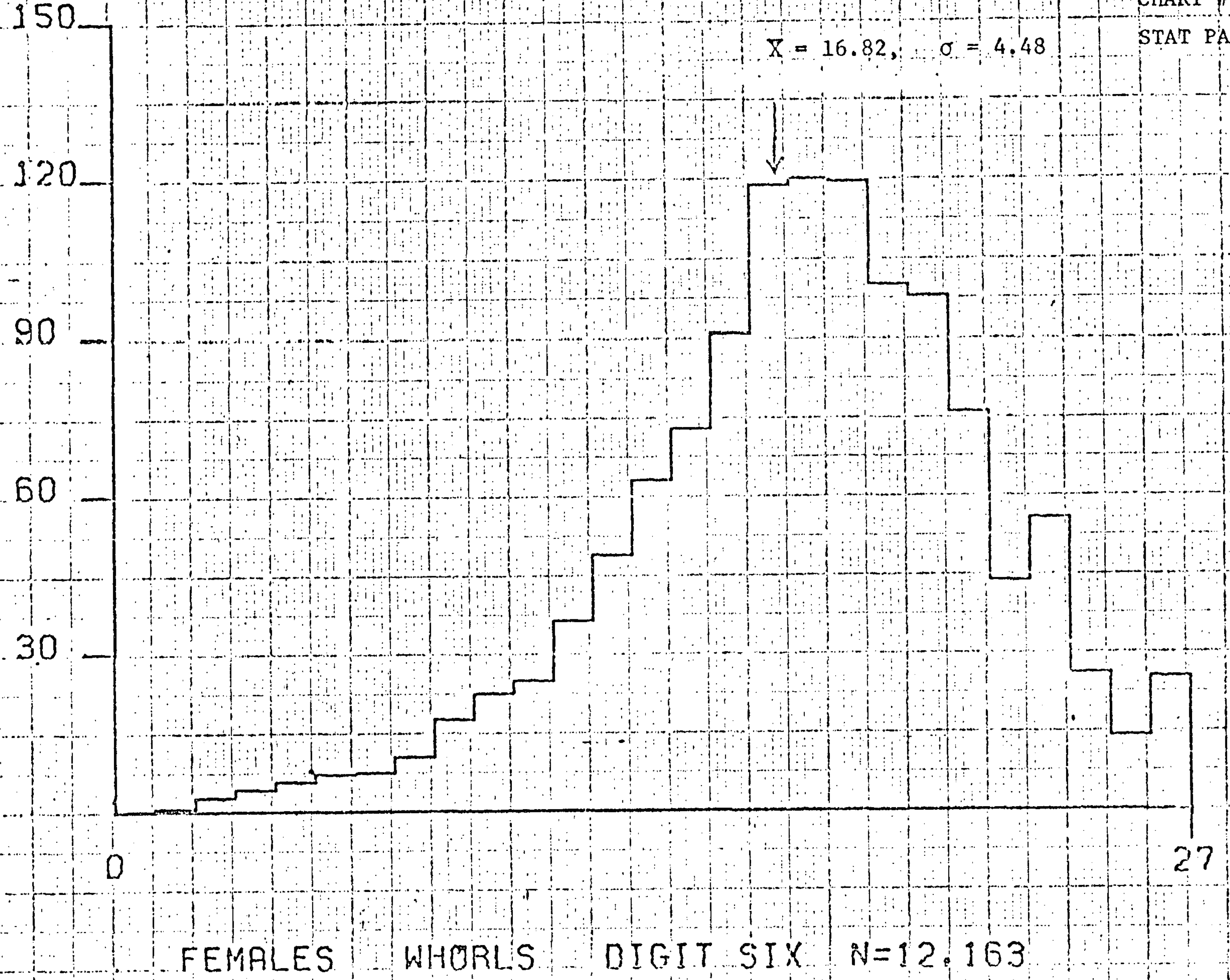
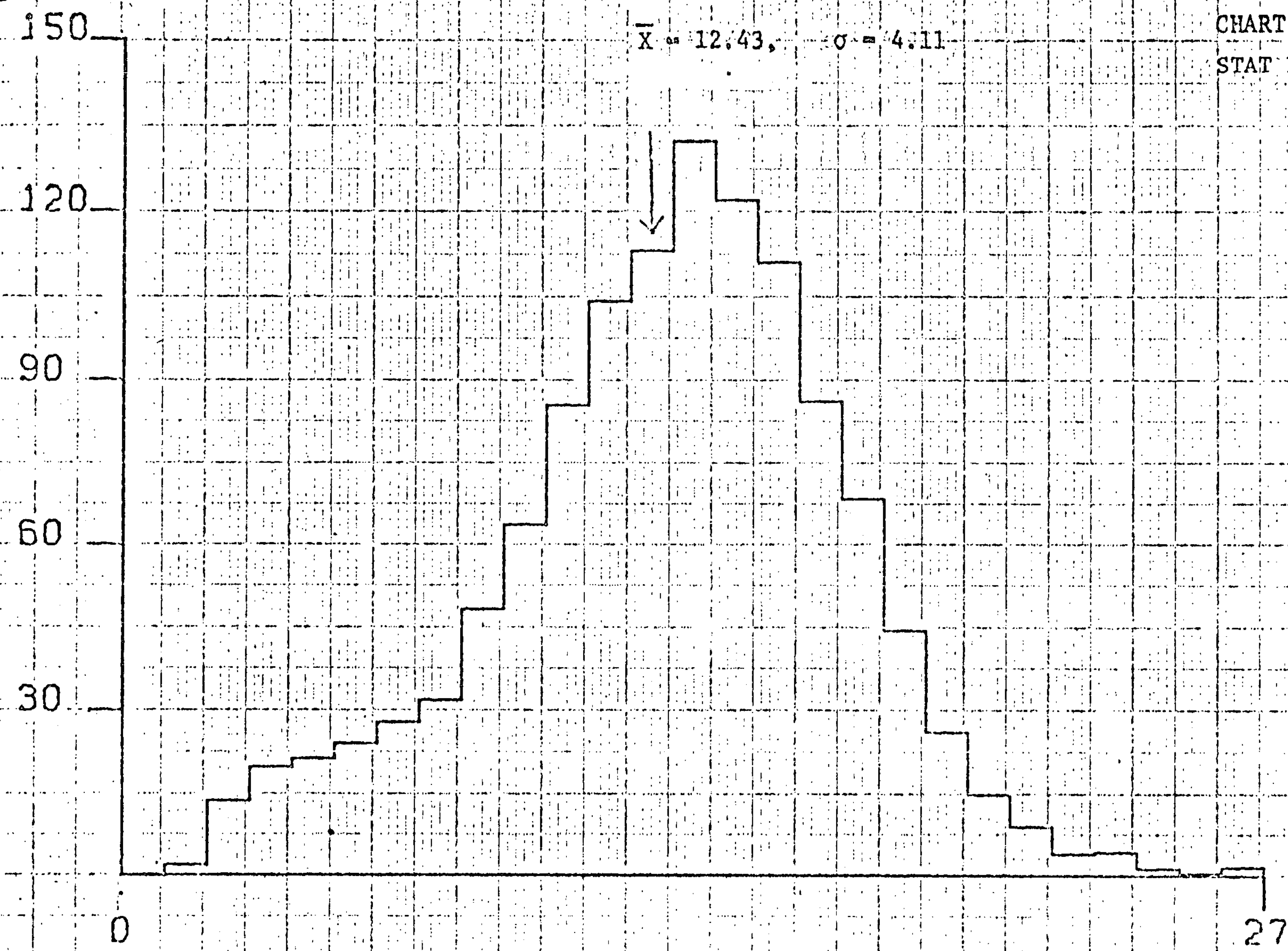


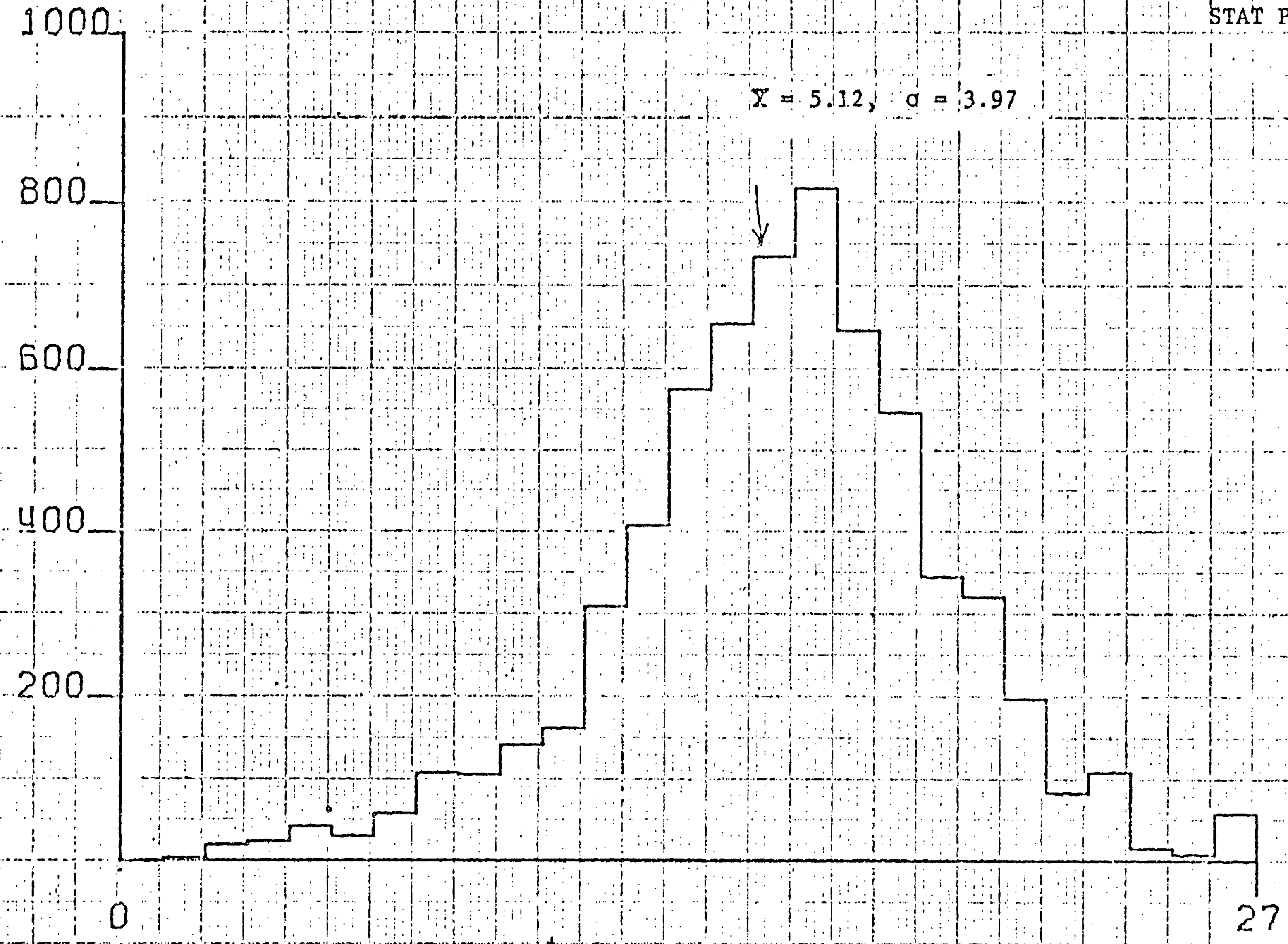
CHART # 105

STAT PAGE 33, ROW 8



FEMALES WHØRLS DIGIT SEVEN N=11,830

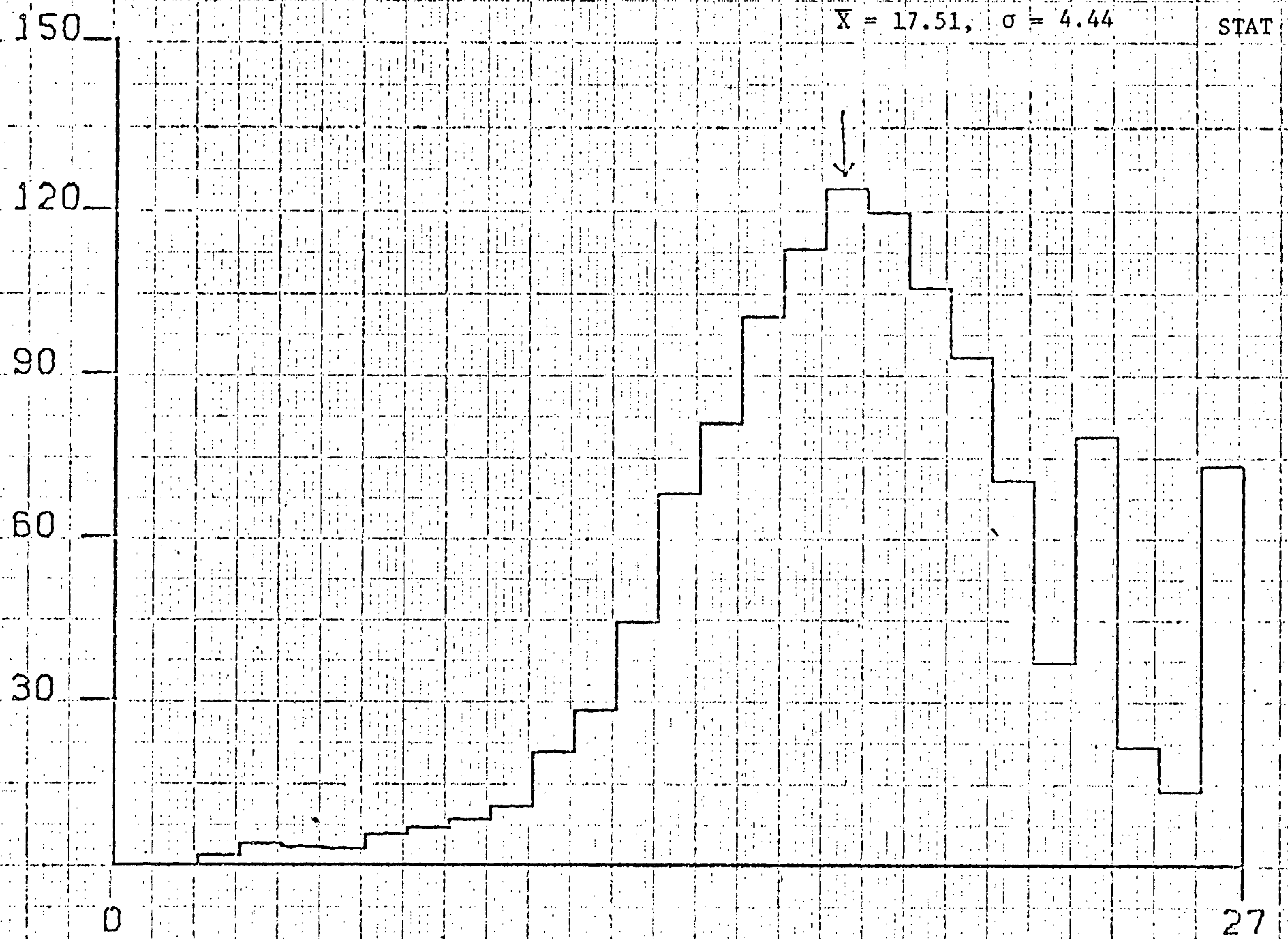
CHART # 106
STAT PAGE 33, ROW 9



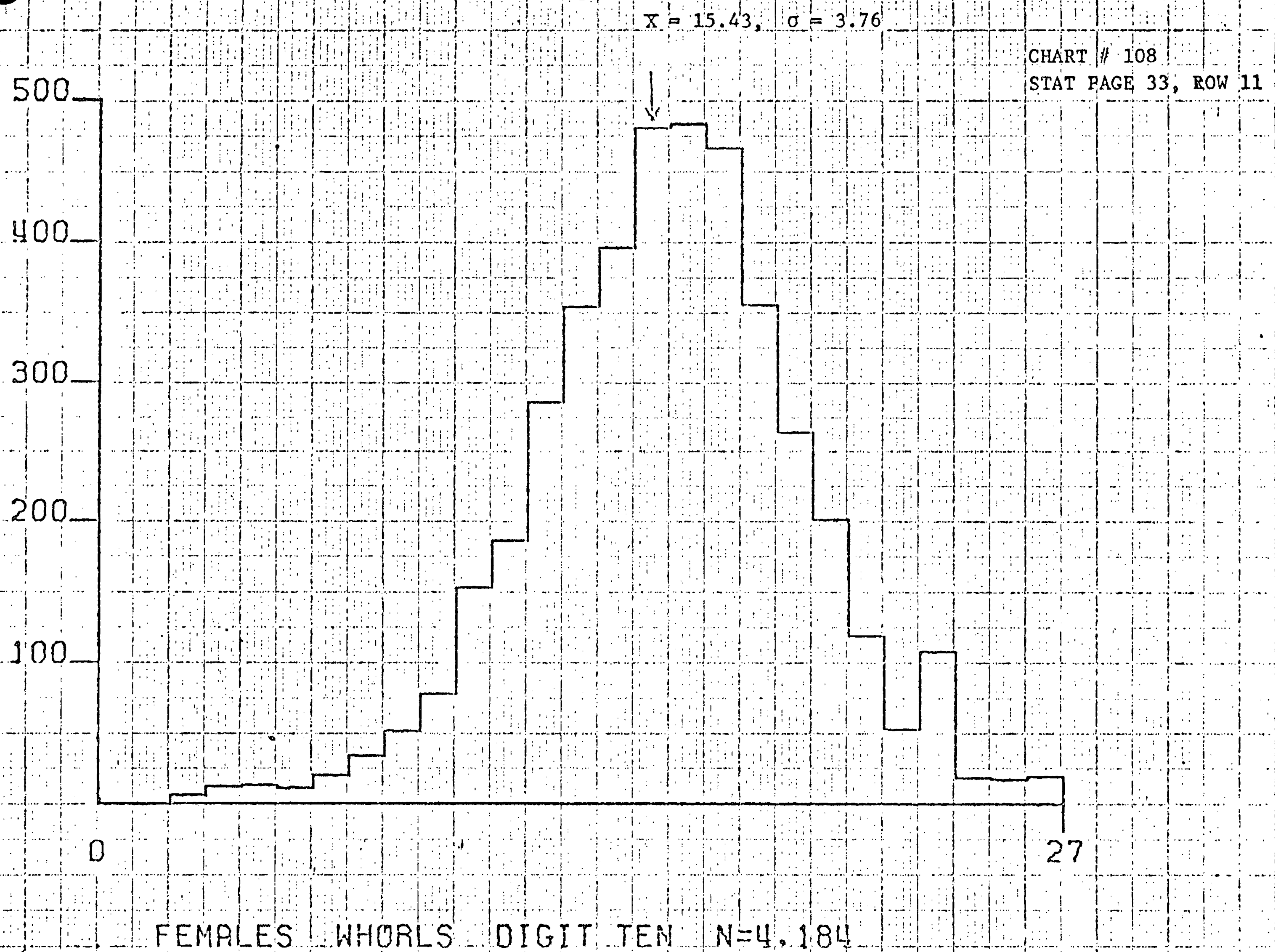
FEMALES WHORLS DIGIT EIGHT N=6,554

CHART # 1

STAT PAGE 33, ROW 10



FEMALES WHORLS DIGIT NINE N=12,382



X = 15.43, σ = 3.76
CHART # 108
STAT PAGE 33, ROW 11
500
400
300
200
100
0
27
FEMALES WHORLS DIGIT TEN N=4,184

APPENDIX B METHODOLOGY

B.1 FINGERPRINT CLASSIFICATION MANUAL

The classification of fingerprints set forth herein follows the standard procedures set down by Cummins and Midlo in 1943. The reason for writing the present manual is to clarify those situations which are left ambiguous by their method and, in some instances, to extend their system. In addition, it should be helpful to develop a working manual which is most relevant to the interests of the Behavioral Sciences Foundation.

There are two major tasks in classification: obtaining a ridge count and determining the pattern type. These two parts of classification are related. Before counting ridges, it is necessary first to have determined the pattern type, at least implicitly. Hence, the determination of pattern type will first be reviewed.

Three classes of finger ridge pattern types exist on human hands. They are arches, loops, and whorls. Each type has a very large number of variations, and the difficulty in trying to classify pattern types, such that epidemiological information is extracted, is in deciding on how many and which of these variations occur in significant numbers among the studied population. In our penitentiary studies, it was decided to distinguish two kinds of arches, three kinds of whorls, and three kinds of loops. An additional category, "accidental", is for those patterns which cannot, even with difficulty. be fit into one of the above categories.

Several factors support this set of pattern types. First, consistent with the widest consensus among dermatoglyphologists, certain pattern types seem to be indisputably natural and useful. Plain arches, radial and ulnar loops, and whorls are universally recognized in fingerprint classification. Tented arches, while not as universally used in classification, are nonetheless widely known and included in many classifications. Biologically, they seem to represent a transition between radial and ulnar loops, and this possibility is important to our interests. Tented arches were once classified as a variant of the plain arch since both have zero ridge counts; hence, the name is solely historic.

The division of whorls into concentric whorls, spiral whorls, double loops, as well as central pocket loops, is not as common in dermatoglyphic studies, although our use of these whorl sub-classes is based on studies in the literature of their digit-specific frequencies. The reason for the three categories in our investigations is exploratory. That is, it was decided to find out whether more refined correlations could be established between a particular kind of whorl, rather than whorls in general, and any epidemiological items. The power and utility of such a correlation is obvious.

However, there is a good deal of difficulty in reliably defining the three whorl patterns. If significant correlations emerge from the data, future studies, in order to attain more accuracy, may include an additional category for whorls which do not fit into one of the three possibilities provided here. Many patterns are necessarily arbitrarily designated, partly because of the poor quality of the fingerprints, but also because of the basic ambiguity of the patterns themselves.

Central pocket loops seem to represent a transition between loops and whorls. Hence, they are biologically interesting.

Definitions

A characteristic of plain arches is the absence of a triradius. Consequently, no ridge count is possible. The ridges run in slightly curved lines with very little, if any, looping. (See Figs. 1-a and 1-b)

Fig. 1-a

Fig. 1-b

A tented arch has one triradius whose distal arm, or spoke, is also either the core of the pattern or part of the core. If the distal arm forms a loop, the pattern is a loop. (Fig. 2-b)

Fig. 2-a
Core is part of triradius.

Fig. 2-b
Loop: R.C. = 0

Therefore, a tented arch has no ridge count; or, it has a ridge count of zero; because there are no ridges lying between the pattern core and the triradius.

Ulnar and radial loops are the most numerous patterns. A loop in which the distal arm may be traced to the radial side of the hand (thumb side) is a radial loop, and one which may be traced to the ulnar side (the side opposite the thumb) is an ulnar loop. There is little difficulty in determining a loop.

A concentric whorl, like all other whorls, has two triradii associated with it and is recognized by its concentric rings. Perfect concentric whorls, that is, whorls in which every ridge is an unbroken circle, are extremely rare. Indeed, even imperfect concentric whorls themselves are not abundant. When a pattern has more ridges forming complete rings than ridges spiraling outward from the core, it is called concentric. In practice, accurately and carefully proceeding in this manner is too laborious and inefficient. Therefore, a subjective judgment is made about whether a whorl is concentric or spiral on the basis of a careful but brief tracing of three ridges.

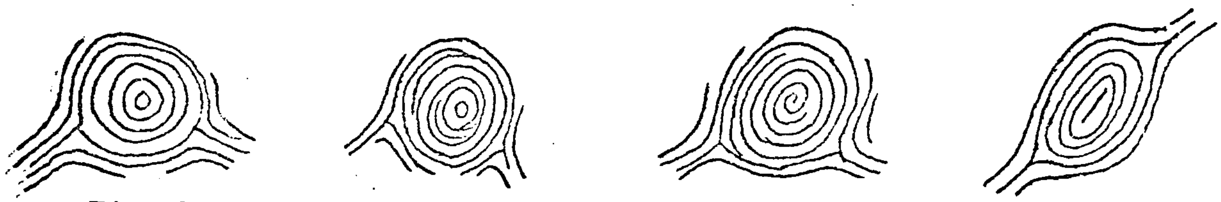


Fig. 3a
A perfect concentric whorl

Fig. 3b and 3c
Frequently occuring concentric whorls

Fig. 3d
Rod as core

Spiral whorls are a relatively common sub-class of whorls. In perfect form, a spiral whorl has a single ridge which spirals outward from the core all the way to one of the two triradii. Most frequently, though, numerous breaks and divisions are observed along the basic, spiraling ridge so that it is impossible to follow one ridge all the way from the core to a triradius. Either a single core or a single, basic, spiraling ridge, or both, is the defining quality of a spiral whorl. Often, a single ridge will be seen to spiral outward from the core by a distance of only one ridge per revolution. This idiosyncrasy is an aid in quickly identifying spiral whorls.

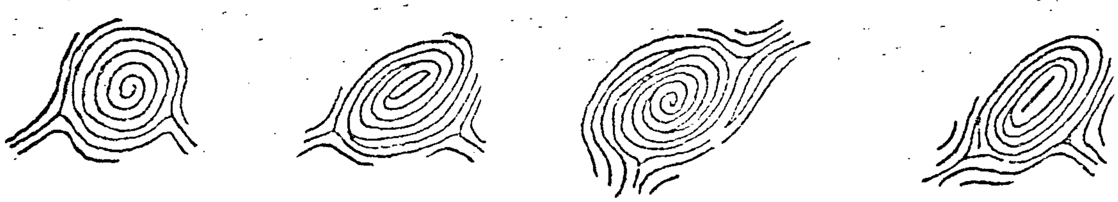


Fig. 4a
A perfect spiral whorl

Figs. 4b and 4c
Common spiral whorls

Fig. 4d
Spiral whorl with a rod as the core

Double loops, the most frequently occurring whorl patterns, typically have two triradii and two cores. Following a single ridge as it winds outward from the center shows that the ridge progresses outward by more than one ridge per revolution. This is always true of double loops. A number of combinations of designs are seen among double loops. What appear to be two distinct loops sometimes intertwine to form a double loops (Fig. 5a). In other cases (Fig. 5b), a single loop has seemingly doubled back on itself to form a double loop. A third arrangement is two single ridges wrapping around each other (Fig. 5c); and a fourth, a "hybrid", is a single ridge and a loop wrapping around each other (Fig. 5d).

Fig. 5a
Two interweav-ing loops

Fig. 5b
A single doubled-back loop

Fig. 5c
Two single inter-looping ridges

Fig. 5d
A single ridge interlooping with a doubled-back loop

<u>Central pocket loops</u> are relatively infrequent. They can be thought of as unilaterally-developed or one-sided double loops. The typical central pocket loop is a normal loop containing a second loop opening in the opposite direction from the larger loop, and it is usually found with two triradii, one of which is oddly shaped or "small" due to its peculiar association with the small, inner loop. Both radial and ulnar counts are not possible in some kinds of central pocket loops, because there are no ridges lying between one of the triradii and the pattern core. Hence, ridge counts may resemble those of radial and ulnar loops. However, there is usually a double ridge count, although the ridge count is lopsided, e.g., 1/20 or 15/2. Both radial and ulnar counts are made whenever possible.

Fig. 6-a

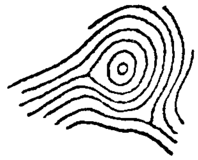


Fig. 6-b
A c.p,l. with both radial and ulnar counts

Fig. 6-c

Fig. 6-d

Central pocket loops, like other loops and whorls, can be designated as either radial or ulnar, depending on the direction toward which the larger loop opens.

The *accidental* category is for patterns which do not fit the criteria of any other pattern types. Included among accidentals are usually patterns which have been grossly deformed, apparently resulting from healing and new growing epidermis following some trauma to the finger tip (such as a severe laceration). Occasionally double patterns, for instance, two loops side by side with a single triradius, occur; and these are included among accidentals as well.

No information or amputated is the category used for missing terminal phalanges and for fingerprints which indicate dysplasia of the ridges. In the latter case, there are no ridges or very few, preventing any pattern determination or ridge count. Instead of ridges, numerous dots or specks, representing many islands on the finger tip, are most often seen on the print. This is different from those accidental patterns which are abnormally formed ridges.

Ridge counts are made along a line running between the triradius and the core of a pattern. All ridges crossing the line, except ridges which form the core and the triradius, are counted. When a loop is the pattern core, it is counted as one in the ridge count. Very short ridges which contain no sweat gland orifices are not counted. (Fig. 7-a)

Fig. 7-a
"Islands" are not counted. R.C. = 4

Fig. 7-b
Vestigial ridges are not counted. R.C. = 4

Also, very faint ridges, in contrast to the normal, bold ridges, on a print are not counted. These impressions are called "vestigial" ridges. Distinguishing them is not always easy, and lightly printed ridges are sometimes included in the ridge count for that reason.

A ridge which divides into two or more ridges at the point where the line of count crosses it, is given a value equal to the number of ridges into which it divides. For example, a ridge which splits into two ridges, is counted as two ridges. (Fig. 7-c)

R.C. = 4

Fig. 7-c.

There is a good deal of trouble in consistently locating the core and triradius of a pattern, and the subjective choice of the classifier is occasionally necessary. The triradius is that point or that junction of ridges associated with the pattern being classified which (1) represents three different "families" of ridges, i.e., ridges which flow in three distinct directions relative to each other; and (2) approximates a trisected circle; that is, the ridges are nearly 120 degrees apart around a circle which has its center at the center of the triradius. When more than one point meets both of these conditions, the one closer to the core of the pattern is chosen. (Fig. 8-c) Examples are given below with the triradius circled.

In some cases (Fig. 8-b), ridges flowing from three directions do not actually join. The triradius then is an imaginary point located at


Fig. 8-a

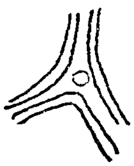


Fig. 8-b

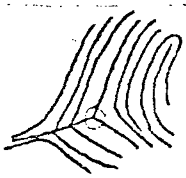


Fig. 8-c


Fig. 8-d

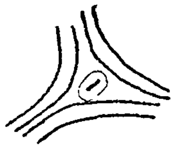


Fig. 8-e

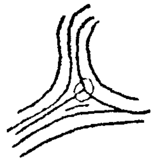


Fig. 8-f

the center of a circle which is approximately trisected by the nearest ridges flowing from three different directions relative to each other. Often, the end of a single ridge (Fig. 8-d) or an "island" (Fig. 8-e) is found in that area and is conveniently used as the triradius.

The core is more troublesome to locate than the triradius. In a loop, the core is the end of the single ridge or loop which is situated at the center of the pattern. Where two rods (Fig. 9-c) or two loops (Fig. 9-e) are at the center, the one farther from the triradius is the core. Where three occur, the middle one is chosen (Figs. 9-d and 9-f).

Fig. 9-a

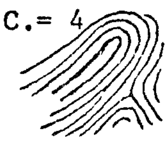


Fig. 9-b

Fig. 9-c

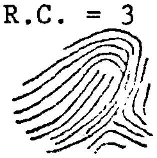


Fig. 9-d

Fig. 9-e

If the central rod or loop terminates some distance short of the end of the pattern (Figs. 9-g, 9-h, 9-i), the core is located on the end of the

Fig. 9-f

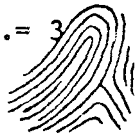


Fig. 9-g

Fig. 9-h

Fig. 9-i

Fig. 9-j

innermost loop or rod which does extend to the end of the pattern. Other possible core configurations are shown in Fig. 9. When the distal ridge eminating from a triradius is part of the pattern core (e.g., Fig. 2-b), the pattern always has a ridge count of at least one. This ensures the rule that only arches and tented arches have zero ridge counts.

Fig. 9-k

Fig. 9-1

Cores of whorls follow similar patterns. A rod at the center of a whorl has the core located on its end lying nearest the triradius (Fig.10-a).

Fig. 10-a

Fig. 10-b

Fig. 10-c

Fig. 10-d

In Figure 10 the line of count is drawn connecting the core and the triradius.

Technique

The fingerprints in some studies are Xerox copies of fingerprint records. Some detail is lost in a copy of this sort, and more details are missed as the quality of the original print and the copying machine decrease. On those prints which are kept in a study, however, one should be confident that the ridge counts and pattern determinations are reasonably accurate. Some cautious guessing is tolerated, and this should be remembered when critically evaluating the fingerprint data.

One disadvantage of poor prints is the tendency to imagine more or less ridges in the line of count than really exist on the subject's finger. For this reason, only those impressions which require guessing for no more than 5 ridges are classified.

Somewhat the same problem exists with missing triradii. By comparing ridge counts made on prints with and without triradii, it was found that the position of the triradius is unpredictable if it lies more than a ridge away from the last ridge on the poor print. However, a cautious guess is infrequently made when the triradius is thought to lie within three ridges of the last legible line on a print of a pattern which is missing a triradius. It is hoped that the infrequency of this practice and the size of the population will correct for resulting inaccuracies.

Fingerprints are rejected as illegible when the specific pattern type is not determinable, due not to the basic ambiguity of the pattern, but rather to the loss of ridge impressions from the Xerox copy of the print. A considerable number are deleted from the study for this reason. Again, on comparison of good and poor quality prints it is evident that

unless the particular pattern type (i.e., one of the possibilities defined above) can be determined with assurance, there is a great deal of doubt about the location of triradii and cores, and consequently about the accuracy of ridge counts as well. Loops can be mistaken for arches, and whorls can be confused with loops.

B.2 Coding Methods and Forms

Fingerprint Code

In order to incorporate information on the symmetry of finger pattern types the following code will be used. The code is a two-digit code, the first digit specifies the symmetry and the second digit specifies the pattern type. Arches, tented arches, and accidental whorls are not specified with respect to symmetry.

The first-digit symmetry codes are:

1 = ulnar direction
2 = symmetrical
3 = radial direction

The second-digit pattern codes are:

1 = plain arch
2 = tented arch
3 = single loop
4 = double loop
5 = central pocket loop
6 = concentric whorl
7 = spiral whorl
8 = accidental whorl

Arches, tented arches, and accidentals are coded 01, 02, and 08 respectively, the zero signifying exemption from symmetry considerations.

Single loops can only be radial or ulnar direction, therefore the codes are:

13 = ulnar loop
33 = radial loop.

Code 23 = a symmetric loop, which is not an acceptable pattern type.

Whorls can occur as radial, ulnar, or symmetric. Therefore the codes for double loop whorls are:

14 = ulnar double loop
29 = symmetric double loop
34 = radial symmetric loop.

The definition of radial, ulnar, and symmetric for whorls follows the police definition for inner, meet, and outer whorls. This is determined by tracing the arms of the triradii which trend towards the opposite triradius. On the right hand the arm leading from the left (printed) triradius to the right is followed. If this arm passes inside of the right triradius it is an inner whorl; if it passes within three ridges of the right triradius it is a meet whorl, and if below the right triradius by more than three ridges then it is an outer whorl.

Identification practitioners always trace from the left triradius on the print, regardless of which hand the print is on. For this reason the terms radial and ulnar are not strictly coequal to those of inner and outer whorls. In terms of symmetry the following chart explains this:

Police type	Right Hand	Left Hand
inner	radial	ulnar
meet	symmetric	symmetric
outer	ulnar	radial

This problem may be overcome in the following way:

On a print of the right hand, trace from the left triradius to the right.

On a print of the left hand, trace from the right triradius to the left.

Code	Pattern Type	Symbol
01	plain arch	A
02	tented arch	T
13	single loop, ulnar	U
33	single loop, radial	R
14	double loop, ulnar	DL^u
24	double loop, symmetric	DL^s
34	double loop, radial	DL^r
15	central pocket loop, ulnar	CPL^u
25	central pocket loop, symmetric	CPL^s
35	central pocket loop, radial	CPL^r
16	concentric whorl, ulnar	CW^u
26	concentric whorl, symmetric	CW^s
36	concentric whorl, radial	CW^r
17	spiral whorl, ulnar	SW^u
27	spiral whorl, symmetric	SW^s
37	spiral whorl, radial	SW^r
08	accidental whorl	Acc.

01, 02, 08, 13-17, 24-27, 33-37

Name ______ Date ______

id.			Source			Card Type			Sequence			Status Code
						0	2	1	0	0		
1	2	3	4	5	6	7	8	9	10	11	12	15

	radial		ulnar		pattern	
I	16	17	18	19	20	21
II	22	23	24	25	26	27
III	28	29	30	31	32	33
IV	34	35	36	37	38	39
V	40	41	42	43	44	45

I	46	47	48	49	50	51
II	52	53	54	55	56	57
III	58	59	60	61	62	63
IV	64	65	66	67	68	69
V	70	71	72	73	74	75

JW-1-1

76	77	78
Coder	Sex	Race

FINGERPRINT CODING FORM

GENERAL CODES

II. Sex

1 = male

2 = female

9 = data unavailable

III. Race

1 = black

2 = white

3 = Spanish

4 = other

9 = data unavailable

IV. Counter

1 = J. Wohlleb

2 = T. Reed

3 = A. Gerald

4 = L. Cataldo (asst)

5 = L. Cataldo

codes/ Form JW-1-1 general

Feb. 1972
TJER

FINGERPRINT PATTERN COEES

Code	Pattern Type	Symbol
01	plain arch	A
02	tented arch	T
13	single loop, ulnar	U
33	single loop, radial	R
14	double loop, ulnar	DL^u
24	double loop, symmetric	DL^s
34	double loop, radial	DL^r
15	central pocket loop, ulnar	CPL^u
25	central pocket loop, symmetric	CPL^s
35	central pocket loop, radial	CPL^r
16	concentric whorl, ulnar	CW^u
26	concentric whorl, symmetric	CW^s
36	concentric whorl, radial	CW^r
17	spiral whorl, ulnar	SW^u
27	spiral whorl, symmetric	SW^s
37	spiral whorl, radial	SW^r
08	accidental whorl	Acc.

01, 02, 08, 13-17, 24-27, 33-37

codes/Form JW-1-1

Feb. 1972
TJER

B.3 Proposed Manual Probability Prediction Based on One or More Known Digits

The following procedure, based upon NYSIIS distributions, is intended as a manual method of determining the most probable search strategy based on a knowledge of the pattern type and ridge-count of one or more digits when the digit, hand and sex are known.

Although fingerprints can be used to differentiate sex, this cannot yet be done on the basis of only one or two digits with as much reliability as knowledge of the type of crime committed. According to NYSIIS figures it is possible to determine the digit from a latent in about 40% of the cases; when this is not possible and no other data are present, a pattern should be assigned to the digit on which it is most common (i.e., a whorl to digit IV, an ulnar loop to digit X, etc). Exact procedures for cases in which the digit is not known have not yet been calculated.

worksheet

Digits: ______ I ______ II ______ III ______ IV ______ V

Section A ______ VI ______ VII ______ VIII ______ IX ______ X

Section B

1. Pattern Frequency Value (from Chart 1) __________
2. Pattern Number Value (from Chart 2) __________
3. Pattern Ridge-Count Adjustment __________
4. Pattern Correlation Value (from Chart 3) __________

Section C

Sum of B2 + B3 = ________ ÷ 2 = __________

Sect B1 __________

Sect B4 __________

Total: __________

Total value index ÷ 3 = Probability index = __________

Procedure: Section A

1. Place a "1" on the line above every digit known to be a whorl.

2. Place an "0" on the line above every digit known not to be a whorl

3. Place the values corresponding to each digit from chart 1 for the remaining unknown digits.

Chart 1

Digit	I	II	III	IV	V
Value	.50	.38	.21	.53	.19
	VI	VII	VIII	IX	X
	.38	.35	.20	.40	.14

The following procedures are to determine whether the digit with the highest value (but not a 1) of Section A is a whorl or not. Place this highest value on the line at the end of line B-1.

Section B, Part 2

1. Count the number of 1s in Section A.

2. Add 1

3. Place the value in chart 2 corresponding to this number on the line at the end of B-2 on the worksheet.

Chart 2

Number	Value	Number	Value
1	.80	6	.23
2	.66	7	.16
3	.52	8	.11
4	.41	9	.05
5	.31	10	.01

This is to determine the probability of another whorl existing

(Optional)

Section B, Part 3

1. Calculate the mean ridge-count for all known whorls ($\overline{X}_w$).

2. Divide $\overline{X}_w$ by the value from Chart 3 which corresponds to the number of known whorls plus one.

Chart 3

Number	Value	Number	Value
1	14.6	6	16.5
2	15.7	7	16.8
3	15.7	8	17.3
4	15.9	9	17.8
5	16.2	10	18.10

3. Divide the result of this division by 2.

4. Enter the result on line B-3 of the worksheet.

Section B, Part 4

1. Take the value from Chart 4 which corresponds to:

   a. the opposite, homologous digit if known

   b. the nearest known digit on the same hand (preferably a whorl)

   c. any digit.

2. Enter the tables by the digit specified in operation 1 above. If this value is a 1 use the Chart 3-A. If it is a 0 use Chart 3-B.

3. Read across on this line to the row corresponding to the unknown digit; i.e. the digit of Section A with the highest value other than one from Chart 1.

4. Place this value on line B-4.

Section C

1. Add the values on lines B2 + B3; divide by 2; enter this value on line C1.

2. Enter values from Sections B1 + B4.

3. Add these three values

4. Divide by 3.

Table 6a. Conditional frequencies of main types of patterns in male co[illegible] of digits. W/W- and NW/W-patterns.

MALES:

CHART FOUR

1. Conditional frequencies of W-patterns in .... against W-patterns in ....

	L.I	L.II	L.III	L.IV	L.V	R.I	R.II	R.III	R.IV
L.I		51.24	31.92	51.42	18.21	85.81	53.12	35.o9	66.72
L.II	50.45		42.38	59.62	19.72	66.57	70.68	47.11	76.9o
L.III	54.61	73.64		80.47	27.24	69.79	75.o3	70.1o	89.82
L.IV	47.2o	55.58	43.17		25.26	62.97	60.29	45.88	85.72
L.V	58.oo	63.76	50.71	87.65		68.71	69.18	50.oo	89.41
R.I	58.5o	46.o8	27.8o	46.76	14.71		49.21	33.12	66.1o
R.II	48.61	65.69	40.13	60.11	19.88	66.o6		46.o8	78.6o
R.III	51.46	70.15	60.o8	73.29	23.o2	71.24	73.84		90.25
R.IV	40.64	47.57	31.98	56.89	17.1o	59.o7	52.32	37.47	
R.V	50.54	60.2o	44.38	78.6o	43.59	71.37	71.15	49.89	91.2o
Unconditional frequency of W-patterns ...	30.21	30.68	17.66	32.91	9.49	44.32	33.o1	20.6o	49.6o

2. Conditional frequencies of W-patterns in .... against NW-patterns in ....

	L.I	L.II	L.III	L.IV	L.V	R.I	R.II	R.III	R.IV
L.I		21.78	11.48	24.9o	5.71	26.36	24.31	14.33	42.19
L.II	21.25		6.71	21.o9	4.95	34.47	16.34	8.87	37.51
L.III	24.98	21.47		22.72	5.68	38.86	24.oo	9.99	40.97
L.IV	21.88	18.47	5.14		1.75	35.17	19.63	8.2o	31.87
L.V	27.3o	27.21	14.19	27.18		41.76	29.22	17.53	45.43
R.I	7.7o	18.42	9.58	21.89	5.33		20.12	10.64	36.46
R.II	21.14	13.43	6.58	19.51	4.37	33.61		8.o5	35.3o
R.III	24.7o	20.44	6.65	22.43	5.97	37.33	22.42		39.o5
R.IV	19.95	14.o6	3.57	9.32	1.99	29.81	14.o2	3.99	
R.V	26.46	25.23	12.72	24.47	3.19	39.32	25.97	15.19	41.91
Unconditional frequency of W-patterns ...	30.21	30.68	17.66	32.91	9.49	44.32	33.o1	20.6o	49.6o

From Vogelius Anderson, 1969

Interpretation

If the probability Index is .50 then there is a 50/50 chance that the pattern on the unknown digit is a whorl. If this value is above .60 (or so) then this digit may be assumed to be a whorl.

This procedure should be repeated for the next highest (non-one) value from Section A until the Probability Index is below (say) .40.

worksheet

				PI=.71	
Digits:	W 14	O	.21	.53	W 13
	I	II	III	IV	V
	PI=.55			PI=.63	
Section A	.38	.35	.20	.40	.14
	VI	VII	VIII	IX	X

TEST DIGIT IV

Section B

1. Pattern Frequency Value (from Chart 1) .53
   Digit IV
2. Pattern Number Value (from Chart 2) .52
   2+1=3
3. Pattern Ridge-Count Adjustment .86
   13.5 / 15.7
4. Pattern Correlation Value (from Chart 3) .91
   V to IV

Section C

Sum of B2 + B3 = 1.38 ÷ 2 = .69

Sect B1 .53

Sect B4 .91

Total: 2.13

Total value index ÷ 3 = Probability index = .71

∴ Probability of a whorl on IV is .71

worksheet

Digits: ___ I ___ II ___ III ___ IV ___ V

Section A ___ VI ___ VII ___ VIII .67 IX ___ X

Section B   TEST DIGIT IX

1. Pattern Frequency Value (from Chart 1) IX .40
2. Pattern Number Value (from Chart 2) 2+1 .52
3. Pattern Ridge-Count Adjustment .86
4. Pattern Correlation Value (from Chart 3) .79

Section C

Sum of B2 + B3 = 1.38 ÷ 2 = .69

Sect B1 .40

Sect B4 .79

Total: 1.88

Total value index ÷ 3 = Probability index = .63

Probability of whorl on IX is .63

worksheet

Digits: ___ I ___ II ___ III ___ IV ___ V

Section A ,55 VI ___ VII ___ VIII ___ IX ___ X

TEST Digit VI

Section B

1. Pattern Frequency Value (from Chart 1) .38
2. Pattern Number Value (from Chart 2) .52
3. Pattern Ridge-Count Adjustment .86
4. Pattern Correlation Value (from Chart 3) .59

Section C

Sum of B2 + B3 = 1.38 ÷ 2 = .69

Sect B1 .38

Sect B4 .59

Total: 1.66

Total value index ÷ 3 = Probability index = .55

INTERPRETATION OF WORKED EXAMPLE

The P.I. for a whorl on digit IV is .71 and the P.I. for a whorl on digit IX is .63. Since .71 is higher, it is indicated that there is a 52% chance that a third whorl is present and a 71% chance that a whorl is present on digit IV. PI for digit VI is .55.

The next step in analysis is to determine whether a fourth whorl is present and on which digit. The procedure shall be continued, this time using a PNV for four whorls, examining first the highest remaining Pattern Frequency Value (Chart 1) and second the highest Pattern Correlation Value corresponding to a known digit (i.e. in this case digits I,II or IV, but not IV, which has been calculated). When this procedure has been repeated until low Probability Indices are generated, then the FBI-Henry classes may be calculated, using the usual values.

B.4 Software

B.4.1 Program titles, machines, inputs and functions

B.4.2 Elementary statistics lists to be used for computer programs.

B.4.1 NYSIIS PROGRAMS

Program Name	Language	Machine	Input	Program Function
GETENTRY	Algol	Burroughs 6700	NYSIIS finger-print file	screens file, eliminates records which are not related to set of fingerprints on file or that pre-date mid-196
STATCT	Algol	Burroughs 6700	GETENTRY	extracts sub-set classes from file by race, criminal history, mental status and sociological and demographic variables.
NYSSTAT	Algol	Burroughs 6700	STATCT	calculates descriptive statistics: means, standard deviations, frequencies and distributions of finger-print data.
MGHMAT	Algol	Burroughs 6700	GETENTRY	constructs a correlation, variance, and covariance matrices of the fingerprint and social history data.
MGHDATA	Fortran	Burroughs 3500	MGHSTAT	calculates descriptive statistics, and analytic statistics from the MGHMAT matrix. Summarizes data in minimal usable format.
STATPR	Cobol	IBM/370	NYSSTAT	prints frequency distributions

B.4.2 ELEMENTARY STATISTICS LIST

All statistics are derived according to categories of race and sex.

I. Ridge Count Frequencies

For each item, the mean, standard deviation, median, skewness, kurtosis, variance, standard error, and the number of subjects (N) are computed in addition to a frequency distribution.

1.1.1 Bimanual absolute total finger ridge count (AFRC)
1.1.2 Right Hand " " " " " "
1.1.3 Left Hand " " " " " "

1.2.1 Bimanual Bonnevie total finger ridge count (BFRC)
1.2.2 Right Hand " " " " " "
1.2.3 Left Hand " " " " " "

1.3.1 Bimanual Galton total finger ridge count (GFRC)
1.3.2 Right Hand " " " " " "
1.3.3 Left Hand " " " " " "

2.1 Bimanual Radial ridge count

2.2 Right Hand Radial ridge count
2.3 Left Hand " " "

3.1 Bimanual Ulnar ridge count

3.2 Right Hand Ulnar ridge count
3.3 Left Hand " " "

4.1.1.1 Bimanual absolute digit I ridge count
4.1.1.2 " " " II " "
4.1.1.3 " " " III " "
4.1.1.4 " " " IV " "
4.1.1.5 " " " V " "

4.1.2.1 Right Hand absolute digit I ridge count
4.1.2.2 " " " " II " "
4.1.2.3 " " " " III " "
4.1.2.4 " " " " IV " "
4.1.2.5 " " " " V " "

4.1.3.1 Left Hand absolute digit I ridge count
4.1.3.2 " " " " II " "
4.1.3.3 " " " " III " "
4.1.3.4 " " " " IV " "
4.1.3.5 " " " " V " "

4.2.1.1 Bimanual Bonnevie digit I ridge count
4.2.1.2 " " " II " "
4.2.1.3 " " " III " "
4.2.1.4 " " " IV " "
4.2.1.5 " " " V " "

4.2.2.1 Right Hand Bonnevie digit I ridge count
4.2.2.2 " " " " II " "
4.2.2.3 " " " " III " "
4.2.2.4 " " " " IV " "
4.2.2.5 " " " " V " "

4.2.3.1 Left Hand Bonnevie digit I ridge count
4.2.3.2 " " " " II " "
4.2.3.3 " " " " III " "
4.2.3.4 " " " " IV " "
4.2.3.5 " " " " V " "

4.3.1.1 Bimanual Galton digit I ridge count
4.3.1.2 " " " II " "
4.3.1.3 " " " III " "
4.3.1.4 " " " IV " "
4.3.1.5 " " " V " "

4.3.2.1 Right Hand Galton digit I ridge count
4.3.2.2 " " " " II " "
4.3.2.3 " " " " III " "
4.3.2.4 " " " " IV " "
4.3.2.5 " " " " V " "

4.3.3.1 Left Hand Galton digit I ridge count
4.3.3.2 " " " " II " "
4.3.3.3 " " " " III " "
4.3.3.4 " " " " IV " "
4.3.3.5 " " " " V " "

5.1.1 Bimanual radial digit I ridge count
5.1.2 " " " II " "
5.1.3 " " " III " "
5.1.4 " " " IV " "
5.1.5 " " " V " "

5.2.1 Right Hand radial digit I ridge count
5.2.2 " " " " II " "
5.2.3 " " " " III " "
5.2.4 " " " " IV " "
5.2.5 " " " " V " "

5.3.1 Left Hand ulnar digit I ridge count
5.3.2 " " " " II " "
5.3.3 " " " " III " "
5.3.4 " " " " IV " "
5.3.5 " " " " V " "

6.1.1 Bimanual ulnar digit I ridge count
6.1.2 " " " II " "
6.1.3 " " " III " "
6.1.4 " " " IV " "
6.1.5 " " " V " "

6.2.1 Right Hand ulnar digit I ridge count
6.2.2 " " " " II " "
6.2.3 " " " " III " "
6.2.4 " " " " IV " "
6.2.5 " " " " V " "

6.3.1 Left Hand ulnar digit I ridge count
6.3.2 " " " " II " "
6.3.3 " " " " III " "
6.3.4 " " " " IV " "
6.3.5 " " " " V " "

II. Pattern Frequencies

For each item, the frequency (in both per cent and absolute value) and the numbers of subjects (N) are computed in addition to a frequency distribution.

1.1.1 Bimanual frequency of arches
1.1.2 " " " tented arches
1.1.3 " " " ulnar arches
1.1.4 " " " radial loops
1.1.5 " " " double loops
1.1.6 " " " whorls
1.1.7 " " " central pocket loops

1.2.1 Frequency of arches on Right Hand
1.2.2 " " tented arches on right hand
1.2.3 " " ulnar loops on right hand
1.2.4 " " radial loops on right hand
1.2.5 " " double loops on right hand
1.2.6 " " whorls on right hand
1.2.7 " " central pocket loops on right hand

1.3.1 Frequency of arches on Left Hand
1.3.2 " " tented arches on left hand
1.3.3 " " ulnar loops on left hand
1.3.4 " " radial loops on left hand
1.3.5 " " double loops on left hand
1.3.6 " " whorls on left hand
1.3.7 " " central pocket loops on left hand

2.1.1.1 Bimanual frequency of arches on digit I
2.1.1.2 " " " tented arches on digit I
2.1.1.3 " " " ulnar loops on digit I
2.1.1.4 " " " radial loops on digit I
2.1.1.5 " " " double loops on digit I
2.1.1.6 " " " whorls on digit I
2.1.1.7 " " " central pocket loops on digit I

2.1.2.1 Bimanual frequency of arches on digit II
2.1.2.2 " " " tented arches on digit II
2.1.2.3 " " " ulnar loops on digit II
2.1.2.4 " " " radial loops on digit II
2.1.2.5 " " " double loops on digit II
2.1.2.6 " " " whorls on digit II
2.1.2.7 " " " central pocket loops on digit II

2.1.3.1 Bimanual frequency of arches on digit III
2.1.3.2 " " " tented arches on digit III
2.1.3.3 " " " ulnar loops on digit III
2.1.3.4 " " " radial loops on digit III
2.1.3.5 " " " double loops on digit III
2.1.3.6 " " " whorls on digit III
2.1.3.7 " " " central pocket loops on digit III

2.1.4.1 Bimanual frequency of arches on digit IV
2.1.4.2 " " " tented arches on digit IV
2.1.4.3 " " " ulnar loops on digit IV
2.1.4.4 " " " radial loops on digit IV
2.1.4.5 " " " double loops on digit IV
2.1.4.6 " " " whorls on digit IV
2.1.4.7 " " " central pocket loops on digit IV

2.1.5.1 Bimanual frequency of arches on digit V
2.1.5.2 " " " tented arches on digit V
2.1.5.3 " " " ulnar loops on digit V
2.1.5.4 " " " radial loops on digit V
2.1.5.5 " " " double loops on digit V
2.1.5.6 " " " whorls on digit V
2.1.5.7 " " " central pocket loops on digit V

2.2.1.1 Frequency of arches on Right Hand digit I
2.2.1.2 " " tented arches on right hand digit I
2.2.1.3 " " ulnar loops on right hand digit I
2.2.1.4 " " radial loops on right hand digit I
2.2.1.5 " " double loops on right hand digit I
2.2.1.6 " " whorls on right hand digit I
2.2.1.7 " " central pocket loops on digit I

2.2.2.1 Frequency of arches on Right Hand digit II
2.2.2.2 " " tented arches on right hand digit II
2.2.2.3 " " ulnar loops on right hand digit II
2.2.2.4 " " radial loops on right hand digit II
2.2.2.5 " " double loops on right hand digit II
2.2.2.6 " " whorls on right hand digit II
2.2.2.7 " " central pocket loops on right hand digit II

2.2.3.1 Frequency of arches on Right Hand digit III
2.2.3.2 " " tented arches on right hand digit III
2.2.3.3 " " ulnar loops on right hand digit III
2.2.3.4 " " radial loops on right hand digit III
2.2.3.5 " " double loops on right hand digit III
2.2.3.6 " " whorls on right hand digit III
2.2.3.7 " " central pocket loops on right hand digit III

2.2.4.1 Frequency of arches on Right Hand digit IV
2.2.4.2 " " tented arches on right hand digit IV
2.2.4.3 " " ulnar loops on right hand digit IV
2.2.4.4 " " radial loops on right hand digit IV
2.2.4.5 " " double loops on right hand digit IV
2.2.4.6 " " whorls on right hand digit IV
2.2.4.7 " " central pocket loops on right hand digit IV

2.2.5.1 Frequency of arches on Right Hand digit V
2.2.5.2 " " tented arches on right hand digit V
2.2.5.3 " " ulnar loops on right hand digit V
2.2.5.4 " " radial loops on right hand digit V
2.2.5.5 " " double loops on right hand digit V
2.2.5.6 " " whorls on right hand digit V
2.2.5.7 " " central pocket loops on right hand digit V

2.3.1.1 Frequency of arches on Left Hand digit I
2.3.1.2 " " tented arches on left hand digit I
2.3.1.3 " " ulnar loops on left hand digit I
2.3.1.4 " " radial loops on left hand digit I
2.3.1.5 " " double loops on left hand digit I
2.3.1.6 " " whorls on left hand digit I
2.3.1.7 " " central pocket loops on left hand digit I

2.3.2.1 Frequency of arches on Left Hand digit II
2.3.2.2 " " tented arches on left hand digit II
2.3.2.3 " " ulnar loops on left hand digit II
2.3.2.4 " " radial loops on left hand digit II
2.3.2.5 " " double loops on left hand digit II
2.3.2.6 " " whorls on left hand digit II
2.3.2.7 " " central pocket loops on left hand digit II

2.3.3.1 Frequency of arches on Left Hand digit III
2.3.3.2 " " tented arches on left hand digit III
2.3.3.3 " " ulnar loops on left hand digit III
2.3.3.4 " " radial loops on left hand digit III
2.3.3.5 " " double loops on left hand digit III
2.3.3.6 " " whorls on left hand digit III
2.3.3.7 " " central pocket loops on left hand digit III

2.3.4.1 Frequency of arches on Left Hand digit IV
2.3.4.2 " " tented arches on left hand digit IV
2.3.4.3 " " ulnar loops on left hand digit IV
2.3.4.4 " " radial loops on left hand digit IV
2.3.4.5 " " double loops on left hand digit IV
2.3.4.6 " " whorls on left hand digit IV
2.3.4.7 " " central pocket loops on left hand digit IV

2.3.5.1 Frequency of arches on Left Hand digit V
2.3.5.2 " " tented arches on left hand digit V
2.3.5.3 " " ulnar loops on left hand digit V
2.3.5.4 " " radial loops on left hand digit V
2.3.5.5 " " double loops on left hand digit V
2.3.5.6 " " whorls on left hand digit V
2.3.5.7 " " central pocket loops on left hand digit V

III. Pattern specific ridge counts

For each item, the mean, standard deviation, variance, median, skewness, kurtosis, standard error, and the number of subjects (N) are computed in addition to a frequency distribution.

1.1.1	Bimanual ridge count per ulnar loops
1.1.2	" " " " radial loops
1.1.3.1	Bimanual absolute ridge count per double loops
1.1.3.2	Bimanual Bonnevie ridge count per double loops
1.1.3.3	Bimanual Galton/radial ridge count per double loops
1.1.3.4	Bimanual ulnar ridge count per double loops
1.1.4.1	Bimanual absolute ridge count per whorls
1.1.4.2	Bimanual Bonnevie ridge count per whorls
1.1.4.3	Bimanual Galton ridge count per whorls
1.1.4.4	Bimanual ulnar ridge count per whorls
1.1.5.1	Bimanual absolute ridge count per central pocket loops
1.1.5.2	Bimanual Bonnevie ridge count per central pocket loops
1.1.5.3	Bimanual Galton ridge count per central pocket loops
1.1.5.4	Bimanual ulnar ridge count per central pocket loops
1.2.1	Right Hand ridge count per UL
1.2.2	Right Hand ridge count per RL
1.2.3.1	Absolute " " " DL for right hand
1.2.3.2	Bonnevie " " " DL " " "
1.2.3.3	Radial/Galton ridge count per DL for right hand
1.2.3.4	Ulnar ridge count per DL for right hand
1.2.4.1	Absolute ridge count per W for right hand
1.2.4.2	Bonnevie " " " " " " "
1.2.4.3	Radial/Galton ridge count per W for right hand
1.2.4.4	Ulnar ridge count per W for right hand
1.2.5.1	Absolute ridge count per CPL for right hand
1.2.5.2	Bonnevie " " " " for right hand
1.2.5.3	Radial/Galton ridge count per CPL for right hand
1.2.5.4	Ulnar ridge count per CPL for right hand
1.3.1	Left Hand ridge count per UL
1.3.2	" " " " " RL
1.3.3.1	Absolute left hand ridge count per DL
1.3.3.2	Bonnevie left hand ridge count per DL
1.3.3.3	Radial/Galton left hand ridge count per DL
1.3.3.4	Ulnar left hand ridge count per DL
1.3.4.1	Absolute left hand ridge count per W
1.3.4.2	Bonnevie left hand ridge count per W
1.3.4.3	Radial/Galton left hand ridge count per W
1.3.4.4	Ulnar left hand ridge count per W
1.3.5.1	Left hand absolute ridge count per CPL
1.3.5.2	Left hand Bonnevie ridge count per CPL
1.3.5.3	Left hand Radial/Galton ridge count per CPL
1.3.5.4	Left hand Ulnar ridge count per CPL

2.1.1.1 Bimanual digit I ridge count per UL
2.1.1.2 Bimanual digit I ridge count per RL
2.1.1.3.1 Bimanual absolute digit I ridge count per DL
2.1.1.3.2 Bimanual Bonnevie digit I ridge count per DL
2.1.1.3.3 Bimanual Radial/Galton digit I ridge count per DL
2.1.1.3.4 Bimanual Ulnar digit I ridge count per DL
2.1.1.4.1 Bimanual absolute digit I ridge count per W
2.1.1.4.2 Bimanual Bonnevie digit I ridge count per W
2.1.1.4.3 Bimanual Radial/Galton digit I ridge count per W
2.1.1.4.4 Bimanual Ulnar digit I ridge count per W
2.1.1.5.1 Bimanual absolute digit I ridge count per CPL
2.1.1.5.2 Bimanual Bonnevie digit I ridge count per CPL
2.1.1.5.3 Bimanual Radial/Galton digit I ridge count per CPL
2.1.1.5.4 Bimanual Ulnar digit I ridge count per CPL

2.1.2.1 Bimanual digit II ridge count per UL
2.1.2.2 Bimanual digit II ridge count per RL
2.1.2.3.1 Bimanual absolute digit II ridge count per DL
2.1.2.3.2 Bimanual Bonnevie digit II ridge count per DL
2.1.2.3.3 Bimanual Radial/Galton digit II ridge count per DL
2.1.2.3.4 Bimanual Ulnar digit II ridge count per DL
2.1.2.4.1 Bimanual absolute digit II ridge count per W
2.1.2.4.2 Bimanual Bonnevie digit II ridge count per W
2.1.2.4.3 Bimanual Radial/Galton digit II ridge count per W
2.1.2.4.4 Bimanual Ulnar digit II ridge count per W
2.1.2.5.1 Bimanual absolute digit II ridge count per CPL
2.1.2.5.2 Bimanual Bonnevie digit II ridge count per CPL
2.1.2.5.3 Bimanual Radial/Galton digit II ridge count per CPL
2.1.2.5.4 Bimanual Ulnar digit II ridge count per CPL

2.1.3.1 Bimanual digit III ridge count per UL
2.1.3.2 Bimanual digit III ridge count per RL
2.1.3.3.1 Bimanual absolute digit III ridge count per DL
2.1.3.3.2 Bimanual Bonnevie digit III ridge count per DL
2.1.3.3.3 Bimanual Radial/Galton digit III ridge count per DL
2.1.3.3.4 Bimanual Ulnar digit III ridge count per DL
2.1.3.4.1 Bimanual absolute digit III ridge count per W
2.1.3.4.2 Bimanual Bonnevie digit III ridge count per W
2.1.3.4.3 Bimanual Radial/Galton digit III ridge count per W
2.1.3.4.4 Bimanual Ulnar digit III ridge count per W
2.1.3.5.1 Bimanual absolute digit III ridge count per CPL
2.1.3.5.2 Bimanual Bonnevie digit III ridge count per CPL
2.1.3.5.3 Bimanual Radial/Galton digit III ridge count per CPL
2.1.3.5.4 Bimanual Ulnar digit III ridge count per CPL

2.1.4.1 Bimanual digit IV ridge count per UL
2.1.4.2 Bimanual digit IV ridge count per RL
2.1.4.3.1 Bimanual digit IV absolute ridge count per DL
2.1.4.3.2 Bimanual digit IV Bonnevie ridge count per DL
2.1.4.3.3 Bimanual digit IV Radial/Galton ridge count per DL
2.1.4.3.4 Bimanual digit IV Ulnar ridge count per DL
2.1.4.4.1 Bimanual digit IV absolute ridge count per W
2.1.4.4.2 Bimanual digit IV Bonnevie ridge count per W
2.1.4.4.3 Bimanual digit IV Radial/Galton ridge count per W
2.1.4.4.4 Bimanual digit IV Ulnar ridge count per W

2.1.4.5.1 Bimanual digit IV absolute ridge count per CPL
2.1.4.5.2 Bimanual digit IV Bonnevie ridge count per CPL
2.1.4.5.3 Bimanual digit IV Radial/Galton ridge count per CPL
2.1.4.5.4 Bimanual digit IV Ulnar ridge count per CPL

2.1.5.1 Bimanual digit V ridge count per UL
2.1.5.2 Bimanual digit V ridge count per RL
2.1.5.3.1 Bimanual digit V absolute ridge count per DL
2.1.5.3.2 Bimanual digit V Bonnevie ridge count per DL
2.1.5.3.3 Bimanual digit V Radial/Galton ridge count per DL
2.1.5.3.4 Bimanual digit V Ulnar ridge count per DL
2.1.5.4.1 Bimanual digit V absolute ridge count per W
2.1.5.4.2 Bimanual digit V Bonneive ridge count per W
2.1.5.4.3 Bimanual digit V Radial/Galton ridge count per W
2.1.5.4.4 Bimanual digit V Ulnar ridge count per W
2.1.5.5.1 Bimanual digit V absolute ridge count per CPL
2.1.5.5.2 Bimanual digit V Bonnevie ridge count per CPL
2.1.5.5.3 Bimanaul digit V Radial/Galton ridge count per CPL
2.1.5.5.4 Bimanual digit V Ulnar ridge count per CPL

2.2.1.1 Right Hand digit I ridge count per UL
2.2.1.2 Right Hand digit I ridge count per RL
2.2.1.3.1 Right Hand digit I absolute ridge count per DL
2.2.1.3.2 " " " " Bonnevie " " " "
2.2.1.3.3 " " " " Radial/Galton ridge count per DL
2.2.1.3.4 " " " " Ulnar ridge count per DL
2.2.1.4.1 " " " " absolute " " " W
2.2.1.4.2 " " " " Bonnevie " " " W
2.2.1.4.3 " " " " Radial/Galton ridge count per W
2.2.1.4.4 " " " " Ulnar ridge count per W
2.2.1.5.1 " " " " Absolute " " " CPL
2.2.1.5.2 " " " " Bonnevie " " " CPL
2.2.1.5.3 " " " " Radial/Galton ridge count per CPL
2.2.1.5.4 " " " " Ulnar ridge count per CPL

2.2.2.1 Right Hand digit II ridge count per UL
2.2.2.2 " " " " " " " RL
2.2.2.3.1 " " " " absolute ridge count per DL
2.2.2.3.2 " " " " Bonnevie ridge count per DL
2.2.2.3.3 " " " " Radial/Galton ridge count per DL
2.2.2.3.4 " " " " Ulnar ridge count per DL
2.2.2.4.1 " " " " absolute ridge count per W
2.2.2.4.2 " " " " Bonnevie ridge count per W
2.2.2.4.3 " " " " Radial/Galton ridge count per W
2.2.2.4.4 " " " " Ulnar ridge count per W
2.2.2.5.1 " " " " absolute ridge count per CPL
2.2.2.5.2 " " " " Bonnevie ridge count per CPL
2.2.2.5.3 " " " " Radial/Galton ridge count per CPL
2.2.2.5.4 " " " " Ulnar ridge count per CPL

2.2.3.1 Right Hand digit III ridge count per UL
2.2.3.2 " " " " " " " RL
2.2.3.3.1 " " " " Absolute ridge count per DL
2.2.3.3.2 " " " " Bonnevie " " " "
2.2.3.3.3 " " " " Radial/Galton ridge count per DL
2.2.3.3.4 " " " " Ulnar ridge count per DL

2.2.3.4.1 Right Hand digit III absolute ridge count per W
2.2.3.4.2 " " " " Bonnevie " " " "
2.2.3.4.3 " " " " Radial/Galton ridge count per W
2.2.3.4.4 " " " " Ulnar ridge count per W
2.2.3.5.1 " " " " absolute ridge count per CPL
2.2.3.5.2 " " " " Bonnevie ridge count per CPL
2.2.3.5.3 " " " " Radial/Galton ridge count per CPL
2.2.3.5.4 " " " " Ulnar ridge count per CPL

2.2.4.1 Right Hand digit IV ridge count per UL
2.2.4.2 " " " " " " " RL
2.2.4.3.1 " " " " absolute ridge count per DL
2.2.4.3.2 " " " " Bonnevie " " " "
2.2.4.3.3 " " " " Radial/Galton ridge count per DL
2.2.4.3.4 " " " " Ulnar ridge count per DL
2.2.4.4.1 " " " " absolute ridge count per W
2.2.4.4.2 " " " " Bonnevie " " " "
2.2.4.4.3 " " " " Radial/Galton ridge count per W
2.2.4.4.4 " " " " Ulnar ridge count per W
2.2.4.5.1 " " " " absolute ridge count per CPL
2.2.4.5.2 " " " " Bonnevie " " " "
2.2.4.5.3 " " " " Radial/Galton ridge count per CPL
2.2.4.5.4 " " " " Ulnar ridge count per CPL

2.2.5.1 Right Hand digit V ridge count per UL
2.2.5.2 " " " " " " " RL
2.2.5.3.1 " " " " Absolute ridge count per DL
2.2.5.3.2 " " " " Bonnevie " " " "
2.2.5.3.3 " " " " Radial/Galton ridge count per DL
2.2.5.3.4 " " " " Ulnar ridge count per DL
2.2.5.4.1 " " " " Absolute ridge count per W
2.2.5.4.2 " " " " Bonnevie " " " "
2.2.5.4.3 " " " " Radial/Galton ridge count per W
2.2.5.4.4 " " " " Ulnar ridge count per W
2.2.5.5.1 " " " " Absolute ridge count per CPL
2.2.5.5.2 " " " " Bonnevie " " " "
2.2.5.5.3 " " " " Radial/Galton ridge count per CPL
2.2.5.5.4 " " " " Ulnar ridge count per CPL

2.3.1.1 Left Hand Digit I ridge count per UL
2.3.1.2 " " " " " " " RL
2.3.1.3.1 " " " " absolute ridge count per DL
2.3.1.3.2 " " " " Bonnevie ridge count per DL
2.3.1.3.3 " " " " Radial/Galton ridge count per DL
2.3.1.3.4 " " " " Ulnar ridge count per DL
2.3.1.4.1 " " " " absolute ridge count per W
2.3.1.4.2 " " " " Bonnevie ridge count per W
2.3.1.4.3 " " " " Radial/Galton ridge count per W
2.3.1.4.4 " " " " Ulnar ridge count per W
2.3.1.5.1 " " " " absolute " " " CPL
2.3.1.5.2 " " " " Bonnevie " " " CPL
2.3.1.5.3 " " " " Radial/Galton ridge count per CPL
2.3.1.5.4 " " " " Ulnar ridge count per CPL

2.3.2.1	Left	Hand	Digit	II	ridge count per UL
2.3.2.2	"	"	"	"	" " " RL
2.3.2.3.1	"	"	"	"	absolute ridge count per DL
2.3.2.3.2	"	"	"	"	Bonnevie " " " "
2.3.2.3.3	"	"	"	"	Radial/Galton ridge count per DL
2.3.2.3.4	"	"	"	"	Ulnar ridge count per DL
2.3.2.4.1	"	"	"	"	absolute ridge count per W
2.3.2.4.2	"	"	"	"	Bonnevie ridge count per W
2.3.2.4.3	"	"	"	"	Radial/Galton ridge count per W
2.3.2.4.4	"	"	"	"	Ulnar ridge count per W
2.3.2.5.1	"	"	"	"	absolute ridge count per CPL
2.3.2.5.2	"	"	"	"	Bonnevie ridge count per CPL
2.3.2.5.3	"	"	"	"	Radial/Galton ridge count per CPL
2.3.2.5.4	"	"	"	"	Ulnar ridge count per CPL
2.3.3.1	Left	Hand	Digit	III	ridge count per UL
2.3.3.2	"	"	"	"	" " " RL
2.3.3.3.1	"	"	"	"	absolute ridge count per DL
2.3.3.3.2	"	"	"	"	Bonnevie " " " "
2.3.3.3.3	"	"	"	"	Radial/Galton ridge count per DL
2.3.3.3.4	"	"	"	"	Ulnar ridge count per DL
2.3.3.4.1	"	"	"	"	absolute ridge count per W
2.3.3.4.2	"	"	"	"	Bonnevie ridge count per W
2.3.3.4.3	"	"	"	"	Radial/Galton ridge count per W
2.3.3.4.4	"	"	"	"	Ulnar ridge count per W
2.3.3.5.1	"	"	"	"	absolute ridge count per CPL
2.3.3.5.2	"	"	"	"	Bonnevie " " " "
2.3.3.5.3	"	"	"	"	Radial/Galton ridge count per CPL
2.3.3.5.4	"	"	"	"	Ulnar ridge count per CPL
2.3.4.1	Left	Hand	Digit	IV	ridge count per UL
2.3.4.2	"	"	"	"	" " " RL
2.3.4.3.1	"	"	"	"	absolute ridge count per DL
2.3.4.3.2	"	"	"	"	Bonnevie ridge count per DL
2.3.4.3.3	"	"	"	"	Radial/Galton ridge count per DL
2.3.4.3.4	"	"	"	"	Ulnar ridge count per DL
2.3.4.4.1	"	"	"	"	absolute ridge count per W
2.3.4.4.2	"	"	"	"	Bonnevie ridge count per W
2.3.4.4.3	"	"	"	"	Radial/Galton ridge count per W
2.3.4.4.4	"	"	"	"	Ulnar ridge count per W
2.3.4.5.1	"	"	"	"	absolute ridge count per CPL
2.3.4.5.2	"	"	"	"	Bonnevie ridge count per CPL
2.3.4.5.3	"	"	"	"	Radial/Galton ridge count per CPL
2.3.4.5.4	"	"	"	"	Ulnar ridge count per CPL
2.3.5.1	Left	Hand	Digit	V	ridge count per UL
2.3.5.2	"	"	"	"	" " " RL
2.3.5.3.1	"	"	"	"	absolute ridge count per DL
2.3.5.3.2	"	"	"	"	Bonnevie " " " "
2.3.5.3.3	"	"	"	"	Radial/Galton ridge count per DL
2.3.5.3.4	"	"	"	"	Ulnar ridge count per DL
2.3.5.4.1	"	"	"	"	absolute ridge count per W
2.3.5.4.2	"	"	"	"	Bonnevie ridge count per W
2.3.5.4.3	"	"	"	"	Radial/Galton ridge count per W
2.3.5.4.4	"	"	"	"	Ulnar ridge count per W

2.3.5.5.1	Left Hand Digit V absolute ridge count per CPL
2.3.5.5.2	" " " " Bonnevie " " " "
2.3.5.5.3	" " " " Radial/Galton ridge count per CPL
2.3.5.5.4	" " " " Ulnar ridge count per CPL
3.1.1	Mean Cumulative ridge count per 1 arch
3.1.2	" " " " " 2 arches
3.1.3	" " " " " 3 arches
3.1.4	" " " " " 4 "
3.1.5	" " " " " 5 "
3.1.6	" " " " " 6 "
3.1.7	" " " " " 7 "
3.1.8	" " " " " 8 "
3.1.9	" " " " " 9 "
3.2.1	Cumulative pattern-specific ridge count per 1 tented arch
3.2.2	" " " " " " 2 tented arches
3.2.3	" " " " " " 3 " "
3.2.4	" " " " " " 4 " "
3.2.5	" " " " " " 5 " "
3.2.6	" " " " " " 6 " "
3.2.7	" " " " " " 7 " "
3.2.8	" " " " " " 8 " "
3.2.9	" " " " " " 9 " "
3.3.1	Cumulative pattern-specific ridge count per 1 ulnar loop
3.3.2	" " " " " " 2 ulnar loops
3.3.3	" " " " " " 3 " "
3.3.4	" " " " " " 4 " "
3.3.5	" " " " " " 5 " "
3.3.6	" " " " " " 6 " "
3.3.7	" " " " " " 7 " "
3.3.8	" " " " " " 8 " "
3.3.9	" " " " " " 9 " "
3.3.10	" " " " " " 10 " "
3.4.1	Cumulative pattern-specific ridge count per 1 radial loop
3.4.2	" " " " " " 2 " loops
3.4.3	" " " " " " 3 " "
3.4.4	" " " " " " 4 " "
3.4.5	" " " " " " 5 " "
3.4.6	" " " " " " 6 " "
3.4.7	" " " " " " 7 " "
3.4.8	" " " " " " 8 " "
3.4.9	" " " " " " 9 " "
3.4.10	" " " " " " 10 " "
3.5.1	Cumulative ridge count per 1 double loop
3.5.2	" " " " 2 " loops
3.5.3	" " " " 3 " "
3.5.4	" " " " 4 " "
3.5.5	" " " " 5 " "
3.5.6	" " " " 6 " "
3.5.7	" " " " 7 " "
3.5.8	" " " " 8 " "
3.5.9	" " " " 9 " "
3.5.10	" " " " 10 " "

3.6.1	Cumulative	ridge	count	per	1	whorl
3.6.2	"	"	"	"	2	whorls
3.6.3	"	"	"	"	3	"
3.6.4	"	"	"	"	4	"
3.6.5	"	"	"	"	5	"
3.6.6	"	"	"	"	6	"
3.6.7	"	"	"	"	7	"
3.6.8	"	"	"	"	8	"
3.6.9	"	"	"	"	9	"
3.6.10	"	"	"	"	10	"

3.7.1	Cumulative	ridge	count	per	1	CPL
3.7.2	"	"	"	"	2	CPL
3.7.3	"	"	"	"	3	"
3.7.4	"	"	"	"	4	"
3.7.5	"	"	"	"	5	"
3.7.6	"	"	"	"	6	"
3.7.7	"	"	"	"	7	"
3.7.8	"	"	"	"	8	"
3.7.9	"	"	"	"	9	"
3.7.10	"	"	"	"	10	"