

# New Tool Will Manage Community Corrections ... and Beyond

By Nancy Ritter

**Authors' Note:** Findings and conclusions reported in this article are those of the author, and do not necessarily represent the official position or policies of the U.S. Department of Justice.

In 2009, the Pew Center on the States reported that one in 45 adults in the U.S. was under some form of community correctional supervision.<sup>1</sup> In the four years since that statistic was released, more and more offenders are being supervised in the community — which means that the nation's parole and probation departments are struggling to find the balance between dwindling financial resources and ensuring the lowest possible risk to communities. Researchers funded by the National Institute of Justice (NIJ) have developed a risk assessment tool that shows great promise in helping states and local jurisdictions with this delicate balancing act.

Development of the tool began when leaders from the Philadelphia Adult Probation and Parole Department (APPD) contacted the University of Pennsylvania's Jerry Lee Center for Criminology looking for an evidence-based way to reform its probation policies. APPD's goal was to tailor its officers' caseloads to the risk level of their probationers.

To help in this effort, NIJ funded University of Pennsylvania researchers Geoffrey Barnes and Jordan Hyatt to join forces with APPD. Using a sophisticated statistical approach called "random forest modeling," the tool they developed considers the nonlinear effects of a large number of variables with complex interactions. In 10 to 15 seconds, the tool performs a risk assessment of each new probationer, looking at many decision "trees"

(hence the term "random forest") that contain millions of decision points.

With a high degree of accuracy, the tool predicts which probationers are likely to violently reoffend within two years of returning to the community. New probationers are assigned to one of three categories: low, moderate or high. The lowest level of risk is assigned to those who are predicted to not commit any new offenses in the next two years. The moderate-risk level identifies those who are likely to commit a crime, but not a serious crime. The high-risk level is for those who are most likely to commit a serious crime (defined by APPD as murder, attempted murder, aggravated assault, rape or arson) within two years of probation. Community supervision is based on the determined risk level; APPD officers who are supervising high-risk individuals are given the smallest caseload.

Since it began using the latest iteration of the tool, the Philadelphia APPD has handled more than 120,000 new "case starts." A case start refers to the beginning of an offender's probation. Because approximately one-third of the offenders have had more than one probation case start, this number represents about 72,000 individual offenders.

## How Can Others Use This Model?

The APPD risk assessment model is not an off-the-shelf tool. It uses data unique to the probationers who are under APPD supervision — and the "outcomes," or risk-level assignments, are unique because APPD officials set their own parameters based on resources and every manner of policy, operational and political reality that they want the tool to consider.

However, in the final NIJ report, Barnes and Hyatt recommend 12 steps that could serve as a blueprint for a jurisdiction that may want to consider building a random forest model risk prediction tool.

The first step is to determine what data already exists in electronic form. As they developed the tool in Philadelphia, for example, Barnes and Hyatt, along with their APPD partners, mined raw data from six different databases. The team then tested hundreds of different predictors using many different approaches, all the while fine-tuning the delicate balance between APPD's resources and the forecasting accuracy that was achievable.

After addressing the issue of data availability, a jurisdiction would need to determine when the forecasting should begin (called the "unit of prediction") and when it should end (the "time horizon"). The beginning point can be any moment in the lifespan of an offender's case — when bail is set, when charges are filed, at sentencing, when the offender enters the correctional system, or when the offender first reports for probation. APPD officials chose the start of probation and a time horizon of two years. Although any time period could be used, it is important to understand that the accuracy of forecasting a longer period depends on the depth of data available.

Once the unit of prediction and time horizon are determined, the next step is to decide what "forecasting outcomes" the tool will be set up to predict. Researchers such as Barnes and Hyatt can guide practitioners through this process, but the practitioners themselves must ultimately make the decisions because resources, personnel, operational and even political realities must be considered. In Philadelphia —

after weeks of examining caseloads and staffing levels — officials decided that approximately 15 percent of their probation population should be classified as high-risk, 25 to 30 percent as moderate-risk, and 55 to 60 percent as low-risk.

## Determining an Acceptable Error Rate

No prediction tool is perfect. The key to building a random forest prediction tool is assessing the risk of getting it wrong. This process involves determining, in advance, an acceptable error rate. This demands intensive collaboration between researchers and practitioners, one in which agency officials — not statisticians — must make crucial policy decisions. In particular, this means comparing pre-specified levels of “false positives” to “false negatives.”

A false negative is an actual high-risk person who was mistakenly identified as moderate- or low-risk. A false positive is an actual low- or moderate-risk person who was identified, and therefore supervised, as high-risk. As practitioners work side-by-side with researchers to set parameters for acceptable risks, they will inevitably encounter the need to make tradeoffs they can live with, according to Barnes and Hyatt. This is referred to as the “cost ratio.”

Hyatt explained how the process worked in Philadelphia. “Basically, we had to determine precisely how much more costly it would be to mistakenly classify a probationer in a lower-risk category who then went on to commit a serious crime, than it would be to intensely supervise someone who is actually a low-risk probationer because the tool had assessed him as high-risk.”

Most jurisdictions that contemplate building a random forest risk prediction tool would likely do what they did in Philadelphia: Set a higher relative cost for false negatives than for false positives. APPD decided on a cost ratio where false negatives were 2.6 times more costly than false positives — but any jurisdiction that wishes to design and implement a similar tool would have to determine its own cost ratio or error rate. And, because there is no single “right answer” — in terms of choosing the unit of prediction, the time horizon, the definition of out-

comes or the cost ratio — a jurisdiction considering a random forest model prediction tool must commit to this very delicate balancing act. Researchers can assist, but the practitioners must do the heavy lifting.

“I cannot emphasize this enough,” said Barnes. “Balancing these different types of errors with the model’s overall accuracy rate is not the job of the team’s statisticians. Because an agency’s leadership has to live with the consequences of any error that occurs once the forecasting tool goes live, they must decide what level of accuracy they can live with and the balance of potential errors they prefer.”

## Accuracy

The model APPD built with Barnes and Hyatt has an accuracy rate of 66 percent when considering all three categories. The final NIJ report provides great detail about the accuracy rates for the three risk categories. For example, probationers who were categorized as high-risk are 13 times more likely to commit a new serious offense within the two-year forecast period than either low- or moderate-risk probationers.

One significant benefit of random forest modeling is that different variables can be added without sacrificing the accuracy of predictions. Unlike linear regression analyses, random forest models do not require that a user know in advance what data will be useful in predicting behavior or which variables will affect the predictive power. The tool can be programmed to simply not consider a factor based on other variables. In other words, data can be “over-included,” and the tool will simply filter them out.

“By working hand-in-hand with their practitioner and policymaker partners, researchers can come up with the right ratio of variables that work within their own, unique jurisdiction, both from a practical standpoint in terms of the data that are available and from a standpoint of political and policy exigencies which decision-makers are comfortable putting into a forecast tool,” Hyatt said.

## Resources, Equitability and Fairness

Given the need to balance fiscal realities with an overarching mission to protect public safety, criminal justice professionals are beginning to look — with the same creativity and vigor as professionals in the private sector — at sophisticated statistical tools to solve problems. Therefore, it is likely that risk prediction tools using random forest modeling may play an important role in the future of our criminal justice system.

“Using random forest modeling gave us the assurance that we made use of the best science available to identify the most dangerous offenders,” said Barnes. “It has ensured that we are preserving resources and that the people who are subject to the policy decisions based on those risk assessments are being treated in a fair and consistent way.” He added, “You may not like being on high-risk probation, but from a procedural justice standpoint, you at least know that the decision was made the same way for everybody.”

### ENDNOTE

<sup>1</sup> The Pew Center on the States. March 2009. *One in 31: The long reach of American corrections*. Retrieved from [www.pew-states.org/uploaded/Files/PCS\\_Assessments/2009/PSPP\\_1in31\\_report\\_FINAL\\_WEB\\_3-26-09.pdf](http://www.pew-states.org/uploaded/Files/PCS_Assessments/2009/PSPP_1in31_report_FINAL_WEB_3-26-09.pdf).

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*Nancy Ritter is a writer and editor with the National Institute of Justice (NIJ). To read the full NIJ report, visit [www.ncjrs.gov/pdffiles1/nij/grants/238082.pdf](http://www.ncjrs.gov/pdffiles1/nij/grants/238082.pdf).*