a system which is often foreign to them. Hispanic parents may need to be offered participatory education in the educational system while their children are being taught skills.

Clearly there are many areas in which opportunities for Hispanics need to be opened, both in education and in the occupations for which they are being trained. If Hispanic students and their families are coming into the system with high hopes, then we must find ways to help the educational system and the wider society keep its promises to them.

In 1993, Hennepin County (which includes the city of Minneapolis and many of its suburbs) contained 24 percent of Minnesota's population, but 51 percent of the state's reported violent crimes and 35 percent of the state's reported property crimes. Public concern over crime and the manner in which the criminal justice system deals with convicted offenders is widespread. This concern is heightened whenever a convicted offender on probation or parole is arrested for a new offense.

Hennepin County's Department of Community Corrections, through its Division of Adult Corrections, supervises adult offenders placed on probation by the courts as well as offenders paroled from prison. In recent years it has had to supervise increasing numbers of offenders. Typically, 4,000 adult offenders are under direct one-on-one supervision. This new number is approximately double what it was in 1988. The number of probation officers and parole agents, however, remains the same, exactly sixty-six. The increased volume along with changes in the philosophy of punishment forced the department's management to reevaluate standards regarding which offenders should be directly supervised and for how long. The current practice of directly supervising all types of offenders similarly for their entire term is no longer workable.

In a joint venture, University experts in computer simulation worked with Hennepin County's Department of Community Corrections to predict how changes in current practice would affect the system of supervision. Would the caseloads for probation officers and parole agents become overburdened if new contact standards were implemented? Would conflicts in contact schedules be created? Either of these outcomes could severely strain a system that simply cannot be allowed to falter, even for a short while. A trial implementation seemed too risky, but through computer simulation the effects of a variety of changes could be explored without jeopardizing the system already in operation.

The Management Dilemma

Past philosophical notions of sentences shaped to each offender's particular circumstances or needs have come into conflict with a new criminological idea, the philosophy of just deserts. Under this philosophy, individual differences in socialization and behavior are largely ignored. Offenders convicted of the same offense who have the same prior criminal record receive similar sentences. Offenders who are deemed most serious (based on their offense and criminal history) are supervised more intensively. Provided no new offenses are committed, an offender's supervision can decline over time.

Because of these philosophic changes and the increasing numbers of offenders, probation and parole management in Hennepin County formulated new contact standards for the supervision of offenders. The proposed standards incorporated two key elements. First, only the most serious offenders would be supervised for a full twenty-four month period. Sex offenders, for example, are categorized among the most serious offenders. This contrasts sharply with current practice, where all types of offenders are supervised for periods that may exceed twenty-four months.

Second, the intensity of supervision would be more frequent at the beginning of the twenty-four-month period (for example, every week) and would decline over time (for example, to once a month) provided the offender had no new convictions. The contact standards might be tighter for person offenders, such as those with sexual assaults. This also differs greatly from current practice, where officers have nearly complete discretion over how often they meet with offenders on their caseload.

In order to maintain caseload integrity, management decided that officers' caseloads should not exceed seventy-five cases at any one point in time. A computer simulation offered a way of telling how these proposed contact standards would affect caseloads and the system's performance. In addition, management was interested in exploring a number of other questions that might be more easily studied through a computer simulation. How many and what type of offenders could be directly supervised by hiring additional officers? What kind of reduction in the number and type of offenders could be handled if the inflow of serious offenders was to accelerate rapidly? How would altering the length of appointments

## Computer Simulation in Probation and Parole Management

by W. David Kelton, Sarah Allen-Welter, Rebecca D. Goodman, Marcy Podkopac, Aarti Shanker, and Dinesh Wadhwani

Dario Menanteau-Horta is a professor of rural sociology and director of the Center for Rural Sociology and Community Analysis, School of Social Work at the University of Minnesota. His research interests include the study of the sociology of development, social organization and social change, rural institutions and community analysis, measurements of inequality and social well-being, and Latin American studies. He is originally from Chile where he studied journalism and sociology before receiving his M.A. and Ph.D. degrees in the United States. Menanteau wishes to thank the Spanish Speaking Affairs Council, the Hispanic students who participated in the survey, and Dr. Jose Salvador Arevalo for his research assistance in the early stages of this study.

This study was supported by an interactive research grant from CURA and the Office of the Vice President for Research, University of Minnesota. Interactive research grants have been created to encourage University faculty to carry out research projects that involve significant issues of public policy for the state and that include interaction with community groups, agencies, or organizations in Minnesota. These grants are available to regular faculty members at the University of Minnesota and are awarded annually on a competitive basis.
affect the system and the number of appointments that an officer could handle each day? If the number of required direct-supervision contacts were changed, perhaps for certain categories of offenders, what changes would occur in caseloads? What would the impact be when offenders were convicted of a new offense during their twenty-four months of supervision and either restarted the contact period or left supervision to go to prison? Where are there congestion points in the system? And are there other opportunities for savings and efficiencies?

The Computer Simulation

Simulation is widely used to design and control systems in manufacturing, transportation, and telecommunications, but many of the same logical operations are present in probation and parole operations as well. Offenders enter the system from several sources, schedule appointments in a prescribed manner, and eventually exit the system. Simulation models have already been applied to court processing,* but we are unaware of any applications to corrections.

Our simulation was designed so that each offender could be represented individually. The offender, contending for appointments with other offenders assigned to the same officer, could be tracked through each appointment until, no longer on probation or parole, he or she left the system. In following this process, the simulation becomes a tool for measuring and observing the system. We can, for example, follow officers’ caseloads and the degree to which offenders have difficulty scheduling appointments to see them.

The system proposed for supervising probation and parole in Hennepin County presented a number of variables that must be programmed into the computer simulation. Offenders arrive from three sources: parolees come from prison, while probationers come from the courts and from the county workhouse, known as the Adult Correctional Facility. Offenders are given a particular schedule of face-to-face contacts with either a probation officer or a parole agent (hereafter generically named officer). The frequency of contact depends on where the offender comes from and the nature of the offense (whether it is a felony or a misdemeanor, for example). These contacts occur over the course of two years (one year for misdemeanants); the maximum frequency being once a week. Typically, contact is more frequent at the beginning of the period and diminishes as time goes by.

An officer is assigned to a particular officer upon arrival, and remains with this officer while in the system. Again, depending on the attributes of the offender or the offense, officer assignment can be restricted. For instance, parolees can only be assigned to parole agents and probationers are only assigned to probation officers. Female parolees can only be assigned to certain agents. Within these constraints, there is an attempt to balance officer caseloads.

To make our model unambiguous, we had to make some assumptions about what will happen if an offender is not able to see his or her officer on the scheduled day. This can happen since only a fixed number of appointment slots are available in any given day. First, we assumed that if the officer has an open slot on either the day before or the day after the desired day, this was acceptable. We scheduled the appointment, and went on. Second, if this was not the case, we assumed that the offender reported on his or her appointed day and filled out some forms in lieu of the face-to-face contact.

- If this happened for an offender’s first visit, we called this a pink slip and regarded it as a serious failure of the system.
- If, however, this happened on a subsequent visit we called it a blue slip, which is still undesirable but not as serious as a pink slip.

One final variable was that an offender might be convicted of a new offense over the course of his or her two years in the system, an eventuality called a failure. Depending on the nature of the new conviction, the offender might go back and restart the two-year period (thus staying in the system) or might leave the system for prison (a typical outcome for parolees). Historical data on new convictions for offenders in Hennepin County were not readily available. We made educated guesses, using a variety of state and national studies of recidivism as models for the probability of failure and, given failure, the probability of restarting in the system or leaving it.

Creating the Model

The current state of the Hennepin County system was used as the initial condition for our simulation. Using information collected over a year, we loaded the system with a random number of offenders coming from the court, prison, and the workhouse. Probationers from the courts were chosen randomly out of a pool of between 3,093 and 3,347 offenders. Probationers from the workhouse came from a pool of between 325 and 364 offenders. And parolees, from prison, came from a pool of between 454 and 801 offenders.

In a simulation of this type, instantaneous events are identified that may change the state of the system. We identified three basic events: arrival in the system, end of an appointment with an officer, and the end of the simulation. Arrival times were based on the mean time between successive arrivals in the system. For parolees the mean time was 0.494 each day, or slightly over two per day. For probationers from court the mean time was 0.205 or about five per day. And for probationers from the workhouse it was 0.269 or slightly more than three per day.


*A fourth source of offenders is impatient treatment centers. Though our simulation had the capacity to include this source, it was excluded from the model because of the incompleteness of historical data about it.

The current practice of directly supervising all types of offenders in Hennepin County’s adult corrections is no longer workable.
Offenders were assigned to an officer based on the type of their arrival. If they were new to the system, we searched for an officer with the least work remaining in the class of officers to whom they could be assigned. Ties were broken in favor of the first officer to be located. If an officer was reentering the system he or she was assigned to the same officer as before. After officer assignment, the caseload statistics for the officer were updated, and the next offender to arrive was scheduled.

At the end of an appointment with an officer, the offender makes the next appointment according to his or her schedule with the assigned officer. It is also at this point that an offender may fail (be convicted of a new offense) and either restart the two-year schedule of appointments or leave the system. Officer statistics were updated at the end of each appointment event. The last event was the end of the simulation. The simulation ran to end after six years.

An event list was used to store essential information about each offender. The list included the time of each of the three types of events (arrival, end of appointment, and end of simulation) as well as where the offender came from (court, prison, workhouse), sex of the offender, officer assigned for supervision, whether or not the offender was a sex offender, whether the offender would fail, and if so when, and whether or not the offender was convicted for a misdemeanor. The appointment schedule for each offender was stored in an array equal in length to the longest required stay in the system (which is 104 weeks at present). Each cell of this array represented a week in the offender’s schedule. The week of the offender’s visit with the supervising officer was represented by a one in the corresponding cell. Other weeks were represented with a zero. This aided the search for when to make the offender’s next appointment.

We coded initially in FORTRAN and later converted to the C language, augmented by a modification of the SIMLIB utility routines.* We used CRAY-2, CRAY X-MP, and CRAY Y-MP supercomputers to run our simulations. The code was about 2,100 lines long. It took approximately forty CPU-minutes (on the first two machines mentioned above) for a replication of the six simulated years. The simulation was run three times and provided reasonably small standard errors while it was producing the measures we asked for.

There were three primary measures we asked the simulation to give us, as a way of assessing the probation and parole system performance:

- The average caseload per officer, as well as the maximum and minimum caseload.
- The number of pink slips and their proportion of the total number of attempts to make first appointments.
- The number of blue slips and their proportion of the total number of attempts to make appointments after the initial appointment.

The validity of the model was tested in several ways. First, we verified the code by testing the extreme values of the input-parameters, such as the rate at which offenders enter the system. Second, we looked at whether the simulation outputs corresponded with the present system. We found, for example, that parole officer caseload statistics from the simulation were consistent with recent observations of actual parole caseload sizes. In these ways we developed confidence in the validity of the simulation.

Findings from the Simulation

In order to explore Hennepin County’s most pressing questions, we ran our simulations so that three distinct scenarios could be compared. The scenarios varied in the number of contact periods officers’ scheduled each day and in how sex offenders were handled.

- Scenario 6—was the base case, setting all inflow rates and failure probabilities to values estimated directly from historical data. The “6” indicates that each officer scheduled six 45-minute face-to-face contact periods a day. Roughly one hour remained each day for other client-related activities.
- Scenario 5—was the same as Scenario 6 except that contact periods were reduced to five per day. It was felt that five periods might be unrealistic in view of the officers’ other responsibilities. Here 1.7 hours remained for other client-related activities.
- Scenario 5S—was the same as Scenario 5, except that all sex offenders were required to come in every week for the entire first year of their sentence. This created a marked increase in contact intensity over the other two scenarios. We ran this scenario as a response to public concern as well as to experiment with how the model would react to stress.

Tables 1-3 show the caseloads for officers under each of these three scenarios. In all there are sixty-six officers available to supervise the probation and parole opera-

tions for the county: fifty-three probation officers and thirteen parole agents. The average and standard deviations shown in the tables are averages over the three replications for the officers in each class. The maxima are taken from all the replications and officers in each class.

The tables show that the ratio of seventy-five offenders for officers' caseloads is severely pressured under each scenario, especially for probation officers, and for all officers if the maximum caseload, rather than the average, must stay below seventy-five. There is, in fact, very little caseload difference across the scenarios. This is because officers will arrive and be assigned to caseloads regardless of the number of appointments per day or the frequency of contact required.

It appears that probation officers' caseloads are heavier and more variable than those of parole agents. This is a function of the inflow rate of these types of offenders, as well as the number of officers of each type (recall that probationers are only assigned to probation officers, and parolees are only assigned to parole agents). If parole agents were assigned some probationers, the workload would become more even across all officers. Alternatively, it might be argued that parolees are inherently more difficult than probationers, justifying the differential in caseload statistics.

The variability of the results appears to be quite low in comparison with the magnitude of the system we were simulating. This was what allowed us to function with only three replications.

The other performance measures, pink slips and blue slips, show dramatic differences between each scenario (Table 4). Here it is clear that reducing the number of appointments from six to five per day increases the frequency of both kinds of slips. This is to be expected, since officers' appointment slots have been decreased by one-sixth, increasing the intensity of supervision for sex offenders (scenario 5S) further increased the frequency of blue slips, but did not have much effect on pink slips. This is because sex offenders still arrive and face basically the same one-time pink slip risk, while the increases in their supervision expose them to much higher risks of not getting appointments after the initial contact (blue slip).

Whether these levels of failure to meet face-to-face with an officer are unacceptable is a matter for management to decide. The simulation clearly indicates and quantifies the consequences of altering officer availability and intensifying some kinds of supervision.

**Management Changes**

A written description of the simulation study was distributed to all probation officers and parole agents prior to implementing any formal changes in the work rules. The results of the simulation contributed to the already intense discussion regarding the imposition of contact standards. The assumptions underlying the model came under particular scrutiny. For example, the union representing officers and agents argued that five appointments per day at forty-five minutes each (Scenario 5) would not leave sufficient time to deal with crises and emergencies, to make necessary but unplanned court appearances, and to travel between work sites. The union also pointed out that each scenario incorrectly assumed that offenders actually show up for scheduled appointments. They provided data showing that offenders frequently do not meet with their officers as scheduled.

The contact standards were implemented following much discussion at all levels of the organization. Modifications were made from the original proposed standards. The simulation made clear that probation officer caseloads could not be held to a maximum of seventy-five offenders. The new standards were put into effect with the full knowledge that probation officers' caseloads would average seventy-five offenders. Because caseload sizes were larger than desired and because of concerns about training officers to handle both misdemeanor and felony cases, it was decided that nine officers would be designated to supervise misdemeanor offenders. How this decision would affect the system remained to be examined in future work.

The simulation confirmed the need for flexibility in the length of each appointment. For the sake of simplicity, all appointments were assumed to last forty-five minutes. It was expected, however, that appointment length would vary according to the offender's behavior under supervision and his or her stage in the two-year period. Given the caseloads for probation officers, it became clear that the length of the appointment was an even greater source of flexibility than was originally imagined. Thus, management stressed that the appointment length was not fixed and was subject to the discretion of each officer.

Management obtained additional flexibility by permitting substitutions in the type of contacts to be made. Rather than requiring that all contacts be face-to-face between the offender and the officer, telephone contact or collateral contacts with other family members were allowed in exchange for some of the face-to-face appointments.

The difficulty in scheduling appointments with officers (shown in the pink and blue slips) was unknown prior to the simulation. When the new contact standards were implemented, procedures were devised to address some of the appointment bottlenecks. In fact, blue slip has become part of the accepted terminology in supervision at the department. Discussions about the contact standards are still ongoing and it is expected that alterations and refinements will continue to be made.

**Current and Future Work**

We are currently extending our work with these kinds of models and simulations in several directions. Further experimentation with the existing model is identifying which of the many input parameters are most critical for system performance. We are also trying to generalize the model for more flexible and realistic appointment scheduling.

In the future, a number of avenues may be open. This modeling and simulation approach could be extended to related arenas, such as juvenile corrections and the courts. The model may also be used to address proposed alternatives that originate both within Hennepin County's Department of Community Corrections and outside it. For example, if the legislature mandates that all sex offenders be seen every week for two years, the simulation could show who would not be directly supervised under such a policy given the existing staff.

---

**Table 1: Caseloads for Scenario 6**

<table>
<thead>
<tr>
<th>Officers</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>71.39</td>
<td>5.54</td>
<td>103</td>
</tr>
<tr>
<td>Probation</td>
<td>74.68</td>
<td>6.85</td>
<td>103</td>
</tr>
<tr>
<td>Parole</td>
<td>58.03</td>
<td>1.02</td>
<td>75</td>
</tr>
</tbody>
</table>

**Table 2: Caseloads for Scenario 5**

<table>
<thead>
<tr>
<th>Officers</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>71.81</td>
<td>5.50</td>
<td>106</td>
</tr>
<tr>
<td>Probation</td>
<td>75.09</td>
<td>6.67</td>
<td>106</td>
</tr>
<tr>
<td>Parole</td>
<td>58.44</td>
<td>0.72</td>
<td>79</td>
</tr>
</tbody>
</table>

**Table 3: Caseloads for Scenario 5S**

<table>
<thead>
<tr>
<th>Officers</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>71.81</td>
<td>5.50</td>
<td>101</td>
</tr>
<tr>
<td>Probation</td>
<td>75.09</td>
<td>6.67</td>
<td>101</td>
</tr>
<tr>
<td>Parole</td>
<td>58.44</td>
<td>0.72</td>
<td>82</td>
</tr>
</tbody>
</table>

**Table 4: Pink and Blue Slips (as a percent of the total number of appointments attempted)**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Pink Slips</th>
<th>Blue Slips</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.08</td>
<td>5.02</td>
</tr>
<tr>
<td>5</td>
<td>1.50</td>
<td>16.69</td>
</tr>
<tr>
<td>5S</td>
<td>1.57</td>
<td>20.70</td>
</tr>
</tbody>
</table>

David Kelton is a professor of operations and management science in the Carlson
School of Management at the University of Minnesota. Sarah Allen-Welter is a research associate and Rebecca Goodman is director of research for the Citizens Council in Minneapolis. They both worked with Hennepin County’s Department of Community Corrections at the time this computer simulation was undertaken. Marcy Podkopaicz is a senior statistical analyst with the Hennepin County Department of Community Corrections. Aarti Shanker is a staff manager for inventory forecasting in the Department of Technical Operations at Northwest Airlines, but was a doctoral student in operations and management science at the University of Minnesota when she worked on this project. Dinesh Wadhwani is currently a doctoral student in operations and management science at the University of Minnesota.

This study was supported by an interactive research grant from CURA and the Office of the Vice President for Research, University of Minnesota. Interactive research grants have been created to encourage University faculty to carry out research projects that involve significant issues of public policy for the state and that include interaction with community groups, agencies, or organizations in Minnesota. These grants are available to regular faculty members at the University of Minnesota and are awarded annually on a competitive basis.

The study was also supported by a grant from Hennepin County. The authors want to express their appreciation to Dennis Avery and Michael Zimmerman for their comments and insights. Computational support provided by the Minnesota Supercomputer Institute was essential for the intensive computing required in this project. Earlier versions of portions of this article have appeared in the Proceedings of the 1993 Winter Simulation Conference (pp. 1244-1249).

Project Awards

In an attempt to keep our readers more up to date about CURA projects, we are featuring capsule descriptions of projects currently underway in each issue of the CURA Reporter. In this issue we feature a new training program housed at CURA.

The Minneapolis Training Program for Neighborhood Organizers

In recent years, Minneapolis organizations have shown an unprecedented level of growth and activity. Many neighborhood activists have said that to take on the problems facing their neighborhoods they need experienced organizers to help develop community leadership skills and build a solid foundation for their organizations. Unfortunately, neighborhood groups find it difficult or impossible to recruit and hire experienced organizers.

This new program, funded by Hennepin County and housed with CURA, is helping to alleviate the problem by providing hands-on training for six organizer interns in six different Minneapolis neighborhoods: Kenny, Field-Regina-Northrup, Bryant, Harrison, Holland, and Downtown. The internships are for one year and began in July 1994. Interns are learning both through training and direct experience. Topics in the training include:

- leadership development
- issue identification
- supervising staff
- office management
- researching issues
- organizing underrepresented groups
- volunteer recruitment
- fundraising
- finances
- running meetings and events
- developing issues and strategies

The interns’ primary task will be to learn how to develop the community’s leadership and recruiting capacities. Instead of providing services for the organization, they will help people involved in the organization do the job for themselves.

The program also offers monthly training sessions for current Minneapolis organizers. An average of twenty organizers attend these trainings. In addition, training will be offered to Minneapolis neighborhood leaders in the future.

New CURA Publication


The University of Minnesota offers many courses that include survey research. Courses are listed in this guide if at least 25 percent of their primary focus is on survey research. Only classes on the Twin Cities campus are included. Listings are alphabetical by department and include course descriptions, prerequisites, quarter when the class will be offered, and the percent of the class devoted to survey research. Contact persons and phone numbers are listed for each department.

CURA publications may be ordered on the Publications Order Form in this CURA Reporter or by phoning 612/625-1551.