INTERACTIVE COMPUTER MAPPING APPLICATIONS TO CRIMINAL JUSTICE PLANNING IN THREE VIRGINIA CITIES

Leonard J. Simutis, Assistant Dean
Todd A. Scott, Instructor
Division of Environmental and Urban Systems
Virginia Tech
Blacksburg, Virginia 24061

The analysis of crime in local communities, and the administrative responses to crime problems, have evolved into a fairly predictable set of descriptions and procedures. The deficiencies in current approaches to dealing with crime and its causes, particularly in terms of useful and reliable data about the social and economic characteristics of high crime areas, have led to the view that significant advances in understanding the causes of crime, and dealing with its consequences will only come about if analysts undertake exhaustive data collection, sophisticated research designs, and clever data analysis.

The project described in this paper works from a substantially different set of premises:

1) that intuition and judgment based on local knowledge and experience are far more important than sophisticated data analysis
2) that no amount of number-crunching will ever unearth the elusive "causes" of crime, particularly if deterministic approaches to data analysis are employed
3) that there are ways in which data display and analysis using heuristic approaches can influence the local decision-making process in dealing with crime problems in local communities.

The project was undertaken specifically to explore the ways in which heuristic approaches to problem definition and data analysis could be applied to the problem of crime in local communities. The project is funded by the Virginia Division of Justice and Crime Prevention, and is being conducted through the Center for Urban and Regional Studies at Virginia Tech, with Professors Sara Rosenberry and Beverly Yanich serving as principal investigators. Initially, the project has been based in Portsmouth, Virginia, but recently the project has been expanded in scope to include the cities of Norfolk and Hampton as well.

The project provides two kinds of technical assistance to local governments. The first relates to interactive computer display and analysis of crime-related data. The second is in problem definition and group problem-solving techniques which focus the utilization of local resources and knowledge in the definition and understanding of crime-related problems in the community. In order to carry out the technical assistance, the first phase involves the creation of a data base to describe the community, working from existing sources of information normally collected and tabulated for use by operating public agencies. The data base is made available through time-sharing computer terminals using commonly available statistical analysis procedures--SPSS--for statistical purposes and data management capabilities. The data analysis capabilities include computer-generated polygon displays and overlays, selective data retrieval and analysis, and a subset of the exploratory data analysis techniques developed by John Tukey. While most of these analysis capabilities are not currently available to most local governments, it can be anticipated that they will become widely available during the next decade.

In addition to the creation of a data base and analysis techniques, the project's procedures also include an analysis of the community's decision-making environment as it relates to crime control. This aspect of the approach is particularly concerned with the various public and private institutions responsible for dealing with crime-related problems, identifying the patterns of interaction among those institutions, and creating mechanisms for exchanging information about decisions which may affect the character of the community. The intent, over time, is to develop not only a shared data base,

but also a shared recognition of a problem and an awareness of the variety for institutional responses developed to deal with crime in communities.

Heuristic Approaches and Exploratory Data Analysis

The operational mechanisms for conducting the project are derived from heuristic approaches to problem recognition and data analysis. The term "heuristic" is based on the Greek word for discovery. Heuristic approaches are meant to be inference-aiding, a way of testing hunches. They rely primarily on a process of conjecture-test: the search for possible solutions to a problem within existing limitations of knowledge and data, but without any formal decision rules based on statistical inference. Rather than relying on elaborate research designs and exhaustive data collection, heuristic approaches depend on the insight and judgment of the analyst when applied to a limited set of data and observations.

Heuristic approaches work from the unfashionable premise that judgment is important, that insight is something to be nourished, nurtured, and rewarded, and that local knowledge and sensitivity derived from experience are valuable and essential elements in any decision-making process. While deterministic approaches try to control for the bias that might be introduced by the analyst, heuristic approaches depend on the analyst bringing prior experience to a problem which constructively contributes to finding a solution.

Heuristic approaches do not rely on formal tests of statistical significance. Rather, they depend on methods for verifying or refuting the judgments and hunches brought to the particular problem. Recently, methods for dealing with data in a heuristic fashion have been greatly improved by the work conducted by John Tukey of Princeton University. Under the title of "exploratory data analysis," Tukey describes a series of data display and analysis procedures which are quite useful in discerning underlying trends or patterns in data distributions without having to rely on more traditional, formal tests of statistical significance.

Tukey's methods are designed to be employed using manual techniques, but the methods are greatly facilitated by employing interactive computing versions of data dis-

play and analysis. By breaking from formal decision rules derived from levels of statistical significance, and relying instead on inspection and judgmental interpretation of data, Tukey has made a major conceptual and analytical contribution which extends the applicability of heuristic approaches to a wide range of social problems.

Project Procedures

The major focus for carrying out project activities is the organization of task forces from the community to define the problem, and to establish the decision rules for data analysis. The task force approach is based on heuristic techniques of inquiry and discovery, drawing on local knowledge and perceptions of the problem. Where possible, data are derived from existing sources as suggested by task force participants. In some instances, special tabulations may be required, but these are normally discouraged. The effort is to make full use of existing data sources, rather than falling back on the excuse of data unavailability to avoid dealing with certain issues.

The major intent is to have local decision-makers actively involved in selecting the data for analysis generating the analysis framework, and interpreting the findings using their insight and experience based on local knowledge. In this way, the technology of interactive computer graphics and data analysis is a way of enhancing rather than replacing local decision-making capability.

Once the data have been coded and stored, it is a relatively simple matter to generate displays of individual variables or to create composite overlays using computer graphics. The graphics displays are used initially to ascertain visually whether there are spatial clusterings of particular community characteristics which may be related to crime. The visual inspection becomes one way in which the insights or prior knowledge of decision-makers may be supported or refuted, and provides a basis for defining further inquiries of the data base.

The displays then, provide both a reconnaissance function and a filtering one, since the inspection of the displays often leads to the focus on a particular area or subset of neighborhoods in the city. The techniques

associated with exploratory data analysis also provide a powerful mechanism for focusing and filtering the spatial patterns which may exist in the community. Of course, such displays have applicability in areas other than criminal justice planning, and have served a useful role in other aspects of community planning.

Subsequent phases of the analysis are focused on specific problems in the community identified by local decision-makers. There is no presumption that analysts from outside the community can go much beyond descriptive statements about the community. Instead, by placing reliance on heuristic approaches, local knowledge and experience can be the basis for refining the questions to be examined and in formulating the hypotheses to be explored in more detail. In Portsmouth, for example, detailed studies are being conducted of the occurrence of crime in selected public housing communities in which there are clusters of crime problems, and social service programs designed to deal with community dysfunctions.

Computer-Based Procedures

Just as there was a reliance on utilizing existing approaches to data collection when initiating the project, there was a similar reliance on modifying the existing computer software for the project, rather than undertaking significant software development. As a consequence, the major software development activity focused on linking together the SPSS package of statistical routines with the CALFORM program for shaded polygon mapping.

This was accomplished by creating a pseudo-interactive environment by linking the two software packages together with minor modifications to their batch versions. The pseudo-interactive environment was relatively easy to create, given the computing environment at Virginia Tech. The hardware configuration is in IBM 370/158 with either Tektronix 4010 family graphics terminals or Hewlett Packard 2648 graphics terminals as the primary output medium. Graphics displays may also be produced on either a Calcomp or a Versatec plotter at the main computing center, or on a Tektronix 4662 plotter tied to a terminal. Installation of a Tektronix 4027 terminal later this fall will allow for color graphic output as well.

The operating system environment is VM370 using CMS time-sharing facilities. VM is itself a pseudo-interactive environment, so in reality the programs are twice-removed from any true interactive computing environment. However, because of the speed of software execution, and the luxury of relatively high transmission rates between the graphics terminals and the host computer (either 2400 or 1200 baud), the process appears transparently to the user as an interactive one. For all standard statistical operations, SPSS is used both for analysis and as a crude data base management system. SPSS is used to generate the necessary input data for CALFORM (using the WRITE CASES option). CALFORM is used, then, only for graphic output generation, and some of the analysis capabilities inherent in CALFORM are currently employed.

Through a series of prompts executed in a conversational mode, the user specifies the data variables to be included in the analysis, the statistical procedures to be employed, and legends and output medium for the graphics displays. For other than trivial tasks, a knowledge of SPSS is essential, and an understanding of the purposes of descriptive and deterministic statistical approaches is assumed. So while the program sequence is meant to be conversational, some intelligence is necessary to make it a meaningful dialogue! Employing a widely known statistics package like SPSS increases the likelihood that the analyst will be comfortable with the processing environment.

The computer procedures for using the exploratory data analysis routines, such as box-plots, stem and leaf plots, and scattergrams all are based on refinements to the algorithms prepared by Donald R. McNeil, Interactive Data Analysis (New York, 1977). Currently, the routines are not tied to graphic displays of the spatial distribution of the results from the exploratory data analysis algorithms; however, it is anticipated that this capability will be available in the near future.

The analysis framework had been applied to a variety of social, economic, land use and criminal justice data using different levels of aggregation in each of the three cities - census tracts in Portsmouth, traffic zones in Hampton, and neighborhood areas called "planning districts" in Norfolk. The results to date have

been most encouraging, and we anticipate being able to continue to refine the heuristic approaches developed to date, as well as the graphics routines, to modify the ways in which crime-related problems are described and analyzed at the local level. Detailed information about the project and computer programs, as well as a project summary report, is available from the authors.