Preface

According to Gewin (2004), in early 2004, the U.S. Department of Labor identified geotechnology as one of the most important emerging and evolving fields. For the last decade or so, as Clarke (2003) points out, the Geographic Information Systems (GIS) industry "has seen double-digit annual growth." Among GIS applications related to socioeconomic issues or public policy, crime analysis is one of the most active fields.

GIS and related geotechnologies have turned crime mapping into a powerful decision-making tool for law enforcement agencies. Based on a 1997 survey conducted by the Crime Mapping Research Center (CMRC) of the National Institute of Justice (NIJ, the research arm of the U.S. Department of Justice), computerized *crime mapping* in law enforcement agencies has experienced rapid growth. See Figure 1 according to Weisburd and Lum (2001). *Crime mapping* is often used as a synonym for *GIS-based crime analysis*. However, GIS is beyond mapping, and increasingly so for crime studies and control.
There are three objectives to this book:

- The first is to showcase *a diverse array of GIS applications in crime analysis that are not limited to crime mapping* (though crime mapping remains the primary and fundamental function of GIS). The book covers themes from general issues such as GIS as a communication process and inter-jurisdictional data sharing to specific applications in tracking serial killers and predicting juvenile violence; from routine GIS tasks such as geocoding and buffer analysis, to advanced simulation models; and from neighborhood violence and crime in and around public housing to homicide across southern states in the U.S.
- The second objective is to feature *a broad range of new methods and techniques* including geographic profiling, agent-based modeling, GPS tracking and web GIS.

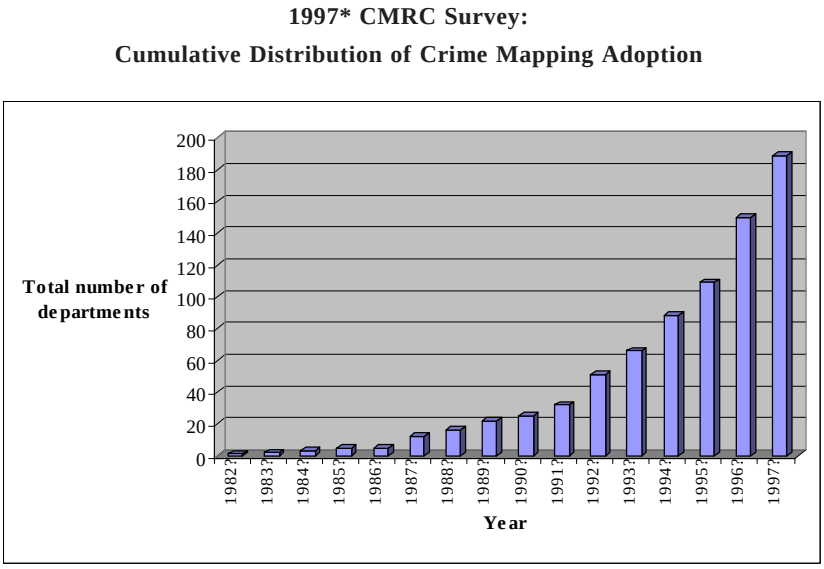
- The third objective is to *bridge the academics and practitioners* for crime analysis and crime control. Contributors range from university professors, criminologists in research institutes to police chiefs, GIS analysts in police departments and consultants in criminal justice.

I believe that this book is useful to a wide range of audience in both academia and in law enforcement agencies.

In the following, I will provide a brief overview of all chapters and highlight what I consider the most important contributions. The overview serves as a tour guide in the "hallway", and points the reader to the various "rooms," where one may explore the rich contents that are of most interests to them.

The first section contains two chapters covering a common issue: *data sharing*. GIS plays an important role in enhancing data sharing, improving public access to data, and assisting decision making in local governments. In Chapter I, *GIS as a Communication Process: Experiences from the Milwaukee COMPASS Project*," Jochen Albrecht and James Pingel report their experience from the Milwaukee COMPASS (Community Mapping, Planning and Analysis for Safety Strategies) project. The National Institute of Justice (NIJ) initiated the COMPASS program in 1999, with an explicit emphasis on using GIS for analyzing public safety problems and on collaborative partnerships with actors outside the criminal justice community. The Milwaukee COMPASS project used a web GIS to foster communication among public safety programs as well as between

Figure 1. Growth of computerized crime mapping in law enforcement agencies in the U.S.



government agencies and local communities, and demonstrated the problem-solving capabilities of GIS. Chapter I details the project's implementation process and various challenges, which may be useful for many agencies that are pursuing similar programs. In Chapter II, *Interjurisdictional Law Enforcement Data Sharing Issues: Benefits of the Use of Geo-Spatial Technologies and Barriers to More Widespread Cooperation*, Mark R. Leipnik and Donald P. Albert cite various examples to illustrate the importance of using GIS to create and disseminate geospatial data across jurisdictions and across departments within a jurisdiction. They also discuss the benefits and barriers for data sharing among law enforcement agencies.

The second section includes three chapters examining several issues related to *data quality*. In Chapter III, *Garbage In, Garbage Out: Geocoding Accuracy and Spatial Analysis of Crime*, Tess McCarthy and Jerry Ratcliffe examine three sources for spatial data inaccuracy (conceptual, positional and attribute) and their impact on crime analysis. Drawn from the experience of geocoding burglary records in an Australian city, they also compile the guidelines for the best practice in geocoding address data. In Chapter IV, *Disaggregating the Journey to Homicide*, Elizabeth Groff and J. Thomas McEwen focus on distances traveled by homicide offenders and by victims. They analyze the differences by homicide motive, by offenders and victims by sex and age, and between Euclidean and street distances. One interesting finding is that both victims and offenders tend to be involved in homicide incidents close to their residences (i.e., a median distance of 0.54 miles for victims and 0.74 miles for offenders). One may find the result useful for justifying a common practice in many studies utilizing aggregate data: using homicide incident locations as approximate locations of offenders. In Chapter V, *Constructing Geographic Areas for Analysis of Homicide in Small Populations: Testing Herding-Culture-of-Honor Proposition*, Fahui Wang and Van M. O'Brien warn the small population problem in analyzing rare events, such as homicide, and propose two simple geographic approaches to mitigate the problem. They apply the techniques to testing the herding-culture-of-honor hypothesis proposed by Nisbett and Reaves, and they find that the herding-culture-of-honor proposition was merely an artifact of unreliable estimate of homicide rates, particularly in areas with small population.

The third section has three chapters on *geographic profiling*, a methodology for analyzing the geographic locations of a linked series of crimes to determine the unknown offender's most probable residence area. In Chapter VI, *Geographic Profiling for Serial Crime Investigation*, D. Kim Rossmo, Ian Laverty and Brad Moore discuss the theoretical foundation for geographic profiling such as the Rigel geographic profiling system: commonly known as the distance-decay law with consideration of a buffer zone around an offender's residence (or workplace). Note that a geographic profile does not pinpoint a single location, but rather provides an optimal search strategy. Its value may be enhanced

when it is combined with other information such as a behavioral profile and neighborhood land use and demographic data. In Chapter VII, *Single Incident Geographical Profiling*, Richard Z. Gore, Nicholas J. Tofiluk and Kenneth V. Griffiths explore a data intensive method that applies geographic profiling techniques in a single incident. The method predicts offender residence by computing the relative frequencies of offender residences obtained from arrest record data for all who have committed crimes around the incident location in the past. They evaluate the effectiveness of different geographic filters and examine the boundary effects in each scenario. In Chapter VIII, *Geographic Profiling and Spatial Analysis of Serial Homicides*, Sunghoon Roh and Mark R. Leipnik use the case of serial killer Robert Yates to illustrate how GIS-based spatial analysis techniques, particularly geographic profiling, was used in serial homicide investigations.

The fourth section is on *crime monitoring and tracking* with three chapters. Chapter IX, *Geographic Surveillance of Crime Frequencies in Small Areas*, by Peter A. Rogerson, describes a system for detecting any increase in any area's crime frequency. The system compares cumulative differences between the observed and expected crime frequencies in an area, and identifies areas that experience any significant increases in crime activities. Chapter X, *Application of Tracking Signals to Detect Time Series Pattern Changes in Crime Mapping Systems*, by Wilpen L. Gorr and Shannon A. McKay has a similar objective: detecting areas with significant changes in crime patterns. Gorr and McKay apply a technique used widely in management science, so-called "smoothed-error-term tracking signal," which uses all prior data to estimate trend and seasonality as the counterfactual basis of comparison and quickly detects step jumps and outliers. Both Rogerson's method and the Gorr-McKay method are implemented in GIS. Chapter XI, *Integrating GIS, GPS and MIS on the Web: EMPACT in Florida*, by Gregory A. Frost, describes the EMPACT (Electronic Monitoring Protection and Crime Tracking) project in Florida. The EMPACT automatically correlates data from GPS tracking of offenders (probationers, parolees, and offenders on pre-trial release) and local crime incident data through a web-based interface, and determines whether a tracked offender is at the scene of a crime incident. It demonstrates how geotechnologies, including GIS and GPS, are used on the frontlines for crime prevention and control.

The fifth section showcases five case studies using *new methods and technologies*. Chapter XII, *Simulating Crime Events and Crime Patterns in a RA/CA Model*, by Lin Liu, Xuguang Wang, John Eck, and Jun Liang, use a cellular automaton (CA) model to simulate crime patterns. Based on the routine activity theory, the model considers offenders, targets and crime places as individual agents and simulates crime patterns based on the interaction between these three agents at a specific time. The calibrated simulation model generates crimes similar to actual crimes in both the total number of crimes and their

spatial distribution. This demonstrates the promise of using such a model as a virtual laboratory for predicting future crime patterns based on different conditions. Chapter XIII, *Integrating GIS and Maximal Covering Models to Determine Optimal Police Patrol Areas*, by Kevin M. Curtin, Fang Qui, Karen Hayslett-McCall and Timothy M. Bray, applies an optimal covering model (commonly used in location and allocation studies), to finding the most efficient spatial distribution of police patrols. The method takes GIS data layers of incidents and road network, uses linear programming to formulate the optimization problem, and finds heuristic solutions that increase the current level of police service. The method should be useful to decision makers by providing alternative (and better) police patrol covering scenarios. Chapter XIV, *Web GIS for Mapping Community Crime Rates: Approaches and Challenges*, by Tung-Kai Shyy, Robert J. Stimson, John Western, Allan T. Murray, and Lorraine Mazerolle, describes a prototype web GIS for mapping crime rates in Brisbane, Australia. In addition, they discuss the challenges for web GIS applications and offer suggestions to overcome the barriers. Chapter XV, *Identifying "Hot Link" Between Crime and Crime-Related Locations*, by Yongmei Lu, goes one step further than the common hot spot analysis. Her objective is to identify "hot links", i.e., the links between crime incidents and the offenders' residence locations or the links between crime incidents and the victims' residence locations. Like the work by Groff and McEwen (Chapter IV), her work represents the efforts of using GIS in analyzing journey-to-crime (J2C) patterns. Chapter XVI, *Remote Sensing and Spatial Statistics as Tools in Crime Analysis*, by Dongmei Chen, John R. Weeks, and John V. Kaiser Jr., discusses remotely sensed satellite imagery to define land use variables that may be associated with criminal activities. The newly-defined variables, along with traditional socioeconomic variables, are used to explain intraurban variation of crime rates in a regression model that accounts for spatial autocorrelation.

Two case studies on *neighborhood crimes* are collected in the final section. Chapter XVII, *Routine Activities of Youth and Neighborhood Violence: Spatial Modeling of Place, Time and Crime*, Caterina Gouvis Roman, aims to explain neighborhood violence by physical environment, neighborhood characteristics, and routine activities of youth. A new angle of the work is its emphasis on how time influences crime patterns across places and environments. It uses a spatial lag model to account for spatial dependence. Chapter XVIII, *Measuring Crime in and around Public Housing Using GIS*, by Harold R. Holzman, Robert A. Hyatt and Tarl Roger Kudrick, addresses the debate whether high crime rates associated with public housing are attributable to the housing itself or the neighborhood surrounding it. Using extracted crime counts in public housing developments and the surrounding neighborhoods in three cities, the study reveals that the answer depends on the types of crime. The risk of aggravated assault in public housing communities is much higher than in the surrounding neighborhoods, whereas risk of property crimes such as burglary, larceny and car theft is much lower.

References

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Weisburd, D. & Lum, C. (2001). Translating research into practice: Reflections on the diffusion of crime mapping innovation. Keynote speech at the *Fifth Annual International Crime Mapping Research Conference*, Dec. 1-4, Dallas, TX.