Overview

- Crime Analysis
  - Definition
  - Types
  - Goals
- Problem Solving
- GIS
  - Definition
  - Capabilities
  - Importance

Crime Analysis

**Definition:**
The qualitative and quantitative study of crime and law enforcement information in combination with socio-demographic and spatial factors to apprehend criminals, prevent crime, reduce disorder, and evaluate organizational procedures.

The main function of crime analysis is to support law enforcement endeavors.
Goals of Crime Analysis

- Apprehending criminals
- Prevent crime
- Reduce disorder
- Evaluate organizational procedures

Crime Analysis Studies

- A study is a systematic way of looking at crime and law enforcement information
- Crime analysis is not examining information haphazardly but rather is applying formal analytical and statistical techniques as well as research methodology to law enforcement information according to the rules of social science.

Types of Crime Analysis

- Intelligence Analysis
- Criminal Investigative Analysis
- Tactical Crime Analysis
- Strategic Crime Analysis
- Administrative Crime Analysis
Intelligence Analysis

The study of “organized” criminal activity, whether or not it is reported to law enforcement, to assist investigative personnel in linking people, events, and property.

Criminal Investigative Analysis

The study of serial criminals, victims, and/or crime scenes as well as physical, socio-demographic, psychological, and geographic characteristics to develop patterns that will assist in linking together and solving current serial criminal activity.

Tactical Crime Analysis

The study of recent criminal incidents and potential criminal activity by examining characteristics such as how, when, and where the activity has occurred to assist in problem solving by developing patterns and trends, identifying investigative leads/suspects, and clearing cases.
Strategic Crime Analysis

- The study of crime and law enforcement information integrated with socio-demographic and spatial factors to determine long term “patterns” of activity, to assist in problem solving, as well as to research and evaluate responses and procedures.

Administrative Crime Analysis

- The presentation of interesting findings of crime research and analysis based on legal, political, and practical concerns to inform audiences within law enforcement administration, city government/council, and citizens.

Crime Analysis Model
Problem Solving in Crime Analysis

Definition:
A methodical process for reducing the impact of crime and disorder problems in a community. The problem solving approach is an integral component of the philosophy of community policing.

SARA Approach to Problem Solving

The SARA approach to problem solving is described as
- scanning (S),
- analysis (A),
- response (R), and
- assessment (A).
That is, once a problem is identified and its characteristics are analyzed, a response is developed and deployed to combat the problem, and after a determined time period, the response is evaluated. The following is a brief discussion of each aspect of the SARA process.

Scanning

Scanning is the first step to problem solving and is the identification of a cluster of similar, related, or recurring incidents through a preliminary review of information, and the selection of this crime/disorder problem among competing priorities for future examination.
Analysis

Analysis is the use of several sources of information to determine why a problem is occurring, who is responsible, who is affected, where the problem is located, when it occurs, and what form the problem takes.

Response

Response is the execution of a tailored set of actions that address the most important findings of the analysis phase.

Assessment

Assessment is the measurement of the impact(s) of the responses on the targeted crime/disorder problem using information collected from multiple sources, both before and after the responses have been implemented.
Defining GIS

Different definitions of a GIS have evolved in different areas and disciplines. All GIS definitions recognize that spatial data are unique because they are linked to maps. A GIS at least consists of a database, map information, and a computer-based link between them.

An Information System Applied to Geographic Data

System: a group of connected entities and activities which interact for a common purpose. Information system: set of processes executed on raw data to produce information which will be useful in decision-making. GIS: uses geographically referenced data as well as non-spatial data and includes operations which support spatial analysis.

Spatial data

Objects or entities that are referenced by their location:
- Latitude / longitude coordinates
- x / y coordinates
- Street address
- Administrative unit
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**Attribute data**

- Data that are linked to the spatial objects
  - Census data by administrative unit
  - Land parcel ownership records
  - Soil or vegetation characteristics
  - Health records by medical center
  - Road quality information

**Spatial and non-spatial data**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Date   Location     Type</td>
</tr>
<tr>
<td>1034161</td>
<td>5 Wheel spoke</td>
<td>1/22   123 James St. Robbery</td>
</tr>
<tr>
<td>1051671</td>
<td>1 Ball bearing</td>
<td>1/24   22 Smith St. Burglary</td>
</tr>
<tr>
<td>1047623</td>
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<td>2/10   9 ElmSt #4A Assault</td>
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<tr>
<td>1021413</td>
<td>2 Tire</td>
<td>2/13   12 Fifth Avenue Breaking &amp; Entering</td>
</tr>
<tr>
<td>1011210</td>
<td>3 Handlebars</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1.1** Two databases. A database contains columns (attributes) and rows (records). The bicycle part list on the left is not spatial. The part could be located anywhere. The list of crimes on the right is spatial because one of the attributes, the street address, locates the crimes on a map. This list could be used in a GIS.

**Attribute relations**

**Police Precincts**

<table>
<thead>
<tr>
<th>Id</th>
<th>Area</th>
<th>Staff</th>
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<tbody>
<tr>
<td>306</td>
<td>3.0</td>
<td>55</td>
</tr>
<tr>
<td>305</td>
<td>5.4</td>
<td>59</td>
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<table>
<thead>
<tr>
<th>Id</th>
<th>Type</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>156</td>
<td>Robbery</td>
<td>1700</td>
</tr>
<tr>
<td>157</td>
<td>Burglary</td>
<td>2141</td>
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</table>

**Lecture 4: Crime Analysis and GIS**
Traditionally information is organized in lists, maps add information about the “where” of the data.

Dueker's 1979 definition has survived the test of time.

"A geographic information system is a special case of information systems where the database consists of observations on spatially distributed features, activities or events, which are definable in space as points, lines, or areas. A geographic information system manipulates data about these points, lines, and areas to retrieve data for ad hoc queries and analyses" (Dueker, 1979, p 106).

The Feature Model

- Dueker's definition uses the feature model of geographic space.
- The standard feature model divides a mapped landscape up into features, that can be points, lines, or areas.
- Using a GIS involves capturing the spatial distribution of features by measurement of the world or of maps.
- Almost all human activity and natural phenomena are spatially distributed, so can be studied using a GIS.
- A GIS uses map features to manage data.
GIS Applications: Law Enforcement and Crime Mapping

**The Feature Model**

<table>
<thead>
<tr>
<th>POINT</th>
<th>LINE</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM 123</td>
<td>River</td>
<td>Lake</td>
</tr>
</tbody>
</table>

*Figure 1.2 The Feature Model: Examples of a point feature (elevation benchmark), a line feature (river) and an area feature (lake).*

GIS enables you to visualize information in new ways that reveal new and important relationships, patterns, and trends.

- GIS integrates various types of spatial data (databases, imagery, GPS coordinates, etc.).

**What can a GIS do?**

- GIS enables you to visualize information in new ways that reveal new and important relationships, patterns, and trends.
- GIS integrates various types of spatial data (databases, imagery, GPS coordinates, etc.).

**Integration, Measurement and Analysis**

- Crime
- Socio-Demographics
- Economic data
- Transportation
- Environmental Considerations

*Figure 4.1 Integration, Measurement and Analysis.*
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Components of GIS

- Data component
  - Geographic data are represented by three basic forms in GIS, which are vector, raster, and surface.
- Technology component
  - includes hardware and software
  - evolves rapidly over time
- Application component
  - covers a diversified set of application areas
- People component
  - viewers, general users, and GIS specialists

Why is GIS important?

- Integrates spatial and other types of information
- Provides a consistent analysis framework for geographically referenced data
- Provides new and insightful ways of manipulating and displaying data
- Allows viewing and analysis of data based on geographical proximity and relationships
Exploring Relationships

Based on geographic location and proximity, GIS makes connections between activities
- Looking at data geographically can often suggest new insights, explanations
- These connections are often unrecognized without GIS, but can be vital to understanding and managing activities and resources
- E.g., we can link pollution sources with disease patterns

Combining data sets

Pollution Sources

Cancer Cases

Information about “where” allows us to combine heterogeneous data sets
GIS Capabilities

Data capture/input:
- Input data by digitizing, scanning, or direct coordinate entry
- Edit data in the GIS to correct errors or add features
- Label the spatial features so they can be identified (names or codes)

Management:
- Link attribute data to spatial objects
- Link to external databases
- Make changes in existing databases
- Update database features
- Import and export from/to other GIS or DBMS
- Combine map sheets to create large databases
- Match the edges of neighboring map sheets

Manipulation:
- Make maps from different sources compatible so that they can be drawn on top of each other
- Transformation of coordinates
- Projection change
GIS Capabilities

Analysis:
- Query
  - Select features by their attributes: “find all precincts with crime rates > 10%”
  - Select features by geographic relationships: “find all robberies that occur in a park”
  - Combined attributes/geographic queries: “find all crimes within 1000 feet of a school that occurred between 7:00AM and 4:00PM”

GIS Capabilities

Analysis Examples for LE:
- Geocoding/address matching: match an address list with a street map
- Buffer: find all crimes that are within 1000 feet of police precinct
- Point-in-polygon operations: count all crimes within certain sectors of a precinct

GIS Capabilities

Modeling: identify or predict a process that has created or will create a certain spatial pattern
- Diffusion: how is the trend spreading in an area?
- Interaction: where do lower income residents live?
- What-if scenarios: if the CCTV is installed, where might crime go?
GIS Capabilities

Display/output:
- Exploratory
  • visualize pattern and identify anomalies
  • compare information in map space and data space
- Cartography
  • produce high quality map output for publication
  • create a digital or paper census atlas
- Export map output to other packages