Crime Predictive Analysis

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Research Project
Crime Predictive Analytics (CriPA)

Security Research Project

• Partners
  - Joanneum Research
  - Criminal Intelligence Service Austria
  - University of Salzburg
  - Z_GIS
  - SynerGIS
  - Institute of the Sociology of Law and Criminology
“Predictive policing in the context of place is the use of historical data to create a spatiotemporal forecast of crime hot spots that will be the basis for police resource allocation decisions with the expectation that having officers at the proposed place and time will deter or detect criminal activity.”

Jerry Ratcliffe (Temple University)
Is it possible to predict future crime?

- How many residential burglaries can we expect to occur within the next week?
- Based on a specific weekday and time of day, where are places with an increased risk of victimization of, for example, robberies?
- **How to effectively allocate police resources to prevent burglaries?**
- How do crime statistics change in a long-term scale?
Study Area & Data

- **Vienna** – the capital city of Austria
- 1.7 Mio residents
- 5th time in a row, the most livable city in the world (International survey by Mercer)

- All events in Austria are stored in a large database
  - Approx. *550,000 incidents in Austria* per year
  - of which ~*210,000* occur in Vienna (38%)
  - About 1,800 street robberies in Vienna per year
CriPA – Predictive Crime Analytics

- Research on quantitative methods on pattern detection and relationships in crime data to forecast future crime
- Models for mid- to long-term prognoses on a small-scale to estimate trends in future crime
  - Spatial regression models using variables such as demography, land use, infrastructure, events, weather, ...
CriPA – Predictive Crime Analytics

• Methods for short term predictions on a large scale
  - Space-time regression models
  - Spatio-temporal analyses (hot spot mapping, near repeat victimization, risk terrain modeling)

• Integration of data mining tools to enhance the quality of predictions

• Aims
  - Focused combating of crime
  - Optimal allocation of law enforcement resources

➡ GIS-based application
Hotspot Mapping
Risk Terrain Modeling

Risk Terrain Map - Robbery 2013
Prediction for the City of Salzburg of Robberies for 2013
Based on a Maximum Spatial Influence of 2 Blocks (220m)

Legend
- Robberies 2013
- City of Salzburg
- Streets
- Lakes
- Rivers
- Buildings
- Forests

RTM - Risk Values
1.0 - 7.0: Low Risk
7.1 - 22.3: Medium Risk
22.4 - 44.6: High Risk
44.7 - 252.5: Highest Risk

Date: April 2014
Author: Milena Kocher
Data Sources: SAGIS, Austrian Federal Criminal Police Office, State Police Headquarters of the City of Salzburg

Risk Terrain Map - Robbery 2014
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- City of Salzburg
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RTM - Risk Values
1.0 - 5.2: Low Risk
5.3 - 18.7: Medium Risk
18.8 - 37.4: High Risk
37.5 - 314.8: Highest Risk

Date: April 2014
Author: Milena Kocher
Data Sources: SAGIS, Austrian Federal Criminal Police Office, State Police Headquarters of the City of Salzburg
Near Repeat Victimization

- After a previous crime event, nearby targets have an increased risk of victimization for a short period of time.

- This way, the focus lies on serial offenders.
Explanations for 
Near Repeat Victimization

- **Boost Explanations**
  - repeat victimization reflects the successful outcome of an initial offense. Specific offenders gain important knowledge about a target from prior experience and use this information to re-offend.

- **Flag Explanations**
  - some targets are unusually attractive to criminals or particularly vulnerable to crime.
Methodical background of CriPA

- Using historical residential burglaries, predictions for future residential burglaries are calculated.

- Based on **Near Repeat Victimization**
  - After a previous crime event, nearby targets have an increased risk of victimization for a short period of time.
  - This way, the focus lies on **serial offenders**.

- Comparison of properties of this event-pair
  - e.g., modus operandi, stolen goods, time of day,…

- Visualizing risks for future residential burglaries.
Space-time estimation of risk

- Modeling space-time risks on a regular raster
  - Modeling the probability for a future crime event to occur in a raster cell at a specific time
  - Consideration of timely information of historical crime events
  - Consideration of criminogenic risk factors
    - Demographic properties (population, family status, income,...)
    - Distance to Points of Interests (schools, major roads, nightlife amenities,...)
  - Consideration of spatial effects (neighborhood effects)
- Aim: Estimation of probabilities of future crime events to occur
Combining approaches

- Capitalize on unique strengths of each method

(Caplan, Kennedy, and Piza 2013)
The ArcGIS platform
Thank you for your attention. Comments are very welcome.