Automation and Visualization of Crime Analysis

Applying GIS tools to improve workflow and data dissemination in the Denver Police Department

Bryce Batchman
Spring 2012
Capstone Peer Review
Advised by Dr Alexander Klippel
Overview

- Background/Problem
- Objectives
- Methodology
- Workflow development
- Timeline
Background

- Spatial crime analysis has a long history
- Analysis focuses
  - Tactical analysis
    - Basic (counts)
    - Advanced (predictive)
  - Strategic analysis
- Despite research trends, many departments still focus on basic tactical crime analysis

Background

- Crime mapping tools
  - GST CrimeMap
  - CrimeStat III
  - CrimeView
  - + many more

- Automation
- Cost
Problem

- New Denver police chief better analysis of Denver’s crime data
- Denver Crime Analysis Unit struggles to meet demand for tactical analysis while needing to apply resources to more advanced analysis
- Need to get analysis products to police daily
- Analysts seek to apply their training to more advanced methods of crime analysis
Objectives

- Understand workflows and requirements of DPD crime analysts
- Develop automated tools for mapping and analysis at low- to no-cost
- Develop tool to better disseminate crime analysis to police officers (fast & focused)
Methodology

- Using modified user-centered design process proposed by Roth, et al (2010)
  - Release initial prototype first, then engage user in all remaining refinements through release of final product
- Iterative design process focused on increasing feature set building toward police officer visualization tool
- Using already available tools (ArcGIS) and free open source tools where feasible
  - Primarily Python-based programming

User-centered process

1. Prototyping
2. Interaction & Usability Studies
3. Work Domain Analysis
4. Conceptual Development
5. Implementation
6. Debugging

Denver current process

Weekly Precinct Crime Maps

- Crime RMS Table
- ArcSDE Layers

Analyst using ArcMap

Symbolize Layers

Create Density Plot

Zoom to Precinct

Output Graphic/PDF

Graphic into Crime Briefing

10-15 times per district
Denver current process

Weekly Precinct Crime Maps

Candidates for automation

10-15 times per district
Example Python script

```python
precinctSet = set(valueList1)
precinctList = list(precinctSet)
precinctList.sort()
del rows
del row
del valueList1

# Define variables for next step
template_filename = arcpy.GetParameterAsText(1)
template_mxd = arcpy.mapping.MapDocument(template_filename)
df = arcpy.mapping.ListDataFrames(template_mxd)[0]

#define Police dist/precs for definition queries
polDistSrc = arcpy.GetParameterAsText(2)
polPrecSrc = arcpy.GetParameterAsText(3)

savefolder = arcpy.GetParameterAsText(4)
modifiedmxdpath = str(savefolder)+"\AllDists.mxd" #was last_saturday
template_mxd.saveACopy(modifiedmxdpath)
modifiedmxd = arcpy.mapping.MapDocument(modifiedmxdpath)
mlyrlist = arcpy.mapping.ListLayers(template_mxd)

#update definition queries and save separate files for each district
for precinct in precinctList:
    template_mxd.tags = str(precinct)
    for lyr in mlyrlist:
        if lyr.isGroupLayer == False:
            if lyr.dataSource == NIBRS2010:
                lyr.definitionQuery = u"Zone" = \"+str(precinct)+u\" AND "NewDesc" = \"+str(lyr.name)+u\"
            elif lyr.dataSource == polDistSrc:
                lyr.definitionQuery = u"DIST_NUM" = \"+(str(template_mxd.tags[1]))+u\"
            elif lyr.dataSource == polPrecSrc:
                lyr.definitionQuery = u"PRECINCT LIKE \"+(str(template_mxd.tags[3]))+u\"
```

Automation progress so far

Weekly Precinct Crime Maps

- Crime RMS Table
- ArcSDE Layers
- FGDB FC's
- Template Map Document
- Symbolize Layers
- Zoom to Precincts
- Create Density Plot
- Output Map Documents
- Output Graphic/PDF
- Graphic into Crime Briefing
Automation progress so far

Weekly Precinct Crime Maps

Next targets...

- FGDB FC's
- Crime RMS Table
- ArcSDE Layers
- Template Map Document
- Symbolize Layers
- Zoom to Precincts
- Output Map Documents
- Create Density Plot
- Output Graphic/PDF
- Graphic into Crime Briefing
...and beyond

- Automate generation of other common maps
- Begin daily generation of maps for police officer use and create tool to get the maps to the officers at the start of shifts

Workflow development

- Basic automation tools have been prototyped and demoed
- Meeting weekly with CAU Director & Staff
Timeline

- Initial prototype automation tool already released and in use/revision
- End of 3Q 2012: automation toolset completed
- End of 4Q 2012/Early 1Q 2013: final release of police officer analysis visualization tool

Plan to submit project as paper presentation for 2013 AAG meeting in April 2013