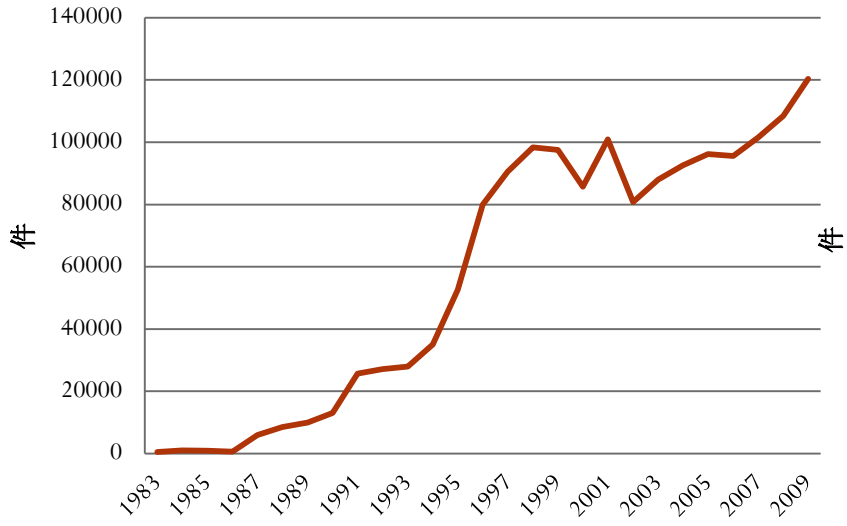
Spatial Study of Crime and Society with Census, Business and GIS data

Shuming Bao

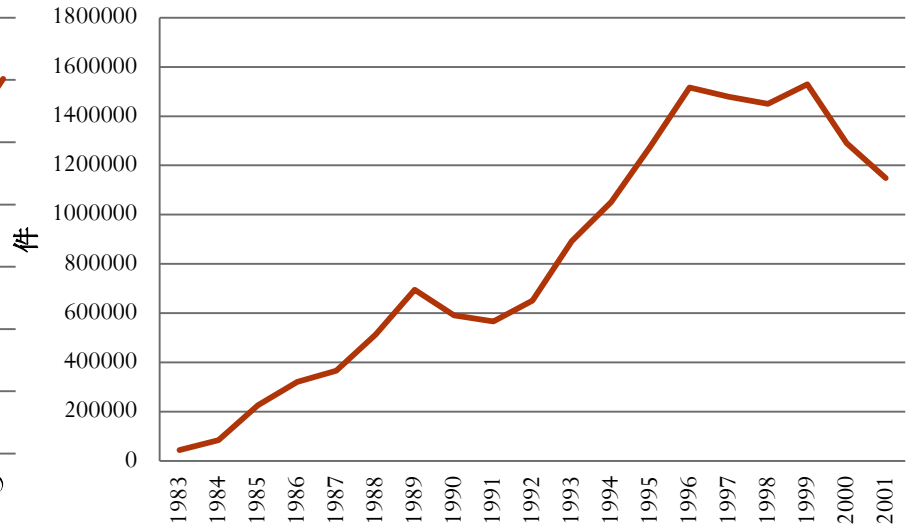
China Data Institute

Crime Trends in China

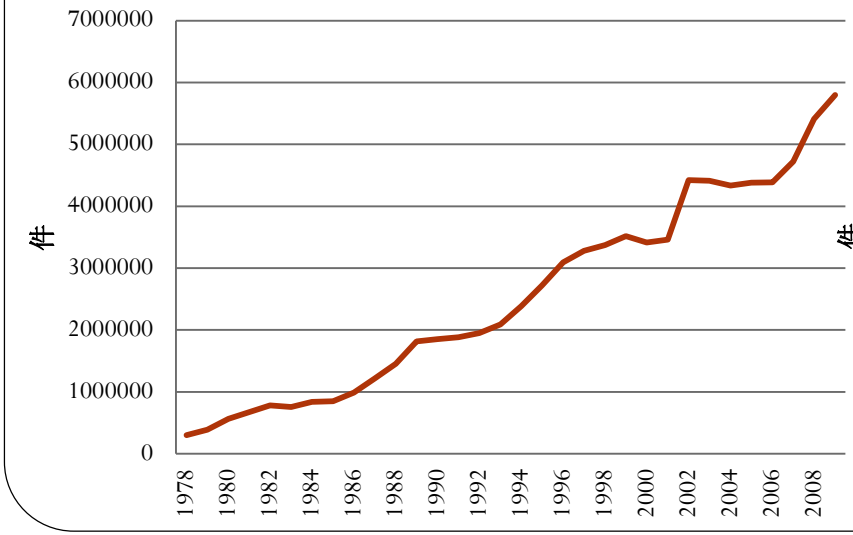
Administrative



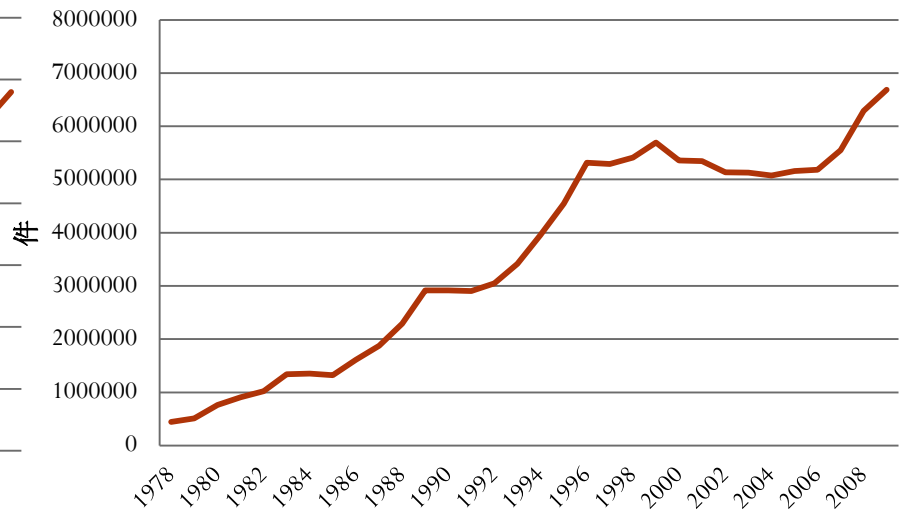
Economic Cases



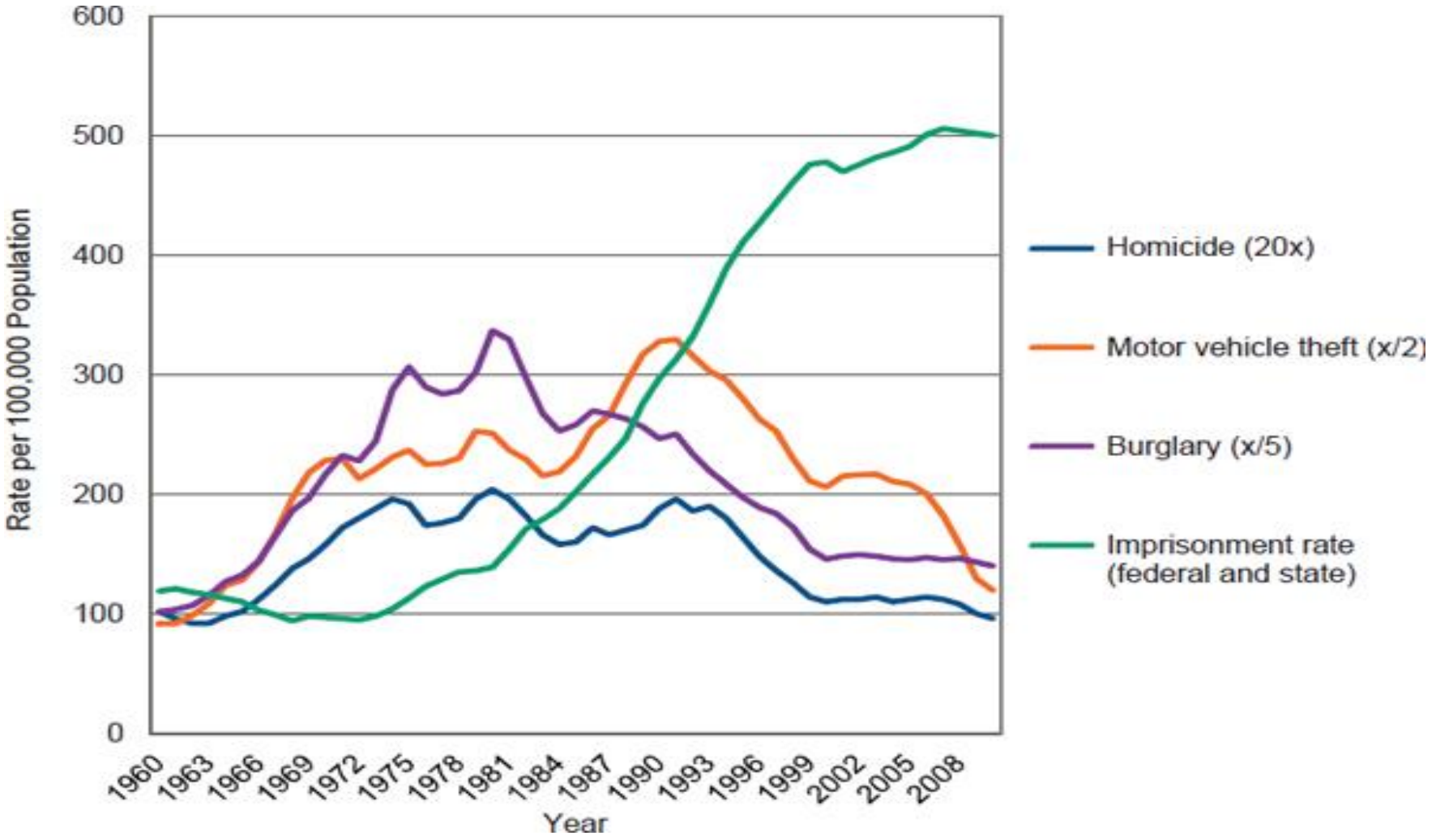
Civil Cases



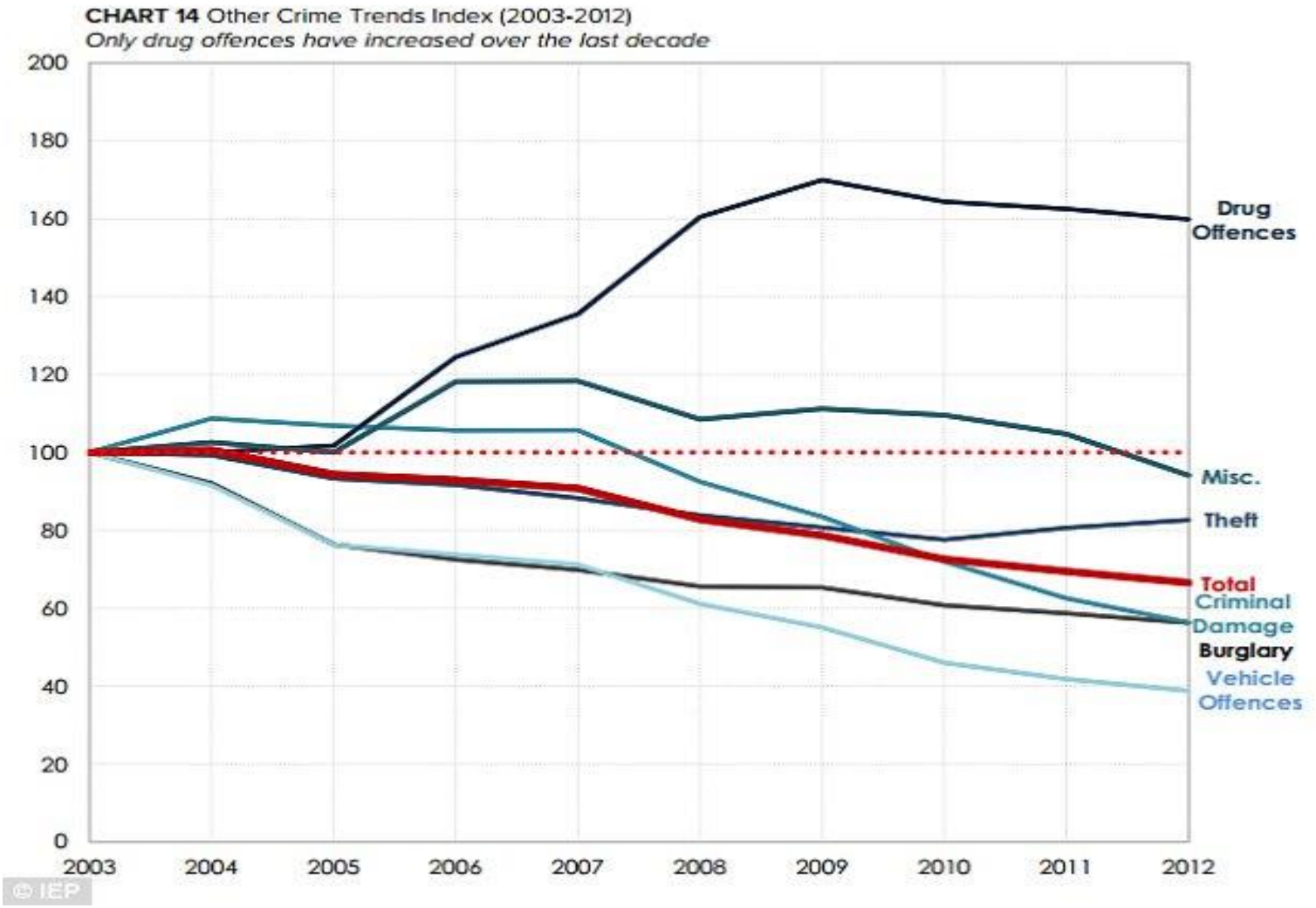
Tried Cases



Crime Trends in U.S.

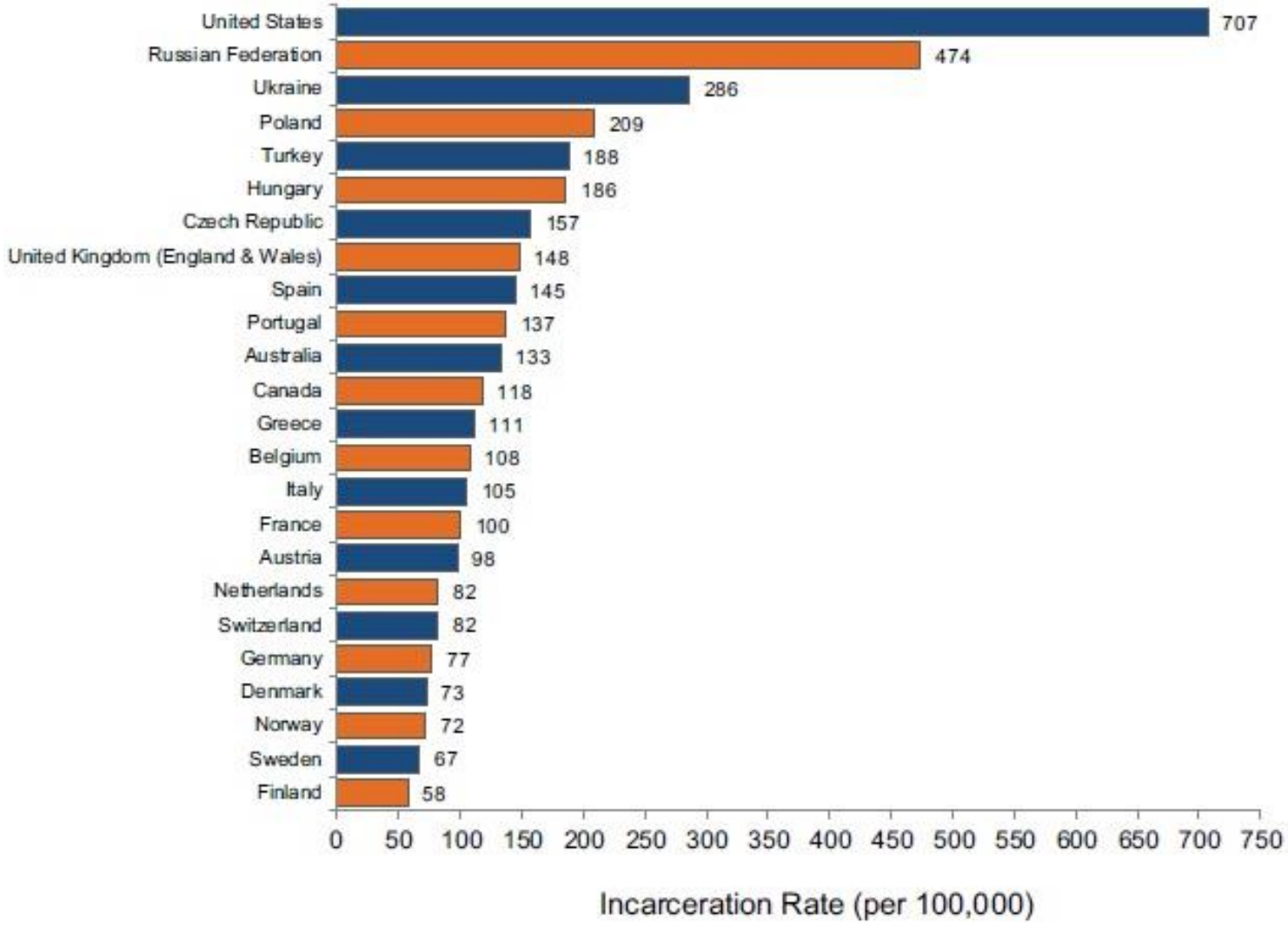


Crime Trends in UK



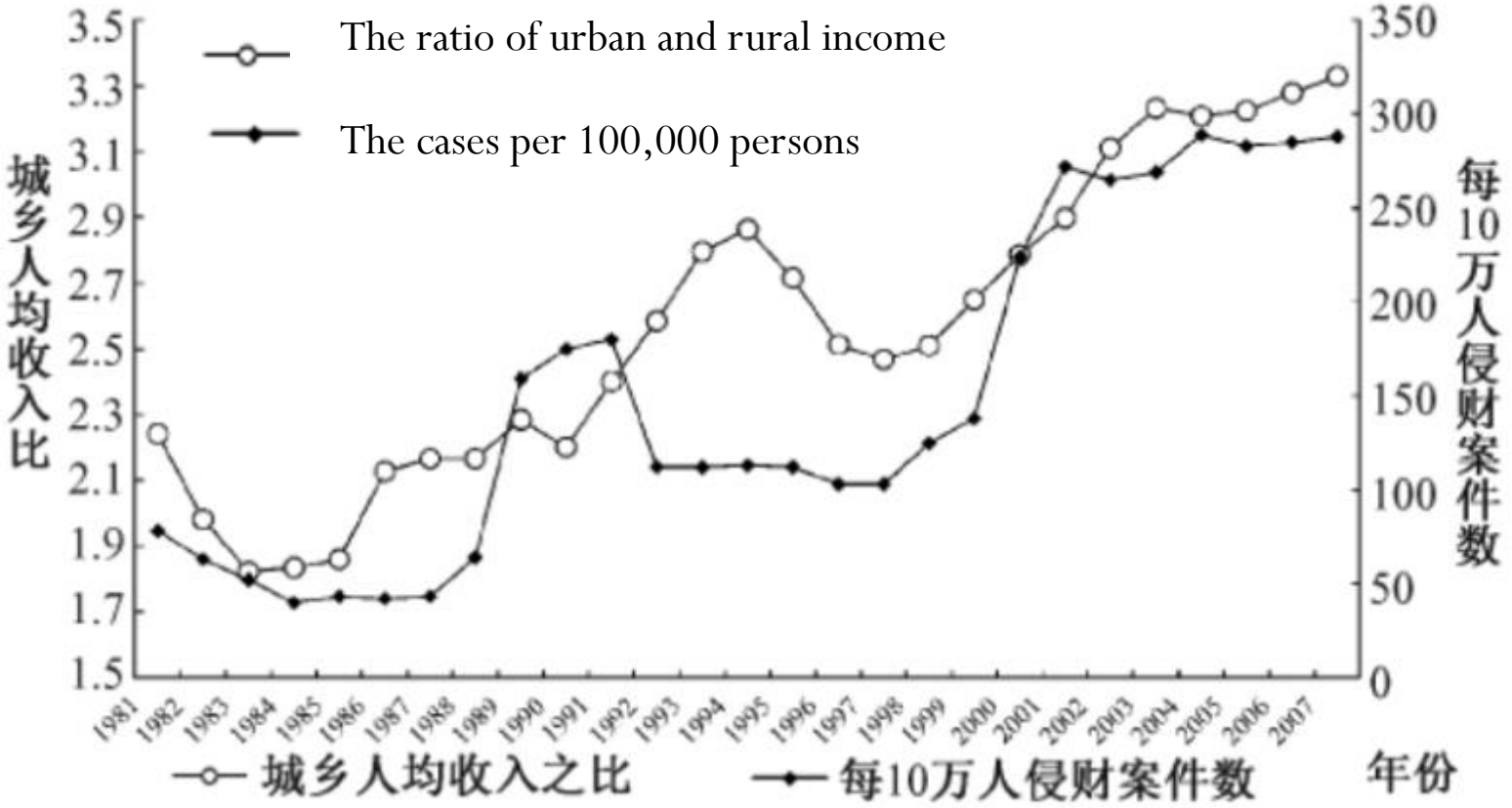
http://www.dailymail.co.uk/news/article-2313942/UK-Peace-Index-Rate-murders-violent-crime-falling-faster-Western-Europe.html

The U.S. has the largest prison population in the world



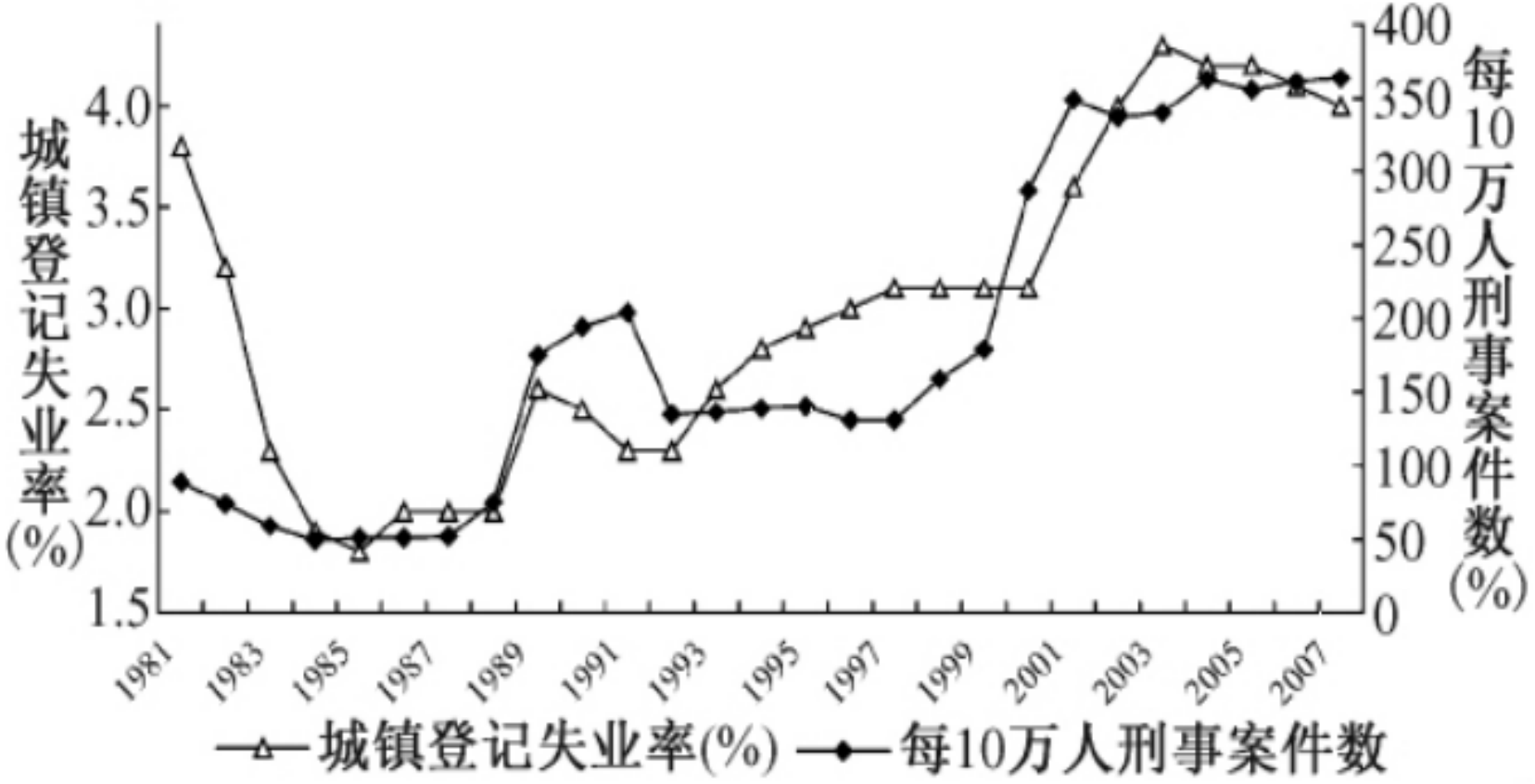
https://publichealthwatch.wordpress.com/2014/05/01/new-report-slams-unprecedented-growth-in-u-s-prisons-highlights-racial-disparities-in-incarceration/

China: Income Inequality and Crime



Source: http://www.lepp.zju.edu.cn/upload/2011-10/11101410433458.pdf

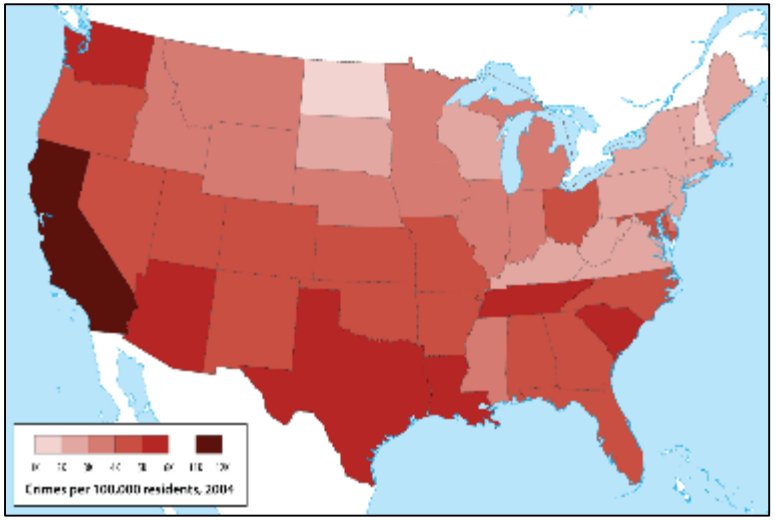
China: Unemployment Rates and Crime



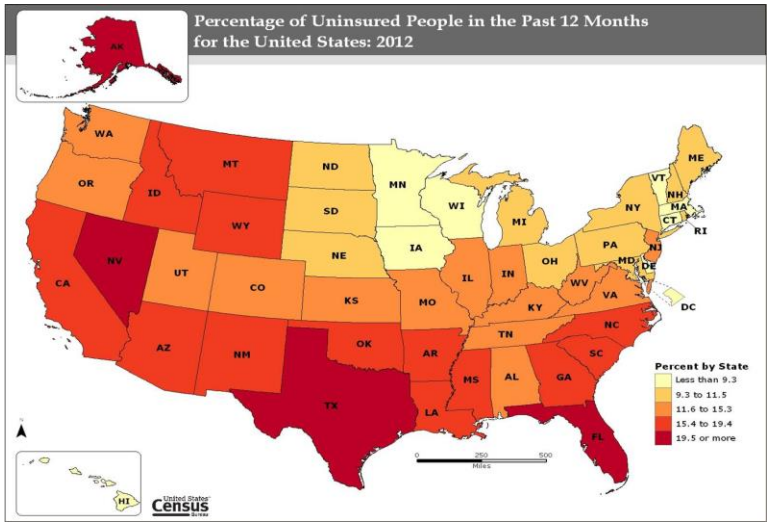
Source: http://www.lepp.zju.edu.cn/upload/2011-10/11101410433458.pdf

US: Safety, Insurance, Unemployment and Climate

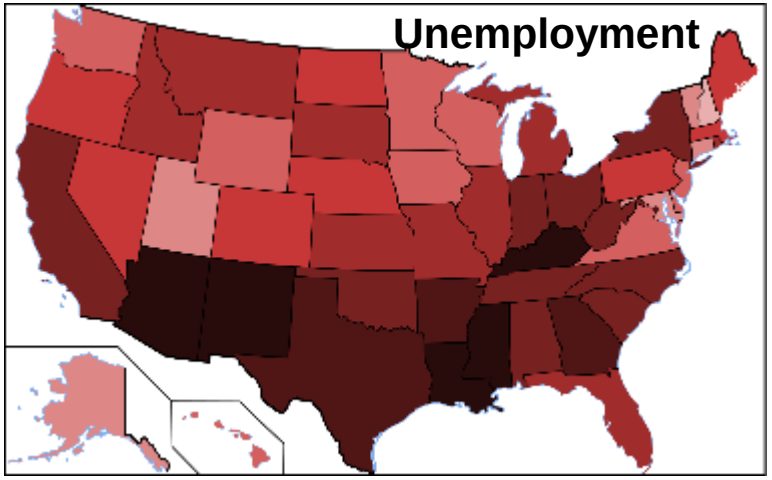
The Map of Safety



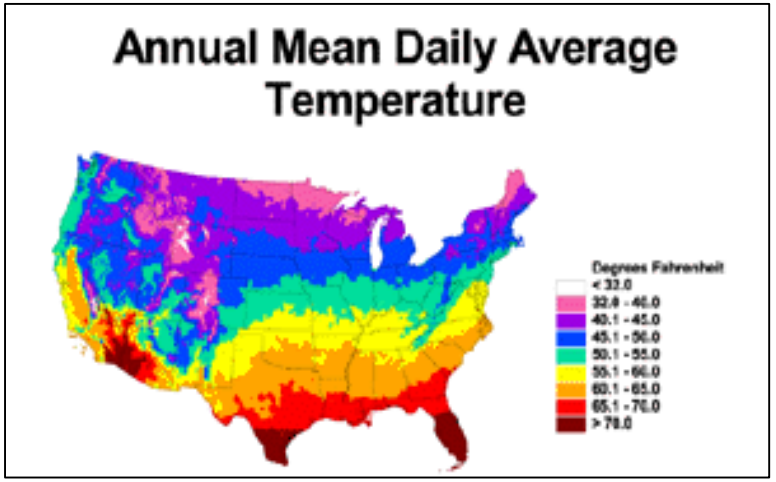
Rates of Uninsured Population



Unemployment



Annual Mean Daily Average Temperature



Spatial Crime: A Spatial Study of Social Ecosystems Based on Crime

A systematic approach

Objective: Complex system

Approach: Ecological analysis

focus: Spatial crime and society

Space + Crime + Society

Why Spatial?

- Location
- Integration
- Time

Spatial Study of Crime and Society

- Spatial **Patterns**
- Spatial **Trends**
- Spatial **Interactions**
- Spatial **Risks**
- Spatial **Policies**

Spatial Theories

Spatial Ecology

Eugene Pleasants Odum, 1971, **Fundamentals of Ecology.**

David Tilman, Peter Kareiva，1997, **Spatial Ecology**, Princeton University Press.

http://www.amazon.com/Spatial-Ecology-David-Tilman/dp/0691016534

Spatial Diffusion

J. C. Hudson, 2010, **Diffusion in a Central Place System,** Geographical Analysis . 09/2010; (1): 45 - 58; http://onlinelibrary.wiley.com/doi/10.1111/j.1538-4632.1969.tb00604.x/pdf

Spatial Attraction

Samuel Frenning, **Attraction Theory**, http://samuelfrenning.efoliomn.com/attraction

Spatial Interaction

Jean-Paul Rodrigue, **Spatial Interactions and the Gravity Model**, http://people.hofstra.edu/geotrans/eng/methods/ch5m1en.html

Spatial Convergence

Farhad Rassekh, 1998, **The Convergence Hypothesis: History, Theory, and Evidence**, Open economies review 9: 85–105

Spatial Contamination

David Greetham, 2010, **The Pleasures of Contamination: Evidence, Text, and Voice in Textual Studies**, Indiana University Press

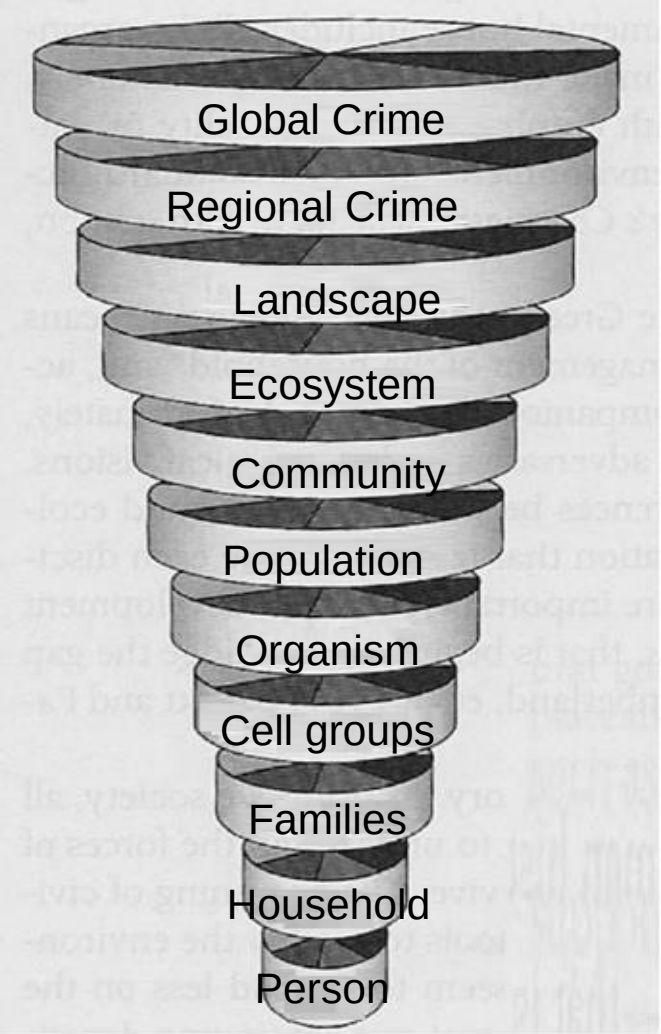
The Fundamental Theory of Spatial Crime: Spatial Ecology

Basic Assumptions：

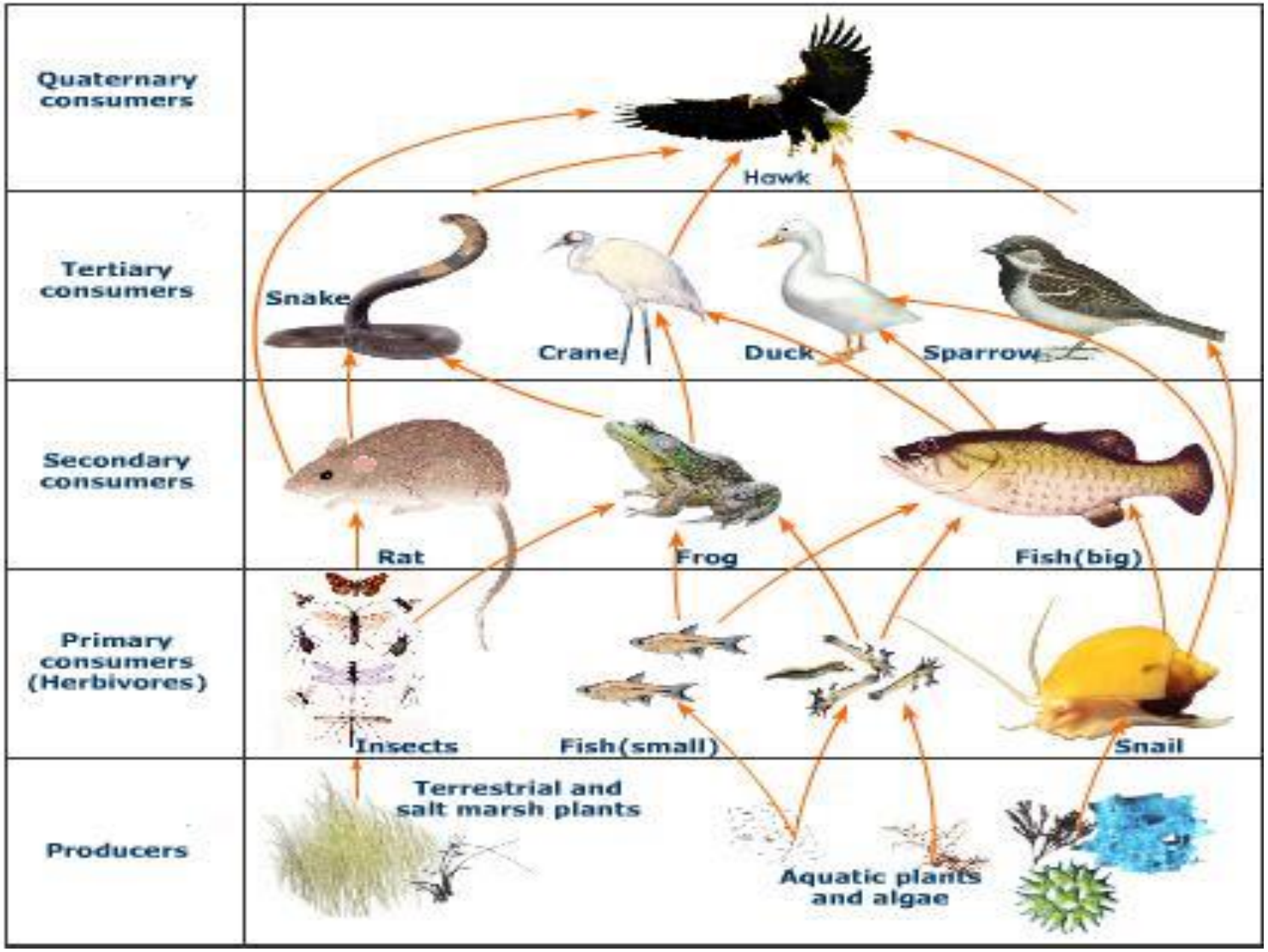
- Degenerative system
- Increasing ecological risks:
  - Environmental risk
  - Health risk
  - Social risk

Core Indicators：

- Biodiversity
- Culture diversity

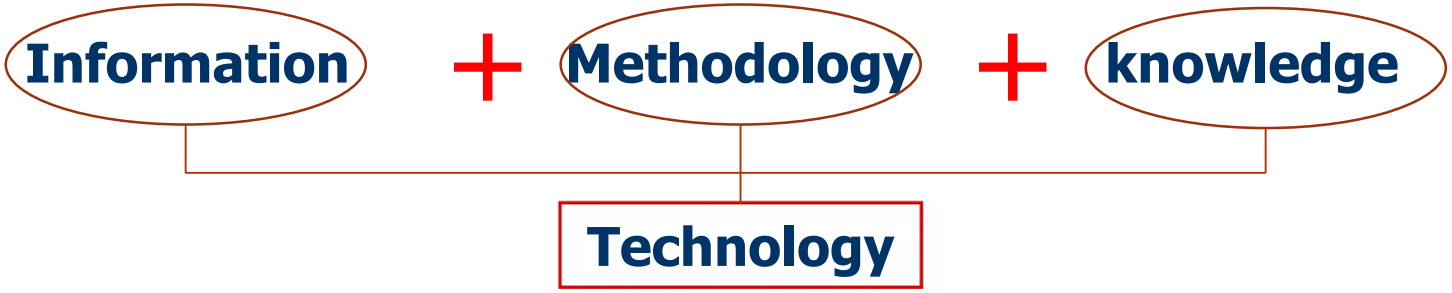


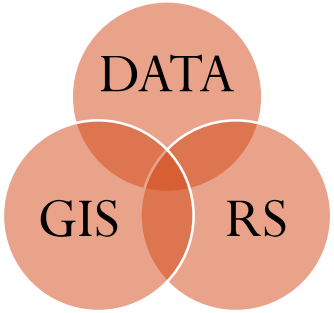
Identify the Biological Chains



Spatial Intelligent Data Analysis

An integration of information, methodology and knowledge for spatial data analysis





$$I(d) = \frac{\sum_{i}^{n}\sum_{j}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{(S^2 \sum_{i}^{n}\sum_{j}^{n} w_{ij})}$$

China and US Geo-Explorers

An Integration of Spatial Data and Analysis for US and China Studies

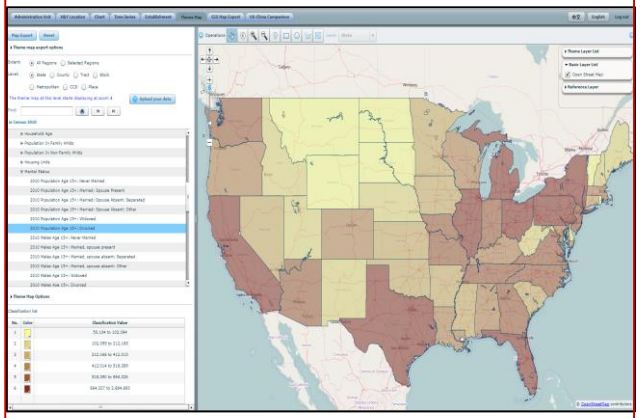
Statistics

Census

GIS

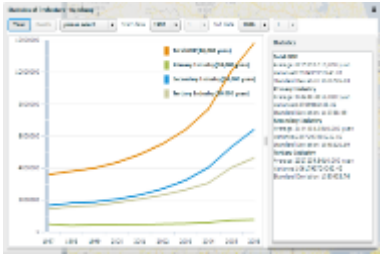
China Geo-Explorer

US Geo-Explorer



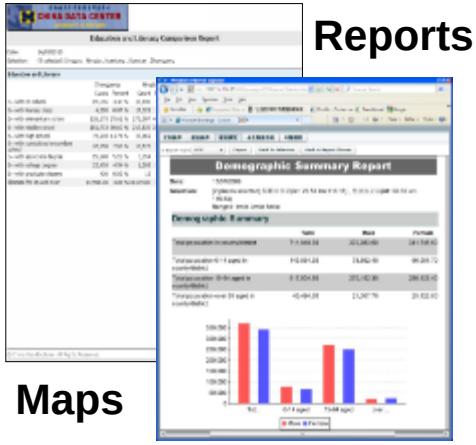
Charts

Output



Tables

Reports



Maps

China Data Sources

- Government Statistics
  - Provincial Statistics (1949 -)
  - City Statistics (1996 -)
  - County Statistics (1997 -)
- Population Census
  - Census 1953 (GRID)
  - Census 1964 (GRID)
  - Census 1982 (GRID)
  - Census 1990 (GRID)
  - Census 2000/2010 (province, city, county, township, GRID)
- Economic Census
  - Industrial Census 1995 (province, city, county, ZIP)
  - Basic Unit Census 2001 (province, city, county, ZIP)
  - Economic Census 2004/2008 (province, city, county, ZIP)
- Establishments (individual companies and organizations)
  - Industrial Census(1995)
  - Basic Unit Census (2001)
  - Economic Census (2004/2008)
- Geography and Environment
  - Land Use data (GRID)
  - Night-Time data (GRID)
  - Transportation (railway, highway, roads)
  - Rivers and Lakes
  - ….

US Data Sources

State
Metropolitan
County
CCD
TRACT
BLOCK

Data Sources:

- Applied Geographic Solutions, Inc. (“AGS” - www.appliedgeographic.com)
- InfoGroup, Inc. (www.infogroup.com)

Data Coverage:

- **Population Census** (State, County, Tract, Block, Metropolitan, CCD, Place)
  - Census 1970
  - Census 1980
  - Census 1990
  - Census 2000
  - Census 2010
  - American Community Survey

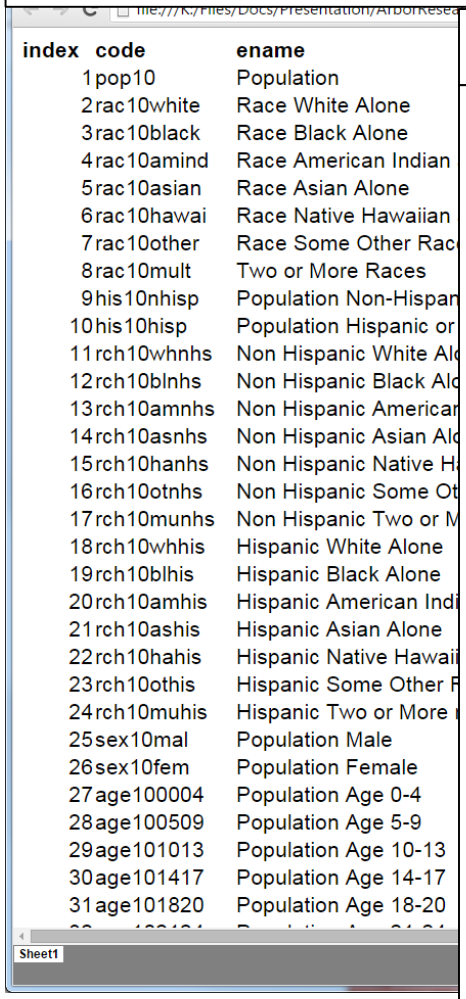
- **Establishments** (individual companies and organizations)
  - Firm level records for 2013 (85 fields)
  - Aggregated data by State, County, Tract, Block, Metropolitan, CCD, Place, ZIP (1997-2013)

US Data Lists

- US Population Census Data
- US Economic Census Data
- US Business Data
- US Firm Microdata
- US Household Microdata

US Data Contents

Population Census



index	code	ename
1	pop10	Population
2	rac10white	Race White Alone
3	rac10black	Race Black Alone
4	rac10amind	Race American Indian
5	rac10asian	Race Asian Alone
6	rac10hawai	Race Native Hawaiian
7	rac10other	Race Some Other Rac
8	rac10mult	Two or More Races
9	his10nhisp	Population Non-Hispan
10	his10hisp	Population Hispanic or
11	rch10whnhs	Non Hispanic White Al
12	rch10blnhs	Non Hispanic Black Al
13	rch10amnhs	Non Hispanic American
14	rch10asnhs	Non Hispanic Asian Al
15	rch10hanhs	Non Hispanic Native H
16	rch10otnhs	Non Hispanic Some Ot
17	rch10munhs	Non Hispanic Two or M
18	rch10whhis	Hispanic White Alone
19	rch10blhis	Hispanic Black Alone
20	rch10amhis	Hispanic American Indi
21	rch10ashis	Hispanic Asian Alone
22	rch10hahis	Hispanic Native Hawaii
23	rch10othis	Hispanic Some Other R
24	rch10muhis	Hispanic Two or More
25	sex10mal	Population Male
26	sex10fem	Population Female
27	age100004	Population Age 0-4
28	age100509	Population Age 5-9
29	age101013	Population Age 10-13
30	age101417	Population Age 14-17
31	age101820	Population Age 18-20

Sheet1

Business Data

COMPANY NAME

ADDRESS

CITY / STATE / ZIP + 4

CONTACT

POPULATION

FIRM/INDIVIDUAL/PROFESSIONAL

EMPLOYEE SIZE

SALES VOLUME

SIC / NAICS

ADSIZE

YEAR 1ST APPEARED

PUBLIC/PRIVATE

LATITUDE

LONGITUDE

Household Data

ADULT AGE RANGE
MARITAL
GENDER
RELIGION
CREDIT CARD
EXPENDABLE
HOUSEHOLD INCOME
HOME VALUE
HOME SALE PRICE
MORTGAGE
LANGUAGE
RESIDENCE
NIELSON REGION
YEARS OF SCHOOLING
MFDU - # OF UNITS
OCCUPATION
METRO/MICRO
DELIVERY SERVICE
POLITICAL PARTY
VEHICLE
AIRCRAFT
PILOT LICENSE
BOAT PROPULSION
INTERNET

US Business Categories

01: Agricultural Production Crops
02: Agriculture production livestock and animal specialties
07: Agricultural Services
08: Forestry
09: Fishing, hunting, and trapping
10: Metal Mining
12: Coal Mining
13: Oil And Gas Extraction
14: Mining And Quarrying Of Nonmetallic Minerals, Except Fuels
15: Building Construction General Contractors And Operative Builders
16: Heavy Construction Other Than Building Construction Contractors
17: Construction Special Trade Contractors
20: Food And Kindred Products
21: Tobacco Products
22: Textile Mill Products
23: Apparel And Other Finished
24: Lumber And Wood Products, Except Furniture
25: Furniture And Fixtures
26: Paper And Allied Products
27: Printing, Publishing, And Allied Industries
28: Chemicals And Allied Products
29: Petroleum Refining And Related Industries
30: Rubber And Miscellaneous Plastics Products
31: Leather And Leather Products
32: Stone, Clay, Glass, And Concrete Products
33: Primary Metal Industries
34: Fabricated Metal Products
35: Industrial And Commercial Machinery And Computer Equipment
36: Electronic And Other Electrical Equipment And Components
37: Transportation Equipment
38: Measuring Instruments; Photographic; Watches And Clocks
39: Miscellaneous Manufacturing Industries
40: Railroad Transportation
41: Transit And Interurban Highway Passenger Transportation
42: Motor Freight Transportation And Warehousing
43: United States Postal Service
44: Water Transportation
45: Transportation By Air
46: Pipelines, Except Natural Gas
47: Transportation Services
48: Communications
49: Electric, Gas, And Sanitary Services
50: Wholesale Trade-durable Goods
51: Wholesale Trade-non-durable Goods
52: Building Materials, Hardware, Garden Supply, And Mobile Home
53: General Merchandise Stores
54: Food Stores
55: Automotive Dealers And Gasoline Service Stations
56: Apparel And Accessory Stores
57: Home Furniture, Furnishings, And Equipment Stores
58: Eating And Drinking Places
59: Miscellaneous Retail
60: Depository Institutions
changes, And Services
65: Real Estate
67: Holding And Other Investment Offices
70: Hotels, Rooming Houses, Camps, And Other Lodging Places
72: Personal Services
73: Business Services
75: Automotive Repair, Services, And Parking
76: Miscellaneous Repair Services
78: Motion Pictures
79: Amusement And Recreation Services
80: Health Services
81: Legal Services
82: Educational Services
83: Social Services
84: Museums, Art Galleries, And Botanical And Zoological Gardens
86: Membership Organizations
87: Engineering, Accounting, Research, Management
89: Miscellaneous Services
91: Executive, Legislative, And General Government, Except Finance
92: Justice, Public Order, And Safety
93: Public Finance, Taxation, And Monetary Policy
94: Administration Of Human Resource Programs
95: Administration Of Environmental Quality And Housing Programs
96: Administration Of Economic Programs
97: National Security And International Affairs
99: Non-classifiable Establishments

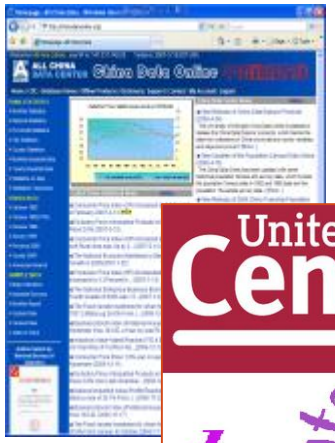
Features of US & China Geo-Explorer

- Rich and unique databases
- Flexible functions for data selection
- Multiple formats for data export
- Easy and time-saving reports, charts, and maps
- Unlimited data from limited data
- Integration of users' data with the online database
- No GIS skills needed for spatial analysis and mapping

Spatial Explorer of Crime

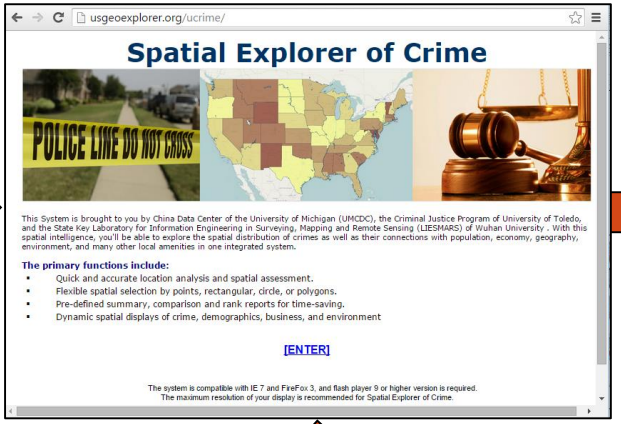
Spatial Intelligence for Space-Time Data Integration and Analysis

Statistics



Census

GIS

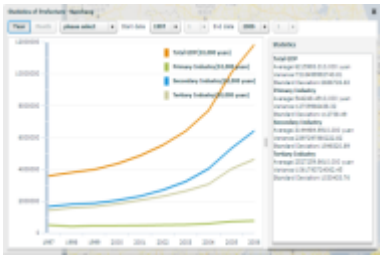


Modeling

PySAL

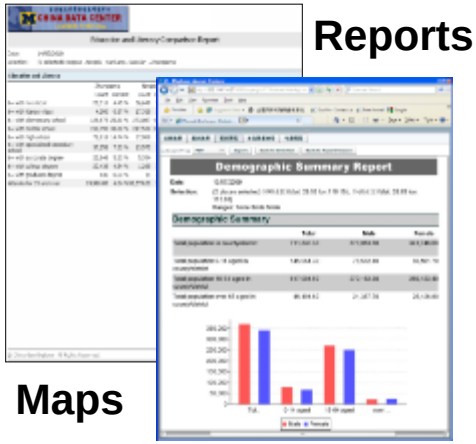
StatGeo

Charts



Tables

Reports

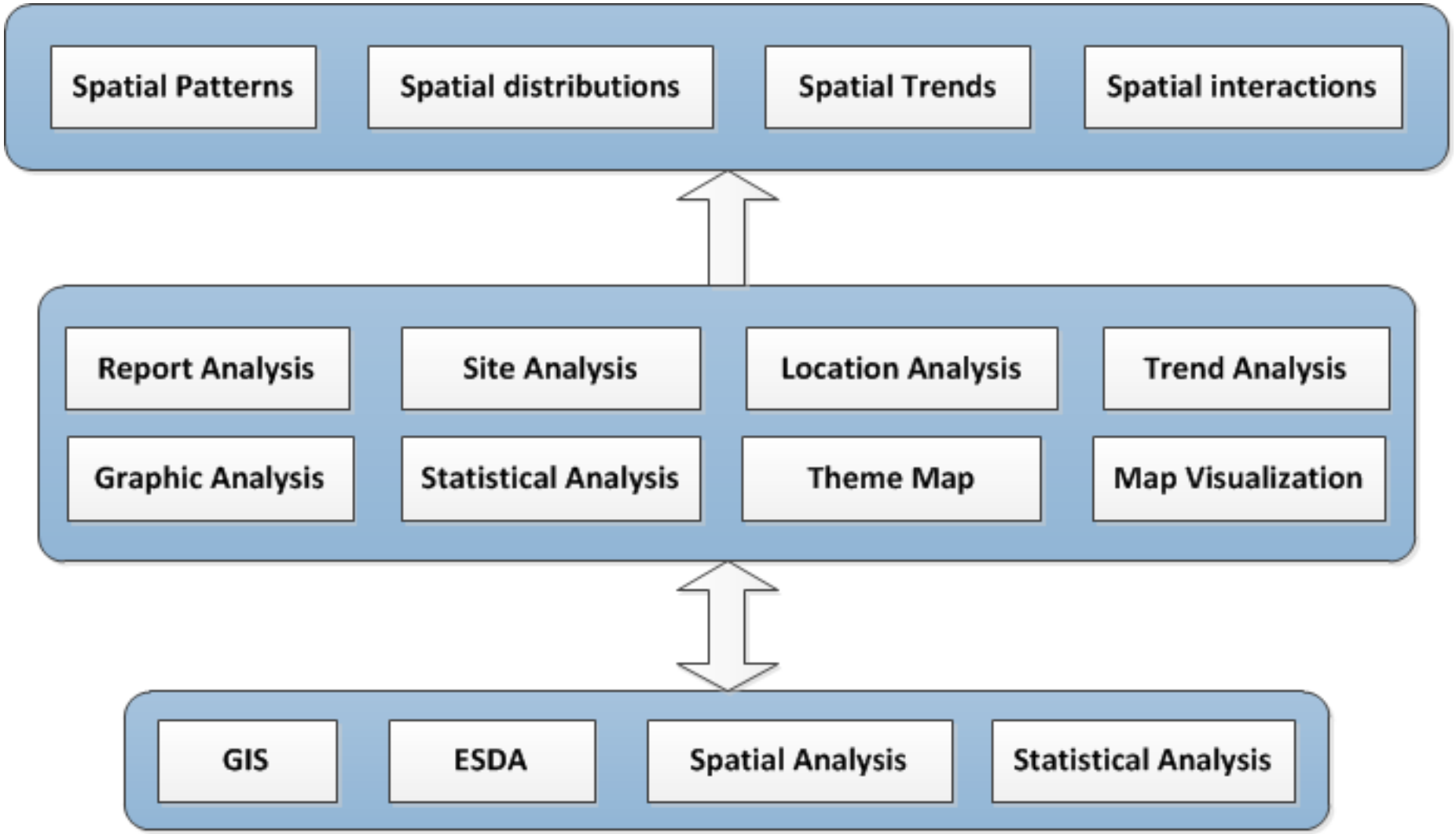


Maps

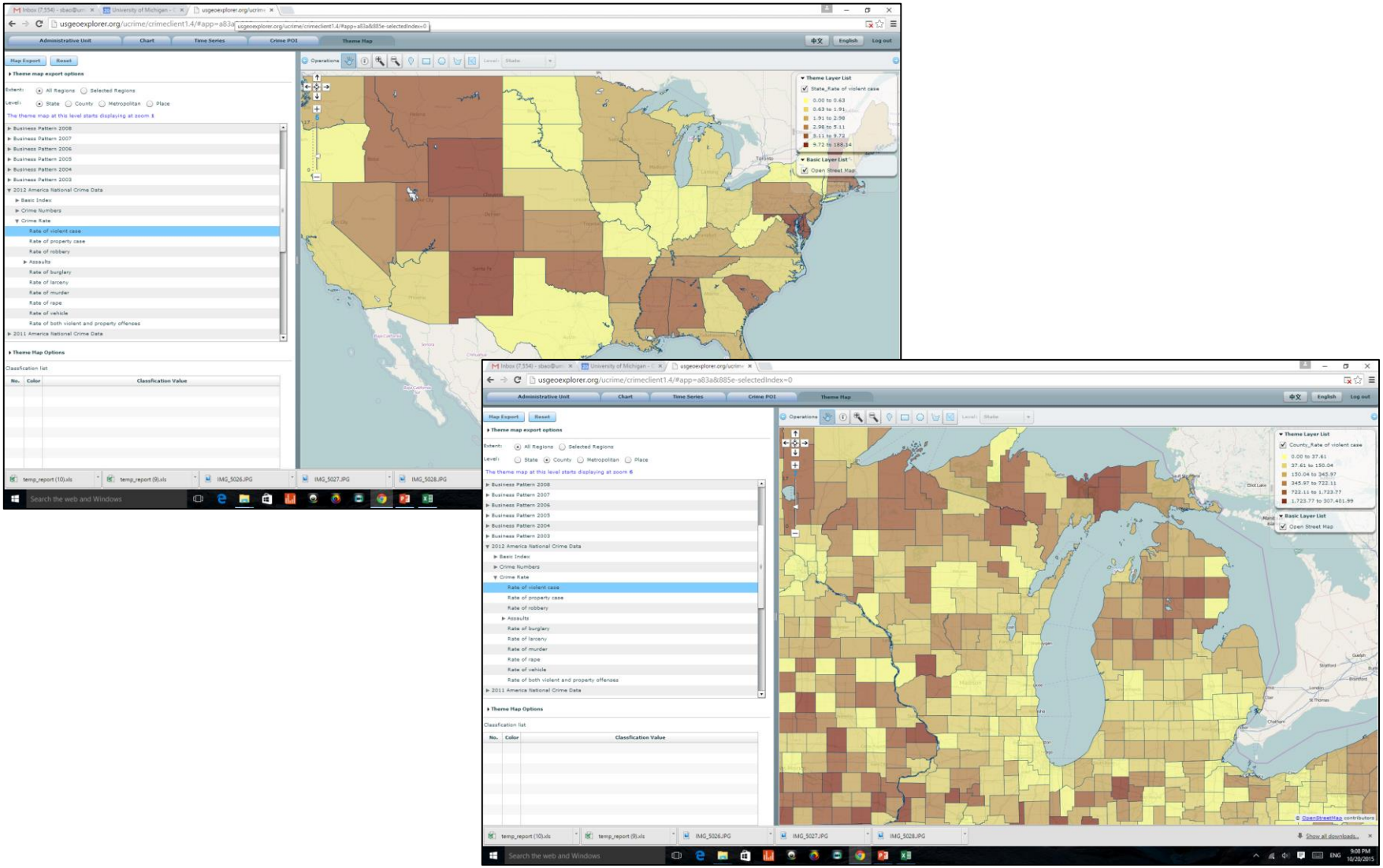
US Crime Data

- Capital Punishment in the United States
- Chicago Women's Health Risk Study
- Expenditure and Employment for the Criminal Justice System
- Federal Justice Statistics Program
- Geographical Information Systems
- Homicide
- Homicides in Chicago
- Law Enforcement Management and Administrative Statistics
- National Corrections Reporting Program
- National Crime Victimization Survey
- National Incident-Based Reporting System
- National Juvenile Corrections Data
- Project on Human Development in Chicago Neighborhoods (PHDCN)
- Survey of Inmates in State and Federal Correctional Facilities
- Terrorism & Preparedness Data Resource Center (TPDRC)
- Uniform Crime Reporting Program
- Violence Against Women
- Crime reports from local police departments
- ….

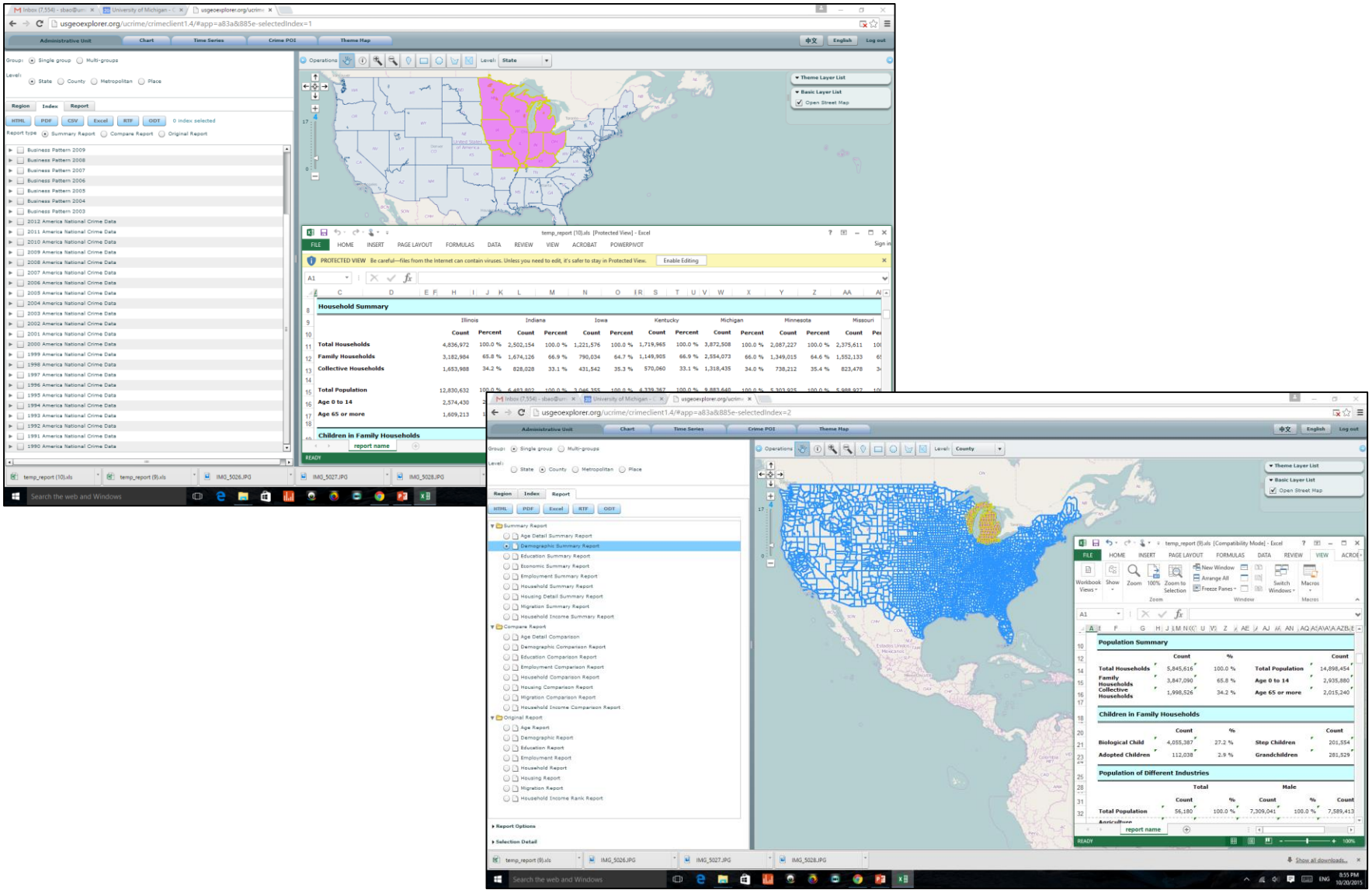
Methodology



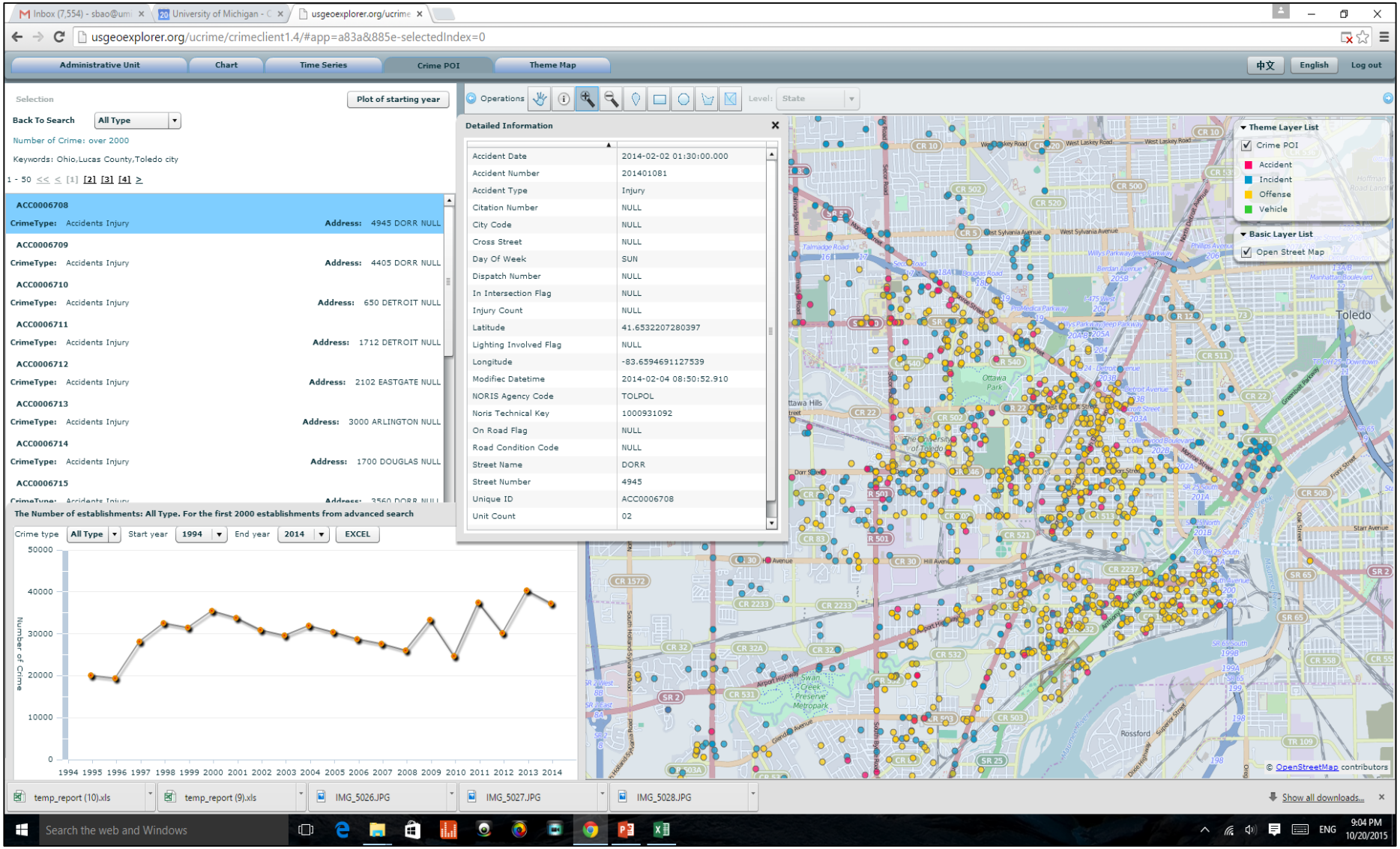
Violent Crimes by States and Counties



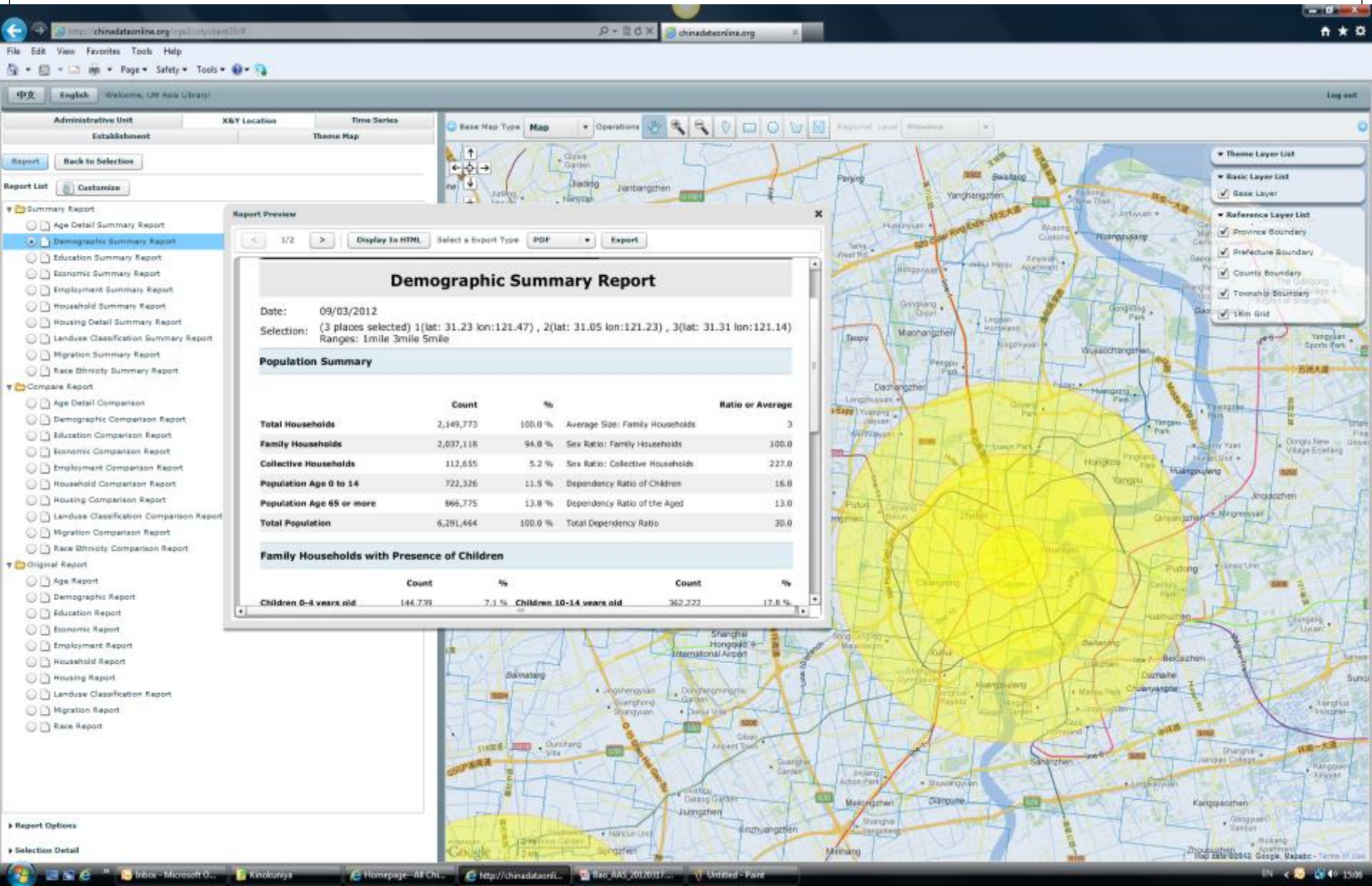
Report Analysis



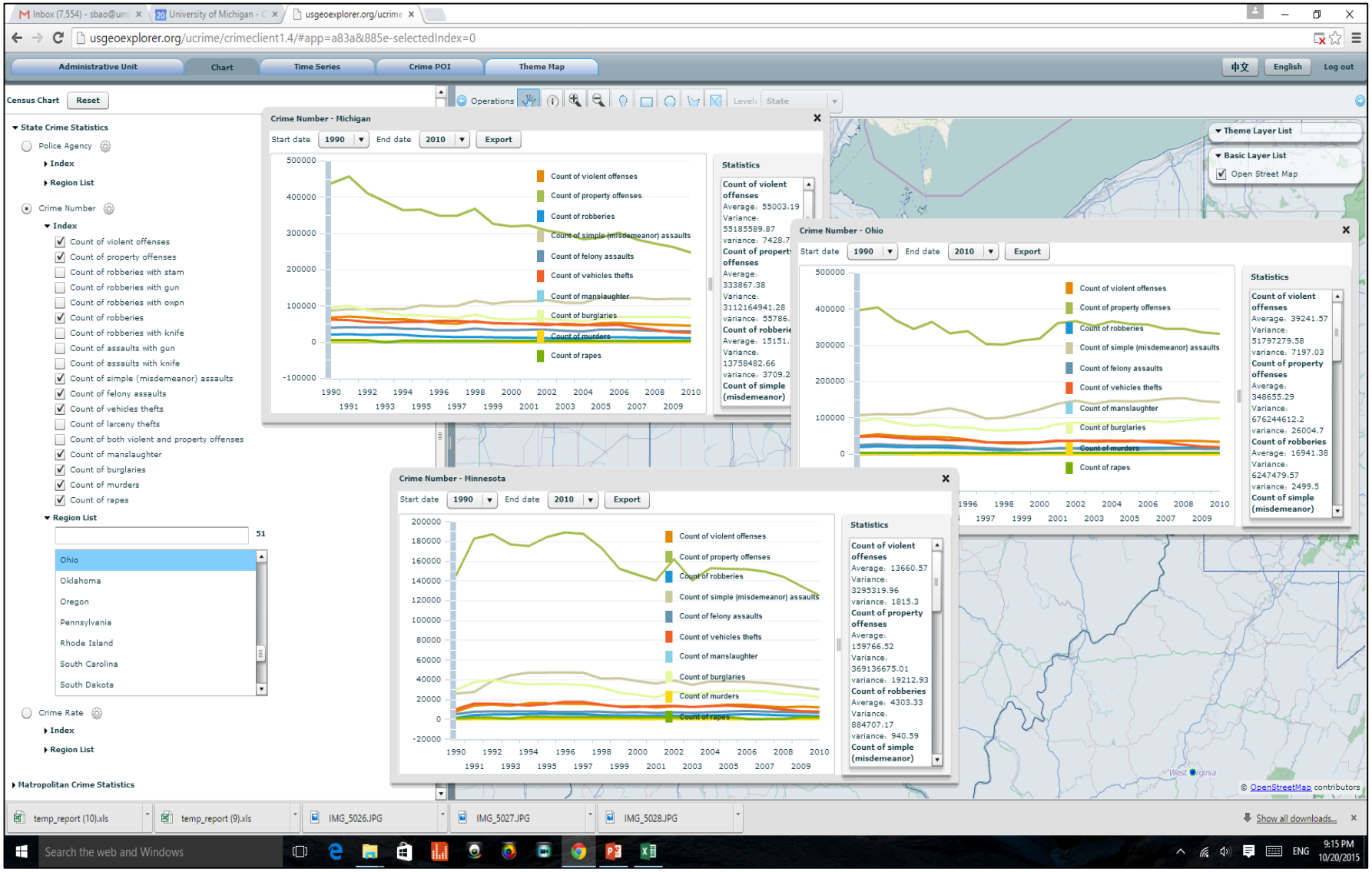
Crime Site Analysis



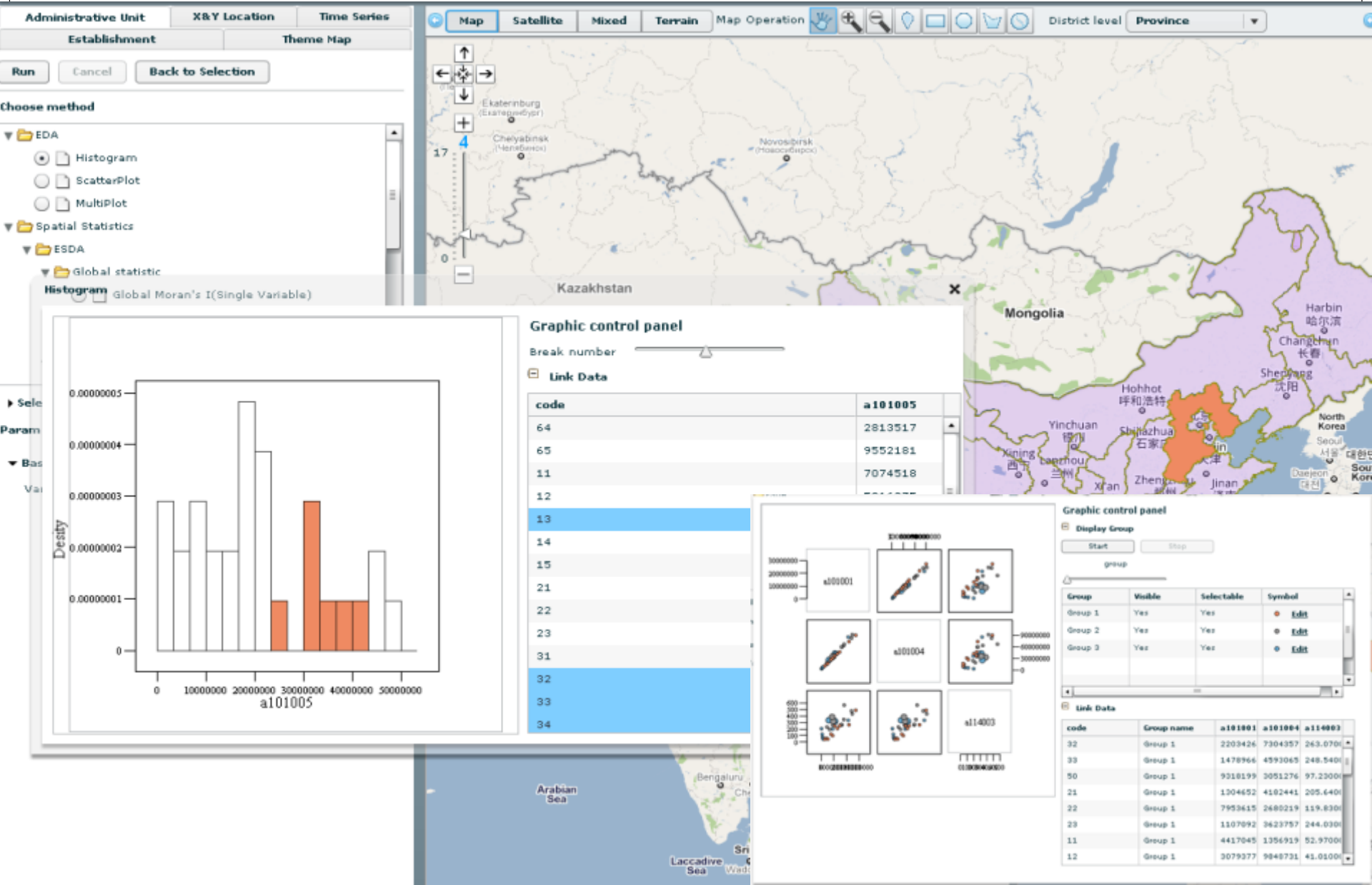
Crime Site Analysis



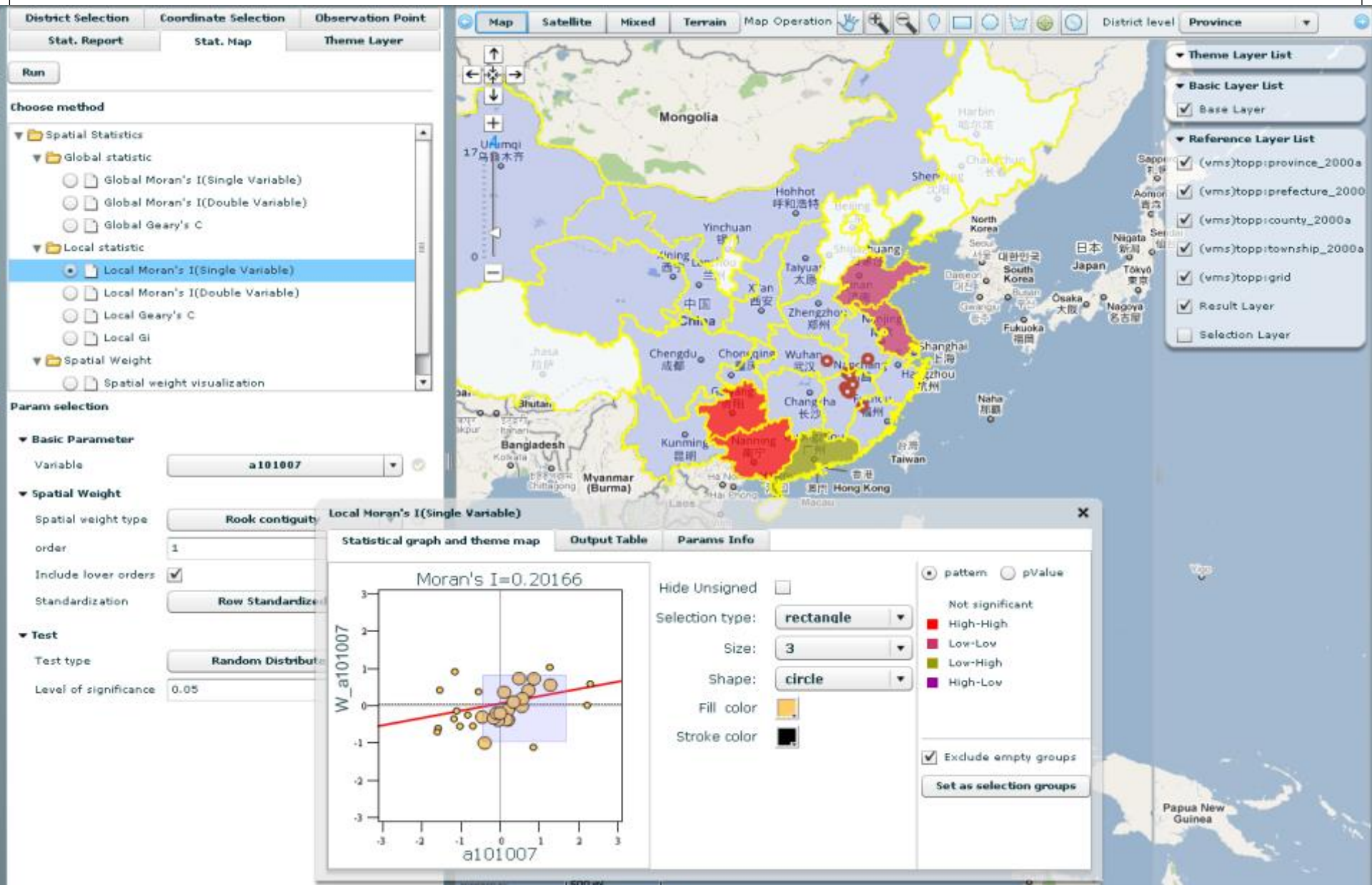
Crime Trend Analysis



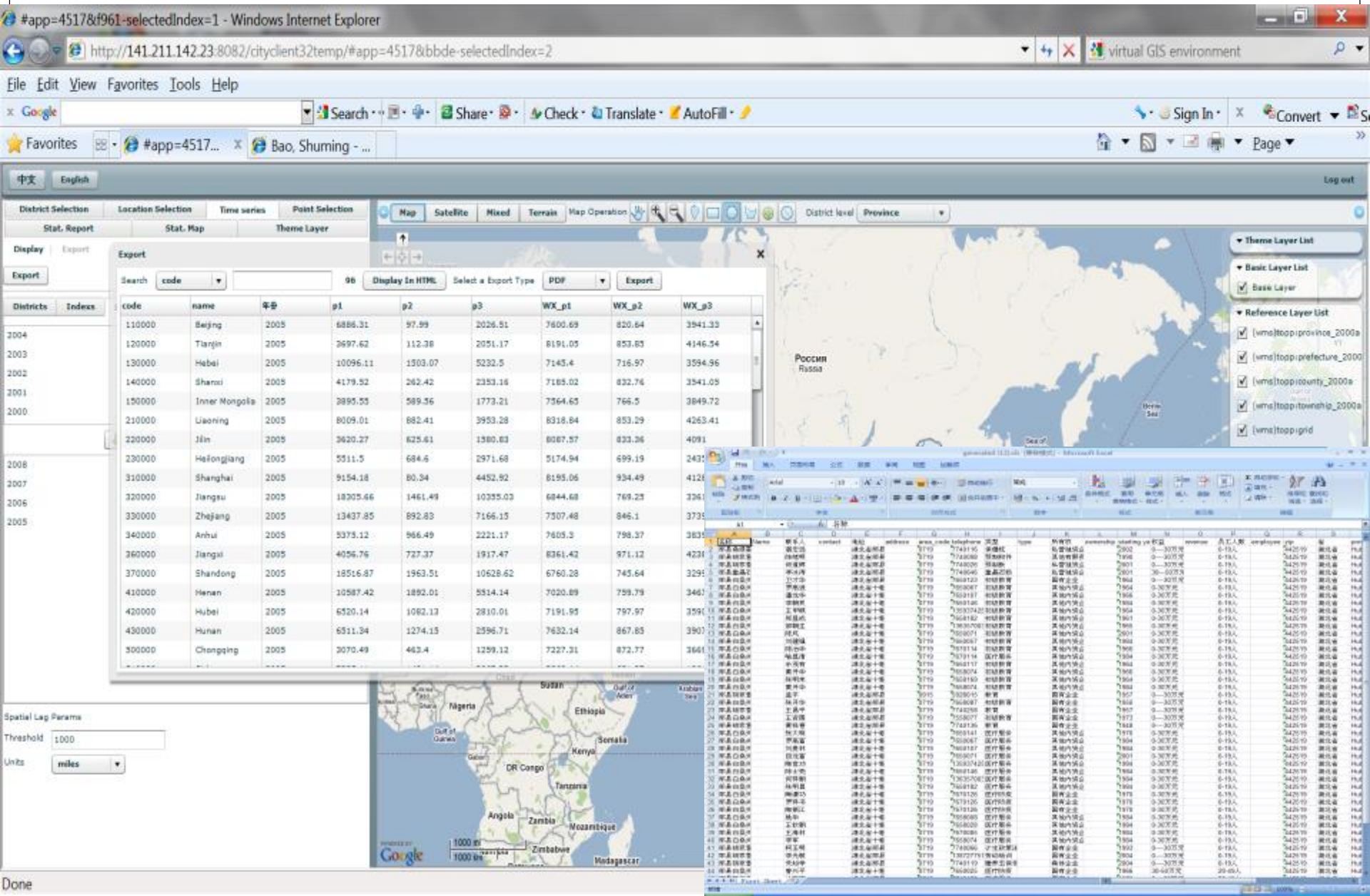
Graphic Analysis



Statistical Analysis



Data Export (Excel, HTM, PDF, Word, Shape)

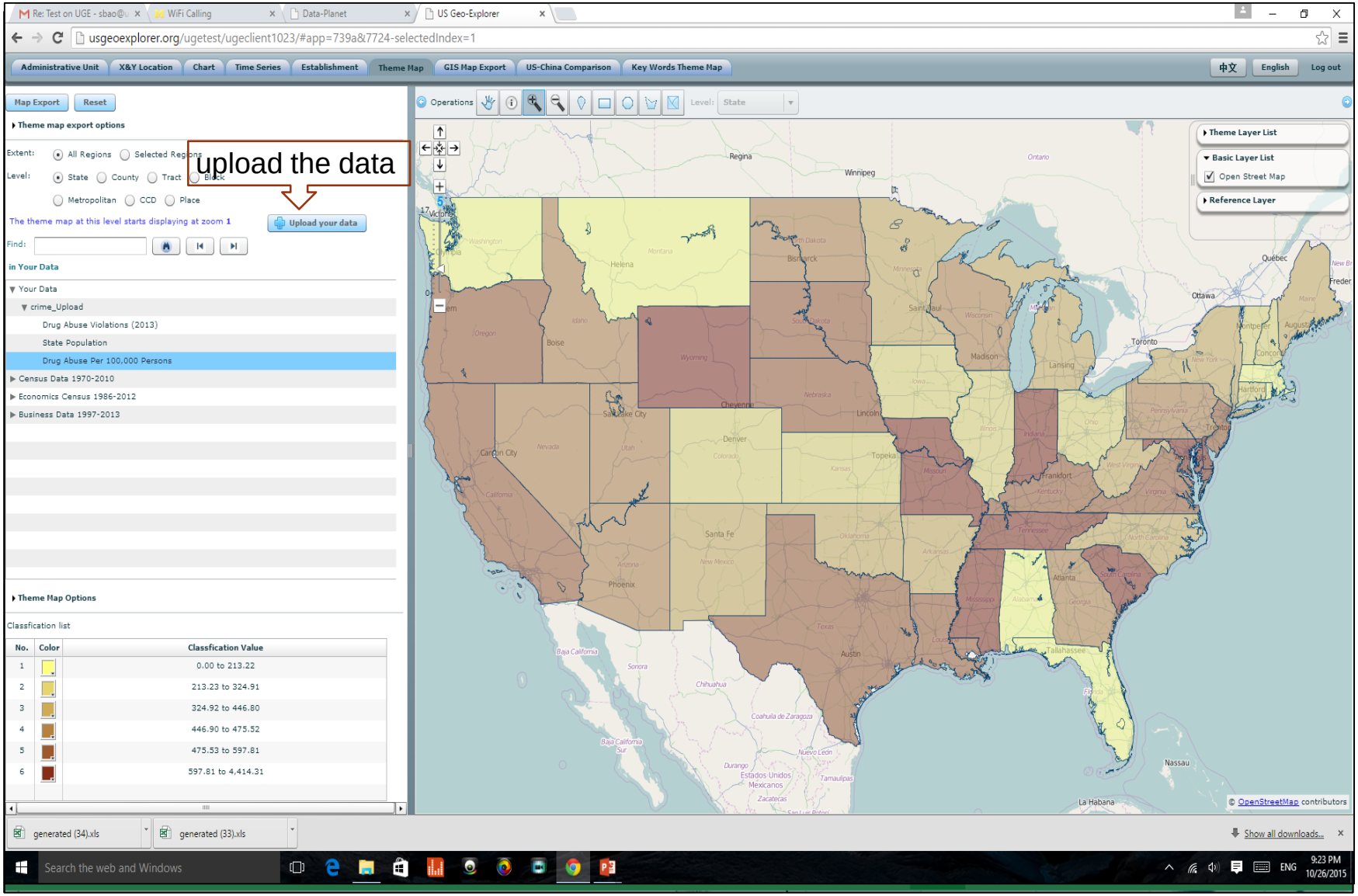


Questions about Spatial Explorer of Crime

- What kind data I should have for converting it into spatial explorer of crime?
- Can I add data into spatial explorer of crime by myself?
- When I download data, how to link my data with other socioeconomic and crime data via geo-explorer of crime?
- If I have crime data from other sources, what can I benefit from using spatial explorer of crime?
- What are the differences between spatial explorer of crime and some other online crime mapping tools such as http://www.crimemapping.com?

Workflows with Spatial Explorer of Crime

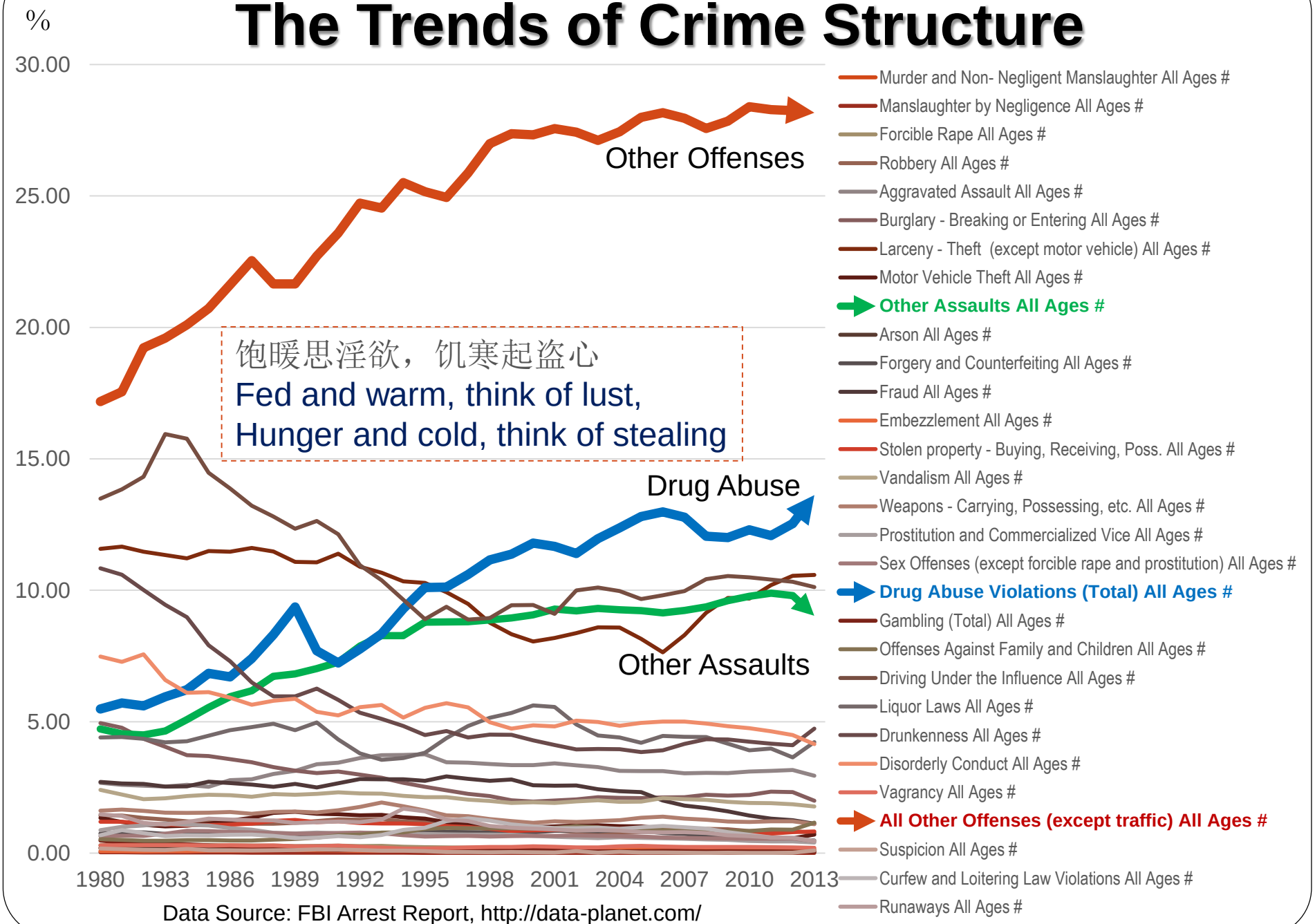
data-planet.com → Excel → usgeoexplorer.org



Applications

- Spatial Patterns of Crime
- Spatial Trends of Crime
- Crime and Population
- Crime and Economy
- Crime and Environment
- Crime and Social Development
- Policy Impacts on Local Crime
- Location Decision of Public Security Facilities

The Trends of Crime Structure

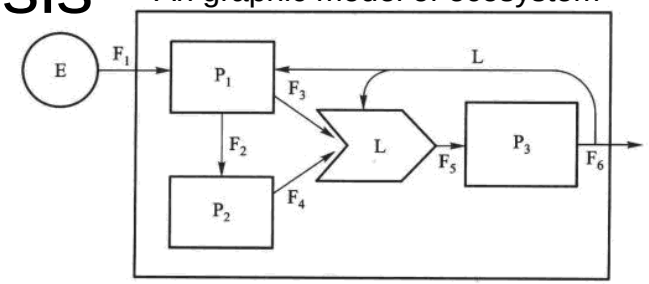


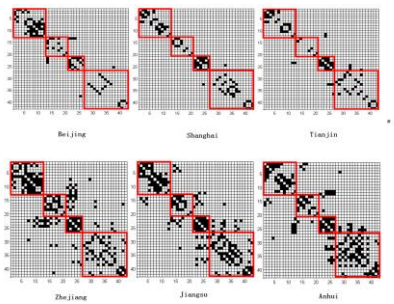
Data Source: FBI Arrest Report, http://data-planet.com/

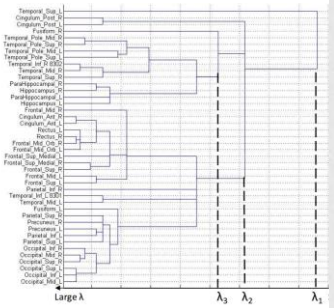
The Ecological Approach

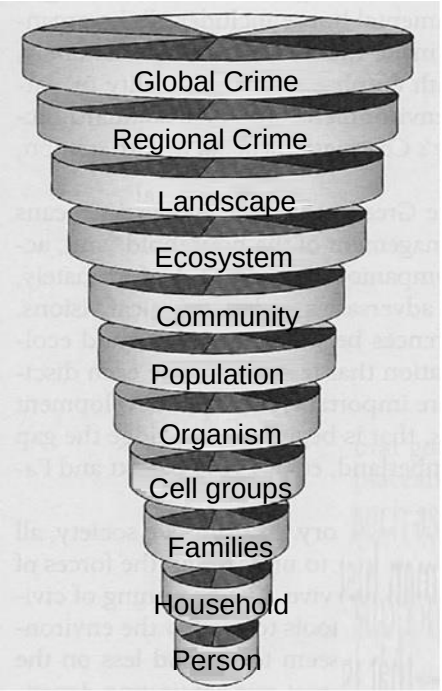
- Ecological crime model（graphic model）
- Multi-scale analysis
- Ecological chain analysis
- Spatial data analysis and visualization
- Quantitative models
- Big data analysis
- Simulations
- Predictions

An graphic model of ecosystem









Problems with Data

- Data is inaccurate
- Data is incomplete
- Data is not comparable
- Data is not available in standard sources

Big Data for Spatial Analysis

Data sources:

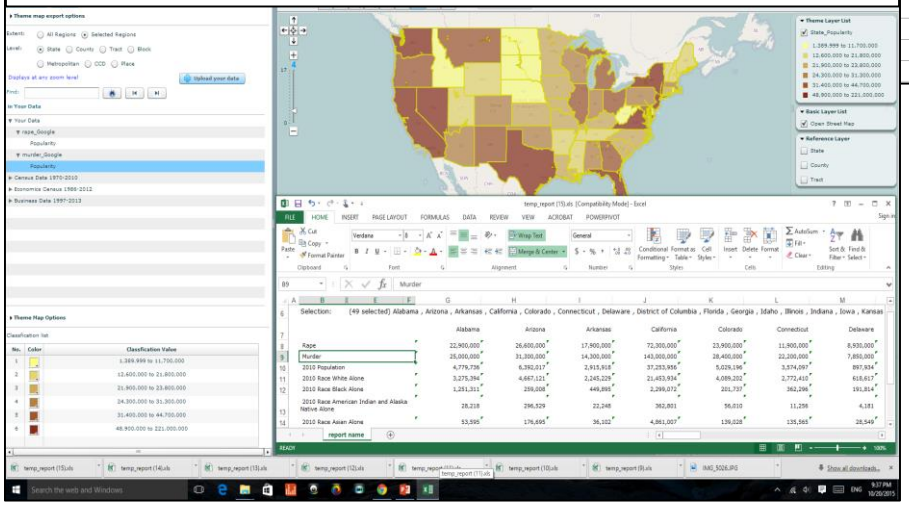
- Search engines (google, yahoo,…)
- Facebook
- Twitter
- Blogs
- WeChat
- QQ
- Users' data

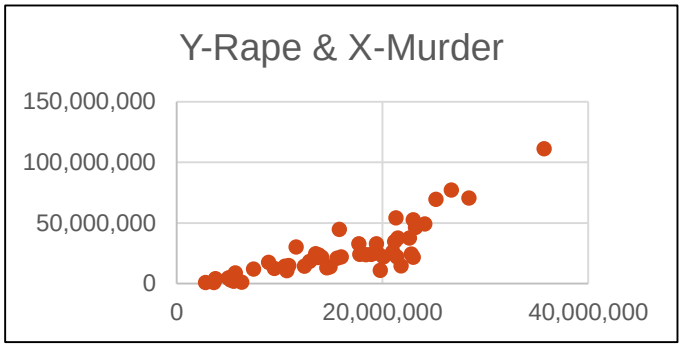
rape Key Words Theme Map

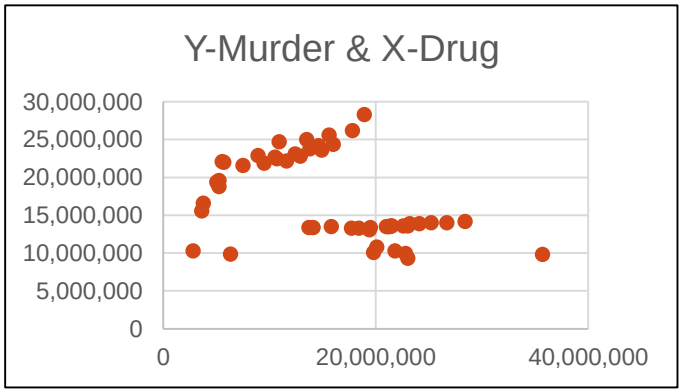
Date: 20/10/2015

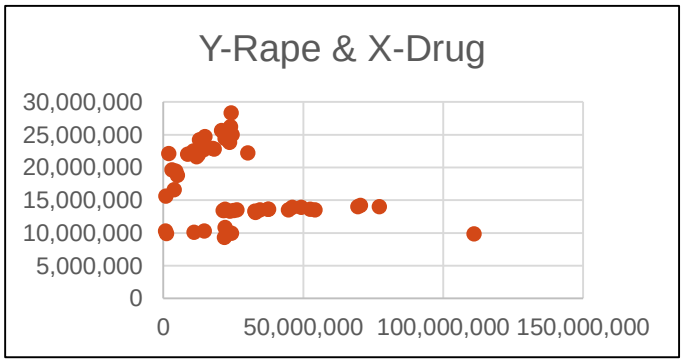
	name	code	Popularity
1	New York	36	111,000,000
2	Texas	48	79,100,000
3	California	06	72,300,000
4	Washington	53	68,500,000
5	Virginia	51	55,400,000
6	Florida	12	50,200,000
7	Ohio	39	46,700,000
8	Hawaii	15	37,400,000
9	Michigan	26	37,400,000
10	Georgia	13	37,300,000
11	Indiana	18	34,900,000
12	Oregon	41	33,900,000
13	Montana	30	32,300,000
14	Arizona	04	26,600,000
15	Kansas	20	25,700,000
			25,200,000
			24,900,000
			24,800,000
			23,900,000
			23,700,000
			23,400,000
			23,000,000

Keyword Search Map: Murder



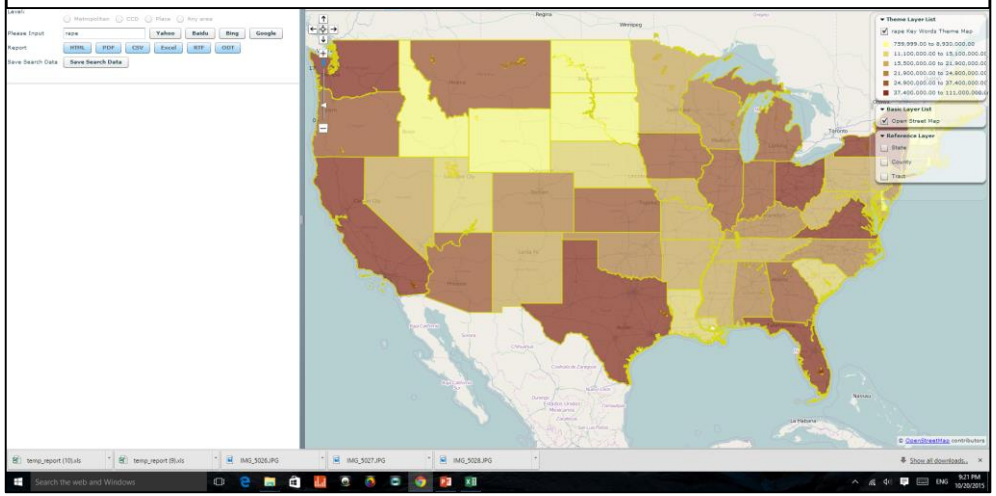






Big Data Application: Keyword Search

Map of Rape



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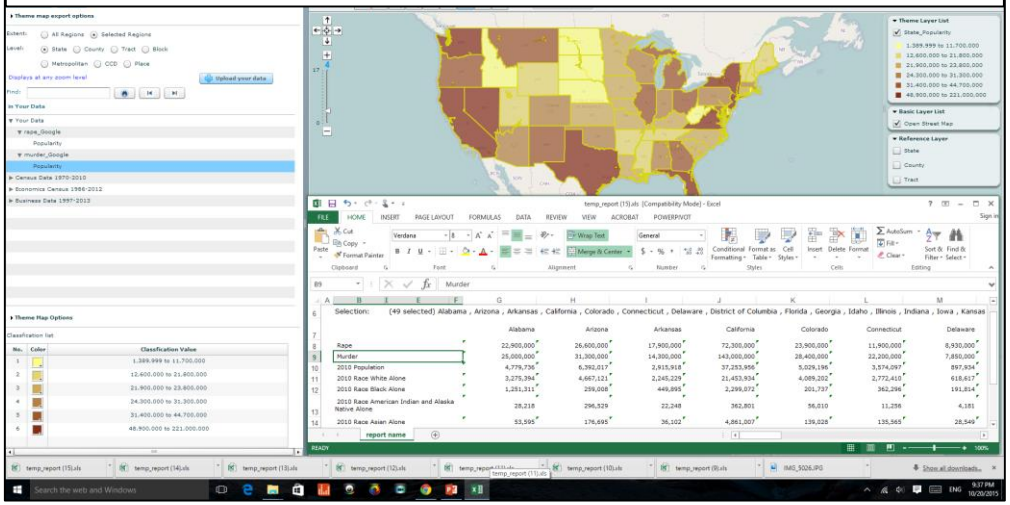
15	Kansas	20	25,700,000
16	Iowa	19	25,200,000
17	Illinois	17	24,900,000
18	New Jersey	34	24,800,000
19	Colorado	08	23,900,000
20	Wisconsin	55	23,700,000
21	Oklahoma	40	23,400,000
22	Kentucky	21	23,000,000

Map of Murder



Building An Research Infrastructure for Spatial Study of Crime and Society