

*The Spatial Distribution of
Illegal Drug Possessions in an
Urban Built-up Environment*

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The 9th Crime Mapping Research Conference. March 28-31. Pittsburg, PA.

Motivation

- Low report rate - drug offenders do not call in to report their illegal drug activities;
- Drug offenses and property crimes are well known to be connected;
- Drug offenses tend to concentrate at certain areas in an urban built-up environment.

Drug and Property Offenses

-- Empirical Evidence --

- Arrestee Drug Abuse Monitoring (ADAM) Program
- Bureau of Justice Statistics
- National Household Surveys on Drug Abuse (NHSDA)
- Empirical Studies:
 - MacCoun, Kilmer, and Reuter (2003)
 - Fagan (1990);
 - Parker and Auerhahn (1998);
 - White and Gorman (2000)

Drug and Property Offenses

-- Models and Empirical Studies --

- Most crime studies are about the causality relationship between the twos -
 - Goode's theory (1997);
 - individual survey of inmates (e.g. Bennett 1998, 2000; Bennet et al. 2001);
 - time series analyses (e.g., Corman and Mocan 2000)
- The spatial relationship between drug offenses and property crimes was largely overlooked.

The Spatial Relationship

-- Theoretical Perspective --

- Routine Activity Theory
- Distance Decay Theory
- Patterns and changes in property crimes might be used as an effective indicator for the pattern changes in drug offenses.
- Location factors for drug offenses, when effectively identified, can assist the efficient and effective use of limited resources.

Questions to answer

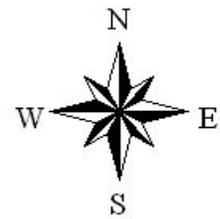
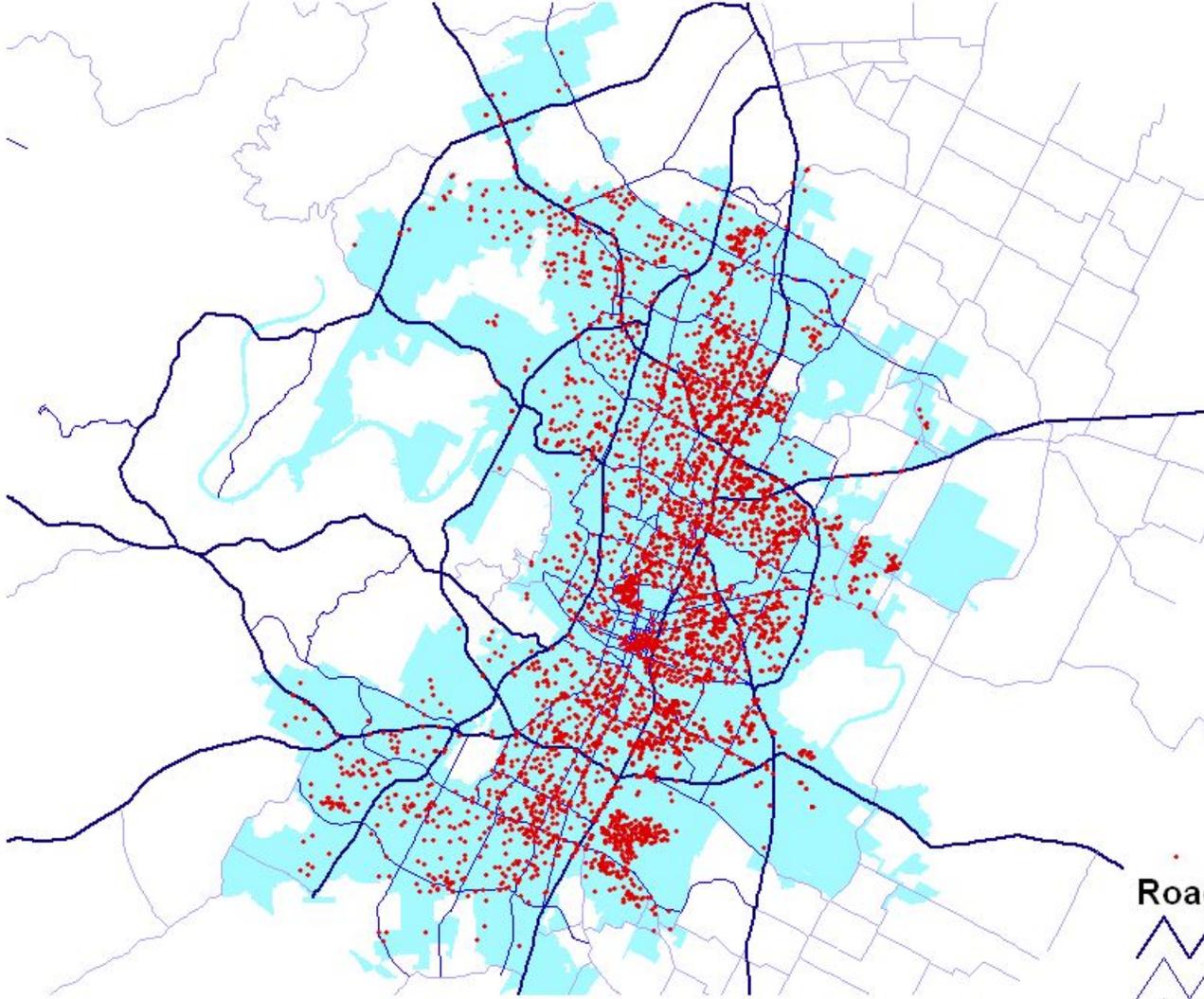
- Are there evidences for a close relationship between the spatial patterns of drug offenses and property crimes?
- If so, how much does the scope and distribution of urban socio-economic activities contribute (or not contribute) to such a relationship?

Data

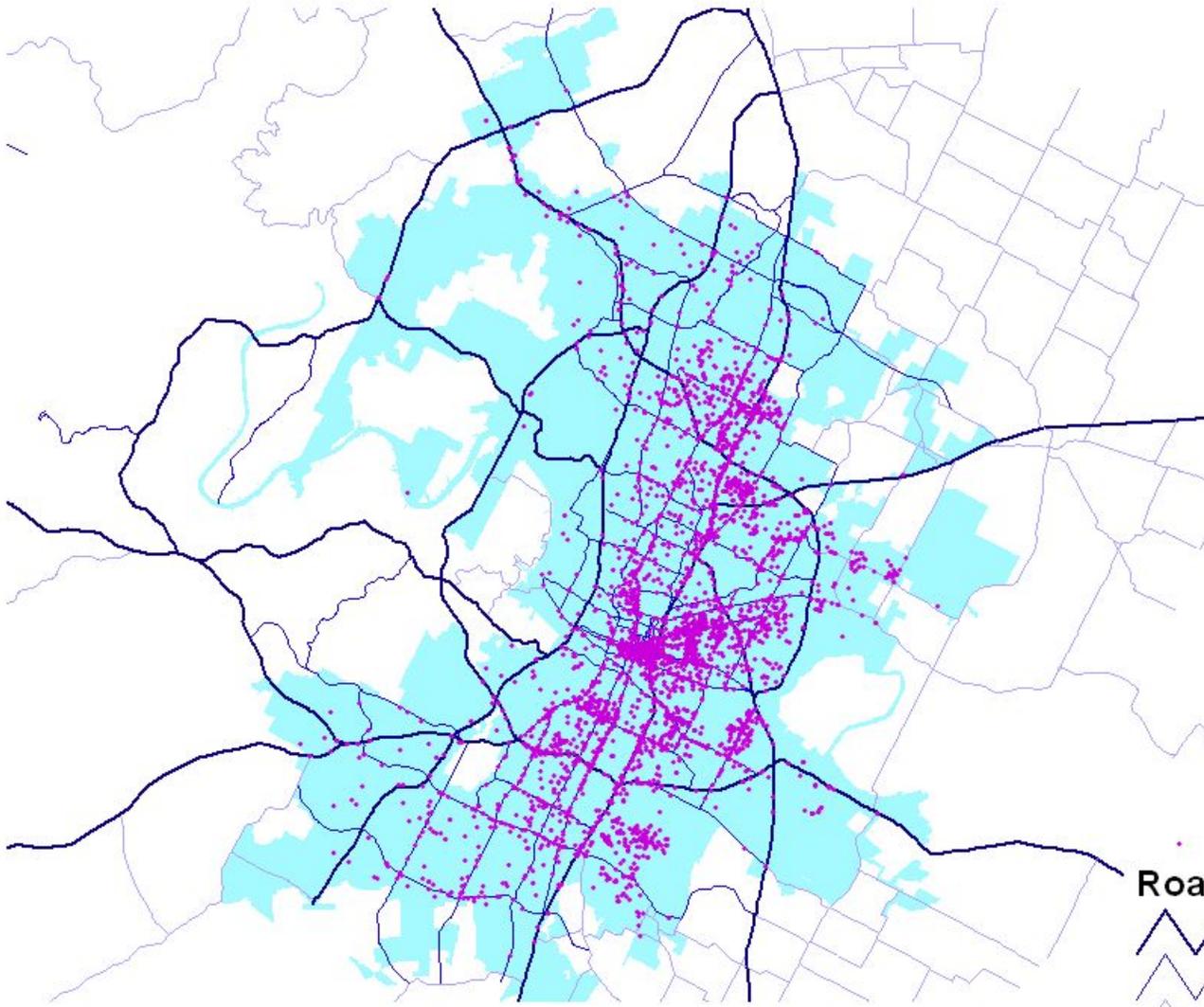
- Two major data sets from Austin Police Department:
 - arrest records for illegal drug possessions in 2000 (indicating drug related activities)
 - records of burglaries of residence and auto thefts in 2000 (to represent property crimes)
- Urban landuse data set from the City of Austin

Questions 1: spatial relationship

- Spatial patterns of illegal drug possessions
- Spatial patterns of property crimes (residential burglaries and auto thefts in this study)
- Spatial relationships between the above two patterns



-  Property Crime
-  Major Road
-  Minor Road
-  Rural Road
-  City of Austin



- Drug Offense
- Roads
 - Major Road
 - Minor Road
 - Rural Road
- City of Austin

4 0 4 Miles

First-order Analysis

- Nearest Neighbor Index

$$\text{NNI} = \frac{\text{average distance between NN}}{\text{expected distance between NN}}$$

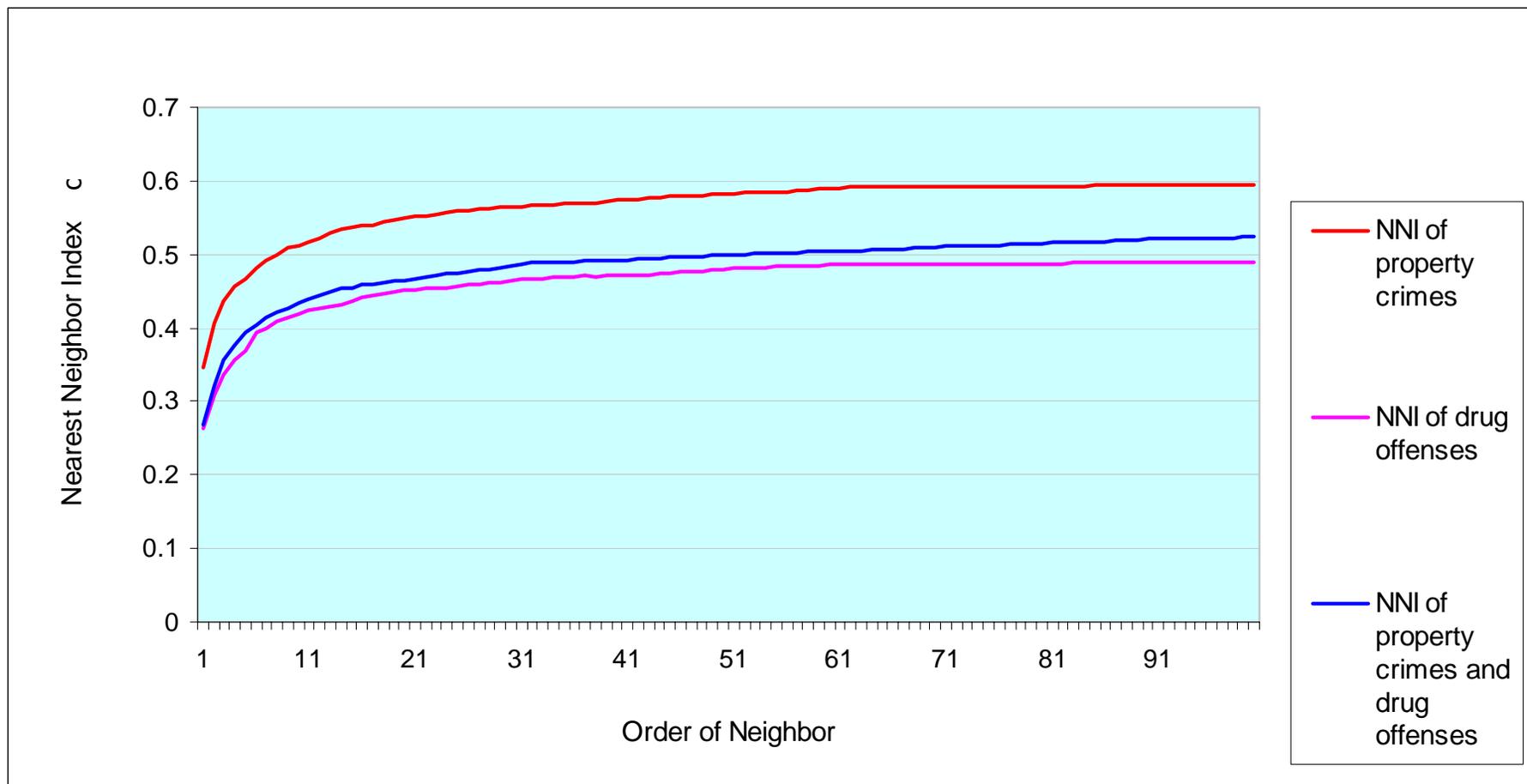
- High-order NNI
- Combined NNI

$$\text{CNNI} = \frac{\text{average distance bw NN from the combined set}}{\text{expected distance bw.NN from the combined set}}$$

Results of NNI

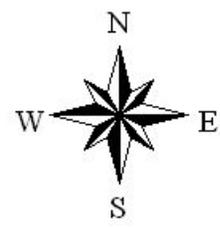
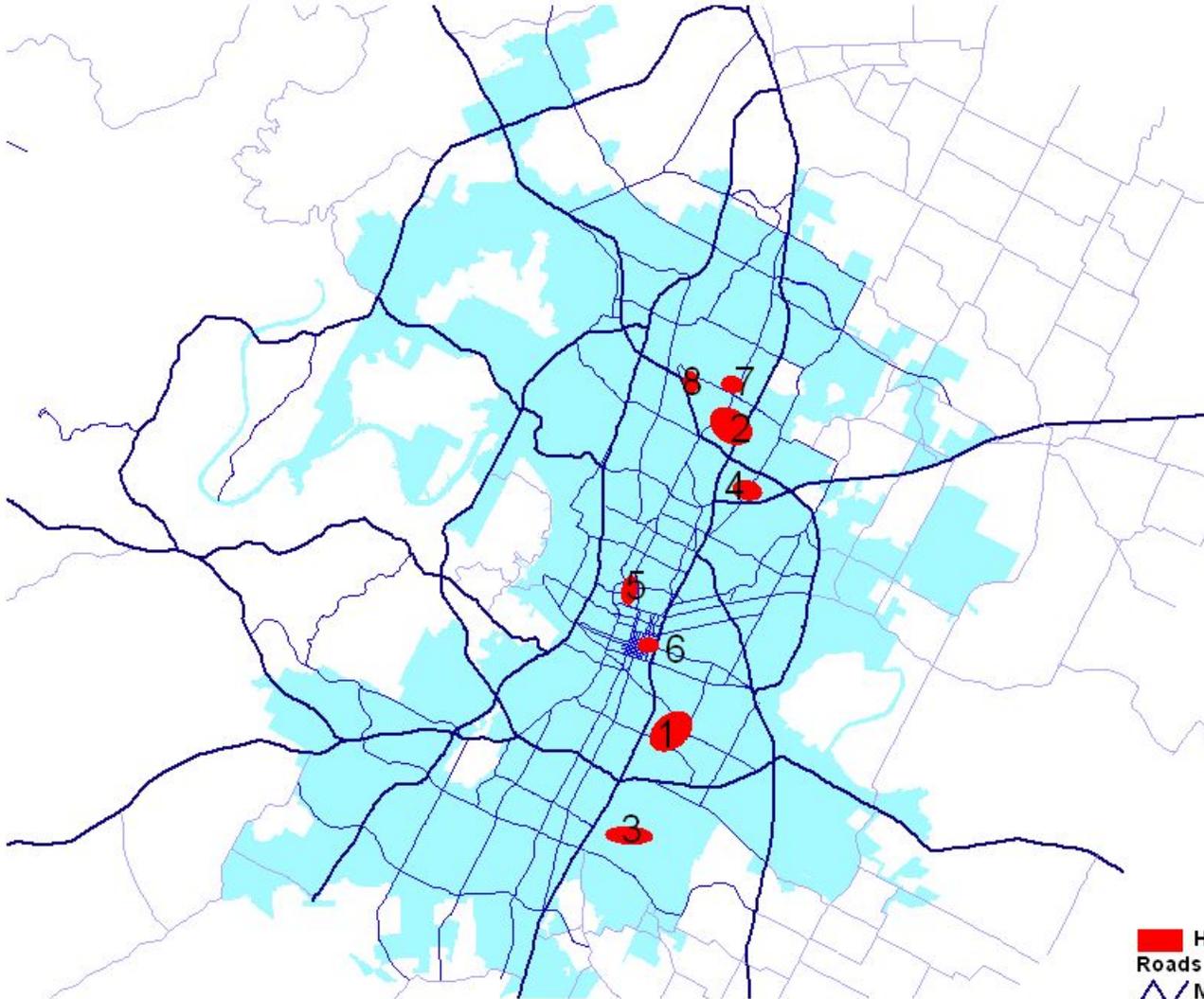
	Drug Offenses	Property Crimes	Combined Offenses
NNI (Euclidean distance)	0.25	0.36	0.25
NNI (Manhattan distance)	0.32	0.46	0.31

High-order NNI

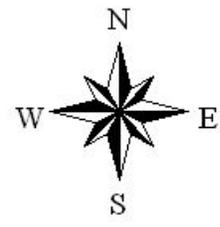
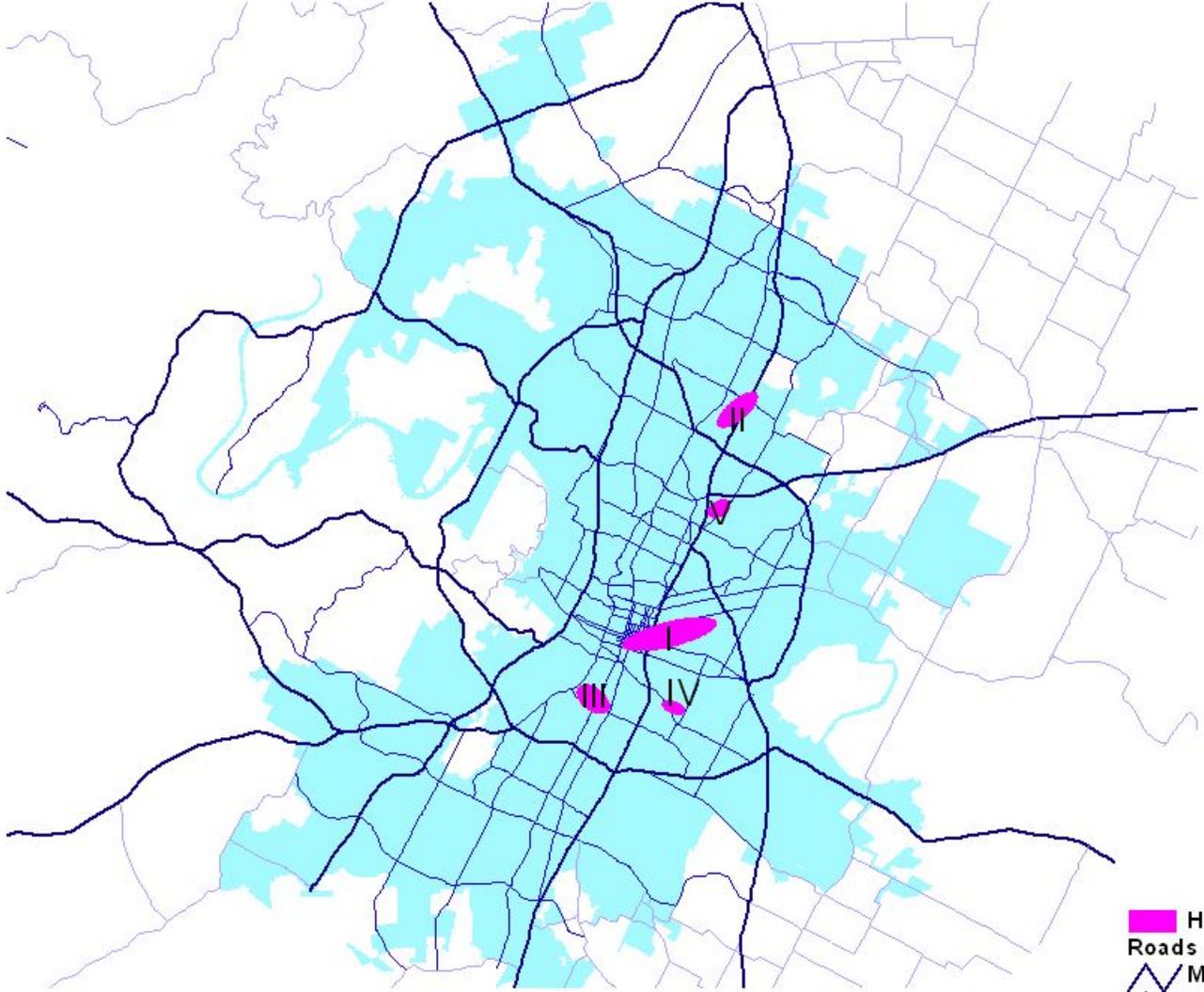


Second-order Analysis

- Hot Spots Analysis
 - STAC
- Distance Matrix
 - Distance between hot spots of different types of offenses

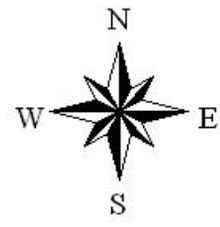
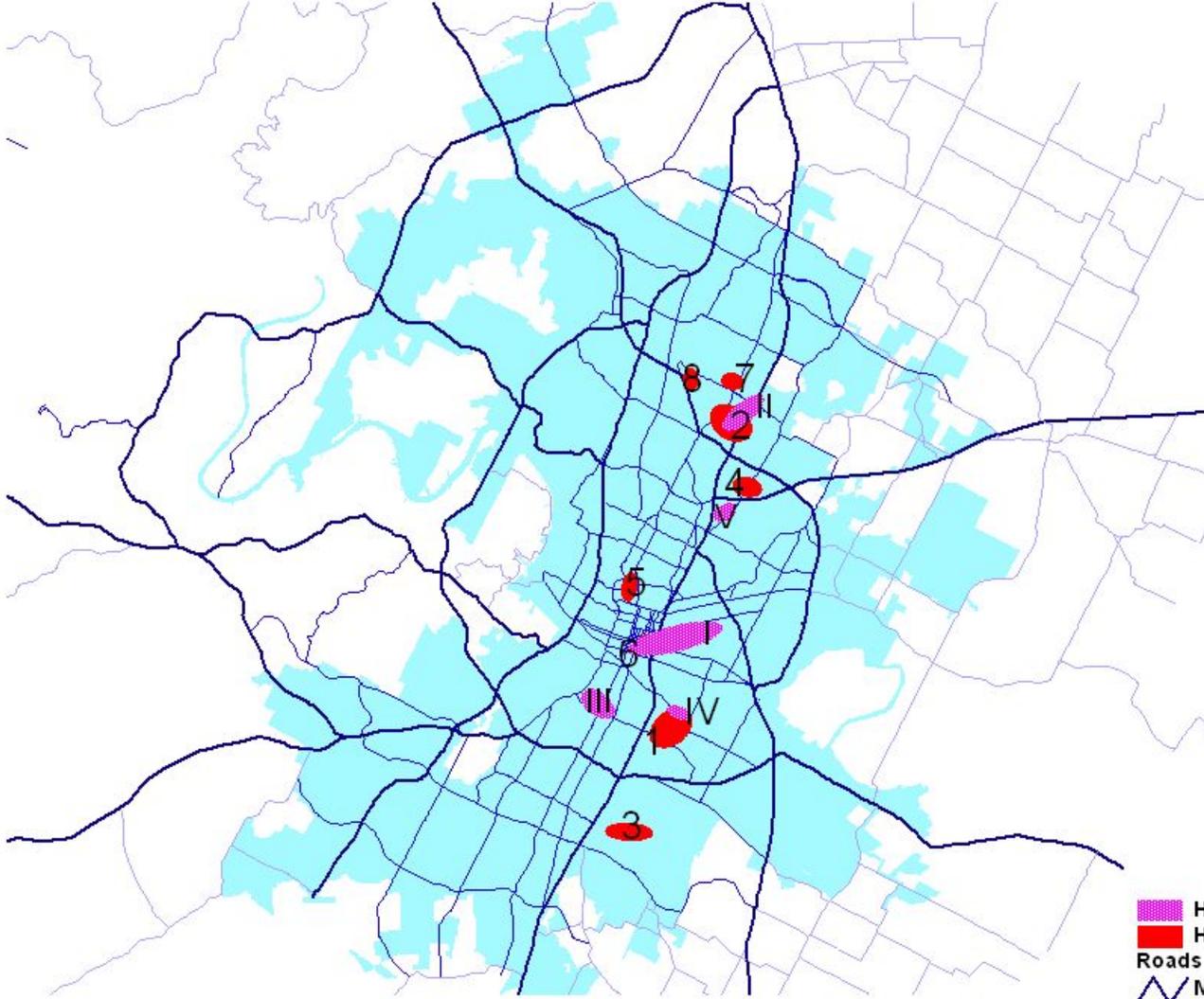


- Hot Spot of Property Crime
- Roads
 - Major Road
 - Minor Road
 - Rural Road
 - City of Austin



4 0 4 Miles

- Hot Spot of Drug Offense
- Roads
 - Major Road
 - Minor Road
 - Rural Road
 - City of Austin



- Hot Spot of Drug Offense
- Hot Spot of Property Crime
- Roads
 - Major Road
 - Minor Road
 - Rural Road
- City of Austin

4 0 4 Miles

Distance Matrix

Hot spots of drug offenses

	I	II	III	IV	V
1	2.36	8.56	2.04	0.46	5.89
2	5.91	0.42	8.24	7.79	2.37
3	5.26	11.51	3.49	3.43	8.84
4	4.46	1.97	6.98	6.24	0.90
5	1.82	5.51	3.21	3.57	3.21
6	0.70	6.57	2.12	2.04	3.98
7	6.99	0.88	9.26	8.89	3.48
8	6.89	1.65	8.95	8.84	3.64

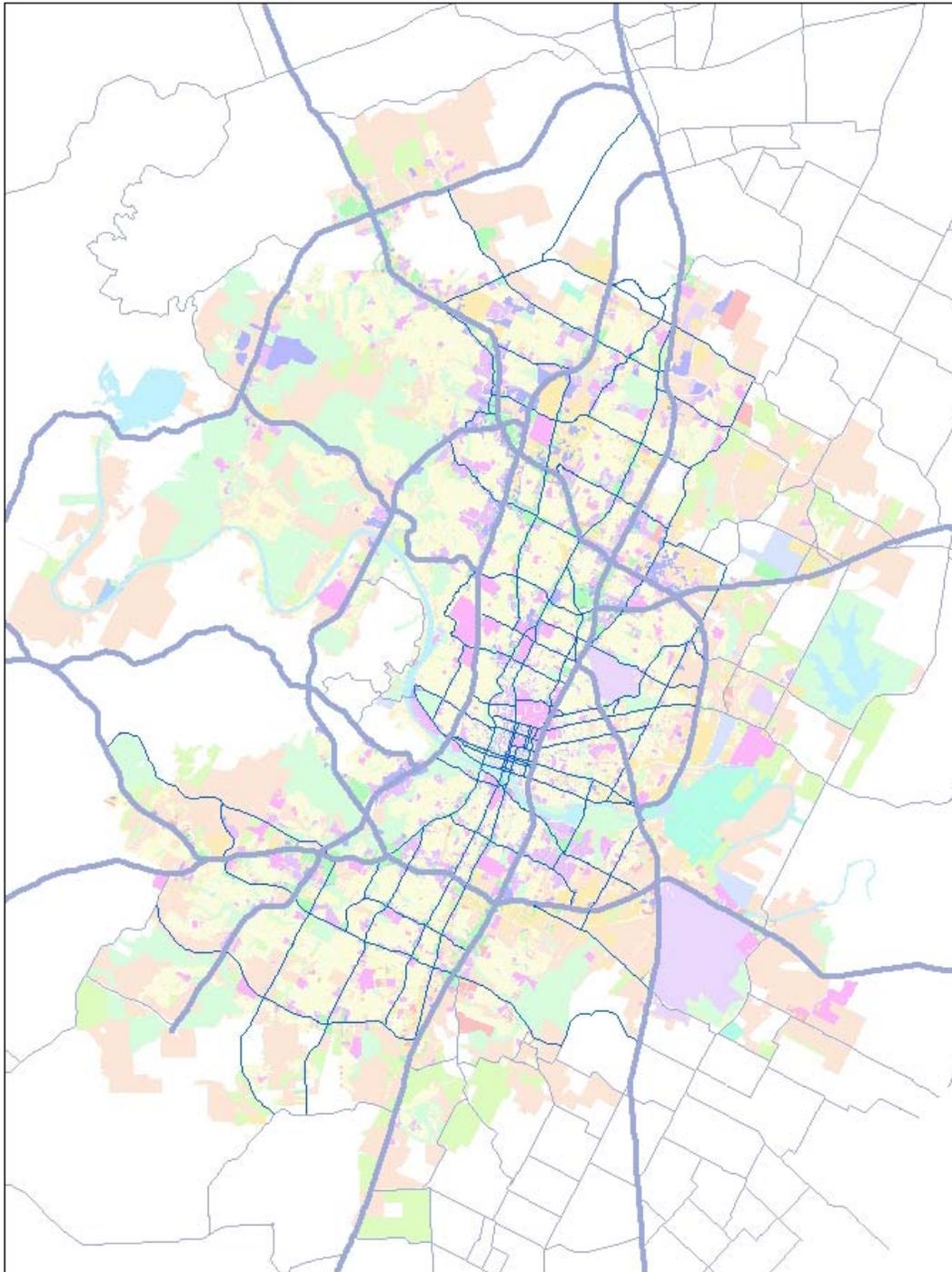
Hot spots of property crimes

Question 2: Impact of Urban Socio-economic Activities

- Spatial distribution of major urban socio-economic activities
- “Attractiveness” of different urban activities for the drug offenses
- Impact of the overall urban socio-economic activities on the drug offenses in regarding to their proximity to property crimes

Urban Landuse in Austin

Landuse Code	Definition	Count	Percent
50	Large Lot Single-family	132	0.08
100	Single-family	141297	81.70
113	Mobile homes	1048	0.61
200	Multi-family	4187	2.42
300	Commercial	4882	2.82
400	Office	1967	1.14
500	Industrial	1843	1.07
560	Mining	39	0.02
600	Civic	1375	0.80
700	Open Space	1701	0.98
800	Transportation	895	0.52
870	Utilities	131	0.08
900	Undeveloped/Rural	11213	6.48
940	Water	112	0.07
999	Unknown	7	0.00



**Austin
Landuse
2000**

Combined offenses on different types of landuse

Landuse Code	Definition	Count	Percent
50	Large lot single-family	15	0.12
100	Single-family	4257	33.80
113	Mobile homes	51	0.41
200	Multi-family	2103	16.70
300	Commercial	2601	20.65
400	Office	782	6.21
500	Industrial	460	2.65
560	Mining	2	0.02
600	Civic	713	5.66
700	Open Space	318	2.53
800	Transportation	283	2.25
870	Utilities	23	0.18
900	Undeveloped/Rural	980	7.78
940	Water	4	0.03
999	unknown	1	0.01

Concentration of Offenses on Different Types of Landuse

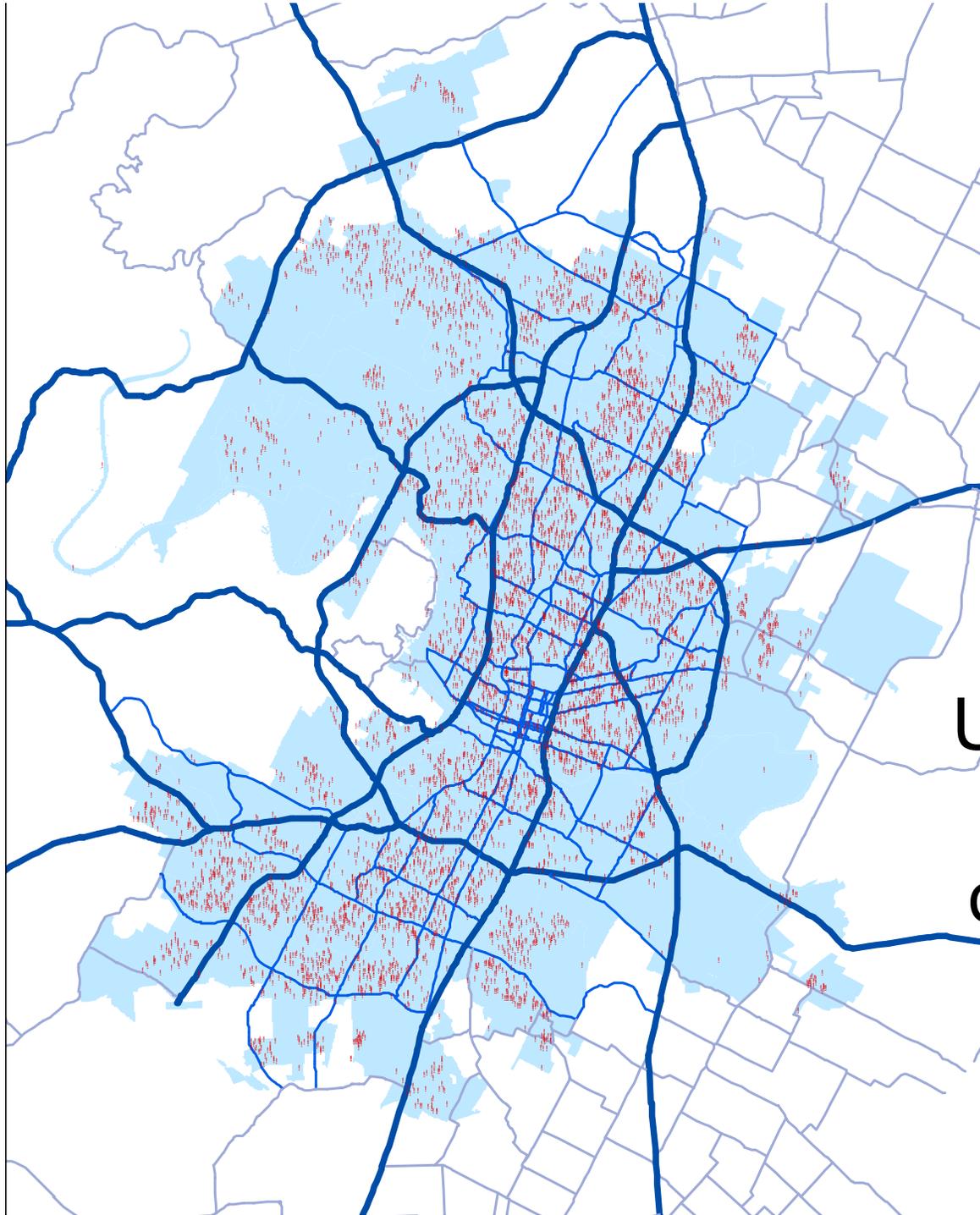
Landuse Code	Drug Offense		Property Crime	
	Percent	Location Quotient	Percent	Location Quotient
50	0.08	0.99	0.17	2.24
100	23.57	0.29	45.48	0.56
113	0.18	0.23	0.66	1.09
200	11.82	4.89	22.25	9.19
300	27.42	9.71	12.94	4.58
400	8.99	7.91	3.04	2.67
500	4.67	4.38	2.50	2.34
560	0.03	1.30	-----	-----
600	7.72	9.71	3.31	4.17
700	3.07	3.12	1.90	1.93
800	2.85	5.50	1.56	3.02
870	0.22	2.95	0.14	1.79
900	9.33	1.44	6.01	0.93
940	0.03	0.46	0.03	0.52
999	0.02	3.75	-----	-----

The impact of Urban Landuse (I)

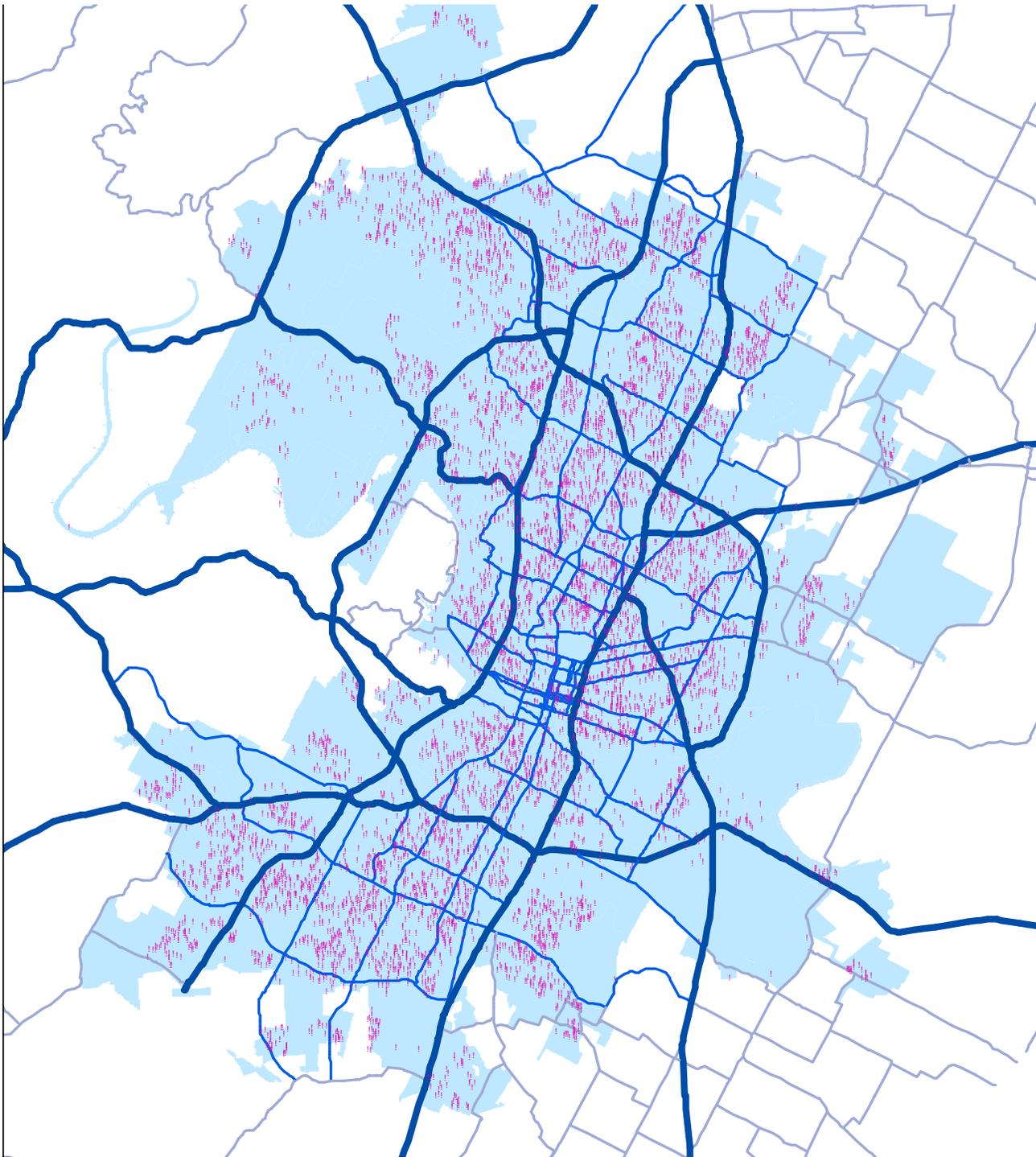
- Uncontrolled simulation of crime locations
 - To randomly simulate the same numbers of drug offenses and property crimes in the study area;
 - To analyze their spatial patterns and relationships

The Impact of Urban Landuse (II)

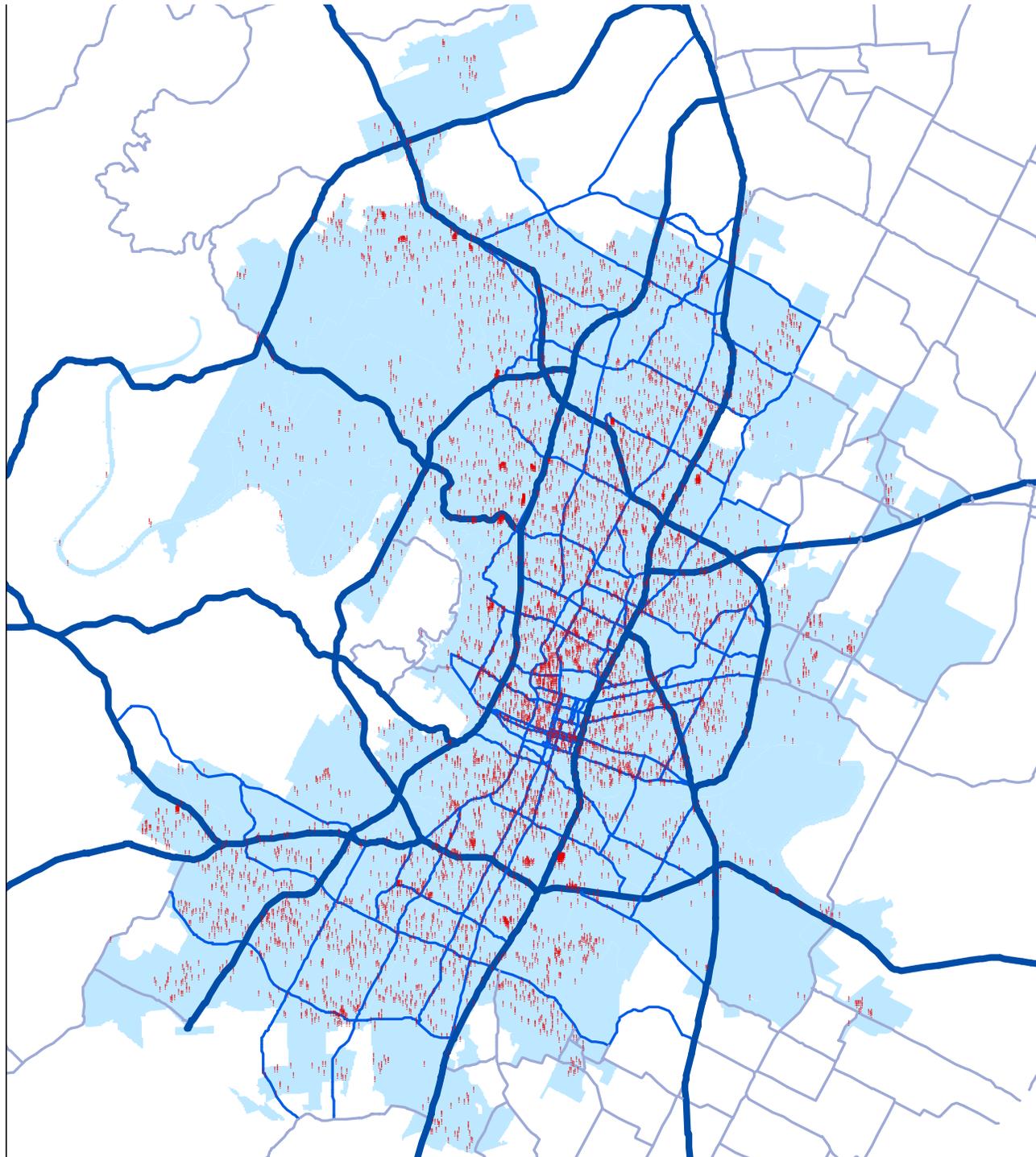
- **Controlled Simulation and Analysis**
 - Stratified random simulation of different types of offenses as related to urban landuse;
 - Analyses of the spatial patterns and spatial relationships.



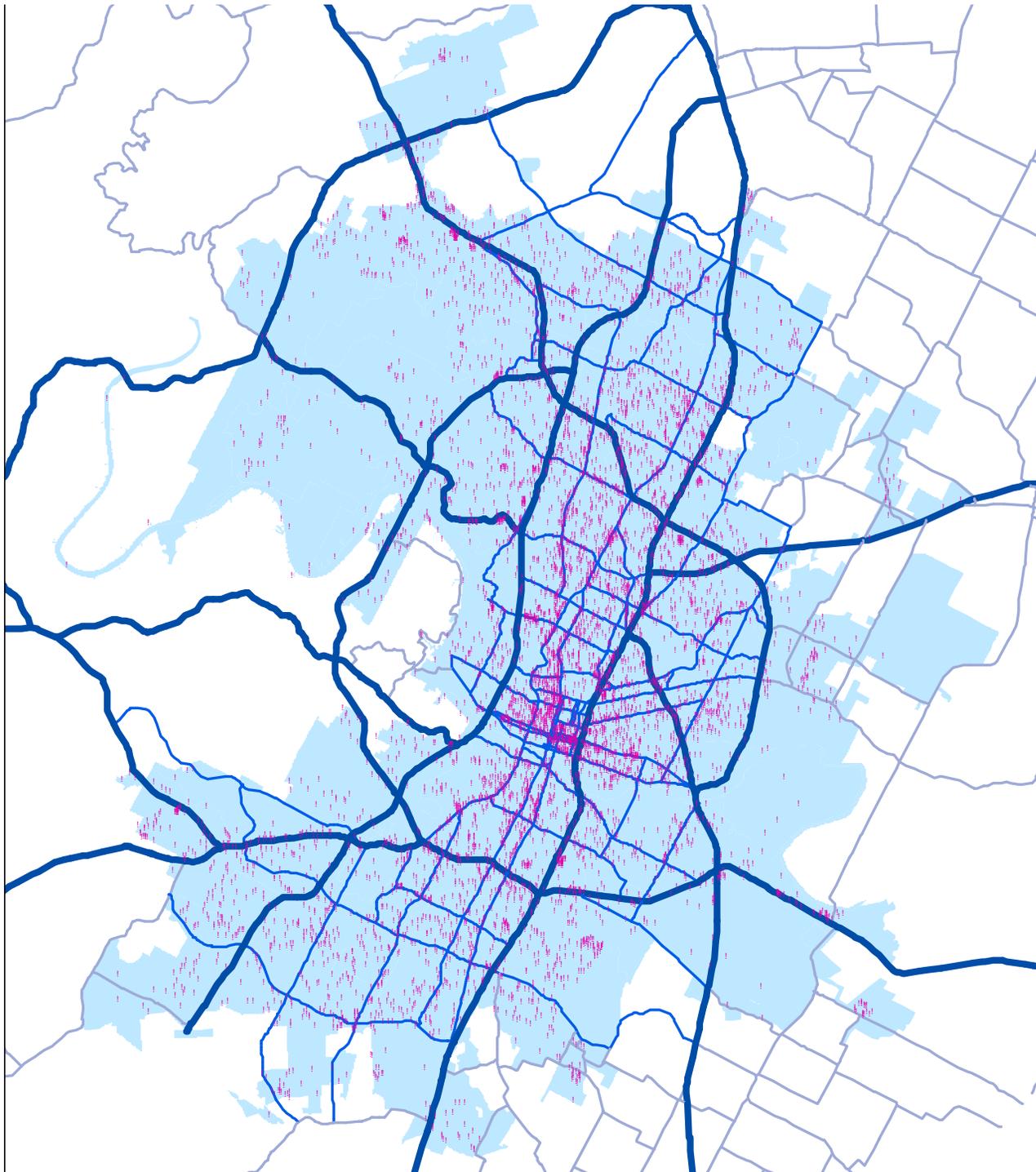
Uncontrolled
Simulation
of Property
Crimes



Uncontrolled
Simulation
of Drug
Offenses



Controlled
Simulation
of Property
Crimes

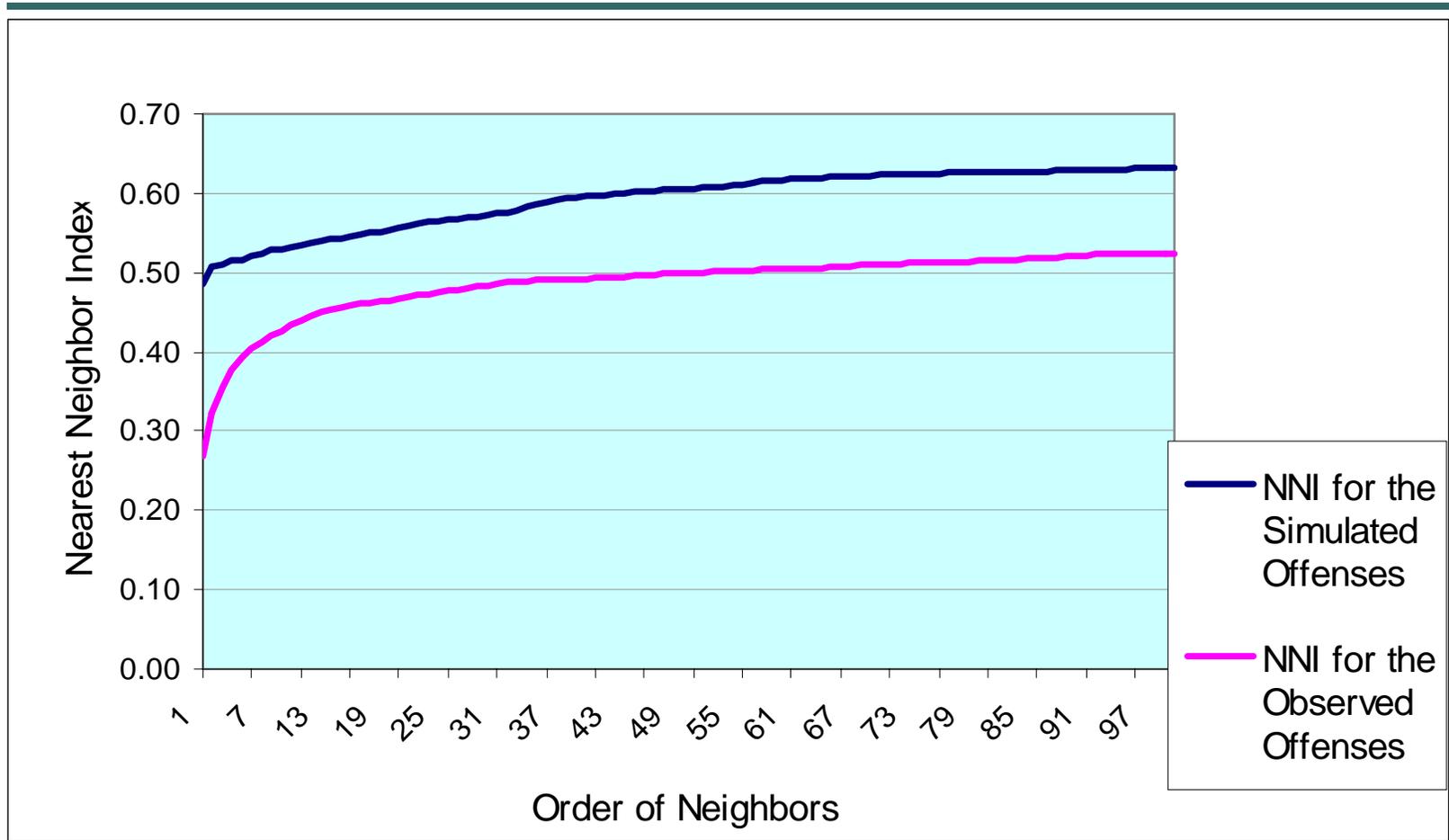


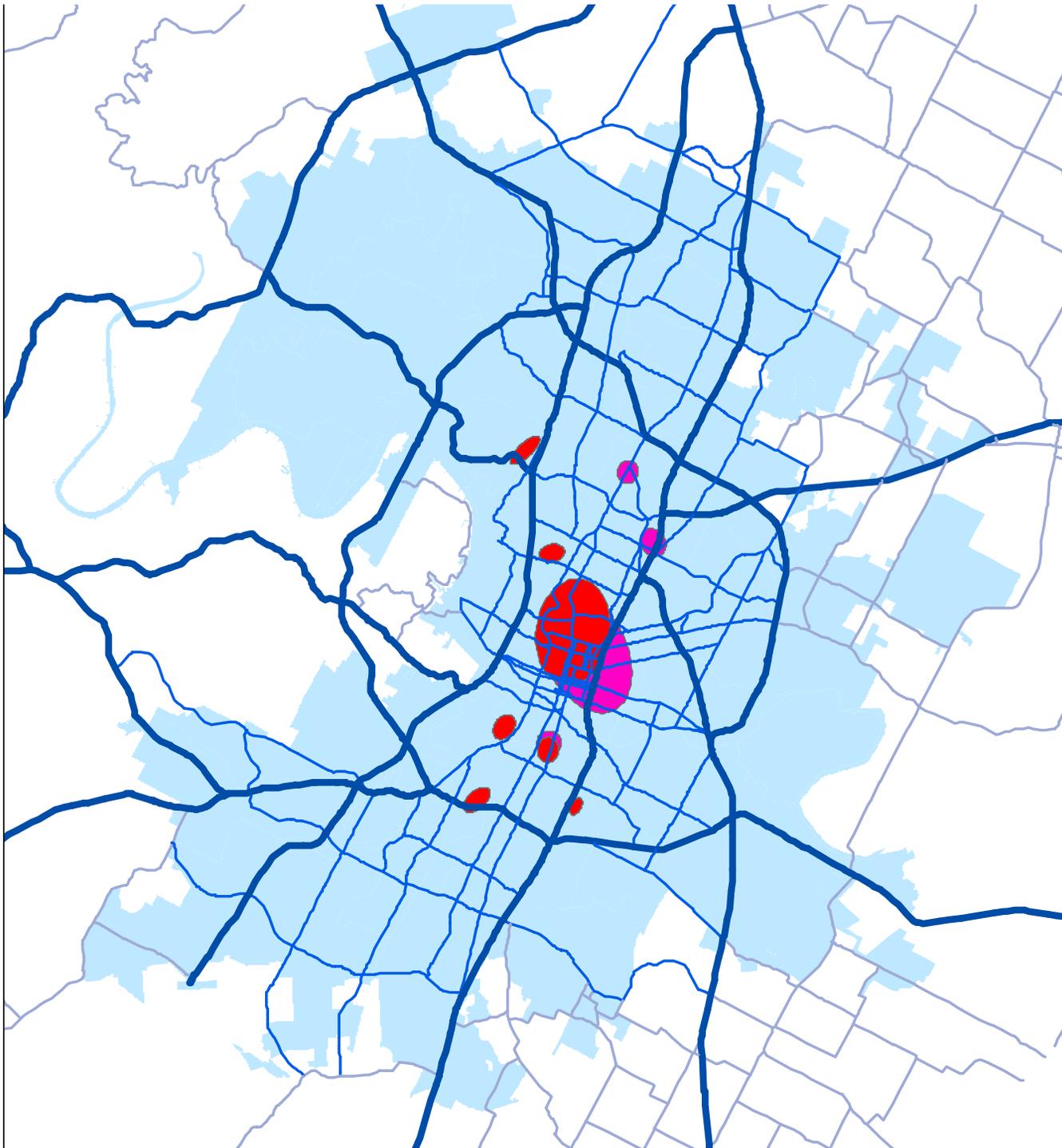
Controlled
Simulation
of Drug
Offenses

NNI analyses of one controlled Simulation vs. the observation

	Drug Offenses		Property Crimes		Combined Offenses	
	Observed	Simulated	Observed	Simulated	Observed	Simulated
NNI (Euclidean distance)	0.25	0.55	0.36	0.53	0.25	0.49
NNI (Manhattan distance)	0.31	0.69	0.46	0.66	0.32	0.62

High-order NNI for the combined offenses





Hot Spots
of the
Controlled
Simulation

Conclusions

- The spatial locations of illegal drug possessions and property crimes are closely related in the study area.
- Both illegal drug possessions and property crimes are closely related to certain types of urban landuse.
- By controlling the impact of urban landuse on the locations of crimes, these two types of offenses still tend to show a close spatial relationship.

Future Research

- Detailed classification of urban landuse types
- More simulations (both controlled and uncontrolled) to reach statistical significance regarding the relationship between drug offenses and property crimes
- More updated and multi-years of data to reveal temporal patterns and relationships