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Spatial Variation in Local Road Pedestrian and Bicycle Crashes

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Background

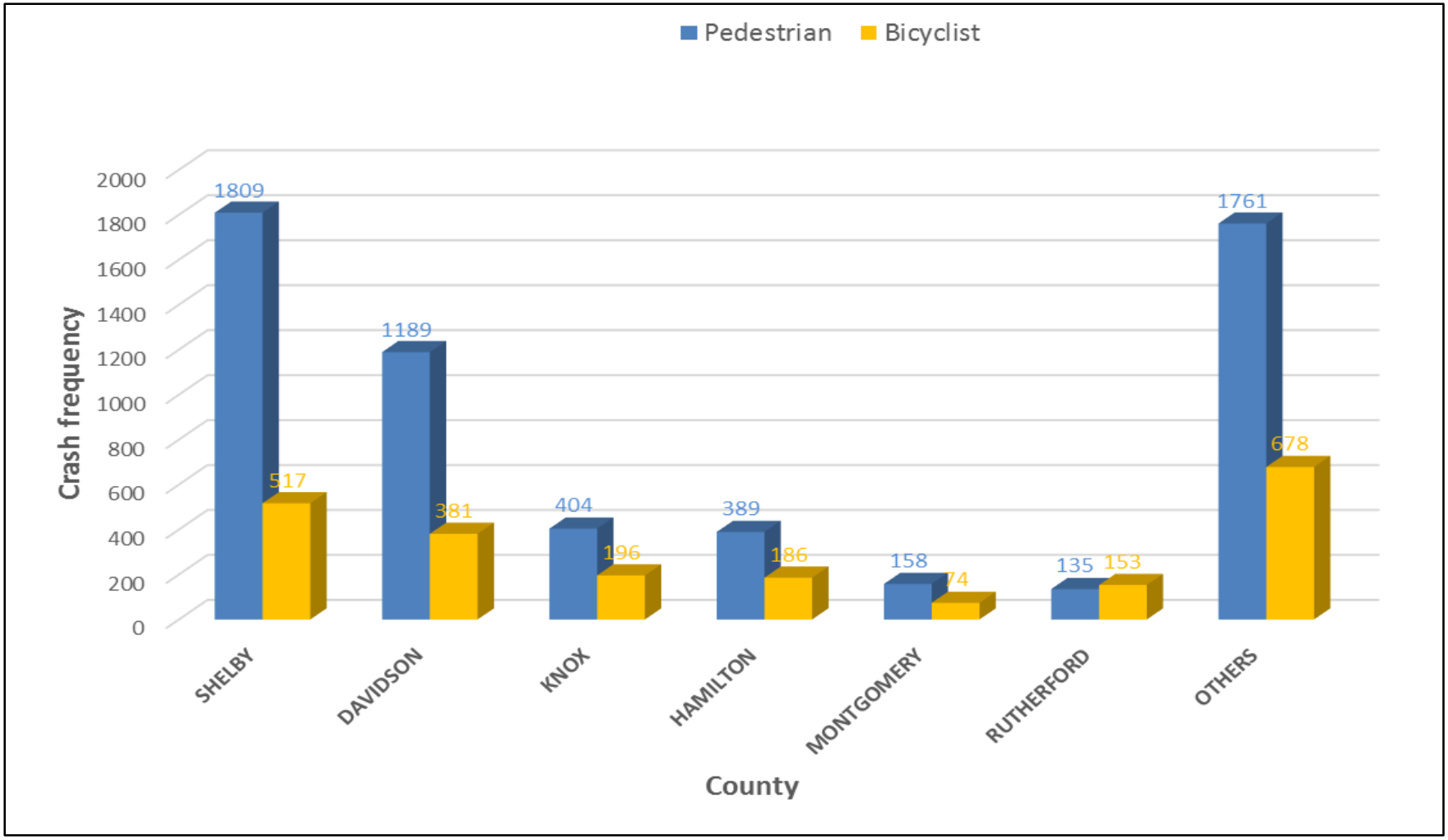
National Statistics for 2012

	Fatalities	Injuries
Pedestrians	4,743	76,000
Bicyclists	726	49,000

Source (NHTSA, 2014).

Background

Crash experience in Tennessee



TDOT crash records: 2008-2012

On what Roads are these crashes?

Table 12. Pedestrian Fatalities and Injuries by Road Type, 2008.

Road Type	Percent of total pedestrian fatalities	Percent of total pedestrian injuries
Total		
Principal Arterial-Interstate	11.68	15.51
Principal Arterial-Other Expressways or Freeways	11.37	10.25
Principal Arterial	30.34	26.04
Minor Arterial	18.76	16.07
Collector	5.66	4.99
Local Road or Street	20.82	23.27
Unknown or Blank	1.37	1.66
Rural*		
Rural Principal Arterial-Interstate	3.62	3.88
Rural Principal Arterial-Other	6.63	4.43
Rural Minor Arterial	4.19	5.54
Rural Major Collector	5.05	4.99
Rural Minor Collector	1.41	1.66
Rural Local Road or Street	6.42	5.82
Unknown Rural	0.19	0.55
Urban*		
Urban Principal Arterial-Interstate	8.06	11.63
Urban Principal Arterial-Other Freeways or Expressways	4.74	5.82
Urban Other Principal Arterial	26.15	20.50
Urban Minor Arterial	13.71	11.08
Urban Collector	4.25	3.32
Urban Local Road or Street	14.40	17.45
Unknown Urban	0.21	1.11

(Source: FARS, 2008). *Note: May not add up to 100 percent as blank responses were not available for the urban and rural strata.

Background

Policy and Funding Changes

- What is 2009 US DOT Agenda?
- Creating sustainable communities through;
  - Enhancing transportation options and reducing travel times.
  - Coordinating transportation and land use planning.
  - Supporting the livability and health of neighborhoods and communities.
  - Pedestrian and Bike safety research.

(U.S. DOT, 2009)

Background

Policy and Funding Changes

Federal Pedestrian and Bicycle Funding and Total Federal Aid Highway Program Funding

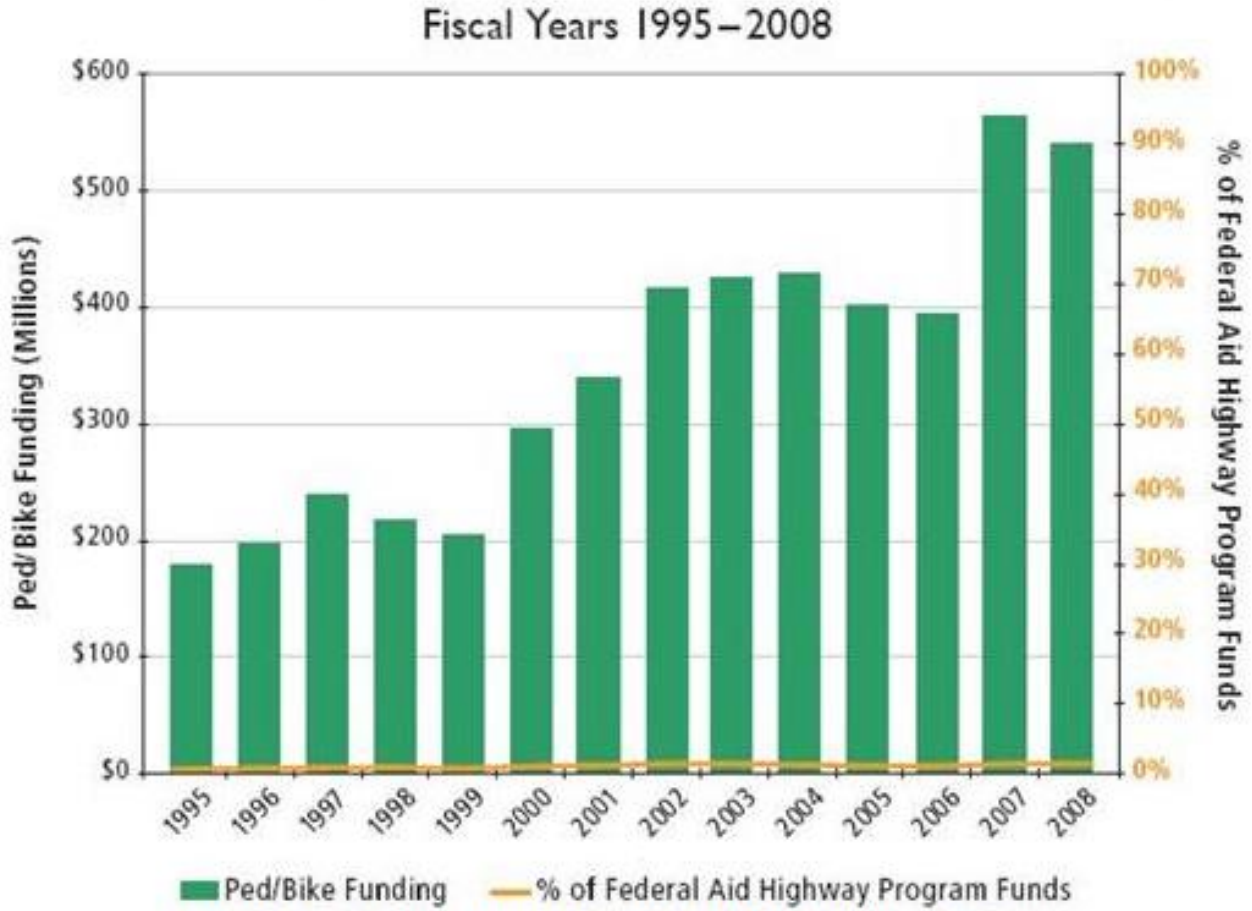


Figure 5. Federal Pedestrian and Bicycle Funding Trends.
(Source: FHWA, 2006a).

Background

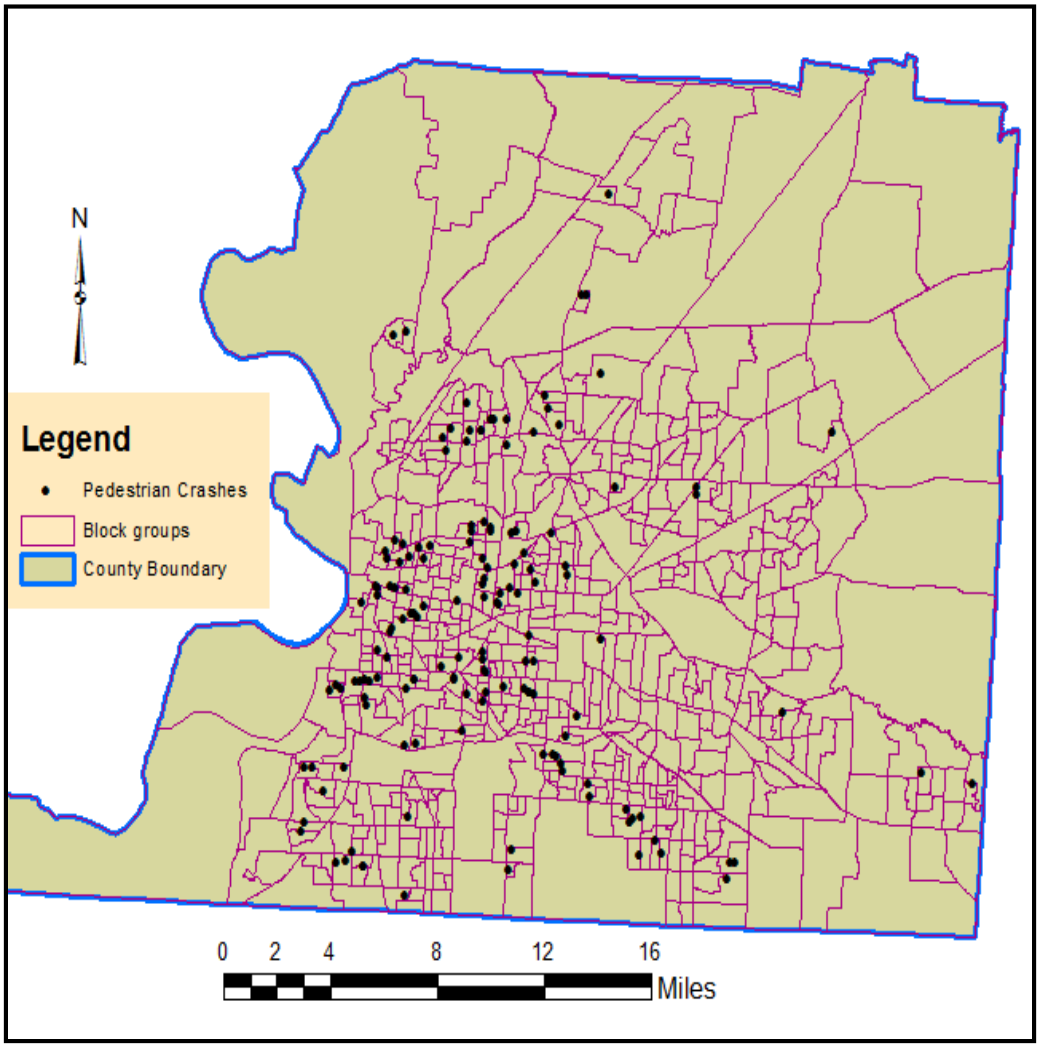
Problem

- How will communities take advantage of this funding or adjust their budgets to make better use of already available resources?

- Identification of high-risk sociodemographic groups is essential to guide appropriate allocation of safety improvement resources.

Methodology

Study Area-Shelby County



- **Tennessee State**
  - 2008-2012: 5,845 pedestrian crashes
- **Shelby County, TN**
  - 2008-2012: 1,809 pedestrian crashes
  - Pop: 927,644 (2010 Census)
  - Geographical Area: 784 mi²

Methodology

Data

Crash data

- Obtained from TDOT traffic crash database
- 5 years 2008-2012 data: 5,845 crash records
- Filtered out 492 local road crashes

Socioeconomic data

- US census bureau,2006-2010 America Community Survey
- Block group data for Tennessee
- Income, Car ownership, poverty status, Transport mode to work

Demographic data

- US census bureau,2006-2010 America Community Survey
- Block group data for Tennessee
- Population counts, age , race

Methodology

Poisson distribution and Chi Square Statistic

- **Poisson distribution**: Test if crashes create a clustered pattern
- Observed frequency Vs. Expected frequency

$$p(x) = \frac{e^{-\mu}\,\mu^{x}}{x!}$$

- **Chi Square**: Test goodness of fit of data to a Poisson distribution

$$\chi^2 = \sum_1^k \frac{(f_o - f_e)^2}{f_e}$$

Methodology

Cluster identification- GIS Kernel density

- $f(x, y) = \frac{1}{nh^2} \sum_{i=1} K \binom{d_i}{h}$

- **f (x, y)** : density estimate at the location (x, y),
- n : number of observations,
- **h** : bandwidth or search radius,
- **K** : kernel function,
- **di** : distance between the location (x, y) and the location of the i^{th} observation

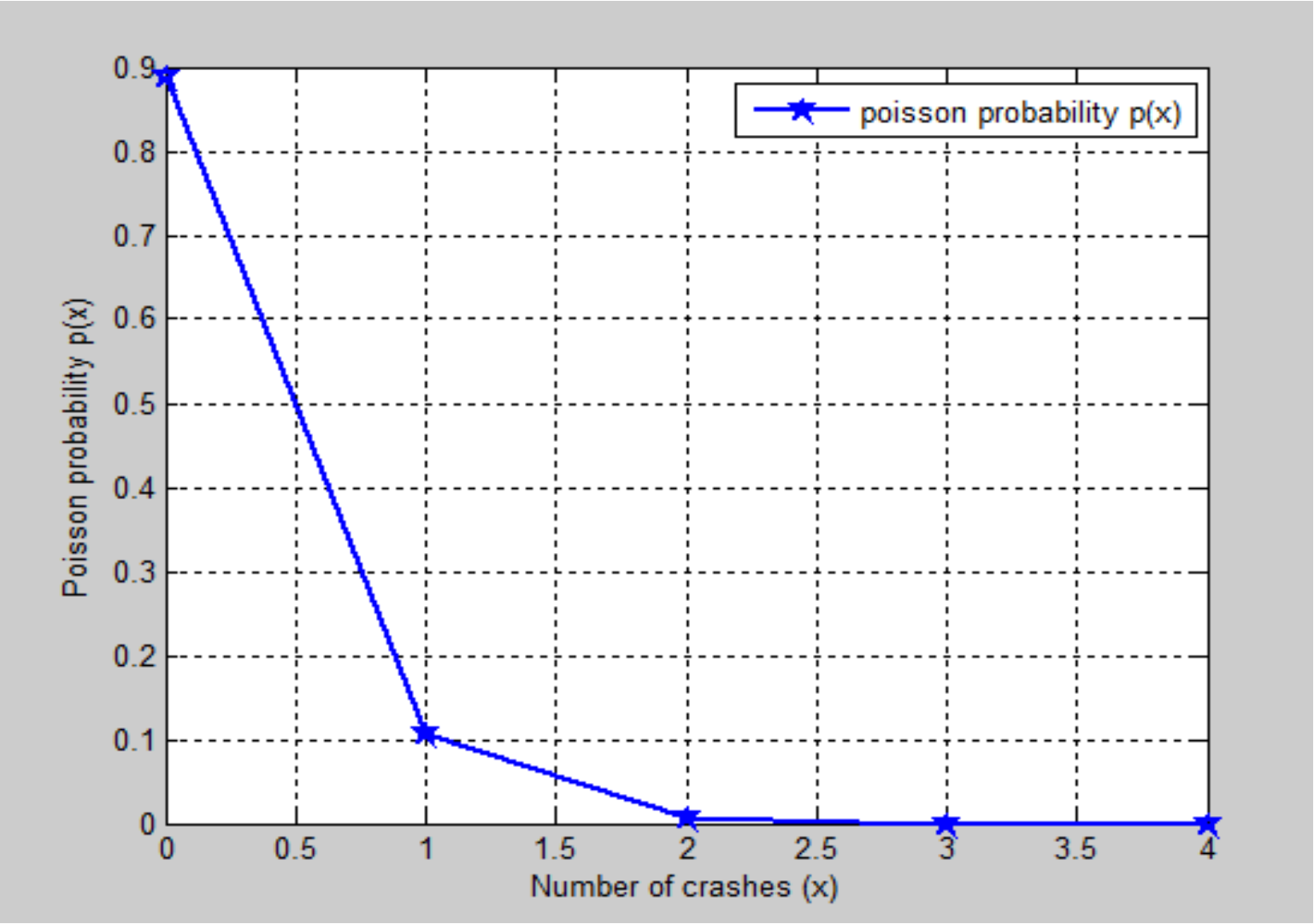
Results and Discussion

Poisson probability

Number of crashes (x)	Observed No. of block groups (f_o)	Total crashes	Probability P(x)	Expected No. of block groups (f_e)
0	3,724	0	0.888	3,661.21
1	328	328	0.106	436.68
2	58	116	0.006	26.04
3	12	36	0.000	1.04
4 or more	3	12	0.000	0.03
	4,125	**492**		

Results and Discussion

Probability curve



Results and Discussion

Chi Square Test goodness of fit test

x	f_o	f_e	f_o-f_e	$(f_o-f_e)^2$	$(f_o-f_e)^2/f_e$
0	3724	3661.21	62.791	3942.77	1.08
1	328	436.68	-108.682	11811.85	27.05
2	58	26.04	31.958	1021.30	39.22
3	12	1.04	10.965	120.22	116.12
4 or more	3	0.03	2.969	8.82	285.55
					469.01

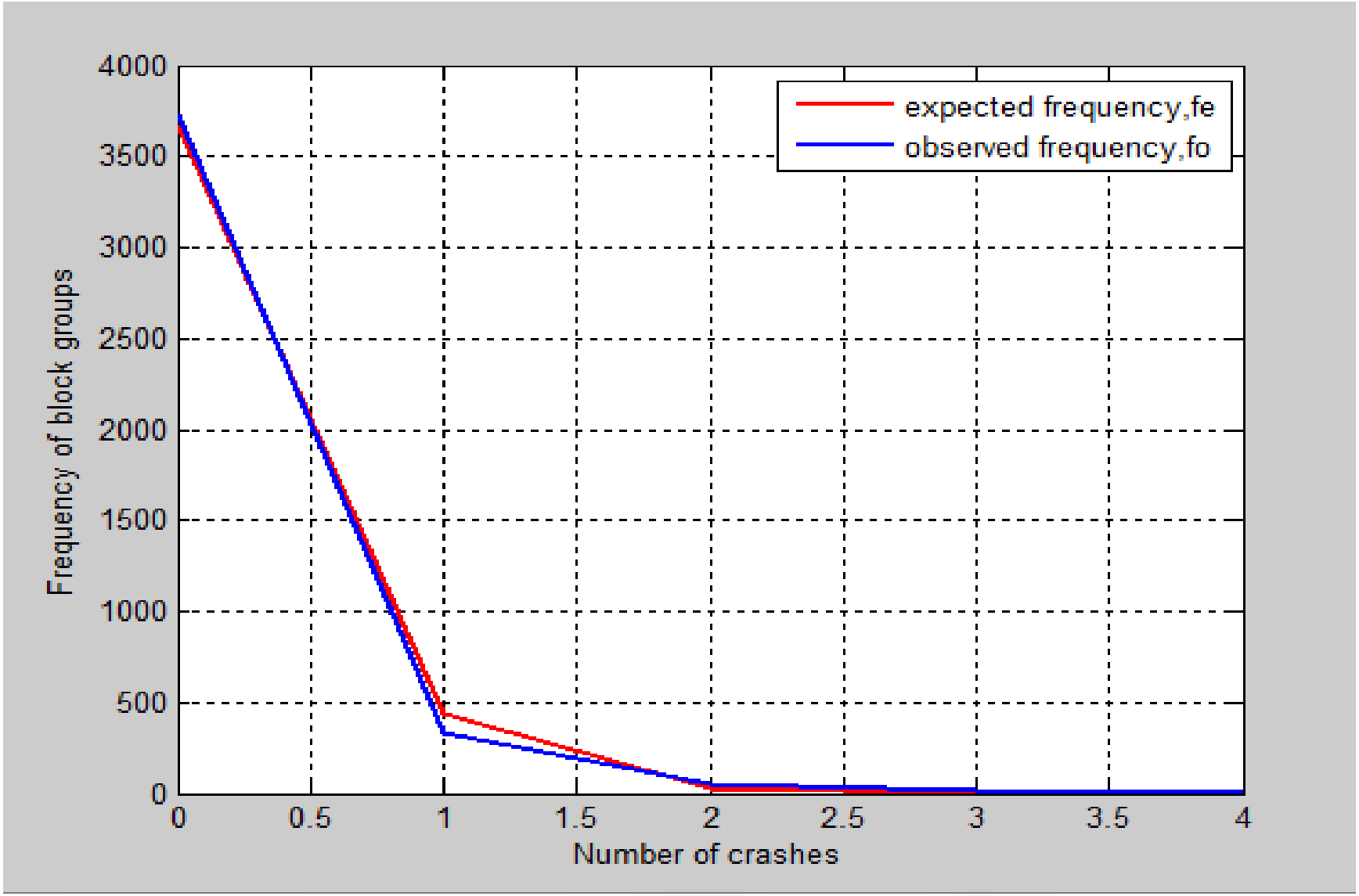
Results and Discussion

Chi Square Test goodness of fit test

- The critical value of χ^2 with 3 df at 0.05 level of significance, is **7.815** (From the Table)
- The decision rule is;
- Reject H_0 if $\chi 2$ > Critical value; otherwise do not reject H_0.
- since **$\chi 2 = 469.01 > 7.815$**, the decision is to reject H_0.

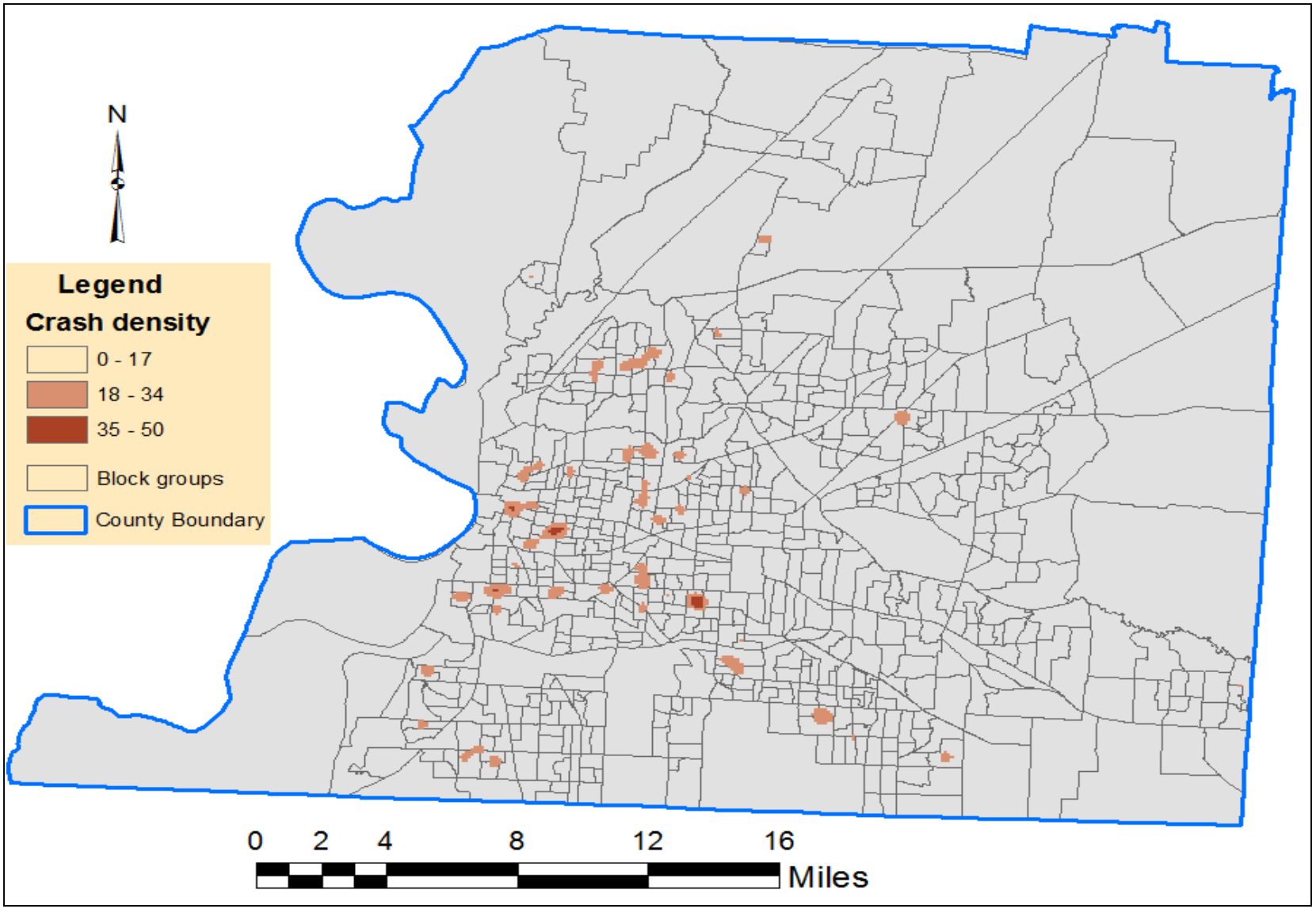
Results and Discussion

Chi Square Test goodness of fit test



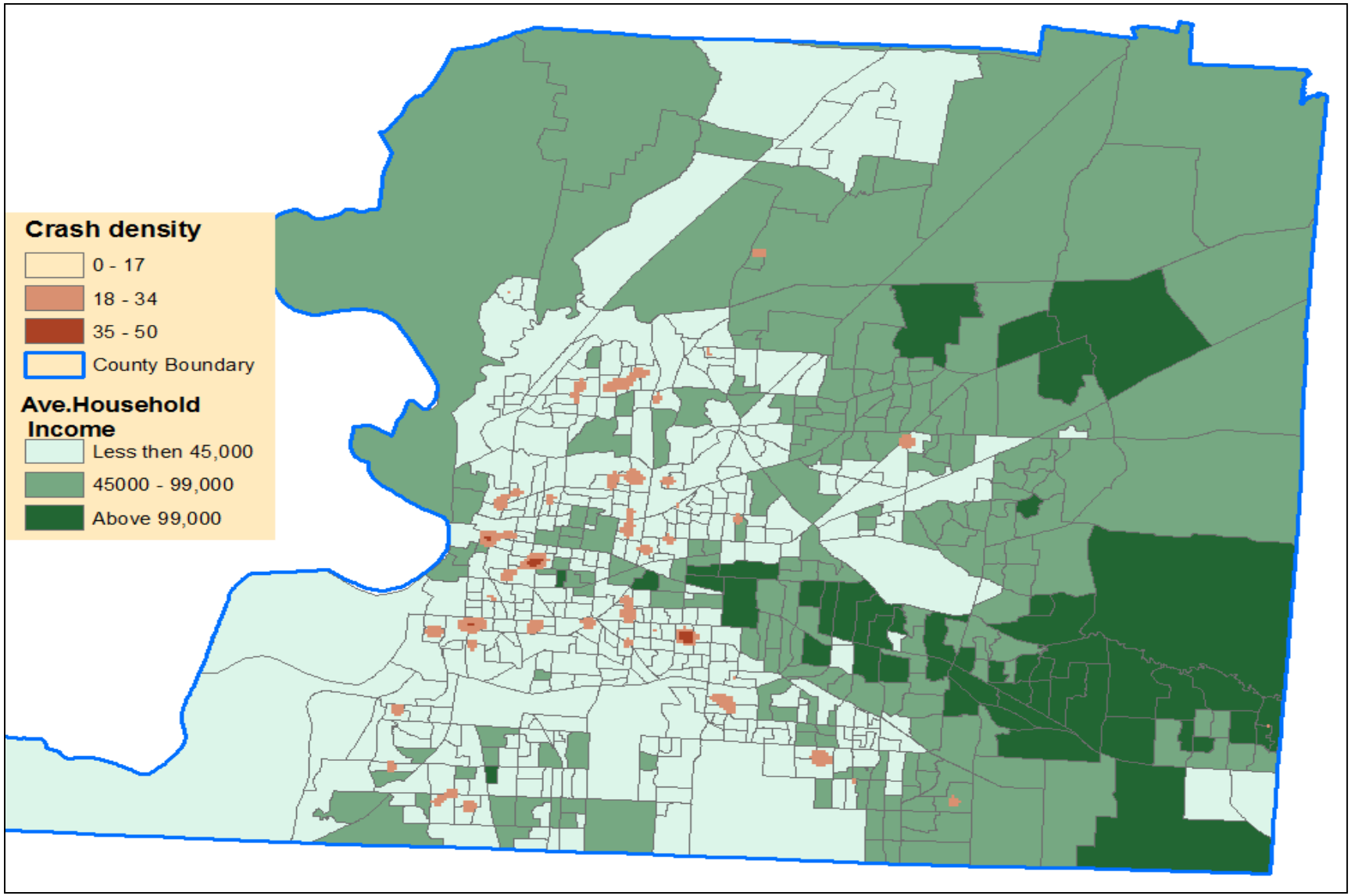
Results and Discussion

Cluster Identification-Kernel Density



Results and Discussion

Identification of associated factors



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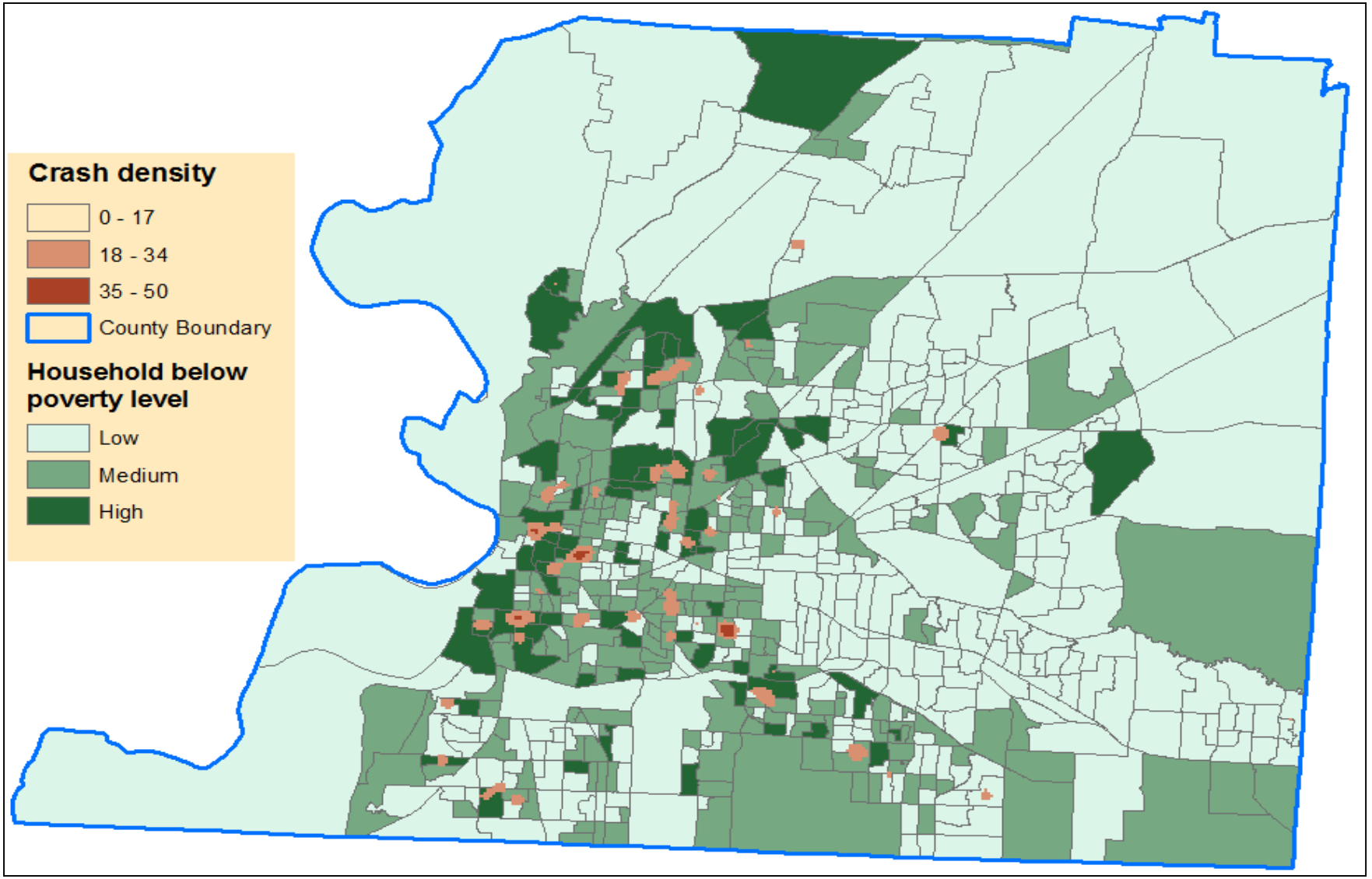

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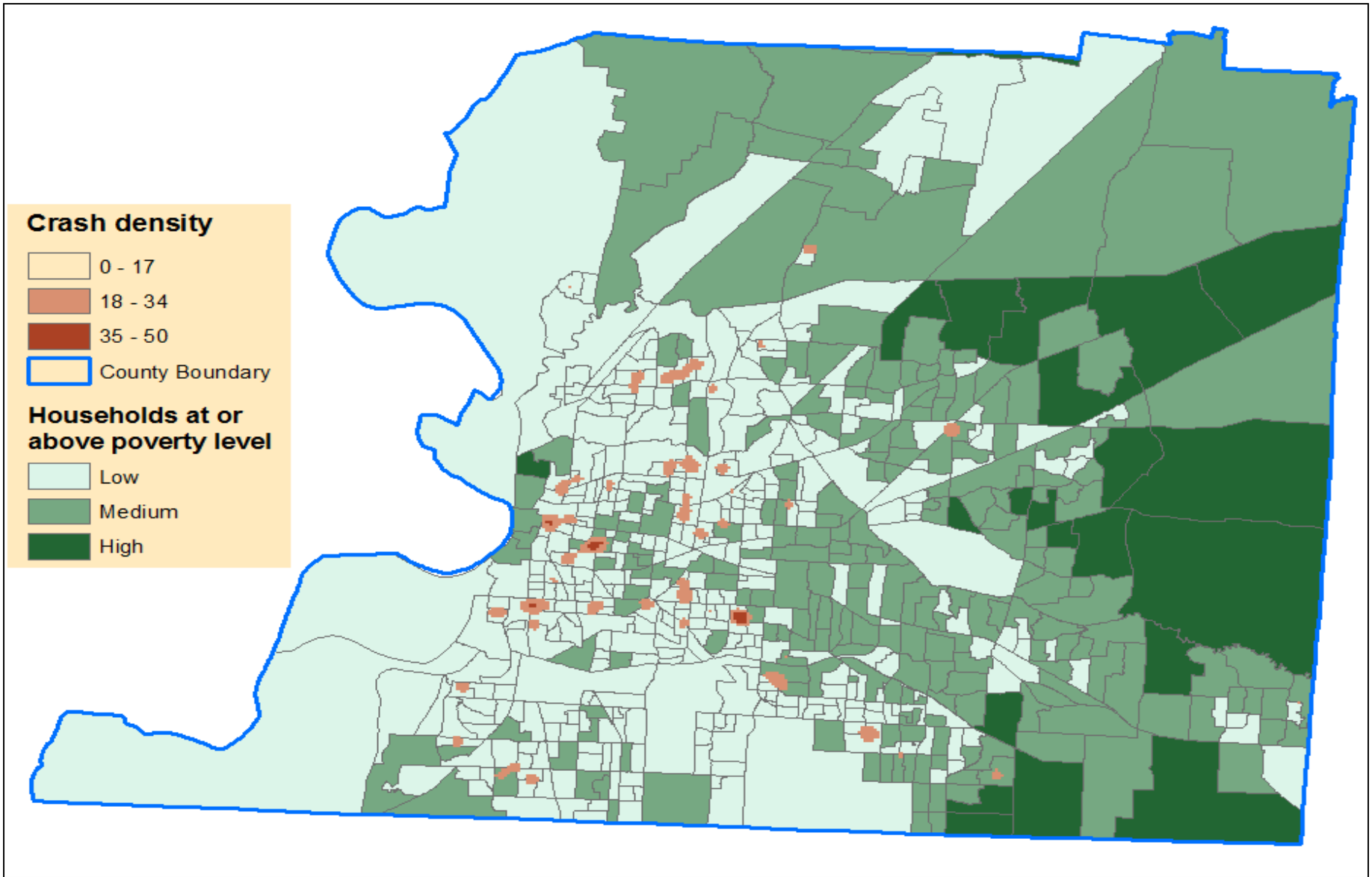

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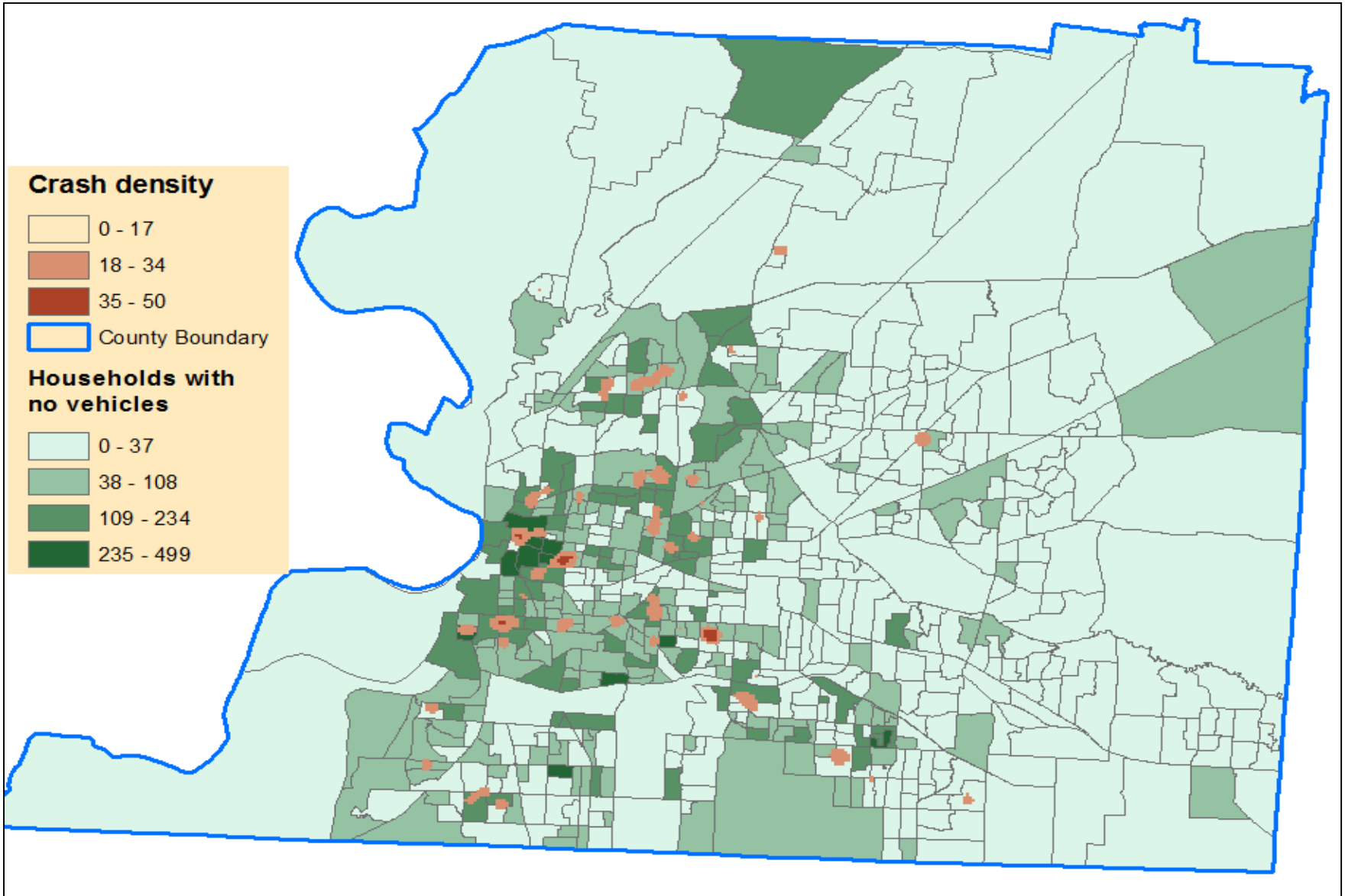

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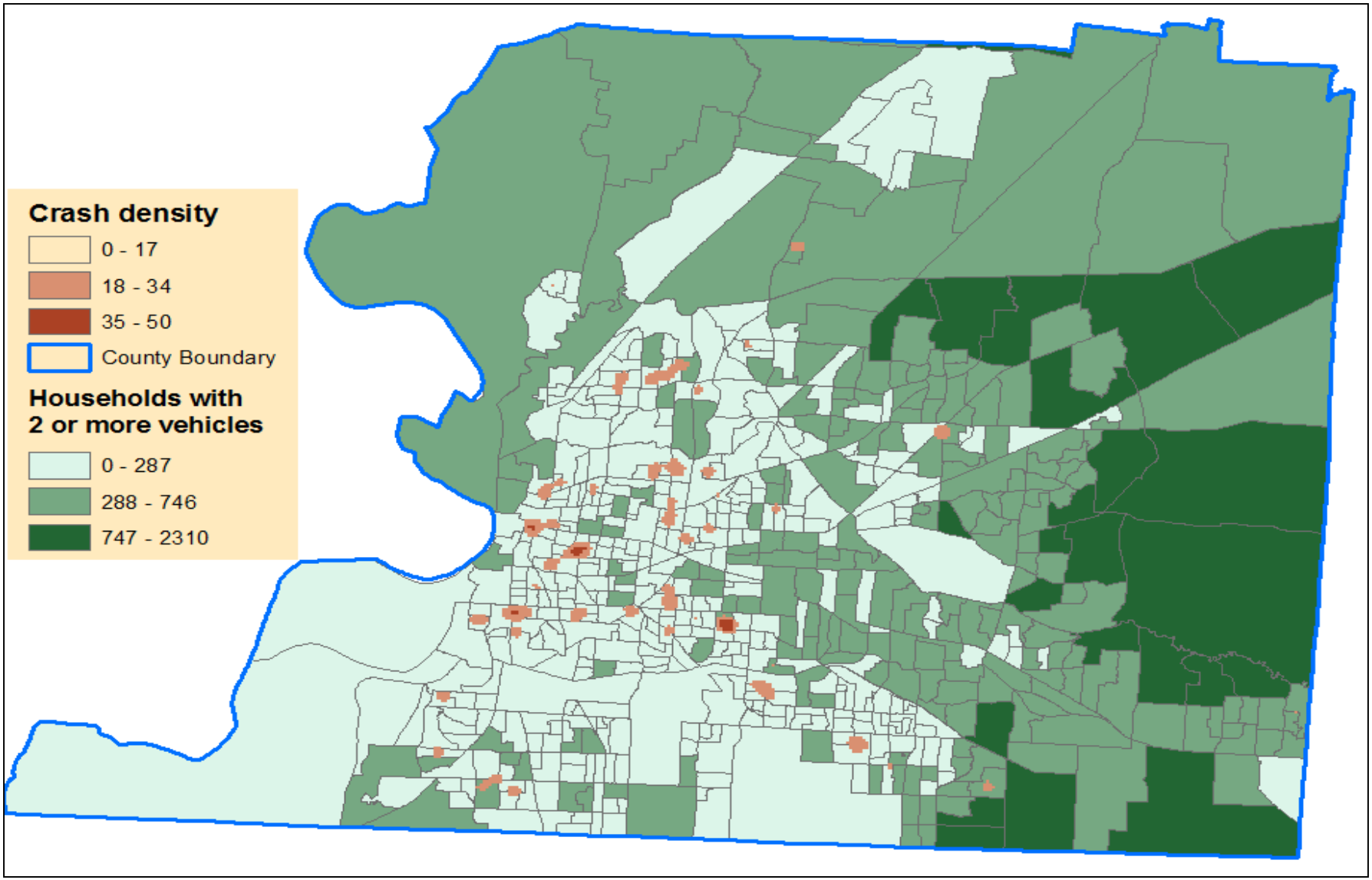

Summary and Conclusions

- Local road pedestrian crashes were analyzed using statistics and GIS.
- Identification of crash clusters was conducted at block group level using GIS kernel density tool.
- Findings help to explain why pedestrian crashes are more frequent with certain sociodemographic groups than with others.
- These results are useful to guide traffic planning process and can assist local decision-makers to develop effective countermeasures to reduce pedestrian crashes.

Thank you!

Acknowledgment

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