

AVAILABILITY OF SUPERMARKETS IN MARION COUNTY

Asrah Heintzelman

Submitted to the faculty of the University Graduate School
in partial fulfillment of the requirements
for the degree
Master of Science
in the Department of Geography,
Indiana University

May 2010

Accepted by the Faculty of Indiana University, in partial fulfillment of the requirements for the degree of Master of Science.

Aniruddha Banerjee, Ph.D., Chair

Jeffrey S. Wilson, Ph.D.

Master's Thesis
Committee

John R. Ottensmann, Ph.D.

Dedication

I dedicate my thesis to my husband Chuck, without whose support and encouragement throughout this process I could not have accomplished this, to my children Zaki and Noor, for their patience in this process, and last but not least to my parents, other family members, and friends for the different ways in which they have supported me.

Acknowledgements

First, I would like to thank Aniruddha Banerjee, Ph.D, my committee chair, for encouraging me to think and explore a topic that not only addresses the requirements set forth by the school, but also makes a contribution in the field of GIS for future researchers. I have also learned different concepts from Jeffrey Wilson, Ph.D, and John Ottensmann, Ph.D, my other committee members, whom I thank for their time invested in me and this process.

I would also like to thank all the individuals along the way who I have learned from and my fellow students.

Abstract

Asrah Heintzelman

AVAILABILITY OF SUPERMARKETS IN MARION COUNTY

Concern over significant increase in obesity has prompted interdisciplinary research to address the physical food environment in various regions. Empirical studies analyze units of geography independently of each other in studying the impact of the built environment in the health of a region. However, we know that geographical spaces have neighbors and these adjacent areas should be considered in analytical analysis that attempt to determine the effects present. This research incorporates the first neighbor influences by developing a refined hierarchical regression model that takes spatial autocorrelation and associated problems into account, based on Relative Risk of corporate supermarkets, to identify clustering of corporate supermarkets in Marion County. Using block groups as the unit of analysis, 3 models are run respectively incorporating population effect, environment effect, and interaction effects: interaction between population and environmental variables. Final model results indicate spatial random effect being significant, meaning space should be incorporated in studying Marion County block groups. Five variables namely: race (percent African American), mean distance to 3 closest corporate supermarkets, distance to the closest fast food outlet, NDVI, and spatial autocorrelation appear significant at different credible intervals of confidence in the combined model. The combined model incorporates all 3 effects stated above. Lastly, based on network distance to corporate supermarkets as a cost matrix, this

work provides a solution to increase supermarkets in an optimal way and reduce access issues associated with these facilities. Ten new sites are identified where policy should be directed towards subsidizing entry of corporate supermarkets. These new sites are over and above the existing block groups that house corporate supermarkets. This solution is implemented using TransCAD™.

Aniruddha Banerjee, Ph.D., Chair

Table of Contents

Introduction.....	1
Background.....	9
Data.....	12
Dependent Variable	12
Theta of corporate supermarkets	12
Independent variables – population effects	15
Neighborhood Index Score (“niscore”).....	15
Social Deprivation Index	17
Census data	19
Independent variables – environmental effects	19
Mean street based network distance to 3 closest corporate supermarkets.....	19
Street based network distance to the closest fast food outlet.....	20
NDVI	22
Methodology.....	24
Basic Model.....	24
Statistical analysis incorporating spatial autocorrelation	26
Transformation of the equation for the BYM model	34
Location of 10 new corporate supermarkets	37
Results.....	39
Graph Theory - optimal facilities location	44
Conclusion	46
Tables	

Table 1. Variables.....	12
Table 2. Corporate supermarkets.....	15
Table 3. Correlation (r) of neighborhood index score.....	16
Table 4. Correlation (r) of social deprivation index	18
Table 5. Fast food outlets	21
Table 6. Median Values	41

Figures

Figure 1a. Block groups with supermarket count in Marion County (2005)	5
Figure 1b. Theta Prior ($\frac{y_i}{e_i}$) of supermarkets in Marion County.....	5
Figure 2. Marion County (Indianapolis).....	8
Figure 3. Block groups	11
Figure 4. Neighborhood Index Score	17
Figure 5. Social Deprivation Index	19
Figure 6. Mean network distance to 3 closest corporate supermarkets.....	20
Figure 7. NDVI.....	23
Figure 8. Geography makes no difference in classical models	25
Figure 9. Block groups	27
Figure 10. Block groups in spatial models	28
Figure 11. Adjacency matrix for non-spatial phenomena	30
Figure 12. Adjacency matrix for spatial phenomena.....	30
Figure 13. Poisson distribution.....	32
Figure 14. Block groups	36
Figure 15. Population and environment theta values	42

Figure 16. Theta for combined model	42
Figure 17. Theta Prior.....	43
Figure 18. Theta Posterior	44
Figure 19. 10 new corporate supermarket locations.....	45
Figure 20. Overlay of locations on combined BYM model results.....	45
References.....	48
Curriculum Vitae	