Applications of GIS and Spatial Analysis Tools in the Development of Demonstration Modules for an Urban Geography Course

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Nashville, Tennessee
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Fall 1999

• Historically Black College – 8,000 students
• Offers only Geography minor – No students minor in Geography
• Geography courses primarily taught to fulfill pre-service teacher requirements
• No visible use of Geographic Information Systems in teaching or research
GIS Capacity Development at TSU
Fall 1999-Summer 2000

- **USDA 1890 HBCU Capacity Building Grant** funds used to launch Geographic Information Sciences (GISc) Laboratory

- **NASA Center for Automated Space Sciences (CASS)** program funds become available to support several undergraduate student researchers and expand the GISc Lab.

- **GISc Lab** formally established during summer 2000 with seven undergraduate student researchers on staff.
• Massie Chair of Excellence in Environmental Science and NASA Center for Automated Space Sciences (CASS) programs provide funding for GIS hardware and software and support for several undergraduate research assistants.

• **GLOBE program**: TSU becomes a partner institution with the support of the Center of Excellence in Information Systems. Several local k-12 teachers are certified in GLOBE environmental sampling protocols.

• **The GISc Lab** establishes informal working partnerships with Fisk University, Vanderbilt University, Meharry Medical College, the Mayor’s Office of Neighborhoods, the Neighborhoods Resource Center, EarthMatters Tennessee, and the Community at Bordeaux.

• **GISc Lab** research assistants and students enrolled in Cartography (GEOG 310) and Urban Geography (GEOG 485) engage in GIS-based environmental/urban studies-based service learning projects…
TSU Upper Division Geography Courses with GIS and Spatial Analysis Content

• **Urban Geography (GEOG 4850)** – Course content includes urban GIS applications. An “Urban GIS Term Paper” is required.

• **Cartography (GEOG 3100)** – Course content updated with GIS-based material. Students are required to complete a “hands-on” GIS project.

• **Physical Geography (GEOG 3010)** – Course content includes GIS, GPS, and remote sensing applications.
Urban Geography (GEOG 4850)
Current Textbooks

- Land Use and Society
- Sprawl City
Need for Development of Demonstration Modules for Urban Geography (GEOG 4850)

- Most students enrolled are social sciences majors who have no background in Geography or Geographic Information Systems.
- The cost of additional texts may be a turn-off for students in an “elective” course.
- Due to students’ lack of background, no current GIS-based supplementary textbook has been effective to date.
Urban Geography (GEOG 4850)  
Former Supplementary GIS-based Texts
<table>
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<th>Major</th>
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<tr>
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<td>Sophomore</td>
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Student Term Paper Topics in Urban Geography (GEOG 4850) – Spring 2005.

- GIS Mapping of Grocery Store Audits vs Local Demographic and Socioeconomic Data
- Distribution of AIDS Cases in Washington, DC
- Impact of a Wal-Mart upon a Smyrna, Tennessee Community
- Spatial Analysis of Three Communities’ Efforts to Keep Wal-Mart out of their Neighborhoods
- Spatial Comparison of the Location of Check-Cashing Businesses vs. Full-Service Banks
Student Term Paper Topics in Urban Geography (GEOG 4850) – Spring 2005 (continued).

- Spatial Location of Abortion Clinics vs Organizations Providing Alternatives to Abortion
- Should Nashville Invest in Expanding its Convention Center?
- Analysis of Land Uses Along a Planned Rev. Dr. Martin Luther King Boulevard Route.
- GPS and GIS Applications in the Development of a Black History/Urban Forestry Educational Walking Trail
GIS and Other Spatial Tools in the Analysis and Delineation of “Urban Food Deserts”

Student’s Major: History – Classification: Senior
The Contextual Effect of the Local Food Environment on Residents’ Diets: The Atherosclerosis Risk in Communities Study

Kimberly Morland, PhD, Steve Wing, PhD, and Ana Diez Roux, MD, PhD

Map created using ArcGIS. Shapefile of grocery stores geocoded from data obtained from Nashville’s Metro Health Department. Census Block Group data obtained from www.esri.com and www.census.gov (American Factfinder).
East Charlotte Avenue "Food Desert"
Nashville/Davidson County, Tennessee

Legend
- Street Grid
- Interstate 40/65
- Grocery Stores
- Public Housing
- Renters With No Cars
- Owners With No Cars

Circle represents a one mile radius around John Henry Hale Homes. Note that Harvey's Bi-Rite is only a corner market. Also note that the community's access to Kroger is cut off by interstate highways.

TSU GISc Lab
October 2004
Edgehill "Food Desert"

Nashville/Davidson County, Tennessee

Circle represents a radius of approximately 1 mile around the Edghill Homes public housing complex.

Legend
- Interstate 40/65
- Grocery Stores
- Street Grid
- Renters With No Cars
- Owners With No Cars
- Edgehill Homes

TSU GISc Lab
October 2004
"Captive" Grocery Store Clientelle
Nashville/Davidson County, Tennessee

Each circle represents about a half-mile radius around grocery stores available to non-vehicle owning households. Residents essentially have only one option for food purchases.

Legend
- Interstate 24/40/65
- Grocery Stores
- Street Grid
- 1 Dot = 1
- Renters With No Cars
- 1 Dot = 1
- Owners With No Cars
- Public Housing
- Interstate 24

Public Housing
1 = Tony Sudekum Homes
2 = J.C. Napier Homes
3 = Edgefield Manor
4 = James A. Cayce Homes

A = Eddie’s Cee Bee Market
B = Piggly Wiggly

TSU GISc Lab
October 2004
Map creating using ArcGIS. Blocks within a “0.10 mile buffer” around the supermarket point file were selected.
Demographic Characteristics of Population within 0.10 Miles of Supermarkets

<table>
<thead>
<tr>
<th>Race</th>
<th>Percent</th>
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<tr>
<td>WHITE</td>
<td>61</td>
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<tr>
<td>BLACK</td>
<td>29</td>
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<tr>
<td>HISPANIC</td>
<td>7</td>
</tr>
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</table>

Chart derived using data downloaded from the attribute table for the selected Blocks within 0.10 mile of supermarkets.
Scatter Graph created using GeoDa: Black population versus numbers of supermarkets per Census Block.
White population versus supermarkets per Census Block in Nashville.
Created with GeoDa
Median Income versus number of supermarkets per Census Block Group. Created with GeoDa.
Numbers of people living below the poverty level versus numbers of supermarkets per Census Block Group. Created with GeoDa.
Total population versus number of supermarkets per Census Block Group. Created using GeoDa.
Future Food Desert Research Initiatives in Nashville

- The TSU GISc Lab will continue to work with Tying Nashville Together; grocery store audit data will be added to map attribute data for further analysis.
- The partnership with the Vanderbilt Community Outreach Partnership Center (COPC) will continue with efforts focused upon bringing a major chain grocery store to North Nashville.
Assessing the Impacts of Greenspace Deficits Upon Racial Health Disparities in Nashville, Tennessee

Student’s Major: English – Classification: Senior

From: Nashville Metro Parks Master Plan November 2002
Assessing the Impacts of Greenspace Deficits Upon Racial Health Disparities in Nashville, Tennessee

• Are the racial health disparities present in Nashville associated with lack of physical activity?
Assessing the Impacts of Greenspace Deficits Upon Racial Health Disparities in Nashville, Tennessee

• Are the racial health disparities present in Nashville associated with lack of physical activity?

• Is the lack of physical activity among African Americans in Nashville associated with urban design factors?
Assessing the Impacts of Greenspace Deficits Upon Racial Health Disparities in Nashville, Tennessee

• Are the racial health disparities present in Nashville associated with lack of physical activity?
• Is the lack of physical activity among African Americans in Nashville associated with urban design factors?
• If provided urban space more conducive to physical activity, would North Nashville’s African American population become more physically active?
REACH 2010 Demonstration Project.

The Nashville REACH coalition will develop a Community Action Plan to reduce and in time, eliminate disparities in cardiovascular disease and diabetes among African Americans in North Nashville, TN.
Premature Death Factors: North Nashville
(data compiled by Nashville REACH project)

Census tracts comprising REACH study area.
Premature Death Factors: North Nashville (data compiled by Nashville REACH project)

- The 1997 age-adjusted death rate due to diabetes for African Americans in North Nashville (54.3 per 100,000) was almost 4 times as high as the rate for whites in Davidson County.
Premature Death Factors: North Nashville
(data compiled by Nashville REACH project)

• The 1997 age-adjusted death rate due to diabetes for African Americans in North Nashville (54.3 per 100,000) was almost 4 times as high as the rate for whites in Davidson County.

• The 1997 age-adjusted death rate due to stroke for African Americans in North Nashville (52.6 per 100,000) was nearly twice as high as the rate for whites in Davidson County.
Premature Death Factors: North Nashville (data compiled by Nashville REACH project)

- The 1997 age-adjusted death rate due to diabetes for African Americans in North Nashville (54.3 per 100,000) was almost 4 times as high as the rate for whites in Davidson County.
- The 1997 age-adjusted death rate due to stroke for African Americans in North Nashville (52.6 per 100,000) was nearly twice as high as the rate for whites in Davidson County.
- The 1997 age-adjusted death rate due to heart disease for African Americans in North Nashville (224.0 per 100,000) was approximately 1.5 times as high as the rate for whites in Davidson County.
Inadequate Exercise Factors: North Nashville
(data compiled by Nashville REACH project)
Inadequate Exercise Factors: North Nashville (data compiled by Nashville REACH project)

- African American females had the highest percentage (82%) “at risk due to inadequate exercise” among the racial-gender groups surveyed.
Inadequate Exercise Factors: North Nashville (data compiled by Nashville REACH project)

• African American females had the highest percentage (82%) “at risk due to inadequate exercise” among the racial-gender groups surveyed.

• African American females had the lowest percentage (69%) who had exercised in the past 30 days among the racial-gender groups surveyed.
Inadequate Exercise Factors: North Nashville (data compiled by Nashville REACH project)

- African American females had the highest percentage (82%) “at risk due to inadequate exercise” among the racial-gender groups surveyed.
- African American females had the lowest percentage (69%) who had exercised in the past 30 days among the racial-gender groups surveyed.
- African American females were nearly twice as likely to be “overweight” than white females according to their recommended weight/height ratio.
Map of residents accessibility to park space in North Nashville. The areas labeled “underserved” represent populations greater than one-half mile away from park space. Modified from Nashville Metro Parks Plan (2002)
“North Nashville History and Urban Forestry Educational Fitness Trail” - Proposed urban design model to encourage physical activity among North Nashville residents.
Defining Study Area Geography for Community Survey

“North Nashville” as defined by the REACH project.
Defining Study Area Geography for Community Survey

“North Nashville” as defined by the North Nashville Community Development Corporation.
Defining Study Area Geography for Community Survey

“North Nashville” as defined by Nashville Metro Government.
Long Term Goals

• Survey results indicate that the proposed historic walking path and fitness trail will significantly increase physical activity among North Nashville residents.

• Upon acknowledging that urban design change will potentially reduce racial health disparities, Metro government funds the project in cooperation with TSU.

• Upon completion, the facility serves as a vehicle for further research on relationships between physical activity and urban design.
Sample Content for Demonstration Module
Developed with GIS and FlowMapper at the 2004 SPACE Summer Workshop:

“Impacts of Urban Sprawl Upon African Americans’ Quality of Life In Nashville and Environs”
Recent studies conducted by USA Today (El Nasser and Overburg, 2001) and the Brookings Institute (Fulton et al, 2001) have identified Nashville as one of the fastest growing urban regions in the United States.

Census estimates put the 1997 population at 1,134,524, an increase of over 280,000 since 1980. The MA grew at a rate of 15.8 percent between 1980 and 1990, and continued at a 15.2 percent rate from 1990 to 1997 (U.S. Department of Commerce, 1998).

Several counties within the MA are expected to grow at exceptionally rapid rates between the years 2000 and 2020: Cheatham (63.9 percent), Williamson (57.8 percent), Rutherford (53.5 percent), Dickson (46.9 percent), Wilson (45.2 percent), Sumner (43.6 percent), and Robertson (34.2 percent) (Center for Business and Economic Research, 1999).
July 2004 – Black Enterprise Magazine names Nashville, Tennessee #4 among the “Best Cities for African Americans. The socioeconomic, demographic, and geographic analysis for the story was conducted by David A. Padgett.

Question: Is Nashville really a great place for African Americans to live, given the potential impacts of urban sprawl??? Can we use spatial tools to assess Blacks’ quality of life in the city?
Distribution of African American Population

Black Persons
1 Dot = 20

Robertson
Sumner
Cheatham
Dickson
Davidson
Wilson
Williamson
Rutherford
# Population Change in the Nashville, Tennessee MSA 1980-2000

<table>
<thead>
<tr>
<th>County</th>
<th>1980 Total</th>
<th>1990 Total</th>
<th>2000 Total</th>
<th>Growth 1980-2000 (%)</th>
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<tbody>
<tr>
<td>Cheatham</td>
<td>21616</td>
<td>27140</td>
<td>35912</td>
<td>66.1</td>
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<tr>
<td>Davidson</td>
<td>477811</td>
<td>510784</td>
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<td>Dickson</td>
<td>30037</td>
<td>35061</td>
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<td>54433</td>
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<td>Rutherford</td>
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<td>85790</td>
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<tr>
<td>Williamson</td>
<td>58108</td>
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<tr>
<td>Wilson</td>
<td>56064</td>
<td>67675</td>
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<tr>
<td>MSA</td>
<td>850505</td>
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<td>1231311</td>
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</table>
# Black Population Change Nashville MSA Counties 1980-2000

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<tr>
<th></th>
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<tr>
<td>Cheatham</td>
<td>595</td>
<td>570</td>
<td>532</td>
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<tr>
<td>Davidson</td>
<td>106,369</td>
<td>119,412</td>
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<td>1,704</td>
<td>1,978</td>
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<td>Robertson</td>
<td>4,960</td>
<td>4,526</td>
<td>4,691</td>
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<td>8,593</td>
<td>10,579</td>
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<td>5,084</td>
<td>5,381</td>
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<td>Williamson</td>
<td>5,202</td>
<td>5,445</td>
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<td>Wilson</td>
<td>4,873</td>
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<td>MSA</td>
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<td>152302</td>
<td>191876</td>
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### Percent Black Population in Nashville MSA Counties 1980-2000

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## FlowMapper Input

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<th>Dickson</th>
<th>Robertson</th>
<th>Rutherford</th>
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<td>3748</td>
<td>31</td>
<td>143</td>
<td>1373</td>
<td>810</td>
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Modified Output From FlowMapper

Population Shift Between Counties
Nashville MSA 1995-2000

Legend
- County Centroid
- Population Flow Direction
Out-Migration from Nashville/Davidson County, Tennessee to Other MSA Counties 1995-2000

Image created using FlowMapper. Data were obtained from the U.S. Census at http://www.census.gov/population/www/cen2000/ctytocytflow.html
Expected Results of Incorporation of Demonstration Modules with GIS and other Spatial Analysis Tools in Urban Geography (GEOG 4850) Course

- Students will gain increased understanding of spatial and cartography principles.
- Students will be able to obtain data pertaining to an urban problem and then analyze the issues from a spatial perspective.
- The course will attract students from across the social sciences disciplines.
- Students will apply spatial analysis tools to support the efforts of local non-profit organizations, public schools, and government agencies.
- Students will produce term papers which will demonstrate their ability to think critically and spatially about issues inherent to urban environments.
Summer Workshops 2005

• Introducing GIS for Undergraduate Social Science Courses  
  1-6 August 2005, San Francisco, California

• GIS and Spatial Modeling for the Undergraduate Social Science Curriculum  
  10-15 July 2005, Columbus, Ohio

• Spatial Analysis for the Undergraduate Social Science Curriculum  
  18-23 July 2005, Santa Barbara, California
GIS and Population Science – Workshops 2005

• State College, Pennsylvania: The Population Research Institute
  The Pennsylvania State University, May 29-June 11, 2005

• Santa Barbara, California: The Center for Spatially Integrated Social Science
  University of California, Santa Barbara, June 19-July 2, 2005
Scholarship Support
There are no fees required to participate in a SPACE workshop. Participants may apply for awards of up to a maximum of $1000. Participants from designated minority institutions in the United States, and participants of Hispanic American, African American, or Native American background may be eligible for additional scholarship support.
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