Using Geospatial Techniques to Address Institutional Objectives: St. Petersburg College Geo-Demographic Analysis

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Supporting quality data and decisions for higher education.

Abstract

Geographic analysis has been adopted by businesses, especially the retail sector, since the early 1990s (Thrall, 2002). Institutional research can receive the same benefits businesses have by adopting geographic analysis and technology. The commonalities between businesses and higher education institutions include the existence of trade areas, the provision of services to clients (students), and the identification of clients geographically by their addresses. Among the valuable information that institutions of higher education can create using business geography are psychographic profiles of student populations, commuting patterns, the underlying demographics of the institution's trade area, and the ability to plan for new facilities to meet the needs of the market. Understanding these geographic characteristics can assist in identifying institutional objectives and planning how to best implement these objectives. This report demonstrates the capabilities of using geographic analyses in an institutional research capacity for St. Petersburg College in Florida.

Introduction

Geospatial Techniques in Institutional Research

Institutional research is defined as research conducted within an institution of higher education in order to provide information which supports planning, policy formation, and decision-making (Saupe, 1981). The use of multiple modes of inquiry can enhance the process of planning, policy formation, and decision-making, and geospatial inquiry is one such mode of investigation that can be more readily used. Institutional research can receive the same benefits other public sectors and businesses have by adopting the use geographic information systems (GIS) in planning and decision-making.

GIS analysis offers utility for a wide range of applications in higher education. One of the most substantial sources of literature

discussing the use of GIS in higher education is the winter 2003 edition of the quarterly sourcebook, *New Directions in Institutional Research* (Teodorescu, 2003). Each chapter details a different utility of using GIS in institutional research and the benefits associated. Applications offered by the book include (a) using census data to inform decisions regarding planning and implementation of recruitment strategies; (b) displaying enrollment trends with maps for visualization and analysis; (c) campus planning and facilities management; and (d) mapping and analyzing alumni donation patterns through the use of address data (Teodorescu, 2003).

Broadly, the use of GIS analysis relates to common decision-making tasks through mapping: where things are, the most and least, density, finding what's inside or nearby, and mapping change (Mitchell, 1999). This paper will focus on these primary principles of geographic inquiry and demonstrate the utility of GIS in studying the student population of St. Petersburg College (SPC) in Florida. St. Petersburg College is Florida's first two-year college (founded in 1927) as well as the state's first community college to offer four-year degrees in 2002.

Purpose and Objectives

An impetus for conducting geospatial analysis of the student population of SPC was a gradual decline in total college enrollment that the college experienced in 2005 and 2006. The initial research proposal was developed through examining the *St. Petersburg College 2006–2009 Strategic Directions and 2006–2007 Institutional Objectives* (Kuttler, 2006). Two examples of high priority objectives included exploring ways to enhance SPC systems and services that lead to an increase in Hispanic student enrollment and to increase effectiveness in recruiting and retention of minority male students. In order to address college objectives, this analysis used geospatial reasoning and technology to examine the SPC trade area. Additional questions examined in this study that are approachable from a geospatial perspective are listed below.

1. What are the students' average drive times from home to the location of service?

2. Are campuses drawing from each others' market area?

3. Do certain market areas need greater focus on recruiting and/or advertising?

4. Are services provided based on geographic demand, and are services offered in the correct locations?

5. Are students clustered by neighborhood or uniformly dispersed around the service area?

6. Where are recommended sites for future expansion or service area reduction?

7. Do students seek out services from the nearest campus or do they skip one campus for another? If so, why is one location preferred to another? (Thrall, 2002)

The purpose of this paper is to address the questions listed above through examinations of market penetration, college trade area, and goal assessment for St. Petersburg College.

Conducting Geographic Analysis in Institutional Research

Understanding the proper terminology, tools, and methods is an important step in preparation for conducting geographic analysis. Key concepts are briefly introduced below.

Trade area. In business, a primary trade area is described as the area within which 80% of the customer base lives. Trade areas can be visually represented and spatially analyzed using GIS, allowing the user to explore relationships between the customer base and other geographic characteristics (e.g., transportation networks, competing service providers, barriers to access).

GIS. GIS is "a powerful set of tools for storing and retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes." (Burrough & McDonnell, 1998, p. 1). GIS specializes in storing, analyzing, compartmentalizing, and describing the properties and attributes of a particular landmark or geographic occurrence (Bolstad, 2002). The analysis conducted for this paper uses GIS software developed by the Environmental Science Research Institute (ESRI).

would find the personalities, values, interests, and attitudes of their current and perspective students interesting? Would you expect these aspects to vary across different discipline groups?

Those who are interested in pursuing the use of GIS will find the section on implementing GIS particularly valuable. The suggestion of finding someone in a related academic area who knows how to use GIS would seem especially important. Also, there needs to be someone on the project that is knowledgeable about the region and the demographic shifts in the neighborhoods. With this knowledge represented on the project, this would seem to be a great way for Institutional Research to produce interesting and valuable information.

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Implications for Higher Education Planning

Using GIS for program management is advantageous for institutional researchers and college planners for a variety of reasons. As noted above, these include informing decisions regarding planning and recruitment through demographic analysis, visualization of enrollment trends, relying on analysis of spatial data for campus planning, and applications associated with funding and alumni (Teodorescu, 2003). Identification of market segments and particular neighborhoods for college expansion or reduction can result from the use of GIS for institutional planning. A better understanding of service areas gives institutional researchers more intuitive capabilities of providing services. For example, resources can be allocated for courses such as English as a second language (ESL) to campuses near neighborhoods dominated by non-English speaking families, or in areas that have high projected growth for non-English speaking families (Pennington & Williams, 2002). Although infrequently used, geospatial analysis and GIS can serve to maximize decision-making in higher education institutions.

The adoption of geographic technology and methodologies to the business realm resulted in the formation of business geography, a subdiscipline that focuses on identifying the needs of business and tailoring business to the client. Based on commonalties with the business world, including the need to provide services to a client and to base decisions on trade area needs, higher education can benefit from utilizing geographic technologies and analyses. Understanding geographic characteristics can assist in evaluating institutional objectives and identifying constraints on implementing these objectives.

Editor's Note:

Marketing's most basic concept is that the three most important factors in marketing are location, location, and location. This IR Application is a highly effective use of Geospatial software (GIS) to look at how well a community college is serving its various service areas with their locations. Since it includes a definition of key marketing terms, it is also a basic primer on how IR can assist in the marketing conversation.

There are several aspects of this research that seem very valuable. First, the concern for Hispanic enrollments is one that is germane to much of higher education. This methodology seems to be particularly well suited to look at service for this segment of enrollment and potential enrollment. Morris and Thrall show that GIS is a significant alternative for looking at Hispanic Enrollment. What are some of the other ways one might look at enrollment and location? For example, a linear model could be constructed with various categorical variables and/or measures of distance to specific campus locations. Obviously, the maps are going to give a much more interesting view. What they lack, however, is the quantitative metrics that come with the more traditional statistics.

In fact, the seven questions are illustrative of the qualitative and quantitative nature of this study. Some of them, such as the average drive times, can have quantitative metrics such as the percent within 7 minutes' drive. Other questions, such as "Do certain market areas need greater focus on recruiting and/or advertising?" are more general questions and need a standard for making a judgment. The strategy here is to look at events relative to the average for the institution. This gives judgments of where the outcomes are above or below average. Other ways might be to set a goal or objective. If there are other institutions in the area, then it may be possible to set an objective relative to their level of activity.

The possibility of other institutions competing for enrollments brings up the fact that this analysis is a look at SPC without looking at the possible impact of competitors. What data would be needed to use this type of analysis and consider competitive aspects? For example if one had the ZIP code of accepted but not enrolled students who went to a regional competitor, then could one use GIS to look at regional competitiveness? The possibility of including the Lifestyle Segmentation Profiles and LifeMode groups makes the possibilities of this type of analysis even more interesting. How many

Market penetration. Market penetration calculates how and where services of a particular service provider are reaching prospective consumers. Evaluating the underlying demographics of potential customers reveals relationships and characteristics of the market that could increase the service provider's level of market penetration.

Geocoding. Geocoding is a GIS operation for converting street addresses into spatial data that can be displayed as features on a map. Through the process of geocoding, student home addresses become points on a map that can be analyzed with the GIS environment.

Lifestyle Segmentation Profile (LSP).[1] Lifestyle Segmentation Profiles are a compilation of an individual's attributes relating to personality, values, attitudes, interests, and lifestyles. In business, these are used to explain market forces and predict and judge current and future business or real estate undertakings (Thrall, 2002). Neighborhoods and individual households can be organized into lifestyle segments that service providers can use to maximize efficiency in marketing. An ESRI software extension called Business Analyst is used in this paper to create market segments for the SPC student population. Factors drawn from the decennial census along with private data sources help develop market segmentation composition. These factors include (a) population by age and sex; (b) household composition and marital and living arrangements; (c) patterns of migration, mobility, and commutation; (d) general characteristics of housing; (e) economic characteristics of housing; (f) educational enrollment and attainment, and employment; (g) occupations and industrial classifications; and (h) household, family, and personal incomes. Following each decennial census, marketing information companies with segmentation systems rebuild the models that produce these systems. The ESRI classification system lists 65 Lifestyle profiles categories, which can be further grouped into 12 LifeMode groups.

LSPs and LifeMode groups are given descriptive names, such as Global Roots or Senior Styles.[2]

St. Petersburg College Geographic Analysis

Data

St. Petersburg College (SPC) is located in Pinellas County, Florida and offers services throughout the county from various campuses and service locations. SPC is broken down into 11 learning sites throughout the county, and 4 of the 11 learning sites (St. Pete Gibbs, Tarpon Springs, Clearwater, and Seminole) are considered full campuses (Figure 1). The intent is to provide services where there is the optimum demand for those services. The Fall 2005 student enrollment data for St. Petersburg College were provided by the college. The database includes
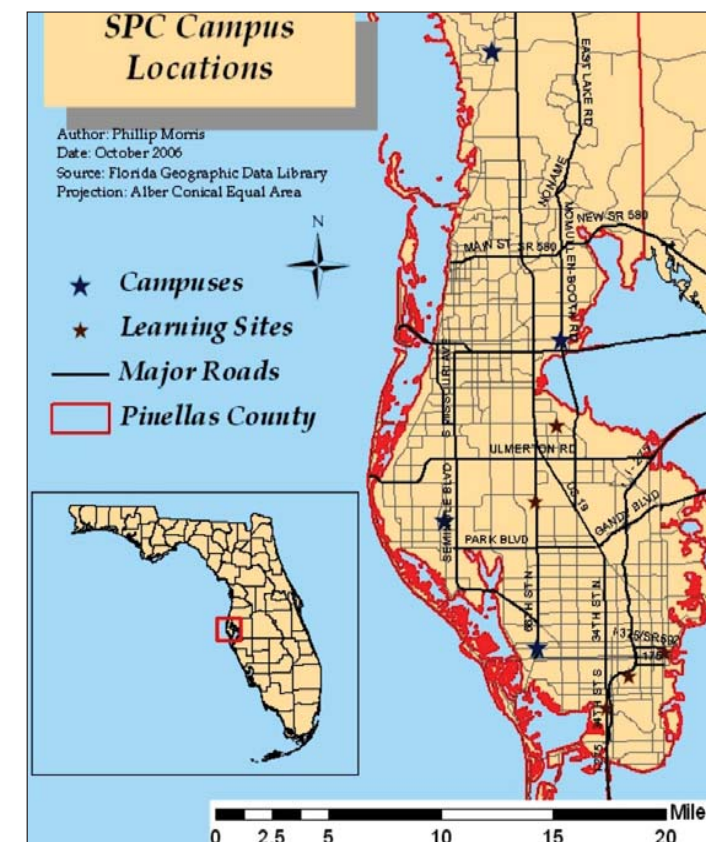
Figure 1. SPC campus and learning site locations.

[1] For a full description of Lifestyle Segmentation Profiles, visit http://www.esri.com/data/esri_data/tapestry.html

[2] A methodology statement describing the development of LSPs and LifeMode Groups can be found at www.esri.com/library/whitepapers/pdfs/esri-data-tapestry-segmentation.pdf

age, sex, race/ethnicity, major, grade point average, and credit earned by campus. Students' addresses were geocoded, and data records were assigned psychographic profiles, known as LSP when using ESRI's Business Analyst. Addresses and any other personally identifying information were deleted.

Geographic Distribution of Students

In this section of the analysis, student geographic distribution, drive-time analysis, age distribution of students, and segmentation composition of enrolled students are examined. The population of Pinellas County is not evenly distributed geographically, and, as such, the analysis allows us to identify the geographic areas that contain a high number of prospective students. Using these measures, the

college can better understand the current SPC student population and formulate a plan to better represent the surrounding population.

In the Florida Community College System, restrictions apply to marketing outside of a college's service area, so analysis of the SPC trade area was limited to within Pinellas County. Of the 22,456 students included in the database provided for the project, 18,035 are identified as having an address within Pinellas County, representing approximately 80% of the total student population. Student geographic distribution within the boundaries of Pinellas County was evaluated by dividing the county into 1.5 kilometer (km) cells. The number of students within each cell was calculated. Figure 2 shows student geographic distribution within
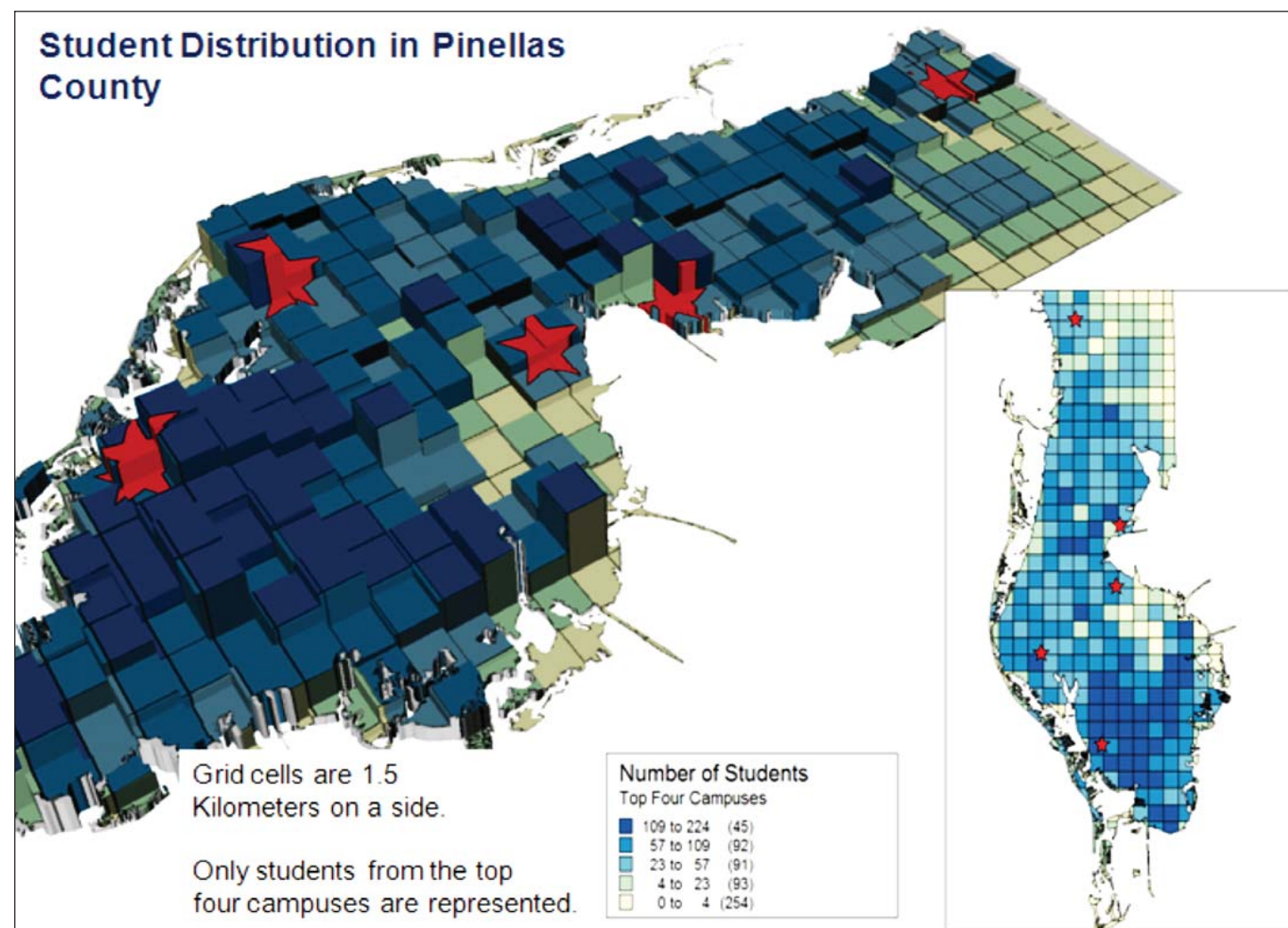

Figure 2. Student population based upon 1.5 km grid.

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distribution of student lifestyles, but a more general landscape view was presented in the form of a map with ZIP codes shown for Pinellas County with designated LSPs as well as LifeMode groups. The maps presented to SPC provided a descriptive as well as predictive view of the community's population demographics and the students' demographic consistency.

An intended outcome of the project was designation of segments of the population that can be better served by the college. Market segments of potential opportunity (MSPO) show potential areas of improvement throughout the stages of analysis based upon criteria used to produce the particular map. MSPOs are show as ZIP codes within the maps produced. Findings such as these provide a better understanding of the demographic characteristics of a college's service area and of which markets and submarkets to target in order to meet the institutional objectives and goals.

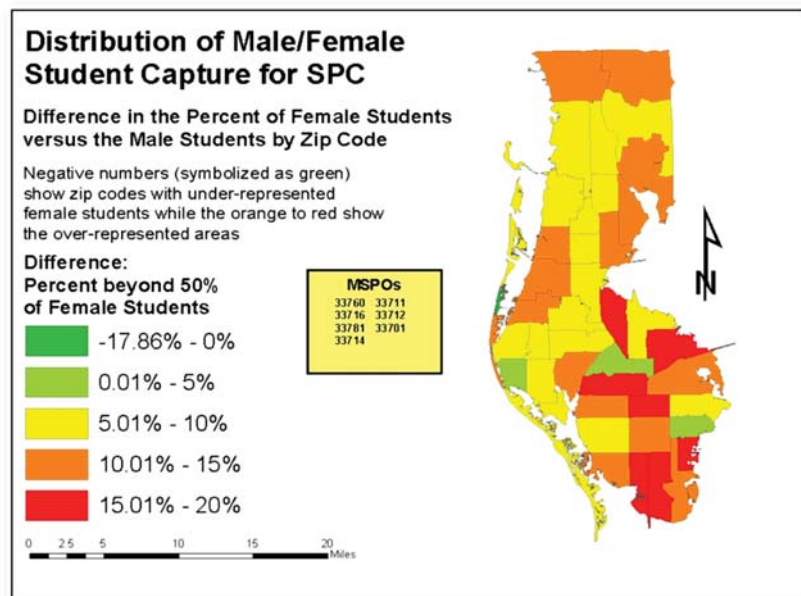## Lessons Learned and Guidelines for Future Use of Geospatial Techniques

Lessons learned. The SPC study revealed a few notable points for improvement for a similar study conducted in the future. The study was broad in nature from the beginning, and there were few specific questions identified to answer using geographic technology. An open collaborative process involving leadership team members as well as GIS analysts is important for narrowing the scope of the analysis to more specific issues. Initial objectives should be structured to establish detailed criteria for investigation rather than using objectives delineated by the college mission statement. In this example, a general geo-demographic analysis of the landscape provided an appropriate starting point.

Costs/benefits of implementing geospatial methods. A consideration for conducting geospatial analysis is resource allocation and access to proper technology. This study was conducted through partnership between SPC and the Department of Geography at the University of Florida. IR offices likely won't have access to the software and technical training needed to conduct these reports and analyses, but through partnering with other

academic units, IR offices can examine institutional objectives through geospatial analysis. Departments of Geography and Urban Planning are examples of academic units that have GIS software licenses and a labor pool of professors or students that may be willing to work with IR personnel. Software license fees and training vary depending on the software package and level of access, but institutional site licenses fees are significantly reduced for education institutions. Hiring consultants is another option for pursuing geographic inquiries, but can be costly depending on the specificity of the project and data used. Software programs, such as Tableau, have the capability of integrating spatial inquiries along with a multitude of other data visualization functionalities; since many IR offices use Tableau currently, this may be a more practical option for conducting similar research.

Practical guidelines. To implement the use of GIS for institutional research, the skills and technology must be imported from other disciplines such as Geography or Urban Planning. This suggests that the most efficient way to access the skills and technology required for similar analyses as presented here, would be to incorporate interdisciplinary research approaches in institutional research. Alternatively, institutional researchers might consider short courses and other training options for learning about benefits that tools such as GIS offer to their research. For example, ESRI has a virtual campus, which offers certificate programs in GIS. Other options include downloading a trial version of Tableau or a similar software program that can be tested and used for spatial data visualization.

This work demonstrates that geographic analyses in institutional research must consider the appropriateness of the demographic classifications for the institute in question. Additionally, the ZIP codes—though useful for SPC postal marketing—are a coarse scale dataset that did not allow for detail with regards to local populations. Use of census blocks as the core geographic unit of analysis would increase the detail and accuracy of findings. However, considering the marketing value of using ZIP codes, a combination of ZIP codes, ZIP+4 codes, and census blocks would likely provide the most useful data for both analysis and marketing purposes.

Figure 13. Ratio of male to female enrollment in Pinellas County.

Figure 14. Summary observations of geo-demographic analysis of SPC students.

coordinates and plotted on a map that contained ZIP codes and demographic data for the people within these ZIP codes. With the knowledge of how many students live within these ZIP codes in Pinellas County, analytical relationships were asserted and recommendations about marketing and recruitment were made to the college.

Along with ZIP code boundaries, the analysis LSPs were assigned to all students. This allowed for analysis of the student population based on lifestyle profiles. ZIP codes were then labeled based on the majority or dominant lifestyle population. Specific recommendations were not given to the college based on the geographic
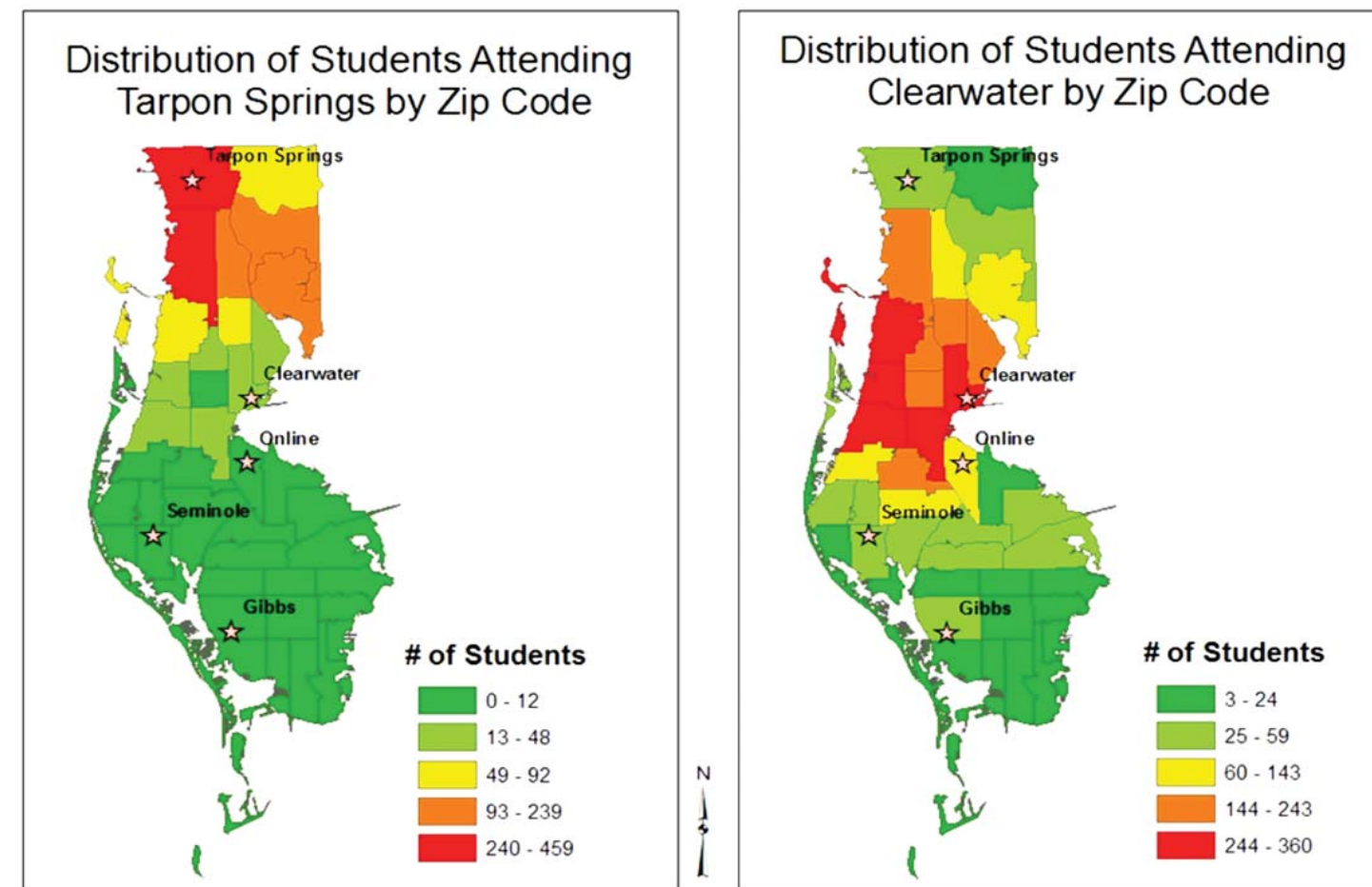

Figure 3. Distribution of students by campus and ZIP code.

Pinellas County. The darker, elevated cells have more students than the lighter, lower cells. The geographic distribution of SPC students is clustered in the southern perimeter of the county, with SPC serving fewer students in the northeast. Also, areas of the southeastern region of the county show enrollment dropping to below 50 students per 1.5 km cell.

There is a strong correlation between enrollment of students and proximity to the campus. SPC does well in enrolling students within close proximity to the campus. Online students, however, show greater geographic dispersal of home addresses than traditional campuses. Figure 3 shows student enrollment separately for the Tarpon Springs and Clearwater campuses, by ZIP code. Each area of the county is revealed to be well served by at least one of the SPC campuses, with the exception of the northeast. The northeast is shown to be part of the

Tarpon Springs trade area, but comparatively few students from this area are enrolling at SPC.

Student Drive-Time Analysis

An integral component of the community college mission is providing unrestricted access for citizens within the community (Cohen & Brawer, 2003). Access is directly rated to the cost of transportation, and increased distance equals increased costs for students. Analysis of drive times to each campus can be used to understand the costs of transportation and for discussions on improving access. Figure 4 shows drive-time zones around each SPC learning site or campus. Each of the irregular polygons shows the distance a person could drive in 7 minutes from the campus. The software used for this graph allows the user to determine the drive time and the speed of travel
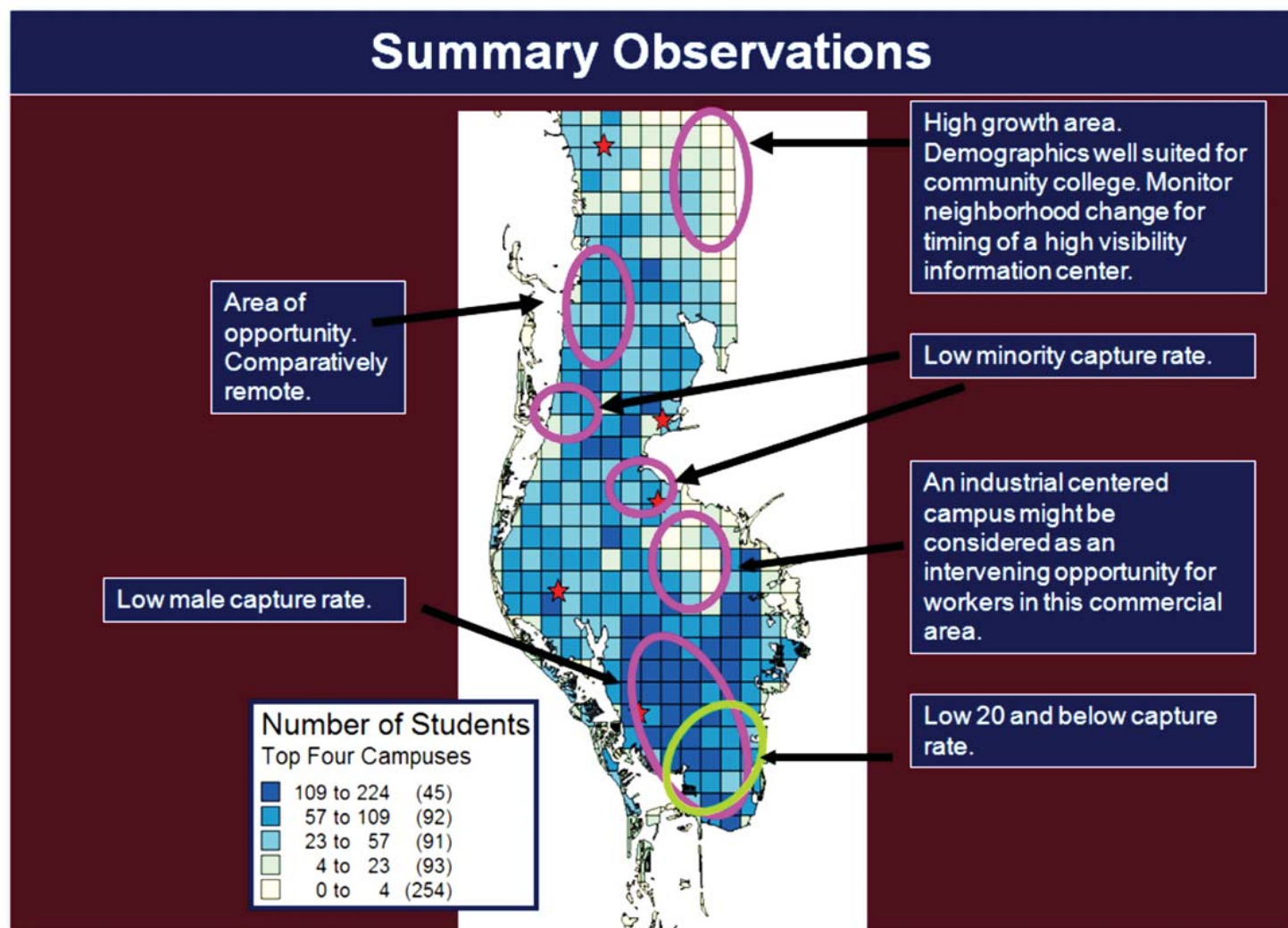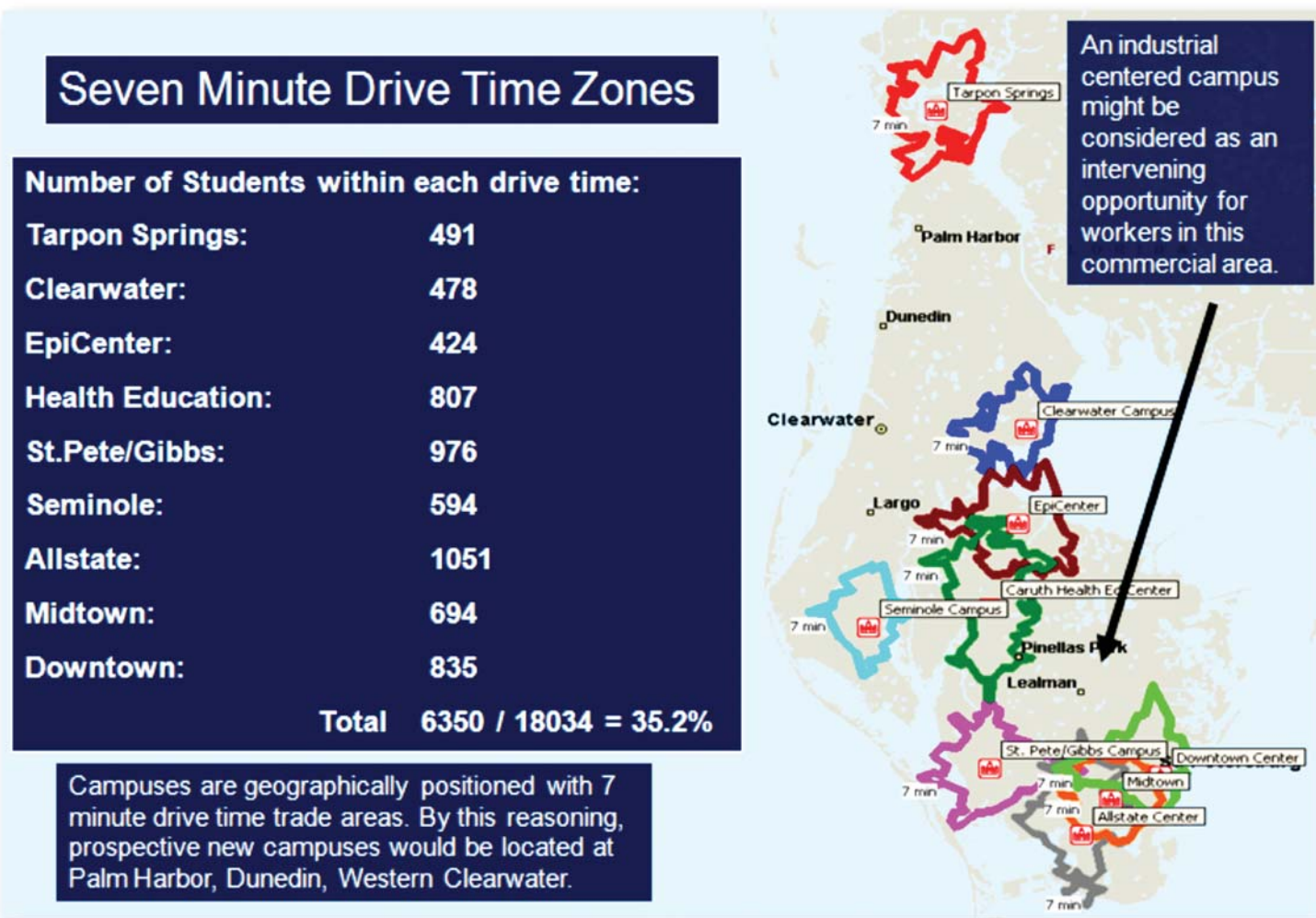
Figure 4. Drive-time zones for each SPC campus.

before creating the polygon. Once the zones were created, the number of students living within these 7-minute zones were tabulated. Approximately 35% of the SPC enrollment lives within 7 minutes of a learning site or campus. The 7-minute zones were used here to reduce overlap of zones and for ease of analysis. Areas outside of these drive times within the county that are more geographically remote from SPC services are Palm Harbor, Dunedin, and Western Clearwater. Based upon current and future population projections, this type of analysis can assist in planning for expansion or reduction of services to a particular area. A foundational geographic principle relating to college participation is that interactions between places are inversely proportional to the cost of travel between them (Tobler, 1970). This supports the idea that students

are more likely to attend college courses that are nearer to their homes. Enrollment management specialists can take this type of geographic analysis into account when considering expanding access geographically.

Market Segments of Potential Opportunity

According to the population growth estimates included in the database provided by ESRI's Business Analyst, each of the ZIP codes of Pinellas County was expected to see an average increase of 144 people between the ages of 15 and 45—the typical college age population—by 2010. Some ZIP codes were estimated to grow by up to 430 potential college students. The greatest estimated growth was in the northern part of the county served by the Tarpon Springs campus (Figure 5). These areas represent
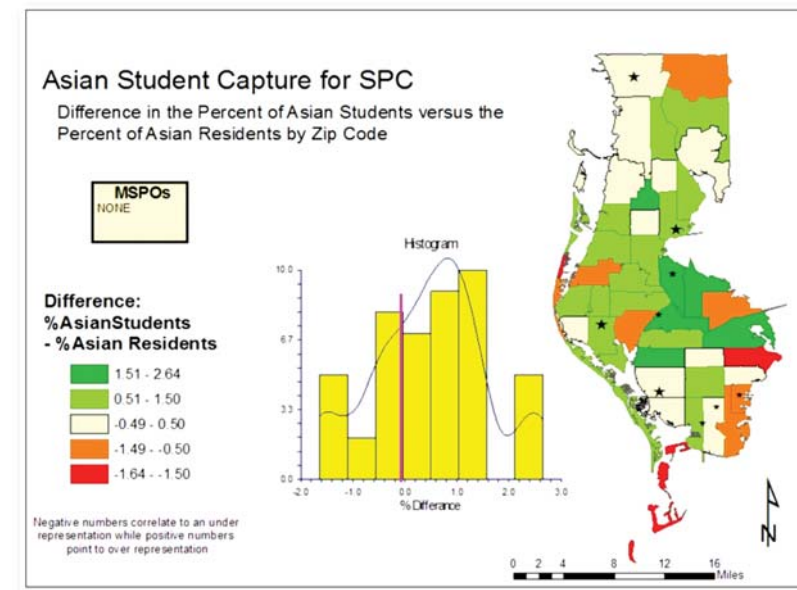

Figure 11. Representation of Asian student enrollment in Pinellas County.
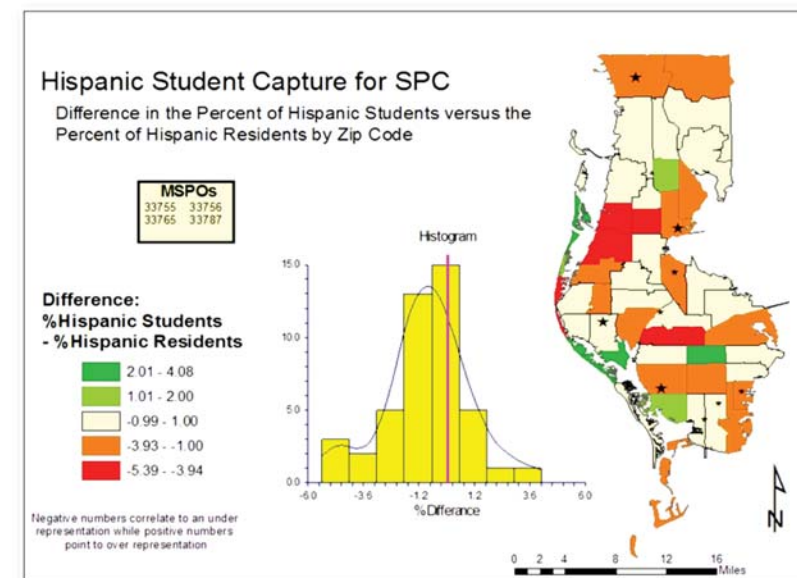

Figure 12. Representation of Hispanic student enrollment in Pinellas County.

and recruiting emphasis (Figure 14). The northeast part of the county will have high growth and should be monitored for neighborhood change for timing of a high visibility information center. Demographics in this area are well suited for a community college.

SPC should monitor areas in the central county that have a low minority capture rate. Drive-time analysis shows that prospective new campuses or learning sites could

be located at Palm Harbor, Dunedin, and Western Clearwater to improve accessibility. An industrial-centered campus might be considered as an intervening opportunity for workers in commercial areas in the south-central area of the county. Several market segments identified by ZIP code according to age, race/ethnicity, gender, capture rate, and major industry have promise for potential enrollment (Figure 14). Results of this research were presented to SPC in form of an oral presentation and a documented report.

Discussion and Conclusions
Institutional Implications for SPC

The analysis completed for St. Petersburg College represents the overall advantages gained from a geo-demographic analysis report. Geo-demographic measurements are descriptive characteristics of a population, arranged and ordered by scales of geography that are meaningful to the analysis (Thrall, 2002). In the SPC analysis, the most meaningful geographic scale is ZIP codes because of the functional nature of postal code designation for advertising and marketing campaigns. The use of maps for geo-demographic analysis provides a graphical representation of the landscape.

This reasoning is typically used for business analysis, but, as demonstrated here, can be transformed for the use of higher education. Higher education is becoming increasingly consumer-market-driven and students care less about whether a college is a for-profit or public institution, a predominantly online or brick-and-mortar instructional system, and more about absolute results (Morgan, 2008). This evolution of students into consumers of education, along with the need for innovative methods of reaching disadvantaged segments of the population, validates the methods described in this study.

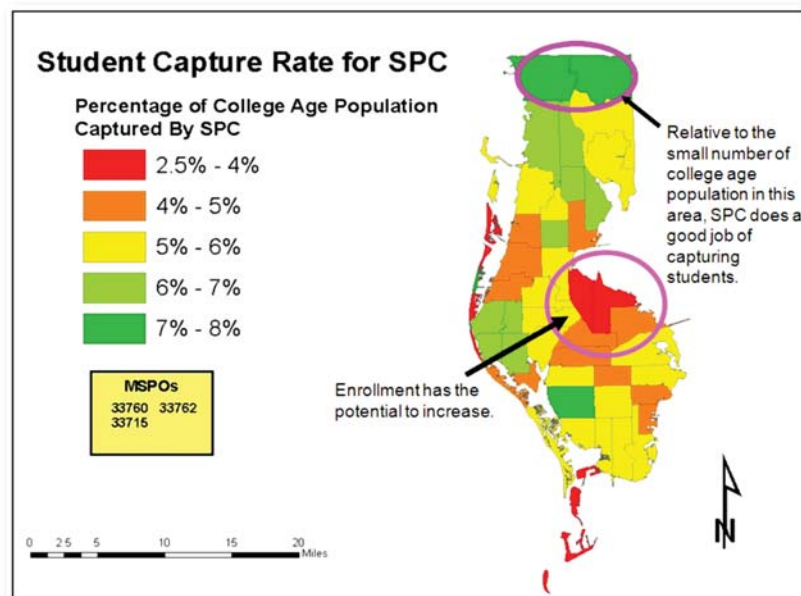Using geospatial technology, the students of SPC were assigned geographic
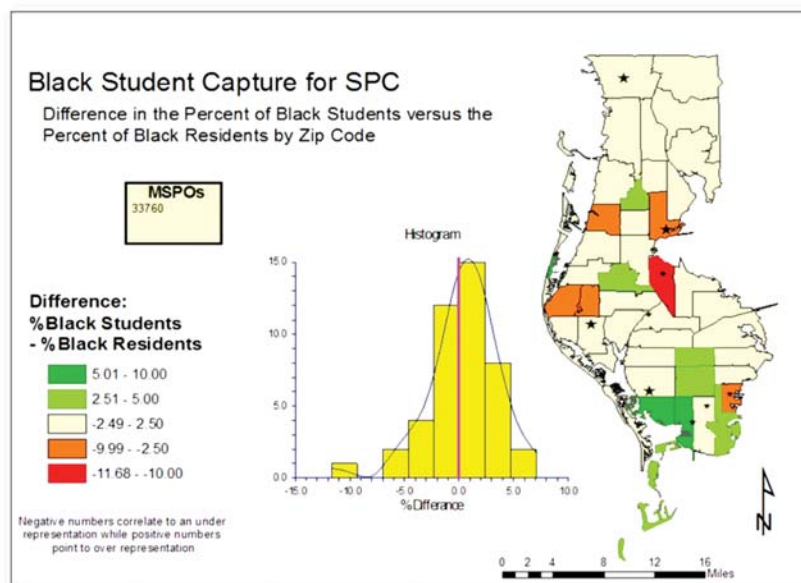
Figure 9. Market penetration analysis.

Figure 10. Representation of Black student enrollment in Pinellas County.

SPC's institutional objectives and strategic directions illustrate the importance of improving ethnic representation at the college. Capture rate analysis can reveal if a racial group is under-represented or over-represented at the college. The traffic-light-style color ramp used in Figures 10–12 does an effective job displaying under-represented (red) ZIP codes to those that are very close equal (neutral) and the over-represented areas (green). The histograms show

the frequency of ZIP codes near zero, which indicates an equivalent representation by SPC throughout the county. These maps also show the ZIP codes that are over-represented by the particular racial group.

The Hispanic population analysis reveals four MSPOs, where enrollments represent a market penetration substantially below the typical penetration of the college (Figure 12). These four ZIP codes fall within the -4% to -5.5% range. Overall, the county has 19 orange and red ZIP codes, which indicates an opportunity to increase Hispanic student enrollment. Figure 12 can give administrators at SPC an idea of where to emphasize effort to increase Hispanic enrollment.

The female capture rate throughout the county is an average of about 10% higher than males (Figure 13). There are various ZIP codes within Pinellas County that have a 15–20% higher female capture rate than males. This is especially true in the southern part of the county. No significant ZIP codes have a higher percentage of males than females attending SPC. These maps demonstrate the capability of the software to produce valuable market penetration maps for a variety of student attributes (i.e., age, race/ethnicity, gender).

Summary of Findings

Geographically, SPC effectively serves the entire Pinellas County with higher education. This analysis draws attention to opportunities for SPC to increase market penetration within the county by greater targeting of particular population segments identified in this report. Additionally, several geographic areas warrant monitoring due to high population growth, which may call for expansion of services for growing segments of the market.

Based upon the objectives listed by SPC in the strategic plan along with a list of questions well suited for geographic inquiry, this analysis has revealed locations within Pinellas County where SPC can put marketing
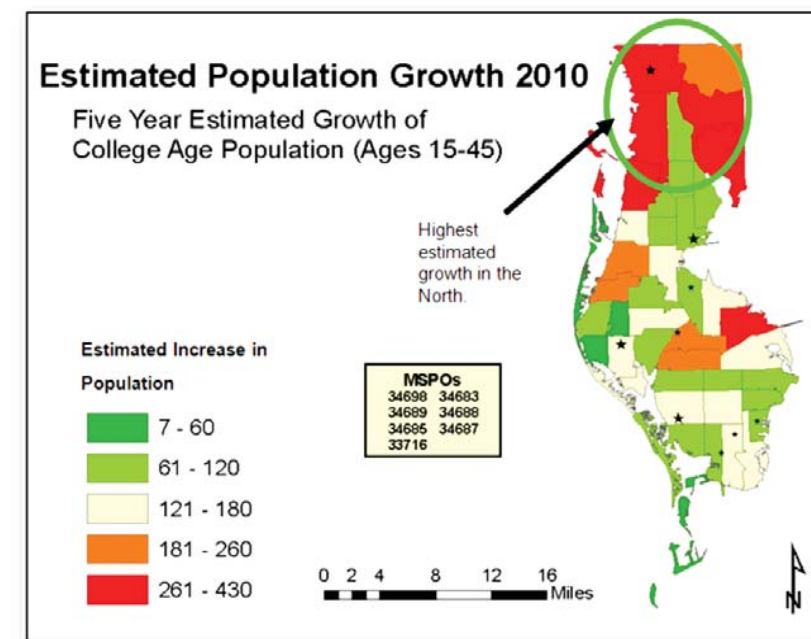

Figure 5. Estimated growth in college-age population throughout the county.
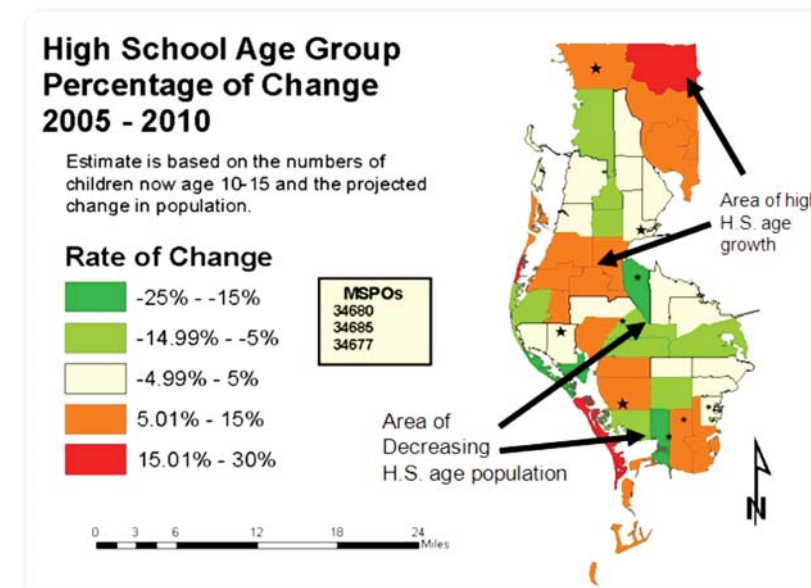

Figure 6. Projected changes in high-school-age population throughout the county.

market segments of potential opportunity (MSPOs), as designated in the figures throughout this analysis. The color ramp used in Figure 5 is also used at various times in this analysis. The traffic light pattern of green and red was chosen to designate the highs and lows, or hot and cold areas of the county.

An impetus for conducting this study relates to the gradual decrease in high-school-age population enrollment at SPC in 2006. Using population projections from the database provided by the ESRI software, age-group maps can be produced to determine areas for recruitment. Figure 6 shows a high-school-age-population projection from 2005–2010 for Pinellas County. According to the projections, the northern part of the county was expected to see the greatest growth of high-school-age population, while the central county was projected to have decreasing numbers of high-school-age population. SPC was not capturing a high number of students from the northeast corner of the county, but population projections show growth in high-school-age population in this area, representing a target of opportunity for SPC.

Being an older, more established, and densely populated area, Pinellas County has less room for growth than surrounding counties, therefore, examination of the overall population trends throughout Pinellas and the surrounding counties is important (Figure 7). On average, each ZIP code within Pinellas County was expected to increase in population 0.5% from 2005–2010. Figure 4 illustrates that the greatest increase was expected for ZIP code 34688, bordering Pasco and Hillsborough Counties; ZIP 34688 was estimated to grow by 4.5%. Both Pasco and Hillsborough Counties showed high growth rates, particularly in areas adjacent to Pinellas County. These adjacent areas shown in Figure 7 represent MSPOs. Using the current geographic distribution of the students along with population projections, IR professionals can prepare for future market trends and focus recruiting efforts on high growth and low capture areas.
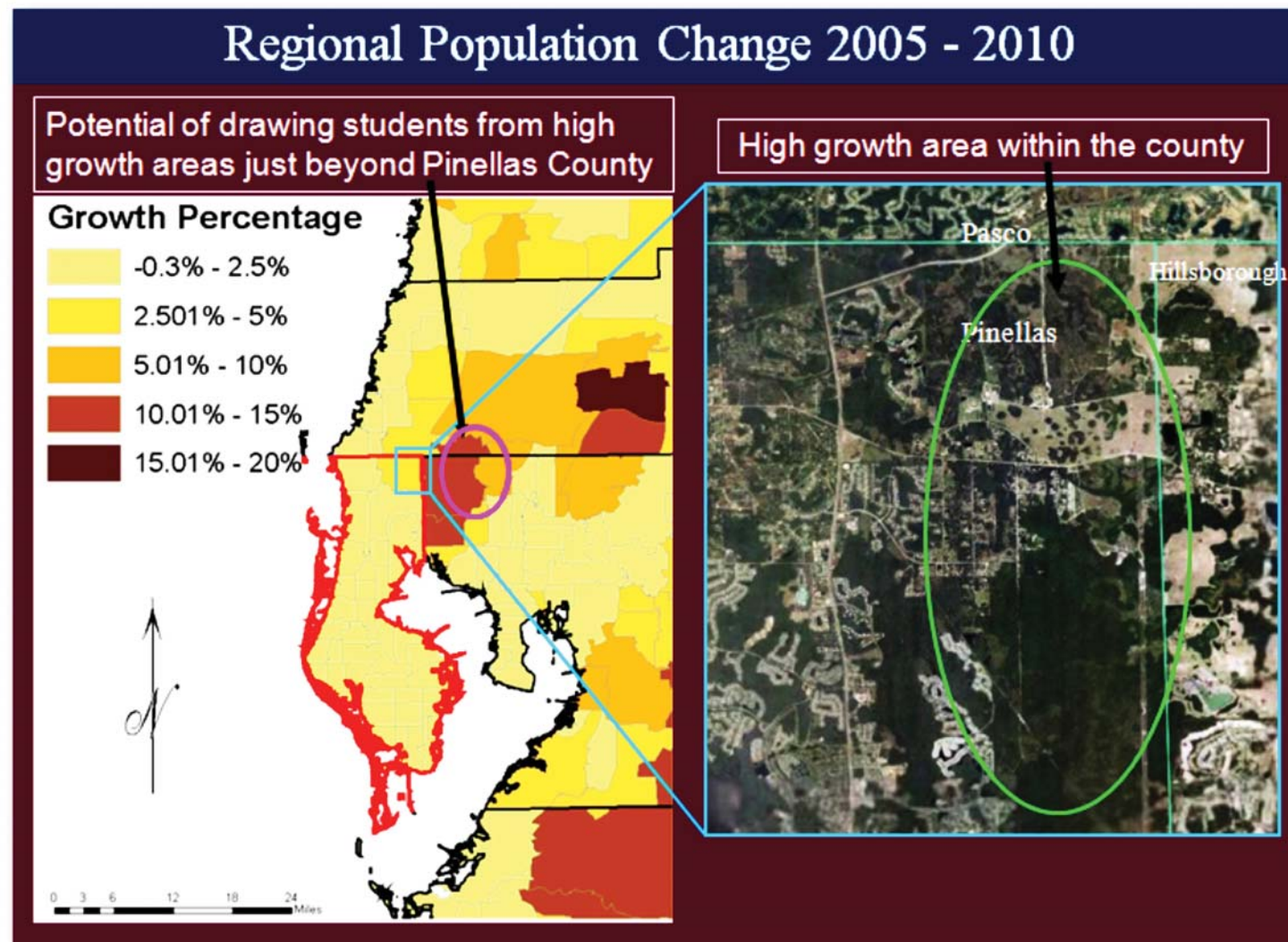
Figure 7. Regional population changes and target areas of opportunity.

Figure 8. ESRI Lifemode Groups by ZIP code.

Market Segmentation Profiling

In the SPC analysis, student demographics were analyzed using market segmentation profiling. The reasoning behind market segmentation profiling is that people with similar tastes, lifestyles, and behaviors cluster in terms of consumption, housing, and educational aspirations. These behaviors can be measured, predicted, and targeted (Thrall, 2002). By examining these profiles with student data, IR staff can better understand the economic landscape from which a college or university draws students. The marketing and services can then be adapted to the indentified segment.

Lifestyle Segmentation Profiles of SPC students were calculated using ESRI's Tapestry LifeMode groups (ESRI, 2009). Figure 8 shows ZIP codes color coded to dominant LifeMode group. The majority of SPC students are from areas with aging populations. The SPC trade area has 17 ZIP codes dominated by the LifeMode group Senior Styles, which is comprised of Rustbelt Retirees, Senior Sun Seekers, The Elders, and others (Figure 8). Examples in this map of MSPOs are ZIP codes dominated by LSPs High Hopes, Young and Restless, Solo Acts, Metropolis, Great Expectations, and Global Roots (Figure 9). A possible explanation for the fact that students are commuting from neighborhoods with aging populations is that students are living with grandparents or older family members through colleg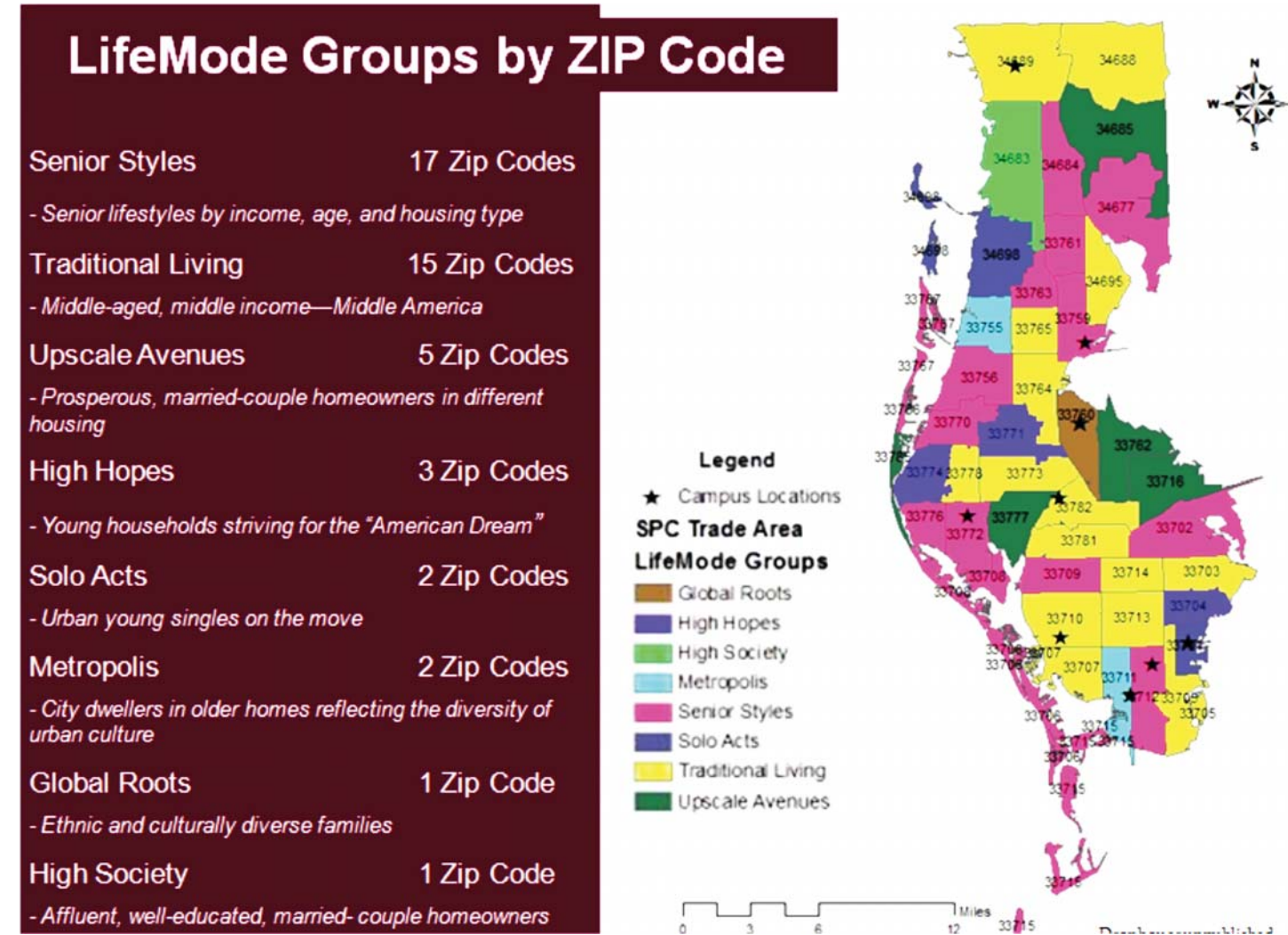e. Alternatively, this may be explained by the fact that ZIP codes are too broadly defined to show the heterogeneity of the neighborhoods within the ZIP codes. By understanding the differences in these groups, SPC enrollment management specialists can better understand their trade area and develop recruitment strategies to appeal to their desired segment.

Market Penetration

Examining market penetration can reveal the ratio of enrolled students to college-age population for attributes of the population such as race/ethnicity, age, or gender. Market penetration in this analysis compares the percent of student enrollment from an attribute group in a ZIP code to the percent of the actual population within that attribute group from that particular ZIP code.

SPC enrolls from 5–6% of the college-age population in 17 of 47 ZIP codes within the county (Figure 9). The average capture rate is 5.4% throughout the county. Two ZIP codes that fall into the MSPO classification are 33760 and 33762, and both capture roughly 3% of the college-age population. SPC captures a high of 7–8% in the two northernmost ZIP codes. The analysis shows that the total numbers of students attending from this area is small but, relative to the small college-age population in this area, SPC does well enrolling students from this area.