TRADE AREA DEFINITION AND CALCULATION

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2007

ACKNOWLEDGMENTS

I thank the chair and members of my supervisory committee for their mentoring. I also thank MapInfo for providing the software and support to complete my application along with St Petersburg College, Florida for providing the data for this analysis. Lastly I would like to thank the American Real Estate Society (ARES) for selecting our manuscript (Patel, Fik, and Thrall) as a prize winner under the category of Real Estate Market Analysis, sponsored by Torto Wheaton Research.

TABLE OF CONTENTS

page

ACKNOWLEDGMENTS 3

LIST OF TABLES 5

LIST OF FIGURES 6

ABSTRACT 7

CHAPTER

1 INTRODUCTION 8

2 THE WEDGE CASTING METHOD 18

3 OVERVIEW OF THE APPLICATION 22

4 OVERVIEW OF THE APPLICATION’S PROCEDURE 23

5 CONCLUSION 31

LIST OF REFERENCES 32

BIOGRAPHICAL SKETCH 33

LIST OF TABLES

Table page

1-1 List of data displayed for each wedge in application..26

LIST OF FIGURES

Figure page

1-1 Ring trade area example. Map produced by MapInfo. 16

1-2 Drive-time area example. Produced with Microsoft Mappoint. 16

1-3 Wedge based trade areas. Produced with MapInfo..17

1-4 Distance decay function. Produced with SPSS...17

2-1 A grid overlaid on top of the study area that is then converted to centroids. 20

2-2 Wedges set around the anchor point that contains all centroids. 20

2-3 Distance-decay line applied to one of the wedges. 21

2-4 Distance at the lower level confidence interval at mean UI. 21

4-1 Application: Initial screen..27

4-2 Application: Grid overlay. 27

4-3 Application: Wedge creation. 28

4-4 Application: Wedges cut (first run). 28

4-5 Application: Minimized study area (first run). 29

4-6 Application: Final trade area...29

4-7 Final trade-area. 30

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Science

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December 2007

Chair: Grant Thrall
Major: Geography

Real estate market analysis begins with the spatial delineation of the geographic market trade area. The less accurate the spatial delineation, the greater the error introduced into subsequent analysis such as calculation of competitive supply, demand and absorption. Advancements in geospatial technology provide for greater ease of execution of traditional methods of calculation of market areas; however trade area estimation methods have not changed along with advancements in geospatial technology. We bridge the gap between geospatial technological advances and analysts' needs for improved accuracy in spatially delineating trade areas. The solution requires a software interface that integrates complex statistical analysis with geospatial manipulation and visualization of geographic data. The algorithm is a composite of traditional methods and in that manner remains intuitive to decision makers. At the same time, because there are so many components to the algorithm, it would have been neither practical nor feasible to achieve the same accuracy as presented here with earlier technologies. The application is written in MapBasic. The executable MapInfo add-in can be downloaded and used by anyone with MapInfo GIS software on their Microsoft Windows based personal computer.

CHAPTER 1
INTRODUCTION

Real estate market analysis generally proceeds by first calculation of the trade area, then calculation of competitive supply, demand, and finally absorption rate. Without trade areas accurately representing the place of origin of a real estate asset's customers relative to the location of the asset itself, measurements of phenomena within the hypothesized trade area will be in error. Analysts have come to accept error in composition, and integrate expected error in their analysis. However, we contend that geospatial technology has advanced so that analysts can reduce error arising from trade area specification, and thereby improve on their forecasts and recommendations.

Because of the ability for Geographic Information System (GIS) software to spatially manipulate geospatial data, the time and effort has been reduced in calculating trade areas. However, the literature on trade area calculation has not taken advantage of the new geospatial technology. Trade area calculation and delineation remains as was done before GIS, though with much less time and effort. While the ease of trade area calculation has decreases with the development of GIS, Dramowicz (2005) states that the software has yet to integrate statistical analysis within its environment for improved trade area measurements. Consequently, there exists a lag between the possibilities made available by geospatial technology and measurement and how trade areas are calculated and spatially delineated. Here, we begin the dialog of integrating contemporary geospatial technology and geospatial statistics to the fundamental real estate analytic issue of trade area calculation and spatial delineation.

Our opening dialogue on trade area algorithms discussed assumes that patrons of a real estate asset such as a shopping center travel from an origin to the asset destination. The so-called "brick-and-mortar" trade area is most common and perhaps traditional. However, we recognize that other kinds of trade areas exist which are beyond the scope of the current study; for example, the e-retail trade area which might be measured by the occurrence of comparatively high density of the e-retail's customers, with little relevance to the location of the e-retailer itself.

William Applebaum (1966) defined a primary trade area as encompassing a geographic region accounting for between 75 and 80 percent of relevant consumers. While Applebaum established reasonable rules-of-thumb benchmarks for interpreting what a trade area represents, he did not provide a repeatable mechanism for calculating where the trade area is. Consequently, different analysts could enclose the same percentage of customers within a trade area, but their trade area polygons would not necessarily be the same.

Many algorithms have been proposed to reliably and repeatedly calculate and spatially delineate trade areas. Because of how trade areas are used by real estate analysts, the importance of repeatability cannot be over stated. William Applebaum's analog method (as quoted in Thrall, 2002) tells us that by identifying the geographic context of a successful real estate asset, if that geographic context is repeated for another asset, the success is also likely to be repeated. Measurement of the geographic context begins with calculation of the trade area. The composition of the population and other phenomena within the trade area has most bearing on the success of the real estate asset, such as a shopping center or retail store, or even an office building. If the trade areas of the various real estate assets are calculated differently, the geographic contexts of the various real estate assets cannot be compared. To achieve repeatability, the following trade area measurement procedures have become generally accepted by analysts and in the literature: ring study, drive time, and gravity models. Part of their acceptance has been their ease of measurement, made even more so by geospatial technology.

Real estate market analysts have most frequently relied upon the ring study (Figure 1-1). Circles are drawn around the real estate asset or proposed site. The radius is increased until a specified number or percentages of customers have been captured by the circular trade area. The radius then becomes known to the analyst who then uses that same radius to calculate hypothetical trade areas for proposed sites. In this way the ring study becomes repeatable. It is also easy to calculate, hence its adoption in the era before personal computers. But are ring based trade areas reliable? Error is introduced in ring based trade areas by the implicit assumption that patronage is either spatially uniform over the entire circular area, or that spatial non-uniformity of customers will vary by the same amount between all study sites. The ring trade area also has an absence of accountability from behavioral, geospatial, road network, or physical conditions that promote or restrict usage in various directions. Golledge (1999) goes on to further claim that the ring trade area does not take into consideration taste preferences or stress levels of patrons as they pass through various neighborhoods. Behavioral geographers illustrate that locations known in one's mental maps may be closer or more remote than they may be in reality. The more these implicit assumptions depart from reality, the greater is the error introduced into subsequent data analysis as proclaimed by Thrall and McMullen (2000, 2002). However, ring based studies are easy to calculate, many decision makers think in terms of ring based trade areas, and the errors introduced by ring based trade areas are thought by many analysts and decision makers to be tolerable and accountable.

The second most common method used by real estate market analysts to spatially delineate a trade area is based upon time of travel between origin and destination. These trade areas are known as "drive-time" trade areas and may be readily drawn with geospatial technology (Thrall, 2002) and may be seen in Figure 1-2. The drive-time trade area calculates how far a customer can travel from origin to destination within a specified period of time. Drive-time algorithms increase the time-of-travel and therefore often distance of travel on the road network, until 80% of customers are encompassed by the calculated trade area polygon. With drive-time known for a specified percentage of customers for a set of like-kind real estate assets such as a retail store, the derived drive-times can be used to calculate hypothetical trade areas around proposed sites. Drive-time polygons offer improvements in calculation of the geospatial delineation of a trade area, and consequently improvements in the analysis that relies upon data measurements of the trade area. However, drive-time polygons are dependent on the accuracy and up-to-date geospatial data of road line vectors. Moreover, time of travel along a road line vector is highly variable. A new subdivision, missing highway, traffic congestion, can make drive time trade areas highly inaccurate. In addition, Fik, Sidman, Sargent, and R. Swett (2005) state that drive-time trade areas also do not take into consideration customer's willingness-to-travel, multiple modes of transportation, consumer preferences, knowledge and experience, perceptions, and spatial-use-patterns. However, like ring based trade areas, drive-time based trade areas are easy to calculate, many decision makers think in terms of drive-time based trade areas, and the errors introduced by drive-time based trade areas are thought by many analysts and decision makers to be tolerable and accountable. It is intuitively evident that a ring based trade area (Figure 1-1) and a drive-time based trade area (Figure 1-2) overlay different geographic locations.

Thrall (2002) asserts that wedge based trade area calculations (Figure 1-3) offer improvements over drive-time calculations. Like the drive-time trade area, the wedge method begins with known locations of customers' origins and the known location of the destination real estate asset. Unlike the ring method which extends one radius, the relevant geographic region around the real estate asset is divided into sectors or wedges. The radius of each sector or wedge is allowed to extend outward until a given percentage of customers are inscribed by the trade area. With the real estate asset at the hub of a wheel, the spokes radiating out from the hub define each wedge. The analyst must use his or her judgment as to how many wedges to include. Too few or too many wedges can introduce errors in the analysis. Wedge algorithms allow each wedge to increment outwards by a distance specified by the analyst. The wedge that is allowed to extend next is that wedge which by its incremental extension will include the greatest number of customers. Directionality thereby enters into the specification of the trade area; the trade area is not merely a circle. The customers' locations are used in a repeatable manner to calculate what might be a highly irregular and off centered trade area (also referred to as amoeba trade areas). However, the wedge based algorithm also introduces systematic error to the analysis.

Wedge based trade areas implicitly assume that space is smooth and continuous, which often is not the case. For example, say a large number of customers are clustered at a distance several incremental steps from a wedge's current radius, and that few and perhaps no customers are within the analyst's chosen incremental steps. It is quite possible that the wedge is not allowed to "grow" outwards to those customers resulting in those customers not being included in the final trade area. The increment to extend the wedge is based upon the analysts' experienced judgment; the increment is not based upon a statistical calculation. Different assumed increments can produce different trade areas. However, the wedge based trade area is not subject to errors of road line vectors as is the drive-time algorithm. And wedge based trade areas have proven effective at calculation of trade areas because in most cases the customer spatial distribution follows the various physical land features, barriers to travel, willingness-to-travel, and so on. The wedge based algorithm is effective at demarcating a trade area polygon and thereby highly useful in summarizing the underlying geodemographics of a trade area which can be used in forecasting the performance of a single or set of real estate assets. While the wedge based trade area is not as sensitive to the implicit assumptions of the other trade area algorithms, it by itself is not repeatable. A wedge polygon trade area cannot be picked up and dropped on a map of a prospective location. Instead, real estate market analysts will calculate drive times by clusters of demographic groups within known wedge trade areas, and apply that to measure hypothetical trade areas.

The third most commonly used method today was introduced by David Huff in 1963, and is a variation on the gravity and spatial interaction model (see Haynes and Fotheringham, 1984). However, the distance decay function, as seen in Figure 1-4 and noted by Haynes and Fotheringham, 1984, upon which gravity and spatial interaction models depend generally do not take into consideration directionality and allow various levels of error to enter the trade area calculation as do the previously discussed trade area algorithms. For discussion of the distance decay function and issues of its calibration and specification see Thrall (1988). Distance-decay models generally are expressed as negative exponential functions. The defense of the negative exponential structure is based upon the assumption that customers are "distance minimizes" and that there is a distance-decay property to usage. In other words, the farther a prospective customer lives from a destination site, the less likely the customer will visit the site. In practice, decision makers and real estate market analysts have frequently shied away from adoption of spatial interaction models because of their complexity of both construction and calibration. Decision makers do not readily adopt black box algorithms whose results are not intuitive. However, the distance decay component has been readily adopted.

So, a trade area algorithm should have ease of calculation, and ease of explanation and understanding. Lower levels of error introduced into the calculation should translate into more reliable subsequent statistical analysis of the geodemographic data of the resulting trade area(s). And, the trade area algorithm should be repeatable. Our objective is then to capture the best component of each of the foregoing approaches and make the resulting algorithm easily accessible. The integrative procedure followed here is wedge-casting, introduced by Fik, Sidman, Sargent, and R. Swett (2005) for calculation of a trade area of customers utilizing a boat ramp. We believe the algorithm is useful for calculation of trade areas for real estate assets with customers accessing the destination asset site from known origins. We also utilize geospatial technology to make the algorithm easily calculable and accessible. The algorithm is readily understandable, so barriers associated with adopting "black box" algorithms do not apply.

The wedge-casting algorithm surrounds a real estate asset, the destination site, with a specified number of wedges. As in the wedge algorithm, the analyst must use his or her judgment on the number of wedges, or wedge angles. Kaboudan (2007) has conjectured that the number of wedges might be able to be calculated using algorithms similar to those used to calculate the optimal number of histogram bars and their breaking points. Like the traditional wedge approach, growth of the wedges allows directionality to be introduced into the trade area calculation. However, unlike the linear incremental step function of the earlier explained wedge algorithm, the problem of discontinuous space is avoided by calculation of a distance-decay function (Figure 1-4) based upon the location of customers within each wedge centered on the site. This enables each wedge to have a separate distance decay model calibrated. We utilize here a simple negative exponential distance decay, though distance decay functions of higher order and more complex specification (for discussion, see Thrall 1988) can be easily adopted to reduce error even further.

Calculating numerous distance decay functions around a central site can be tedious, and time-wise prohibitive. However, with geospatial technology as shown here, the wedge-casting algorithm can be operationalized. The calculations are geospatial and statistical. Therefore, the operationalization requires the integration of separate software packages with interactive communication between the two.

As with the other trade area algorithms discussed above, the wedge-casting algorithm also depends upon the experienced judgment of the analyst. However, because the geospatial technology readily allows many trials, the analyst can easily experiment. The application that integrates the procedures is MapBasic (http://www.mapinfo.com), the programming language for MapInfo GIS software. The MapBasic GIS application provides the analyst the ability to investigate and modify the performance of various variables he or she inputs and also provides tools such as graphs, charts and data on the algorithm's performance in order to improve the analysts judgment.

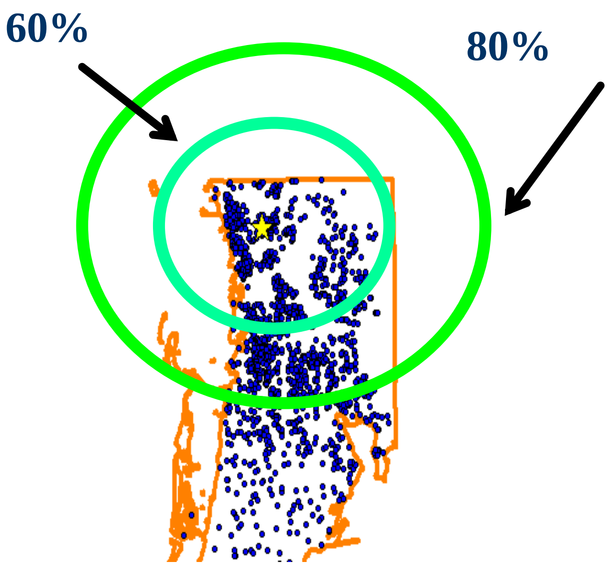


Figure 1-1 Ring trade area example. Map produced by MapInfo.

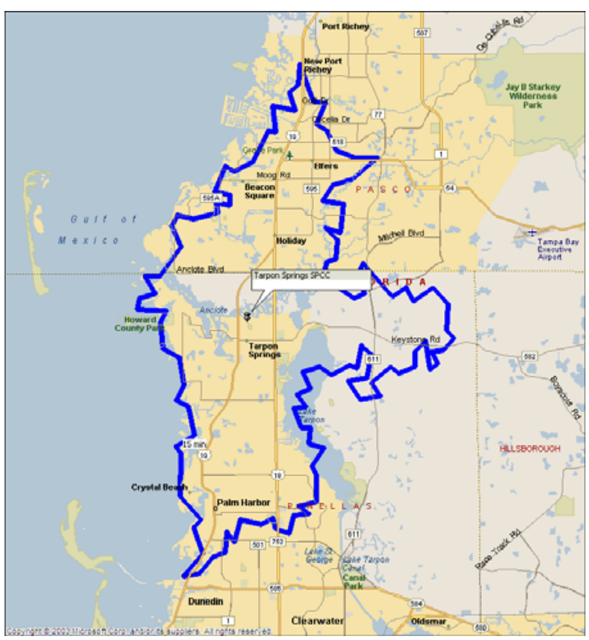


Figure 1-2 Drive-time area example. Produced with Microsoft Mappoint.

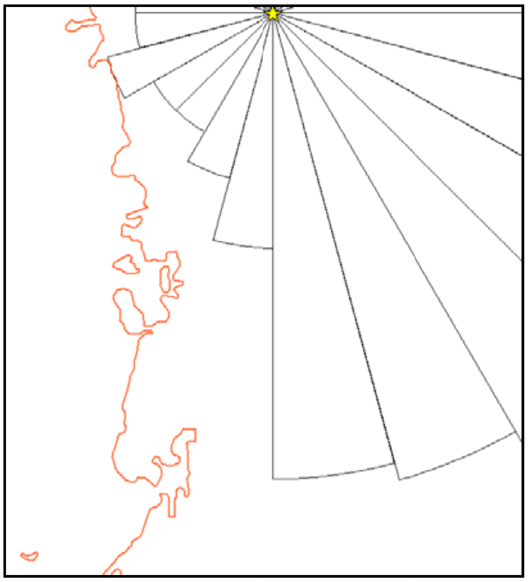


Figure 1-3 Wedge based trade areas. Produced with MapInfo.

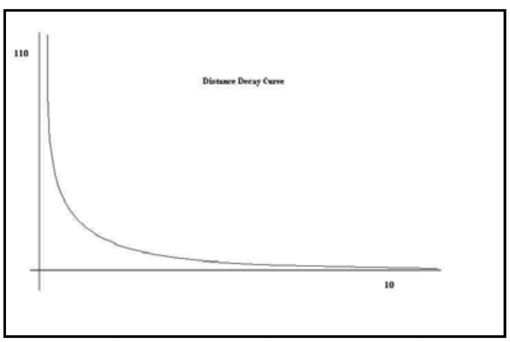


Figure 1-4 Distance decay function. Produced with SPSS.

CHAPTER 2
THE WEDGE CASTING METHOD

The wedge-casting algorithm produced by Fik, Sidman, Sargent, and R. Swett (2005) begins with the calculation of a "distance threshold." The distance threshold is defined by the distance at which marks the outer boundary of the trade area for a specific wedge, or more specifically, the distance at which client interaction falls to a level that is significantly below the average within a wedge. A distance-decay or negative exponential function is fit to the number of patrons residing in a grid-cell. Least sum squares regression is used to estimate the coefficients of the equation. An estimated distance threshold is determined by calculating the distance of the lower-limit confidence interval of the mean client usage for that particular wedge.

The procedure for the wedge-casting approach is explained as follows:

1. Overlay a grid on the region of study. The analyst chooses the size of the cells that make up the grid layer. The analyst is presented with frequency distribution and other statistics on the number of clients that fall in the cells as an aid in the decision on grid cell size. The default we use is one mile, as grids of this size are already routinely used in business geography analysis (Figure 2-1).

2. Calculate the number of client points within each cell, which is a measure of customer intensity.

3. Calculate the centroids of each cell and the distance of the cell center to the real estate asset. The default is straight line distance, but Manhattan, as determined by Thrall (2002), or drive-time (drive-distance) can also be utilized as the distance metric (Figure 2-1).

4. Compute wedges around the real estate asset so they contain all centroids (Figure 2-2). The angle of the wedges depends upon the analyst's judgment, though we recommend that a majority of wedges capture a large sample size of centroids.

5. Calibrate a negative-exponential function to the data within each wedge using ordinary least squares regression under the usual limiting assumptions. Coefficients α and β are estimated (Eq. 2-1 and Eq.2-2) where the equation represents customer intensity as a function of distance. The negative-exponential function follows the following format (the constant term is ignored). (Figure 2-3)

$$y = \alpha * e^{(-\beta * x)} \qquad (2\text{-}1)$$

$$UI = \alpha * e^{(-\beta * d)} \qquad (2\text{-}2)$$

Where:
UI = customer intensity
d = distance

6. Solve the equation for distance as seen in Equation 2-3:

$$d = \ln(UI / \alpha) / \beta \qquad (2\text{-}3)$$

7. Customer-intensity must be set so that a distance that is significantly less than the "mean customer intensity" (UI_m) can be extracted. This distance is the distance threshold (d*). Customer-intensity is set to the lower limit of the $(1 - \alpha) * 100\%$ confidence interval (Eq. 2-4 and Eq. 2-5). The alpha value must be predefined. (Figure 2-4)

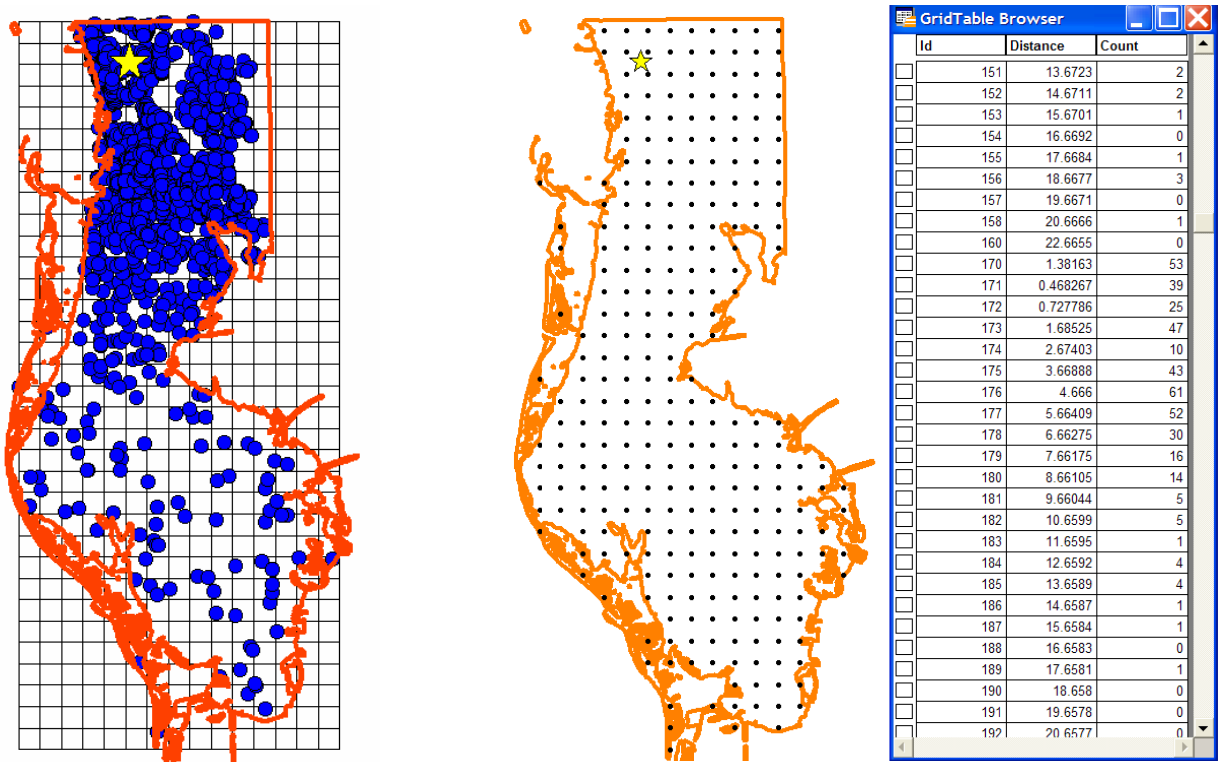
$$\text{Confidence Interval (CI)} = UI_m \pm t_{\alpha}/2 * (\sigma / \sqrt{n}) \qquad (2\text{-}4)$$

$$UI^* = UI_m - t_{\alpha}/2 * (\sigma / \sqrt{n}) \qquad (2\text{-}5)$$

Where:
UI* = lower-limit of the confidence interval

8. D* is calculated by setting UI to UI* in the equation and solving for distance.

When UI* is less than 1.0, UI* is set to 1, the distance where customer-intensity falls to one client per cell using the estimated distance-decay function parameters. If the regression model fails to produce a distance-decay parameter estimate β that is significantly different from zero, or more specifically if one fails to reject the null hypothetic that $\beta = 0$, then an alternative distance threshold must be determined. Alternative thresholds may be the median distance value or the upper value of the confidence interval for the median distance point. Small sample size or limited degrees of freedom, zero variance in customer-intensity values, and poor fit due to the presence of "outliers" may also require the use of an alternative distance threshold.



Id	Distance	Count
151	13.6723	2
152	14.6711	2
153	15.6701	1
154	16.6692	0
155	17.6684	1
156	18.6677	3
157	19.6671	0
158	20.6666	1
160	22.6655	0
170	1.38163	53
171	0.468267	39
172	0.727786	25
173	1.68525	47
174	2.67403	10
175	3.66888	43
176	4.666	61
177	5.66409	52
178	6.66275	30
179	7.66175	16
180	8.66105	14
181	9.66044	5
182	10.6599	5
183	11.6595	1
184	12.6592	4
185	13.6589	4
186	14.6587	1
187	15.6584	1
188	16.6583	0
189	17.6581	1
190	18.658	0
191	19.6578	0
192	20.6577	0

A B

Figure 2-1 A grid overlaid on top of the study area that is then converted to centroids. A) 1 mile grid overlayed on top of a study area. B) The centroids of the cells and their distance to the anchor. Maps and table produced with MapInfo. Note: Geospatial "customer" data are students attending the Tarpon Springs campus of St. Petersburg College

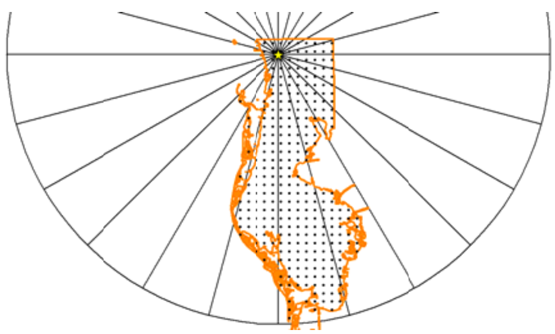


Figure 2-2 Wedges set around the anchor point that contains all centroids. Map produced with MapInfo

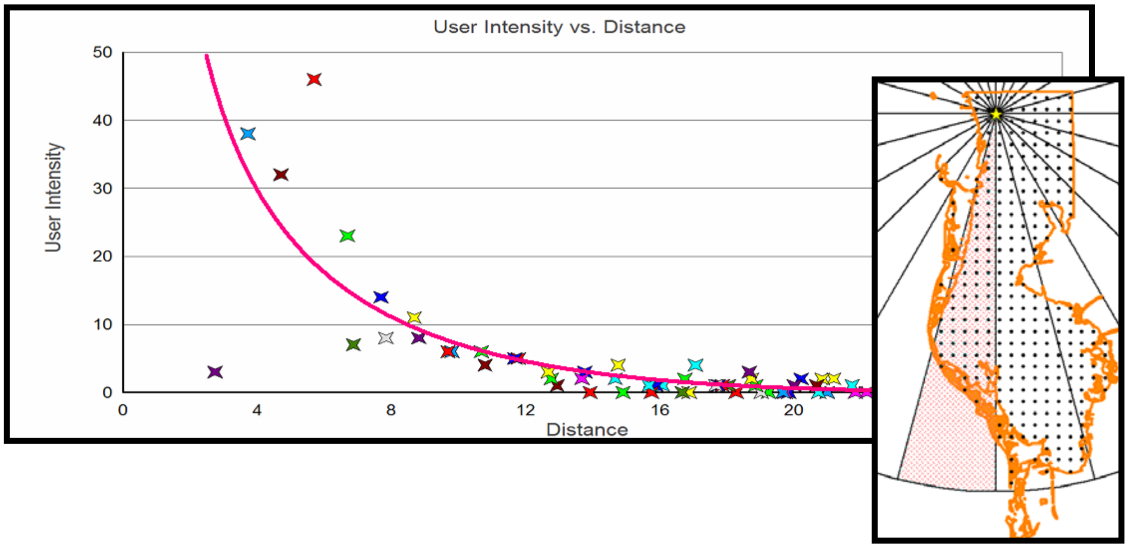


Figure 2-3 Distance-decay line applied to one of the wedges. Figure and graph produced with MapInfo.

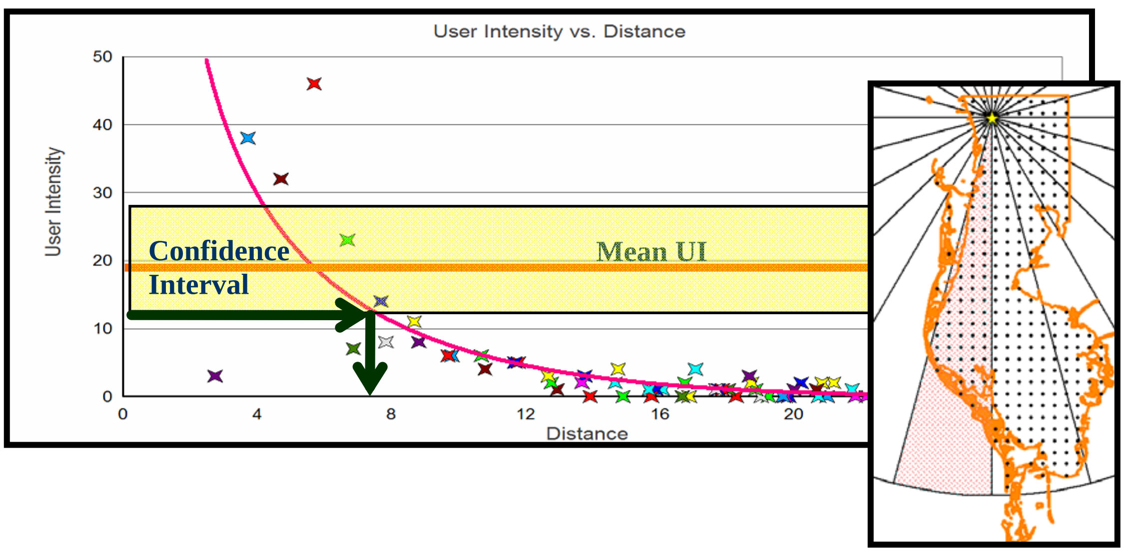


Figure 2-4 Distance at the lower level confidence interval at mean UI. Figure and graph produced with MapInfo.

CHAPTER 3
OVERVIEW OF THE APPLICATION

GIS software including MapInfo and others do not include the ability to perform complex statistical analysis. The algorithm adopted here requires rapid execution, and numerous variables such as the size of the cells, the degree of the wedge angle, and the alpha variable. Therefore, to increase accessibility to the algorithm and lower barriers to its adoption, an interactive and analyst-friendly integrative application was created.

The current version of the application can be downloaded for personal use at http://www.tradearea.info. The application is programmed in C# in a Windows .NET environment. The application takes advantage of MapInfo's MapBasic for geospatial functionality. MapInfo allows for a seamless integration of MapBasic functionality within the .NET environment. This integration also allows for the production of various graphs and charts to assist analysts' judgment. The application also calls various functions from Newcastle Scientific's MathLibX .NET library to perform regression analysis.

While the application does automate many of the calculations and data manipulations, the analyst must have sufficient knowledge of the data, study area, procedures, and application to produce acceptable results. Tools that help the analyst to make the correct decisions in determining these acceptable results are provided within the application.

CHAPTER 4
OVERVIEW OF THE APPLICATION'S PROCEDURE

The application begins by asking the analyst for various inputs (Figure 4-1). This includes file locations, the coordinates of the real estate asset, and initial cell size.

The application calculates a grid data layer, overlaying the customer data points. The analyst may keep the chosen cell size or change the cell size based on the summary information (Figure 4-2). The grid is color coded based upon the count of customer points that fall in each cell. The choropleth map is created by GIS overlay and then visually presented. The application displays a histogram and summary statistical information of the distribution of input points within the cells. After the analyst accepts the cell size to be used, the analyst then specifies the wedge size, the minimum number of points and cells that must fall in a wedge to accept a distance-decay threshold, and the alpha variable for the confidence interval.

The cells are then converted to a centroid point layer and wedges are drawn surrounding the real estate asset destination (Figure 4-3). The wedges extend to the farthest distanced point. The analyst may then recalculate by changing the cell size and/or the angle of the wedges based on summary statistics of the number of points and centroids falling in the wedges.

The application then computes the three distance thresholds for each specific wedge. The default for each wedge varies based on the conditions. The analyst may choose which of the three distance thresholds to use. The first and most desirable distance threshold is the one that is estimated with the least-sum regression equation. If not enough points or cells fall within the wedge to produce an equation or if the negative exponential equation simply does not fit the data, another threshold must be used. The second option is the median confidence interval threshold. This threshold is calculated by taking the calculated median distanced point at the upper limit confidence interval where alpha is 0.05 as seen in Equation 4-1.

$$k = nq + 1.96 \text{ root}(nq(1-q)) \qquad (4\text{-}1)$$

Where:
n = size
q = quantile (0 .5)

The last option is the max distance point in the wedge. This is selected as a default when the estimated threshold falls beyond the max distance point. It should also be used more freely on the first run through of the procedure when a liberal approach is required. If not many points exist within a wedge or the outliers do not look significant, the max point can also be used.

Summary charts, statistics and maps are presented by the application to the analyst to assist in the decision on which threshold to select for each wedge. A selection of the data available is described in Table 1-1. A chart displays the number of points in a cell as a function of the distance to the anchor. The chart allows the analyst to view the pattern of points and if the pattern does reflect a negative-exponential function. After the analyst evaluates the summary statistics for each wedge and is satisfied with its threshold, the application cuts each wedge to that distance (Figure 4-4). The result gives the analyst an initial liberal trade area (Figure 4-5).

An important addition to the procedure is the step to remove influential outliers. This is done by reducing the size of the study area by running through the algorithm of calculating trade areas twice. The first is a liberal approach that includes more than less points. The points that fall within this initial trade are then run again through the algorithm to determine a final trade area.

The analyst now specifies a cell size that extends within the area determined by the first run through. The analyst has the ability to modify the cell size. The wedge angle cannot be modified from the original run through so when a cell size is determined, the wedges are created. The analyst then must go through each wedge again and determine a final distance threshold. The same three options exist as the first run through. Once satisfied with the distance threshold for each wedge, the analyst can cut the wedges to create a final trade area (Figure 4-6). The application displays the number of customers that fall in the total trade area.

Figure 4-7 reveals the final trade area centered on the destination site of Tarpon Springs, Florida. It is self evident by comparison of the wedge-cast trade area of Figure 4-7 with the ring trade area of Figure 1-1, and the drive-time trade area of Figure 1-2, that each method can produce dramatically different trade areas and therefore overlay very different geographic contexts and demographics.

Table 1-1. List of data displayed for each wedge in application.

Column Name	Description
ID	The Id number of the wedge.
Points	Number of points that fall in the wedge.
Cells	Number of cells (centroids) that fall in the wedge.
B-Coef	The B-coefficient of the equation. Equation is determined by least sums regression.
UI*	The calculated Customer Intensity. Calculated by the lower end of the confidence interval. Also set to 1 if the lower end falls below 1.
DT Calc By	How the distance threshold is calculated. [Estmd- estimated from equation, Estmd(1)- estimated from equation where UI=1, Median Pt- the median point distance plus confidence interval, Max Pt- the max point distance]
Dist Thresh	The actual distance threshold in miles.
Pt Dist Median CI	The median confidence interval distanced point.
Pt Dist Mean	The mean distanced point.
Fail Reject H0	[Yes] if fails to reject the null hypothetic that ß = 0
R-Square	The R-square of the equation.
RMSE	The root mean square error of the equation.
% Pts of Total	The percent of points in the wedge of the total.
% Cells of Total	The percent of cells in the wedge of the total.
% Pts in Wedge	The percent of points in the wedge of the actual wedge. Only significant in the second run though.
% Cells in Wedge	The percent of cells in the wedge of the actual wedge. Only significant in the second run though.

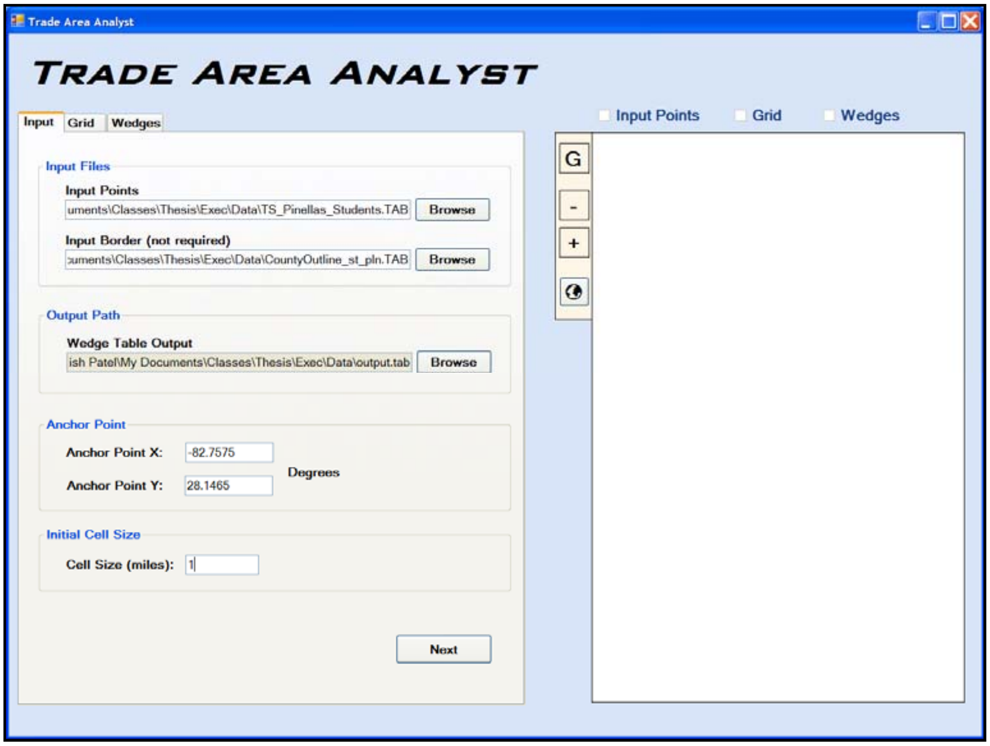


Figure 4-1 Application: Initial screen.

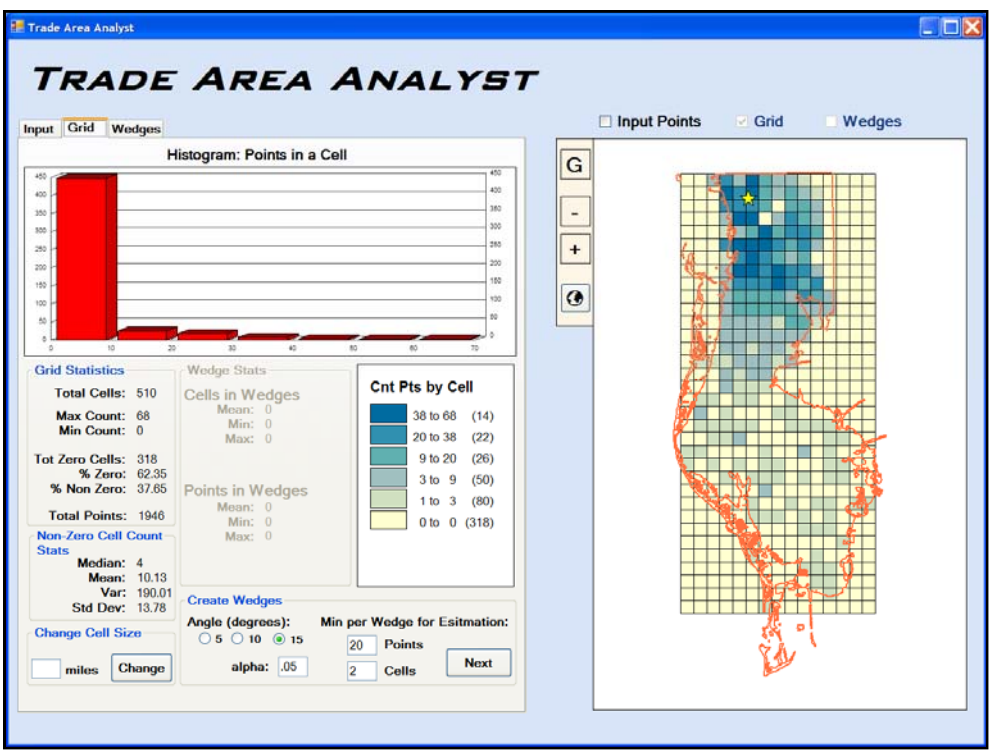


Figure 4-2 Application: Grid overlay.

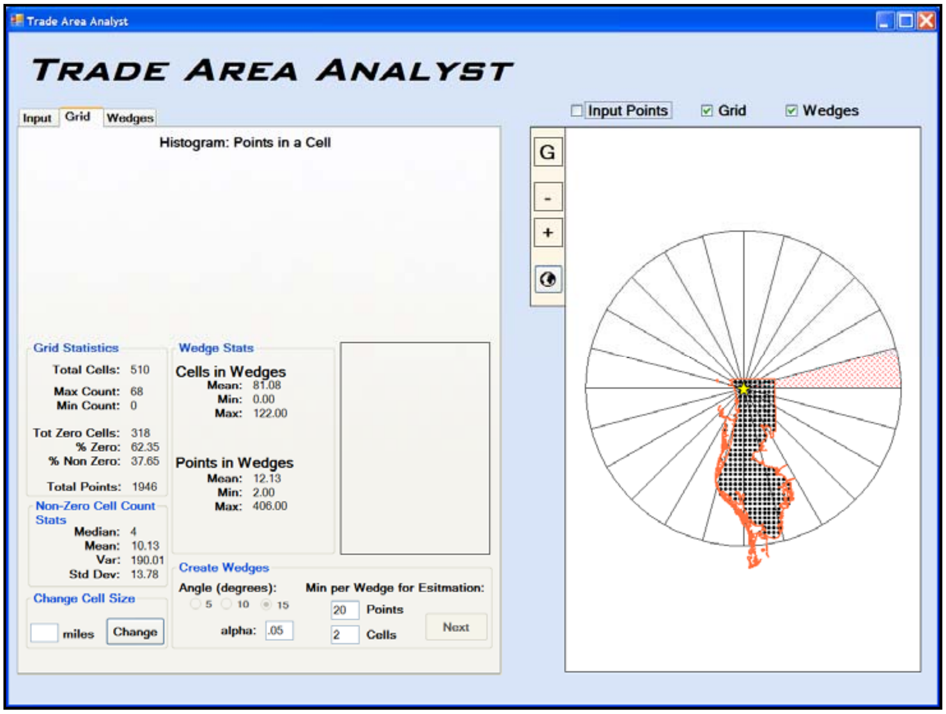


Figure 4-3 Application: Wedge creation.

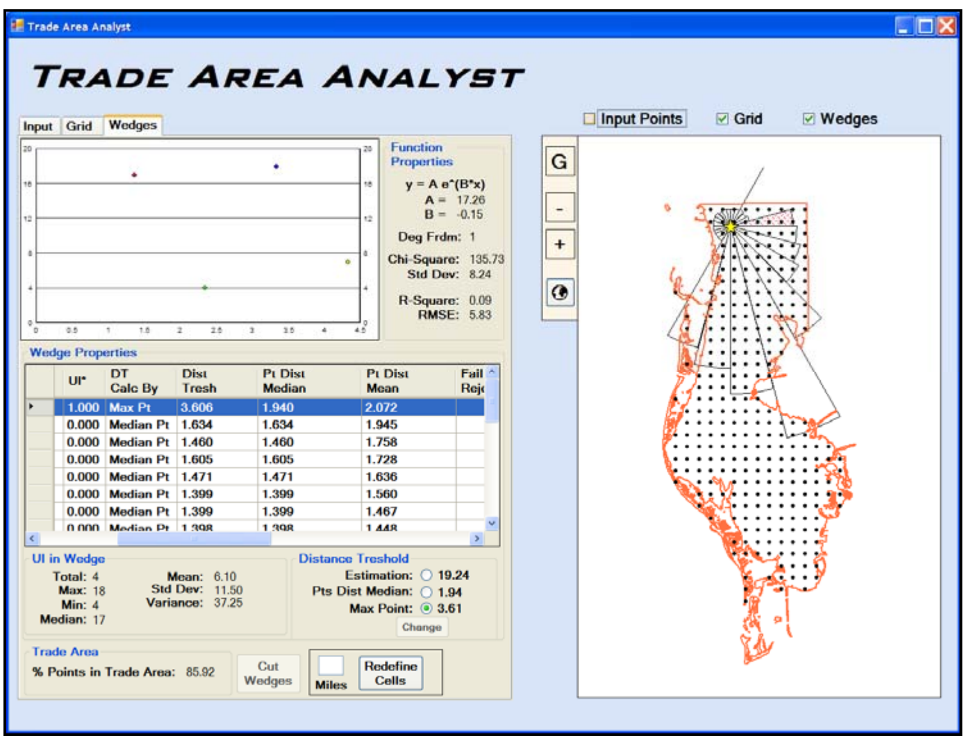


Figure 4-4 Application: Wedges cut (first run).

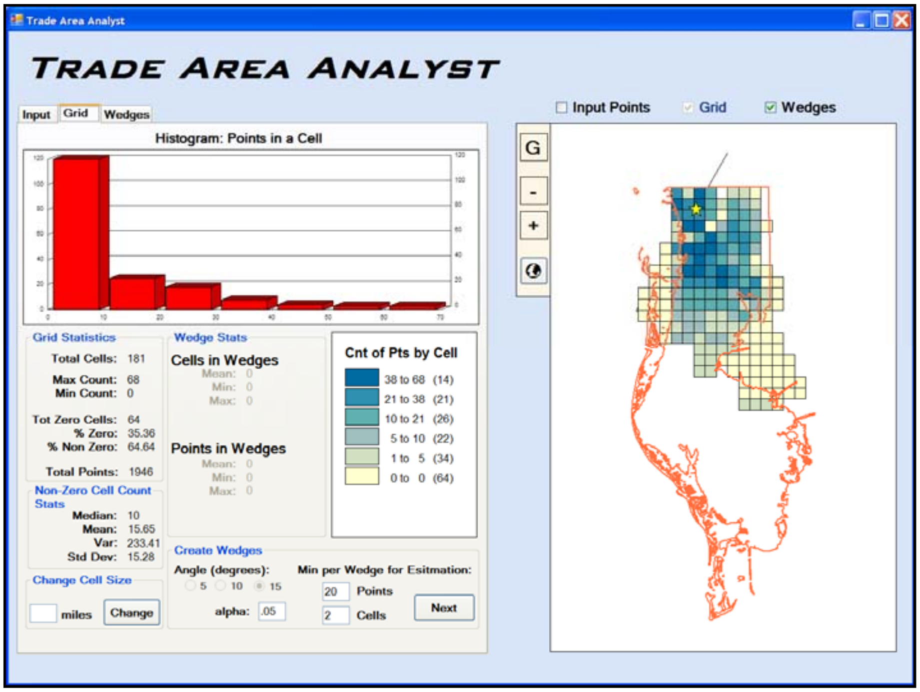


Figure 4-5 Application: Minimized study area (first run).

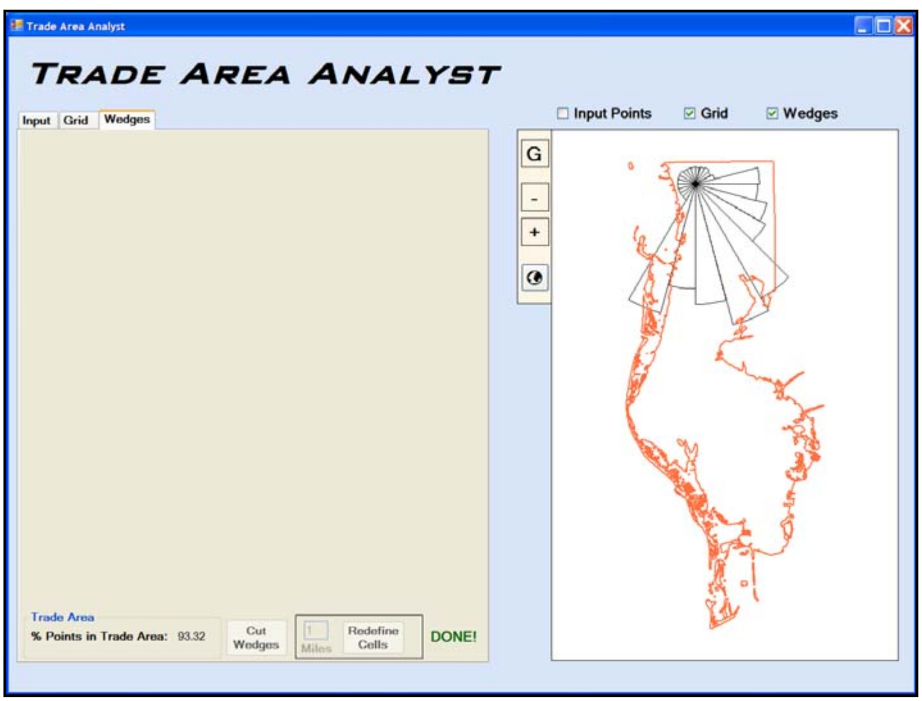


Figure 4-6 Application: Final trade area.

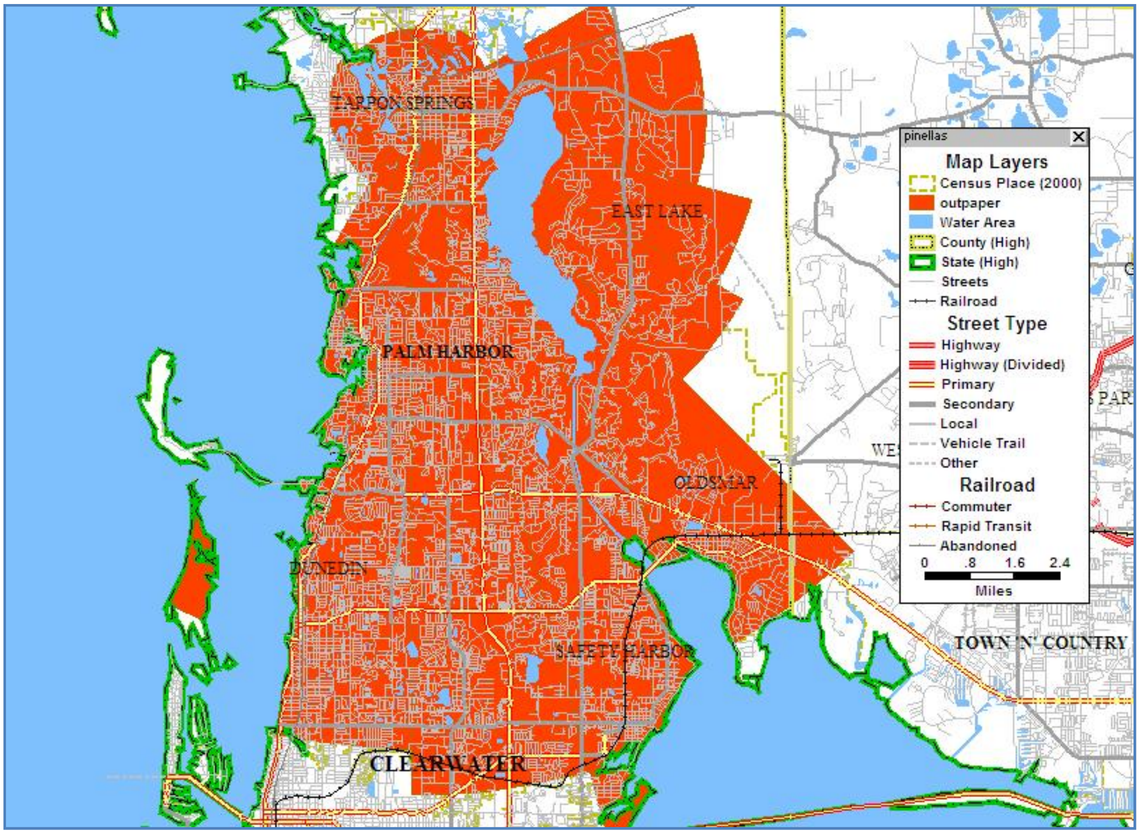


Figure 4-7 Final trade-area. Map produced with MapInfo.

CHAPTER 5
CONCLUSION

It has been commonly observed that 25% of most corporate assets are in real estate, and 85% of multi-branch retail assets are in real estate. A significant component of the value of the asset to the corporate body is its location relative to the trade area the asset serves. The trade area could be for a retail facility, office building, housing subdivision, and so on. Market analysis of site specific real estate must begin with a clear understanding of the market area that the asset serves.

The research introduced here begins a dialogue. Throughout the presentation we have mentioned opportunities for improvement. The wedge-casting approach as presented does not allow for placement of trade areas without existing origin-destination geospatial data. However, the same methods used today for replicating the wedge / amoeba to new environments can be automated within this application as well.

Today trade area calculation has many components of rules-of-thumb and analysts' judgment. The error thereby introduced might be sufficiently small to not make adoption of new methods compelling. However, the error might also be sufficiently large that when coupled with the cost of making a bad decision, adoption becomes compelling. We have automated our intuitive procedure to reduce barriers of adoption. Better trade area estimation can improve calculations of calculation of competitive supply, demand, and absorption rate.

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BIOGRAPHICAL SKETCH

I was born in London, UK in 1982, however moved to the US while quite young and spent my early formative years in Maryland. My undergraduate education was completed at Virginia Tech where I received a B.S. in computer science from the College of Engineering. At the time of completing my M.S. in geography, College of Liberal Arts and Sciences, University of Florida, I am also pursuing a Master of Science degree in decision and information sciences from University of Florida's Warrington College of Business. My near term plans include the completion of a doctoral degree focusing on the business geography field of study at University of Florida.