

Retail Trade Area Analysis: Concepts and New Approaches

By

Donald B. Segal
Spatial Insights, Inc.
4938 Hampden Lane, PMB 338
Bethesda, MD 20814

Abstract:

The process of estimating or measuring store trade areas provides a fundamental basis for understanding the geographic extent and characteristics of store patronage, target marketing, cannibalization studies and identifying market opportunities in support of site selection.

Since its inception, Geographic Information System (GIS) technology has been used to approximate or model retail trade areas. Traditionally, radial ring-based studies, drive time analyses or gravity models are used to summarize and characterize store patronage areas and demographics.

The recent availability in-house customer level point-of sale data has created a new way for retail organizations to explore and evaluate the spatial characteristics of their customer base and the marketplace. These data are now being used operationally to map store trade areas, determine geographic buying profiles, aid in the evaluation of spatial factors which may influence demand, and derive predictive indices for future market growth.

This paper provides a review of traditional GIS based trade area analysis techniques, and introduces a revolutionary new approach that is based on the use of customer level point-of-sale data.

Introduction:

Trade area analysis is a methodology, process or technique that provides a basis for understanding, (visualizing) and quantifying the extent and characteristics of known or approximated trade areas.

Trade area analysis provides the foundation for:

- Understanding the geographic extent and characteristics of store patronage,
- Assessing performance spatially,
- Performing competitive analysis ,
- Evaluating market penetration and market gap analysis,
- Target marketing,
- Merchandising,
- Identifying/quantifying effects of cannibalization,

- Developing and exploiting demographic profiles, and
- Site suitability and site selection studies.

Traditionally, trade area analysis is performed using theoretical techniques that are used to approximate the potential patronage area. Theoretical approaches are used in those cases where actual customer level data is not available. Three types of theoretical approaches are commonly employed, including:

- ◆ Radial (ring) studies
- ◆ Drive time analyses
- ◆ Gravity models

Radial Studies:

Radial or ring based analyses are performed by selecting and evaluating demographics that fall within a pre-defined radial distance from the store location. This analysis assumes that the trade area is circular, and is centered on the store location. The technique does not account for logistical barriers that may cross through the circular area, serving to restrict access. Radial studies are a simplistic approach, which may result in the incorrect delineation of the trade area, and can cause errors of omission or commission.

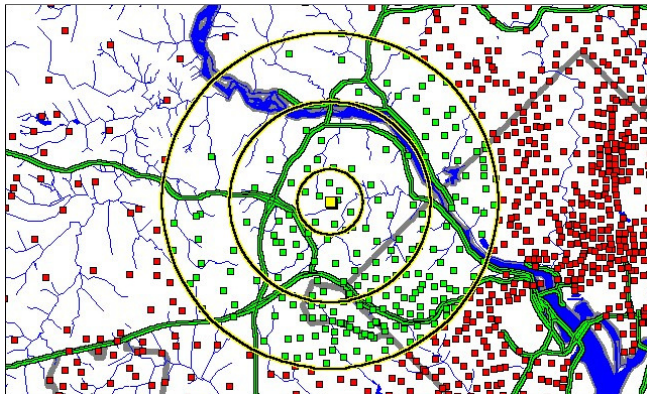


Figure 1. Location of store, showing 1, 3, and 5 mile radii. The dots indicate the locations of demographic samples. Green colored dots fall within the 5-mile radius. Note that samples located across the river would be included in the 5-mile demographic summaries for this site.

Gravity Models:

Gravity, or spatial interaction models provide an approximation of store trade area by looking spatially at the distribution of all locations (including competitors), and evaluating each locations relative attractivity. Typically, a distance decay curve is applied in order to model the spatial interaction of the individual locations. Thus, gravity models approximate the trade area based on its attractivity relative to other locations. Often size of the store, or store sales if available, is used to drive the attractivity parameter. Although more sophisticated than simple radial approximations, most gravity models do not account for logistical barriers, and are limited by the availability

and accuracy of competitor data. They are also sophisticated algorithms, and may not be appropriate for non-technical analysts.

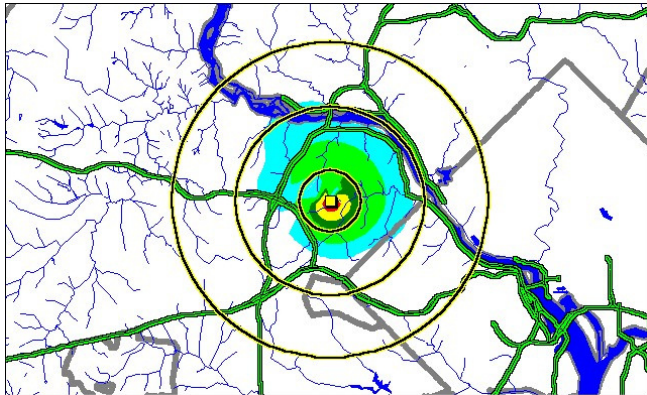


Figure 2a. Gravity based patronage probability model showing the theoretical store trade area. The blue – green – yellow – red progression represents zones of increasing patronage probability.

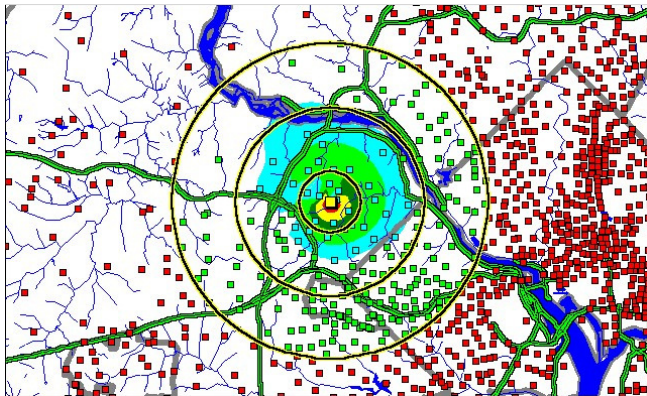


Figure 2b. Gravity based patronage probability model showing the locations of demographic sample sites. Blue colored dots fall within the patronage probability zones. Green colored dots indicate the locations of sample sites that fall within the 5-mile radius but are not within the patronage probability zones.

Drive Time Analysis:

Recently, GIS based tools for modeling the drive time or drive distance from a location have become available. These tools utilize digitized roadway systems that have been attributed to indicate the type of road. Speed limits are assigned based on the type of road, the mode of transportation (car, truck, motorcycle, etc.), congestion parameters, and time of day. These parameters are used to dictate the impedance or ease of travelling along the road segments. Through this process, a polygon is generated which represents the extent to which a vehicle can travel outward from the site in all directions along the existing roadway system. Unlike the radial distance or gravity model based trade area approximations, GIS based drive time analyses do account for logistical barriers.

Drive time analyses are generally considered to be valid for “convenience” scenarios, where patrons are expected to go to the closest or most logistically convenient location. Since the analysis is governed by the presence of properly located and attributed roadway systems, the accuracy of the drive time analysis can be limited by the availability of accurate and up-to-date digitized road networks.

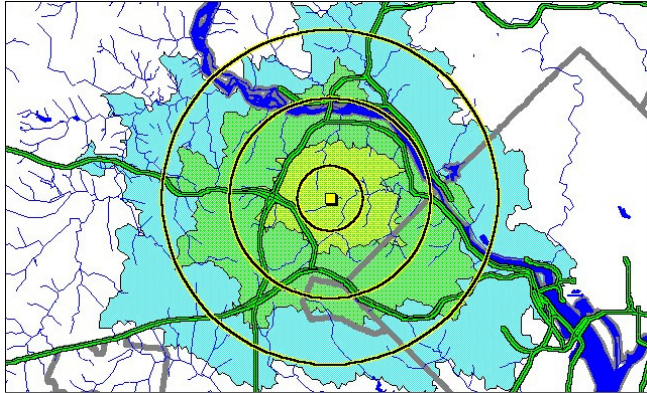


Figure 3a. Drive time analysis showing areas that can be reached within 5, 10 and 15-minute drive times.

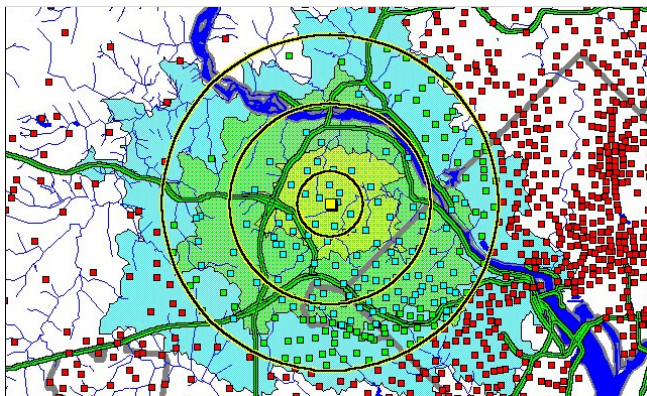


Figure 3b. Drive time analysis showing the location of demographic samples. The blue colored dots represent the demographic sample sites that fall within a 10-minute drive time. Green colored dots represent demographic sample sites that fall within the 5-mile radius, but fall outside of the 10-minute drive time polygon. Conversely, red colored dots that fall within the 15-minute drive time polygon represent demographics that would not be included using a traditional 5-mile radius approach.

TrendMap Analysis:

The use of customer level data has revolutionized the way retail organizations can visualize and characterize store trade areas. Commonly, customer point-of-sale (POS) data is collected via in store surveys, “courtesy card” programs, license plate surveys, credit card transactions or through raffles or business card collections. Typical POS data would contain a record of what was purchased, when it was purchased, where it was purchased and the name and address of the purchaser. This address-based data can be geocoded to provide a geographically referenced position for each customer.

Historically, analysts would be forced to take the address level data and aggregate it into existing postal or census boundaries in order to summarize and map customer counts or revenue. We have found that in many cases, this level of aggregation tends to smooth out and homogenize important subtle variations in the geographic distribution and characteristic of the trade area. This is particularly troublesome in those cases where the trade area is small and clustered around an area near the store, as is the case in most convenience store scenarios.

In order to alleviate this limitation, Spatial Insights, Inc. has developed a radial filter based trend surface modeling application, known as TrendMap, which models trade areas directly from customer level POS data. The TrendMap analysis provides a very accurate and precise measure of the spatial distribution and characteristics of store trade areas. Because customer level POS data is used, the effects of logistical barriers are automatically accounted for.

TrendMap uses a unique radial filter based algorithm that evaluates either the density of points, the sum, or average attribute value calculated from all points that fall within the specified radius.

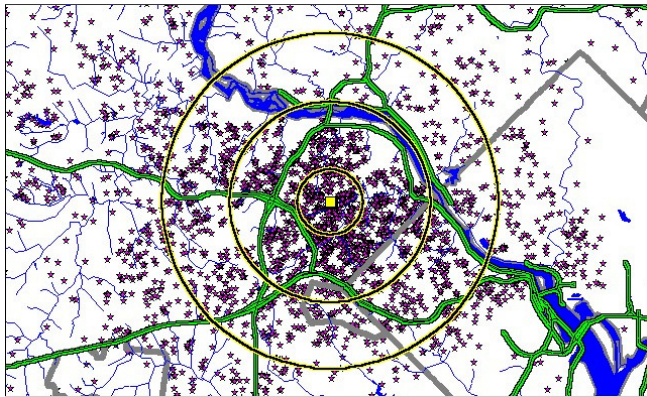


Figure 4. Map showing the location of customers.

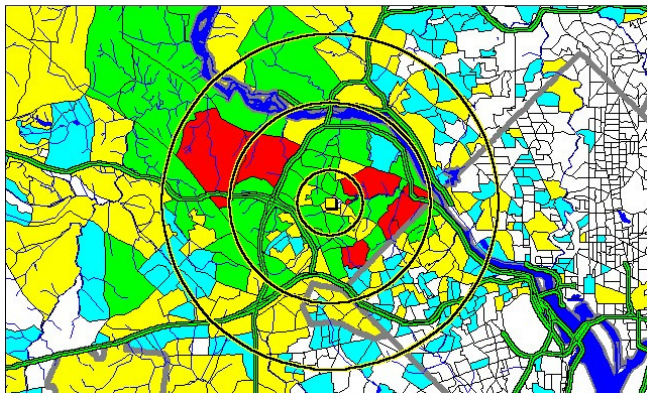


Figure 5. Color thematic trade area map showing concentration of revenue. This map was produced by summarizing the customer revenue data according to the block groups within which the customer locations fall. Colors ranging from blue – green – yellow – red represent the progression from low to high revenue.

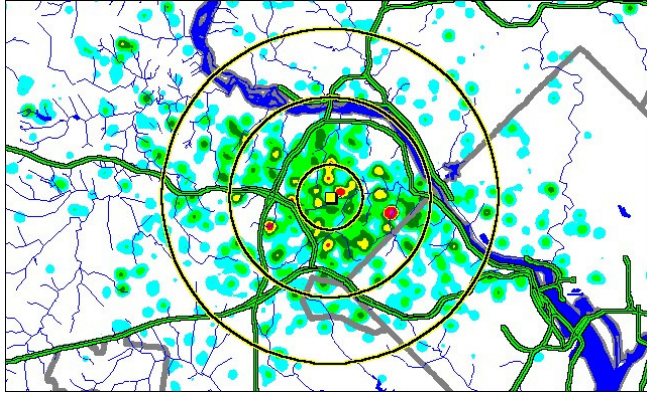


Figure 6a. Revenue based trade area map produced using TrendMap. Colors ranging from blue – green – yellow – red represent the progression from low to high revenue. The TrendMap analysis clearly shows discrete pockets of customer/revenue strength. Note how the “hotspots” identified using the TrendMap analysis are small and discrete, and are not constrained by pre-existing census geographic boundaries.

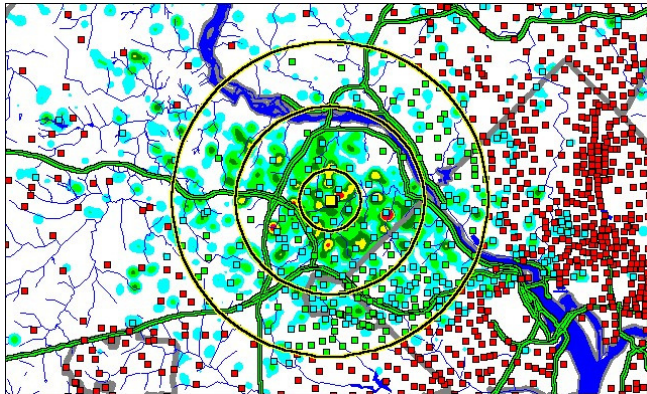


Figure 6b. TrendMap trade area map showing the location of demographic sample sites. Note that blue colored dots represent demographic sample sites that fall within the actual store trade area. Green colored dots represent those demographic samples that fall within a 5-mile radius, but do not fall within the stores' trade area.

	Population	White	Black	Asian	AmerInd	Other	Hispanic	Median Income
1 Mile								
Total	9,217	7,798	191	1,156	10	62	562	\$98,909
Percent	100.0	84.6	2.1	12.5	0.1	0.7	6.1	
3 Miles								
Total	73,098	62,616	2,033	7,276	133	1,040	5,548	\$102,970
Percent	100.0	85.7	2.8	10.0	0.2	1.4	7.6	
5 Miles								
Total	235,832	192,884	12,877	23,994	458	5,619	22,232	\$93,448
Percent	100.0	81.8	5.5	10.2	0.2	2.4	9.4	
5 Min Drive Time								
Total	27,359	23,280	671	3,180	30	198	1,743	\$105,625
Percent	100.0	85.1	2.5	11.6	0.1	0.7	6.4	
10 Min Drive Time								
Total	127,220	107,174	5,450	12,225	243	2,128	9,929	\$94,993
Percent	100.0	84.2	4.3	9.6	0.2	1.7	7.8	
15 Min Drive Time								
Total	396,437	311,225	31,587	38,628	845	14,152	47,148	\$85,948
Percent	100.0	78.5	8.0	9.7	0.2	3.6	11.9	
Gravity Model								
Total	36,386	31,045	781	4,124	49	287	2,070	\$114,767
Percent	100.0	85.3	2.1	11.3	0.1	0.8	5.7	
TrendMap								
Total	225,055	177,201	23,151	18,497	512	5,694	20,624	\$88,130
Percent	100.0	78.7	10.3	8.2	0.2	2.5	9.2	

Comparative Demographic Analysis:

The table above shows basic demographic summaries that were obtained using radial distance, drive time, gravity modeling, and TrendMap methods. Note the large differences between both the summary counts and the relative percentages, depending on which method was used. For example, compared with the 3-mile radius, the actual trade area demographics (as measured using TrendMap) indicate that the store is pulling from a much larger area with over three times the total population. Similarly, the median household income measured using the 3 mile radius shows income that is over 15% higher than the trade area based income.

Similar differences are apparent when comparing the relative distribution of population by ethnicity. For example, the radial, drive time and gravity model based percent black population is consistently lower than the 10.3% that comprises the actual trade area demographics. These differences would have obvious implications regarding the development of demographic profiles, merchandising, and site suitability modeling.

Summary and Conclusions:

A number of traditional GIS based trade area analysis techniques have been reviewed. Use of the radial ring method assumes that the store trade area is circular, and this

method does not account for logistical barriers or the effects of competitors. Trade areas based on drive time analysis offer a more realistic view of the trade area, particularly for a convenience store scenario. However, the availability and accuracy of road networks upon which the analysis is based may limit drive time analysis. Drive time analysis is of limited utility when attempting to model trade areas of destination stores that draw from specific demographics. Gravity modeling is a sophisticated technique, which can account for the effects of competitors and is appropriate for convenience scenarios. Small differences in the gravity model parameters can have a large effect on the resulting trade area.

A new approach, which makes extensive use of customer based POS data, was introduced. This method uses a circular filter to produce a trend surface map, which accurately and precisely delineates the trade area extent and characteristics.

A comparative analysis of the summary demographics calculated using each of these methods was presented. The results of the comparative analysis show significant differences between each of the methods. These differences would have obvious implications regarding the development of demographic profiles, merchandising, and site suitability modeling.

Donald B. Segal
Biography

Mr. Segal is the president and founder of Spatial Insights, Inc., a geographic information services company that provides innovative project consulting services, software and data products to commercial organizations. Originally trained as an exploration geologist, he has works extensively with companies to successfully apply his understanding of data integration and spatial analysis to the development of GIS-based mapping solutions for business applications.

Mr. Segal has over fifteen years' experience in the application of GIS technologies to commercial problems. Mr. Segal is a frequent speaker at GIS and marketing conferences throughout the nation. He is recognized for his expertise in trade area analysis, site selection and related marketing applications of GIS technology. He has participated in the publication of over 60 technical papers. In 1997, he served as the President of the GeoBusiness Association, a non-profit organization dedicated to promoting and advancing the understanding and use of GIS technology to businesses. Mr. Segal holds a B.S. degree in Geology from Franklin and Marshall College.