Dear Reader:

Thank you for your interest in our Whitepaper, "Toward a Better Understanding of Reilly's Law and the Trade Area of Convenience Stores". Enclosed is your complimentary copy. We hope you will find it helpful and informative. This paper explores the basis of the Inverse Square Law in Reilly's Law and suggests that retail trade areas are actually geographically larger than what Reilly's Law implies.
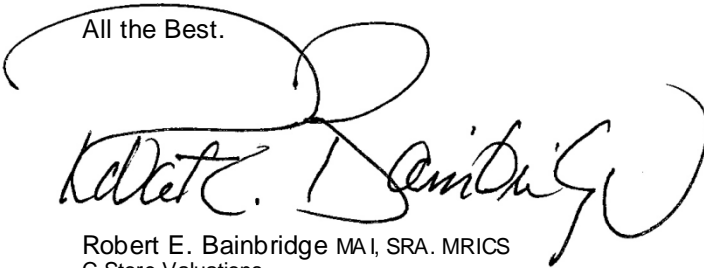
For additional information about current valuation issues in the retail convenience channel, you may wish to visit our website at www.cstorevalue.com. On the "Video Insights" page you will find short, appraisal-related video clips on these important topics:

1. Development Process
2. Supply and Demand
3. Hypermarket Competition
4. What Should be in an Appraisal of a C-Store: A Lender's Perspective
5. A Business Appraiser's Perspective
6. Retail Site Analysis
7. Below-Cost Selling

At our website you will also find useful Whitepapers and current valuation metrics.

If we can be of any assistance to you, it would my pleasure to personally serve you. Please let us know and thank you again.

All the Best.

Robert E. Bainbridge MAI, SRA. MRICS
C-Store Valuations

WHITEPAPER NO. 4

TOWARD A BETTER UNDERSTANDOING OF REILLY'S LAW AND THE TRADE AREA OF CONVENIENCE STORES

By
Robert E. Bainbridge

Summary

Ring and drive-time studies are commonly used in the market analysis of retail trade areas. With the recent proliferation of powerful proprietary software available through the Internet, the analyst may now complete these types of studies quickly and inexpensively from desktop applications. The analyst often has the choice of selecting either a ring study or a drive-time study

The purpose of this paper is to examine whether a difference results when a ring or drive-time study is chosen.

This investigation found that a statistically significant difference exists for population and retail sales estimates for the 1-mile ring and the 1-minute drive time.

Introduction

Many retailers in the U.S. use market studies to evaluate the sales potential of new sites.

[Fanning 114]   Shell, KFC and Burger King are a few examples of retailers that began

using proprietary software in the early part of this decade to assist in market analysis for

new store locations. One of the first widely available proprietary programs that was used

by these retailers was MS Connect AnySite®. The program was delivered to the user via

the Internet. By selecting any street in the U.S., the user had the choice of using either a

ring study or a drive-time study and could then input three choices of geographic

boundaries to examine the market based on the delineation selection.   For a ring study,

the analyst could input three choices of radii as specified in miles. The choices might, for

example, be the one, three and five-mile rings for the particular address. The program

would instantly produce a map showing these three rings with the subject at the center.

An exhaustive amount of demographic information was then instantly available. The

demographic information was separated into individual printable reports for each of the

rings. This demographic information included such socio-economic metrics as

population, number of households, age, race, ethnicity, income levels, etc. In a drive-

time study, the concepts are similar except instead of concentric rings, the trade area

boundaries are drawn based on the time it takes to drive to the subject from the any point

around the periphery. Common drive-times for convenience concepts might be a one,

two and three-minute drive-time.   An output example is included in the addenda. This

example was produced from Site To Do Business®, which now incorporates the ESRI

platform.

Programs that delivered this market analysis information over the Internet were superior to packaged software because the data were always current. No need existed to update the street addressing capabilities or demographic data with supplemental disks or downloads. Each year more and more specialized applications of this type of software are being developed. Today, MS Connect AnySite® is no longer available, having been replaced by superior products. Currently, ESRI is dominating the market for this type of product. As of the Fall of 2006, Site To Do Business®, the market analysis product developed and used by the CCIMs, has shelved their previous in-house platform and adopted ESRI into their offering at the Site To Do Business website. By the end of 2006, their transition to ESRI is expected to be complete.

Nearly all of the proprietary market analysis programs, including ESRI, offer the analyst the choice of using either a ring study or a drive-time study, but not both at the same time. In other words, it's either one or the other.

The Problem

In executing these market analysis programs, the analyst never knows whether or not different results would be obtained by using one method (ring) or the other (drive-time). In the business world today, time and cost efficiency often preclude completing both methods for the same property. The analyst is simply left with making the choice of using either a ring or a drive-time study without knowing if different results would have been obtained from the method not chosen. For a demographic characteristic, such as population count or median household income, significant differences in these types of

demographic metrics could alter the retailer's decision as to whether a new store should be constructed at a particular location. [Fenker 32]   For example, the population count with a specified ring or drive-time could be used in a location quotient calculation. [Bendavid 62]   Variation in the population count would produce different location quotients. If the variation were large, the resulting location quotient may indicate an over-supply (less than "1") or under-supply (greater than "1"), when the alternative method indicated an opposite result.

For convenience concepts such as fast food restaurants and gas stations, a mile ring and two-minute drive time are considered the boundaries of the primary market [Schmitz 144].

This paper asks the question: Do ring studies produce significantly different results from drive-time studies in quantifying the demographic characteristics of retail trade areas?

Methodology

Analysis of the variance (ANOVA) test will be used to test for differences between the demographic output results from ring and drive-time market studies on three critically important retail demographic variables: population, median household income and retail sales potential. [Utts 374]   Twenty three locations of the Walker Oil Company retail convenience stores will be used as the test case. These stores are actual properties analyzed in a recent appraisal assignment.

The ANOVA analysis will be performed on all 23 locations with the 1-mile ring compared to:

     a. 1-Minute Drive-Time

     b. 2-Minute Drive-Time

     c. 3-Minute Drive-Time

for the three demographic metrics: population, median household income, and retail sales potential for gasoline.

The null hypothesis assumes the means of all groups are equal

$$\text{The null hypothesis:} \quad (H_o): \mu_A = \mu_B \ldots$$

$$\text{The alternate hypothesis:} \quad (H_1): \text{These means are not all equal.}$$

We will use a level of significance ($\acute{\alpha}$) of 0.05.

MiniTab©, a statistical analysis program taught by the University of St. Thomas in the Master of Science in Real Estate Appraisal Program, will be used to perform the ANOVA analysis.

The Results

The results of the ANOVA analysis are summarized in the table below and the output summary of each of the nine comparisons is contained in the addenda.

ANOVA SUMMARY

	P-VALUES	CONCLUSION
POPULATION		
1-Mile Ring and 1-Minute Drive-Time	0.0000	Reject the Null Hypothesis
1-Mile Ring and 2-Minute Drive-Time	0.0680	
1-Mile Ring and 3-Minute Drive-Time	0.3350	
MEDIAN HOUSEHOLD INCOME		
1-Mile Ring and 1-Minute Drive-Time	0.2670	
1-Mile Ring and 2-Minute Drive-Time	0.8690	
1-Mile Ring and 3-Minute Drive-Time	0.9780	
RETAIL SALES POTENTIAL		
1-Mile Ring and 1-Minute Drive-Time	0.0000	Reject the Null Hypothesis
1-Mile Ring and 2-Minute Drive-Time	0.0880	
1-Mile Ring and 3-Minute Drive-Time	0.2980	

The selected level of significance is 0.05. For p-values less than 0.05, the null hypothesis

is rejected.

Conclusion

This investigation found that statistically significant differences exist for the mean values

of the 1-mile ring for population and retail sales potential at the 1-minute drive-time. In

other words, the 1-minute drive-time is not a proxy or a good substitute for the 1-mile

ring. This investigation indicates that if the analyst chose a 1-minute drive-time versus a

1-mile ring, different estimates of population and retail sales potential are likely to result.

The 1-mile ring better emulates the 2 and 3-minute drive-times.

These results show that the selection of rings and drive-times are not trivial and the

analyst should use care and thought before making these choices and completing the

market analysis.

Suggested Further Research

1. Data may be grouped into urban and rural locations. Drive-times often encompass a larger geographic area in rural areas. Different results may be obtained for the p-values if this grouping is performed as part of the analysis.

2. Broader geographic areas may be considered. Here, all of the observations were in the State of Utah. Although no reason exists for this data to be skewed simply because of it limited geographic scope, the results of an analysis of a larger geographic area may be compared to these findings to confirm the conclusion found here.

Sources Used in the Paper

Books:

Bendavid, Avrom. *Regional Economic Analysis for Practioners*. New York: Praeger Publishers. 1974

Fenker, Richard M.. *The Site Book*. Ft. Worth, Texas: Mesa House Publishing. 1996

Fanning, Stephen F. *Market Analysis for Real Estate*. Chicago: Appraisal Institute. 2005

Schmitz, Adrienne and Brett, Deborah L. Real *Estate Market Analysis*. Washington, D.C.: Urban Land Institute. 2005

Utts, Jessica. *Seeing Through Statistics*. Pacific Grove, California: Brooks/Cole Publishing Company 1999.

Websites:

ESRI   www.esri.com

Site To Do Business www.stdbonline.com

Addenda

ANOVA ANALYSIS

Population: 1-Mile Ring and 1-Minute Drive-Time
```
Analysis of Variance
Source      DF         SS         MS        F        P
Factor       1  428720579  428720579    20.02    0.000
Error       44  942358709   21417243
Total       45  1.371E+09
                                    Individual 95% CIs For Mean
                                    Based on Pooled StDev
Level       N       Mean      StDev  ----+---------+---------+---------+-
-
POPULATI   23       7018       6477                      (-----*------)
1-MIN PO   23        913        941  (-----*------)
                                    ----+---------+---------+---------+-
-
Pooled StDev =     4628                 0      3000      6000      9000
```

Population: 1-Mile Ring and 2-Minute Drive-Time
```
Analysis of Variance
Source      DF         SS         MS        F        P
Factor       1   97208628   97208628     3.51    0.068
Error       44  1.219E+09   27701908
Total       45  1.316E+09
                                    Individual 95% CIs For Mean
                                    Based on Pooled StDev
Level       N       Mean      StDev  -+---------+---------+---------+----
-
POPULATI   23       7018       6477                 (----------*---------
-)
2-MIN PO   23       4111       3668  (-----------*----------)
                                    -+---------+---------+---------+----
-
Pooled StDev =     5263              2000      4000      6000      8000
```

Population: 1-Mile Ring and 3-Minute Drive-Time
```
Analysis of Variance
Source      DF         SS         MS        F        P
Factor       1   52871040   52871040     0.95    0.335
Error       44  2.448E+09   55646350
Total       45  2.501E+09
                                    Individual 95% CIs For Mean
                                    Based on Pooled StDev
Level       N       Mean      StDev  -----+---------+---------+---------
+-
POPULATI   23       7018       6477  (-----------*------------)
3-MIN PO   23       9163       8327        (------------*-----------)
                                    -----+---------+---------+---------
+-
Pooled StDev =     7460              5000      7500     10000     12500
```

Median Household Income 1-Mile Ring and 1-Minute Drive-Time

```
Analysis of Variance
Source      DF         SS          MS         F        P
Factor       1  247957096   247957096      1.27    0.267
Error       44  8.613E+09   195760217
Total       45  8.861E+09
                                       Individual 95% CIs For Mean
                                       Based on Pooled StDev
Level        N       Mean       StDev  ----+---------+---------+---------+-
-
MEDIAN H    23      48642        9104            (----------*-----------)
1-MIN ME    23      43998       17568  (-----------*-----------)
                                       ----+---------+---------+---------+-
-
Pooled StDev =    13991         40000       45000     50000     55000
```

Median Household Income 1-Mile Ring and 2-Minute Drive-Time

```
Analysis of Variance
Source      DF         SS          MS         F        P
Factor       1    2147472     2147472      0.03    0.869
Error       44  3.427E+09    77892377
Total       45  3.429E+09
                                       Individual 95% CIs For Mean
                                       Based on Pooled StDev
Level        N       Mean       StDev  --+---------+---------+---------+---
-
MEDIAN H    23      48642        9104    (--------------*-------------)
2-MIN ME    23      48209        8538  (--------------*--------------)
                                       --+---------+---------+---------+---
-
Pooled StDev =     8826          45000       47500     50000     52500
```

Median Household Income 1-Mile Ring and 3-Minute Drive-Time

```
Analysis of Variance
Source      DF         SS          MS         F        P
Factor       1      61211       61211      0.00    0.978
Error       44  3.502E+09    79591266
Total       45  3.502E+09
                                       Individual 95% CIs For Mean
                                       Based on Pooled StDev
Level        N       Mean       StDev  -+---------+---------+---------+----
-
MEDIAN H    23      48642        9104   (--------------*-------------)
3-MIN ME    23      48569        8735  (--------------*--------------)
                                       -+---------+---------+---------+----
-
Pooled StDev =     8921          45000       47500     50000     52500
```

Retail Sales Potential: 1 Mile Ring and 1-Minute Drive-Time

```
Analysis of Variance
Source     DF        SS         MS        F       P
Factor      1 1.014E+14 1.014E+14    18.57   0.000
Error      44 2.403E+14 5.461E+12
Total      45 3.417E+14
                                 Individual 95% CIs For Mean
                                 Based on Pooled StDev
Level       N      Mean      StDev  ----+---------+---------+---------+-
-
SALES PO   23   3425020    3272557                       (------*-----)
1-MIN SA   23    455201     461776  (------*------)
                                    ----+---------+---------+---------+-
-
Pooled StDev =  2336971              0   1500000   3000000   4499999
```

Retail Sales Potential: 1 Mile Ring and 2-Minute Drive-Time

```
Analysis of Variance
Source     DF        SS         MS        F       P
Factor      1 2.115E+13 2.115E+13     3.03   0.088
Error      44 3.066E+14 6.968E+12
Total      45 3.277E+14
                                 Individual 95% CIs For Mean
                                 Based on Pooled StDev
Level       N      Mean      StDev  -+---------+---------+---------+----
-
SALES PO   23   3425020    3272557              (----------*----------
)
2- MIN S   23   2069002    1795963  (----------*----------)
                                    -+---------+---------+---------+----
-
Pooled StDev =  2639613        1000000   2000000   3000000   4000000
```

Retail Sales Potential: 1 Mile Ring and 3-Minute Drive-Time

```
Analysis of Variance
Source     DF        SS         MS        F       P
Factor      1 1.571E+13 1.571E+13     1.11   0.298
Error      43 6.079E+14 1.414E+13
Total      44 6.236E+14
                                 Individual 95% CIs For Mean
                                 Based on Pooled StDev
Level       N      Mean      StDev  -----+---------+---------+---------
+-
SALES PO   23   3425020    3272557  (-------------*------------)
3-MIN SA   22   4607089    4210212             (------------*------------
-)
                                    -----+---------+---------+---------
+-
Pooled StDev =  3759810        2400000   3600000   4799999   5999999
```

Example

This is a sample of the demographic output from Site To Do Business and their current ESRI platform.

This output required about 10 seconds to input the street address and select the drive times. The results were available in a PDF file in less than three minutes.