Empirical Analysis of Rural Development along Interstate Highways

By Andrew Kindman*

Abstract:

The theories of Mini-Hub and monocentric growth models are predicated on the understanding that urban centers will expand supporting industry into surrounding rural areas, and an expressed goal of the Interstate Highway system is the facilitation of this process. By performing quadratic regressions of business density at the zip-code level along 18 different stretches of Interstate Highway, this paper provides an empirical analysis of the extent to which spatial growth patterns around urban centers are observed and predictable. Regression reveals that development between urban centers, excluding explicable outliers, adheres strongly to a quadratic model. New GIS technologies also allow for novel visual presentations of the data in Google Earth.

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Contents

Introduction:

Since the inception of the rural economic development movement in the United States, it has been understood that transportation would play a critical role in the revitalization efforts. During the Great Depression the Emergency Relief and Construction Act of 1932 understood roads as make-work schemes for armies of the unemployed. By the 1950s the federal government began to understand the value of the roads themselves. Beginning with the Interstate Highway Act of 1956, a major focus of regional development fell on the highway as a mechanism for stimulating growth (Rephann, 1993: 438). In 1964, Lyndon Johnson's Appalachian Regional Committee determined that poor transportation infrastructure was the underlying cause of economic hardship in the nation's most consistently depressed area (Rephann, 1994: 724). From this basic understanding, many specific theories have sprung forth. One of the most contemporary of these theories is that of Mini-Hub Development. The principle behind the Mini-Hub is described as being akin to the principle of a growth pole in a garden. A rural area connected by major road to an urban area will develop industries that support the urban industries, and can operate with lower rent costs. These rural industries will then perpetuate growth in their own vicinities as employees demand housing, food, education and social services, which may perhaps demand their own supporting industries, ergo the birth of a Mini-Hub (Luger, 2003: 17). This paper examines the extent to which natural patterns of Mini-hub development can be observed.

Based on the concept of the Mini-Hub, the economic footprint of the region between two major cities connected by an interstate ought to adhere to reasonably predictable trends. In the absence of other major highways in the vicinity, in other words a clean connection from one urban area to the next, one would expect to see a positive parabolic relationship between the distance from either urban center along the Interstate and economic activity in proximity to the freeway.

It is important to note that an extremely wide berth of research has used an immense diversity of techniques to determine whether Federal Interstate projects are actually effective tools for rural development. Although the enduring popularity among regional economic development offices of new interstate projects would lead one to believe that the benefits of Interstates are unambiguous (Rephann and Isserman, 1994), the academic community is still divided on the subject. For example, although Chandra and Thompson agree that the introduction of new highways can and should be studied in the context of "exogenous public infrastructure shocks," they also find that the costs associated with new highway construction makes the net regional development gains zero (2000). Rephann and Isserman find, however, that while highways do offer a net benefit to rural areas, it is primarily concentrated in those towns which are in immediate proximity to urban centers (1994). Since the data presented here is not time-series, it therefore cannot make any comment regarding growth. This paper is a purely observational analysis of the extent to which highways allow the spillover of urban economic vigor, a possible indicator of growth and vitality.

Variables and Methods:

With this hypothesis in mind, three major hub cities were selected. Each city had six Interstates protruding from the downtown area and pointing in different directions. Aside from being a major transportation hub, the primary consideration in selecting the major hub cities was their isolation from other major highways. In order to expose clean regressions, it was imperative that the interstates along which the analyses were conducted were not in the vicinity of other major roadways that would bring traffic across the data collection area from uncontrolled points of origin. There are three cities east of the Mississippi River that fulfill these requirements: Nashville, TN, Atlanta, GA, and Indianapolis, IN (see Appendix A item 1). Data collection began at the origin of each Interstate within the hub cities and continued along all six highways until the highway met a defined municipality with a population exceeding 50,000. For example, one set of data regresses information along I65 North from Nashville, TN to Louisville, KY, while another set in the Nashville hub regresses information along I24 West from Nashville, TN to Clarksville, TN.

The specific data is a measurement of business density at a zip code level. A US Census Bureau map of zip codes made it possible to record, in geographic order, every zip code that is crossed or significantly bordered by each Interstate[†]. A dummy variable was then assigned to each zip code representing its order along the Interstate (for example, the origin zip code was assigned a "1," the next zip code along the road was assigned a "2," and so on). This variable became the independent variable. This data was then matched in Excel with the 2005 Census Bureau database (the most recent available) and each zip code was paired with the number of total business establishments within the zip code and the total land area covered by the zip code, represented in square miles. The number of business establishments was then divided by the square mileage of the zip code to produce the dependent variable, businesses/sq. mile within zip code.

[†] If an Interstate was touched only by an insignificant corner of a zip code (a single point of contact as opposed to a border), it was disregarded.

Businesses/sq. mile within zip code is a good measure of the economic footprint for several reasons. First of all, the zip code is the most intricate partition of the United States for which data are available, allowing the maximum number of data points possible. Additionally, zip codes are defined at the logistical convenience of the U.S. Postal Service and therefore have no economic or political bias. Moreover, although both total number of business establishments and total employment by business establishments were considered as measurement of economic activity (and perhaps future scholarship will consider a multivariate analysis), it was ultimately decided that total number of establishments would be preferable 1) because it would imply the business diversity expected in a Mini-hub and be reflective of true *development*, and 2) because experience with employment data has shown that they are very often distorted by inaccurate reporting. Finally, it was important that the data somehow be normalized to account for varying sizes of zip codes, which range from just over one square mile to nearly 50. Ultimately it was decided to normalize by size instead of population because size is readily quantifiable and remains constant while population is measured by survey only once every ten years. Additionally, one would expect endogeneity to become problematic with population given a presumed positive correlation between population and number of businesses.

Once the dependent variable was defined and calculated, Excel was used to calculate and plot a second order polynomial regression (quadratic regression) against the geographic order of the zip codes. The hypothesis was that one would likely observe high businesses/sq. mile at each endpoint, tapering to low businesses/sq. mile in the middle, yielding a sort of parabolic curve. To this end the quadratic regression made sense.

However, many of the Interstate portions turned out to have long stretches of largely undeveloped land towards their centers, thus yielding rather flat mid-sections. Future scholarship may therefore yield tighter models by using higher ordered polynomial regression.

Although the regression is the primary motivation for the analysis, this paper also presents a perfect opportunity to demonstrate the functionality of new breakthroughs in geospatial information systems (GIS) technology. Google Earth is a free software available online that allows users to navigate in three dimensions a Keyhole Markup Language (KML) representation of the globe as stitched together by satellite imaging. The software also allows users to integrate external .kml files with the Google Earth data and superimpose images atop the default .kml representation of Earth. Matching each zip code with the global coordinates representing its geographic center and using a freeware program developed by Ricardo Sgrillo of the Cocoa Research Center in Brazil (http://www.sgrillo.net/googleearth/gegraph.htm), it was possible to create a .kml file that, when opened by Google Earth, places a three dimensional tower (with height proportional to business density) on the corresponding zip code in the map. The result is a graph that uses the actual interstate as an x-axis and altitude as the y-axis, navigable in three dimensions. Another perk of the .kml file is that it can be opened on any computer that has the Google Earth software, and it is small enough to be sent quickly over the internet. Thus, while pertinent screenshots are included in appendix A (Items 2-5), the actual .kml files can be shared for interactive navigation of the data. Navigate to http://www.duke.edu/~amk30/kindman.econ145%20term%20paper%20data.kml to download the .kml file representation of this paper's data (270 KB) and open the file in Google Earth.

Results:

The hypothesis called for an analysis of the extent to which business density along Interstates fits a parabolic model when regressed quadraticly against its approximate distance from either end point. Thus, while the regression yielded a model, which will be useful as a predictive indicator of expected natural growth and will have implications for further scholarship, the primary focus of the data is the R^2 value yielded by the regression.

Origin and Termination	Regression Equation	Minimum (dy/dx = 0) /distance from center	R^2 value for regression
Indianapolis to Dayton, OH	$y = .823x^2 - 16.5x + 75.2$	10.02/ 57.6mi	.689
Indianapolis to Cincinnati, OH	$y = 1.18x^2 - 16.1x + 49.4$	6.82/ 59.7mi	.806
Indianapolis to Terre Haute, IN	$y = 1.71x^2 - 20.5x + 58.398$	5.99/ 39.4mi	.951
Indianapolis to Champaign, IL	$y = 1.01x^2 - 18.7 + 72.73$	9.26/ 61.4mi	.543
Indianapolis to Gary, IN	$y = .672x^2 - 15.0x + 77.6$	11.16/ 75.6mi	.792
Indianapolis to Ft. Wayne, IN	$y = 1.03x^2 - 24.2x + 129$	11.74/ 71.7mi	.671
Atlanta to Chattanooga, TN	$y = 1.486x^2 - 29.2x + 143$	9.86/ 56.6mi	.859
Atlanta to Greenville, SC	$y = .824x^2 - 27.7x +230$	16.81/ 95.7mi	.824
Atlanta to Columbia, SC	$y = .134x^2 - 4.26x +36.4$	15.90/ 135mi	.275
Atlanta to Macon, GA	$y = 1.35x^2 - 11.1x + 27.8$	4.11/ 28.0mi	.488
Atlanta to Columbus, GA	$y = .485x^2 - 8.76 + 43.0$	9.03/ 41.1mi	.386
Atlanta to Birmingham, AL	$y = .326x^2 - 7.04x + 38.8$	10.80/ 74.5mi	.682
Nashville to Clarksville, TN	$y = 1.36x^2 - 13.8x + 35.9$	5.07/ 21.3mi	.710
Nashville to Jackson, TN	$y = 0.480x^2 - 7.20x + 25.6$	7.50/ 75.0mi	.831
Nashville to Birmingham, AL	$y = 0.296x^2 - 9.18x + 65.5$	15.51/ 106mi	.583
Nashville to Chattanooga, TN	$y = 0.843x^2 - 19.4x + 103$	11.51/ 70.5mi	.744
Nashville to Knoxville, TN	$y = 0.504x^2 - 13.6x + 80.4$	13.49/ 80.3mi	.693
Nashville to Louisville, KY	$y = 0.267x^2 - 6.77x + 38.3$	12.68/ 86.5mi	.658
		Mean distance of min: 68.66 (σ =26.9)	Mean R^2=.680 , Median R^2=.691

The mean R^2 is .680 and the median is .691, which indicates that on average nearly 70% of the data is encapsulated by a 95% confidence interval about the individual regressions. The data, graphs, and regression analysis for each individual stretch of Interstate are given in appendices A and B. By single-variable calculus, the minimum point along the regression model was also identified at an average of 68.66 miles with a standard deviation of 26.9 miles (as indicated in the above table).

Conclusions and Discussion:

The calculated business density of each zip code adheres to the expected value as predicted by its respective model with a median R^2 value of .691 over all 18 interstate pathways. While .691 is a modest coefficient, it is at least indicative of a consistent correlation. Between urban centers, areas along interstate highways exhibit parabolic decay then growth as opposed to immediate drops and rises. The data suggests that the Mini-Hub theory of rural development does hold naturally – that rural areas connected to urban centers by interstate highways will develop real economic viability based on proximity and accessibility to industrialized areas, and themselves become small industrial hubs requiring supporting industry. While this conclusion can be inferred logically, technological constraints of the past have prevented such stark empirical demonstration of the spatial patterns.

An R^2 value of .691 is even more impressive when factors of experimental design are taken into account. Primarily, for the purposes of the design, it was necessary to establish a clear definition of “urban center,” in this case, a defined municipality with population in excess of 50,000. The lowest R^2 values occurred along Interstate stretches that intersected cities just under the cut-off. For example, the stretch between Atlanta and Columbia, SC adhered to the model at an R^2 of only .275. By inspection, the data appears to be nearly perfectly parabolic, save for the zip codes in the middle representing the city of Augusta, population 40,000. The .386 R^2 between Atlanta and Columbus, GA can be partially explained by the presence of La Grange and Newman, populations 25,000 and 16,000, along I-85 between the two urban centers. On the other hand, I-70 runs directly from Indianapolis to Terre Haute without intersecting so much as a state highway and encountering no pseudo-urban centers, giving a comparatively non-distorted data set and yielding an R^2 of .951. While most of the regressions yielded reasonable R^2 values, the varying strength of the R^2 can be easily understood by inspection of the map. The R^2 between Atlanta and Macon, GA, to offer another example, is only .488. However, by inspection one understands that the problematic outlier is zip code 30253 – not a heavily populated zip code, but one that contains a 7-spoked hub of state highways. On the other end of the spectrum, I-40 between Nashville and Jackson, TN is crossed only very sporadically and contains no clustering larger than a town. Often weak R^2 are indicative of the presence of pseudo-urban centers between urban centers, which very likely predate the Interstate construction.

There are certain less easily isolated explanatory variables to consider as well. Primarily, no city is perfectly monocentric, and empirical research should not expect to yield data that radiates perfectly about a single point. Notably, Atlanta has long been considered anomalous in distribution and growth, and indeed the three regressions with the lowest R^2 values are all found along spokes radiating from Atlanta. Additionally, the economic composition of the city (manufacturing, service, technology, etc.) will undoubtedly affect the extent to which mini-hubs are necessary. One might, for example, expect to see particularly high adherence to the model among urban centers with high prevalence of complex manufacturing – firms likely to outsource parts of their production process. Lower correlations would be expected around centers with a more service-oriented core. However, since none of the selected hub cities are mono-industrial, this is a correlations that must be left up to future research to confirm.

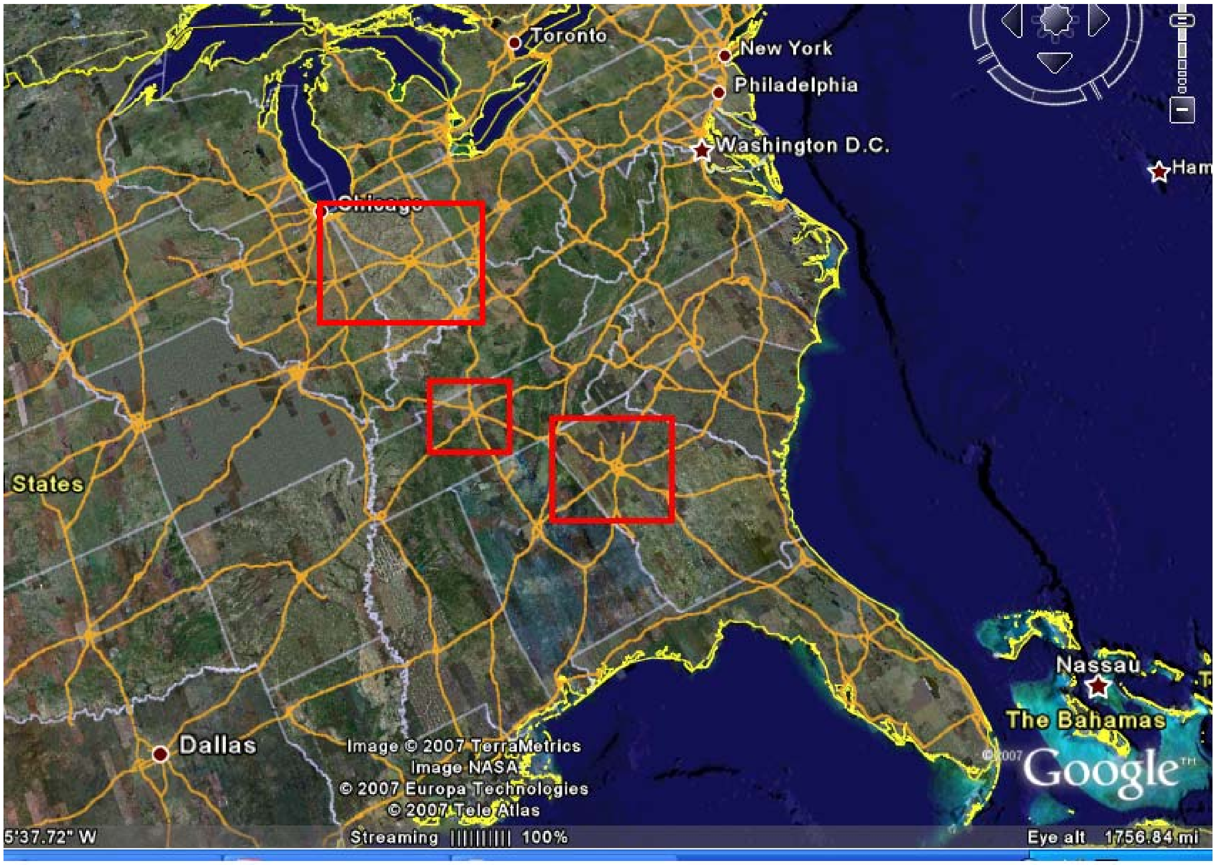
Of these points of critique, some might be corrected by further scholarship while others may remain outside of experimental control. Most obviously, the regression did not use geographic distance as an independent variable, but rather relied upon the geographic order of zip codes to be an acceptable proxy. Given the available technology, it would be possible to regress the data against actual distance in miles, but extremely tedious, as the distances would have to be individually extracted from Google Earth based on individually entered geographic coordinates, and then matched by hand in Excel. This source of error can be corrected in further studies. Second, the placement of interstate highways is extremely political, and as such they tend to run in circuitous patterns to include exits at pseudo-urban centers. This, as well as the interaction of the Interstates with other state highways can cause distortion of the data, but this is unavoidable. Third, there is no way to account for varying tax structures and incentives among counties and states that might promote or discourage business growth regardless of natural market forces.

The topic of this paper is very basic. However, the technique incorporates cutting edge technology which can throw open the doors for further research. Automated Excel spreadsheet matching, spatial graphing, and publicly accessible Census Bureau spreadsheets are tantalizingly auspicious in combination. As further evidence of the Mini-Hub it may be interesting, and certainly would be possible, to repeat the experiment, but use industry specific business establishment numbers as opposed to total business establishments. This potential correlation was mentioned in the initial critique section, and could be topic of stand-alone interest. Using just the first two to four digits of the NAICS (North American Industrial Classification System), code it would be possible to visualize links within industries across spatial planes. This would facilitate a concrete understanding of the kinds of industries which are likely to expand into rural areas, and has particularly strong policy implications for rural economic development offices trying to attract industrial development.

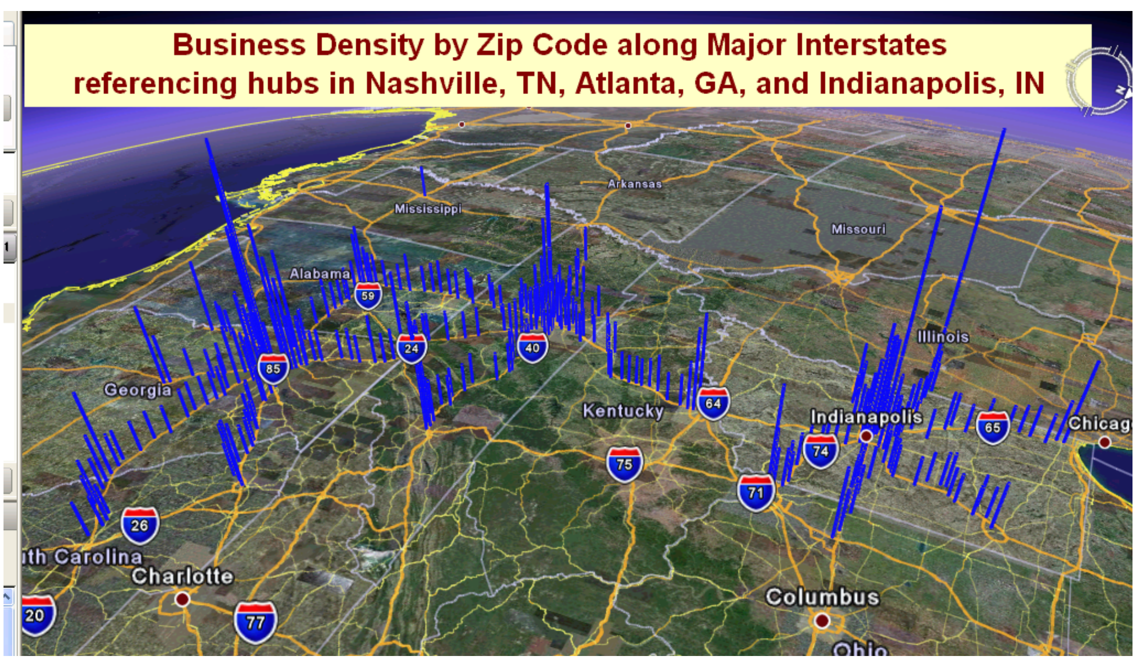
Other potentially useful future scholarship might include examining all of this data in a time series to understand dynamic growth patterns. It would also be fascinating, from a policy perspective, to identify those zip codes that exceed economic expectations and study their competitive strategies. Although, to truly accomplish this one would have to establish a time-series and examine growth, otherwise it does not seem possible to parse out the endogeneity of the fact that more populated areas have more business. The goal of this project, and hopefully of subsequent scholarship, is to understand the full growth potential of rural areas and allow those areas to maximize their growth. This project, is just the first step.

Appendix A

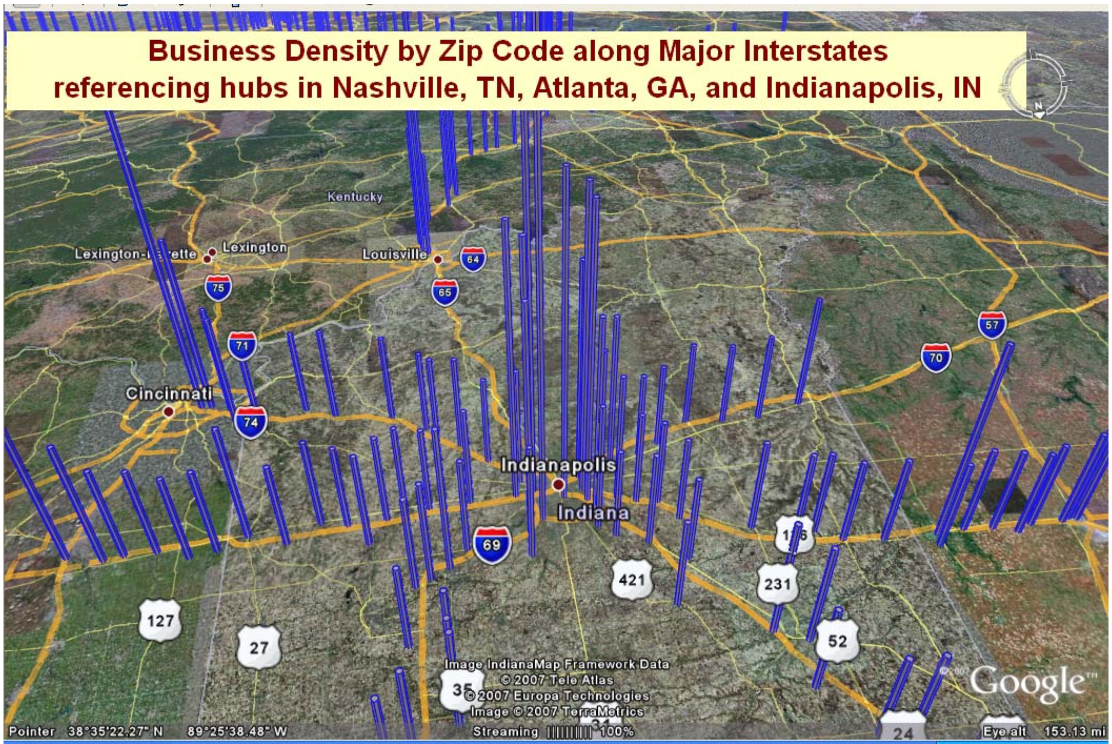
Item 1



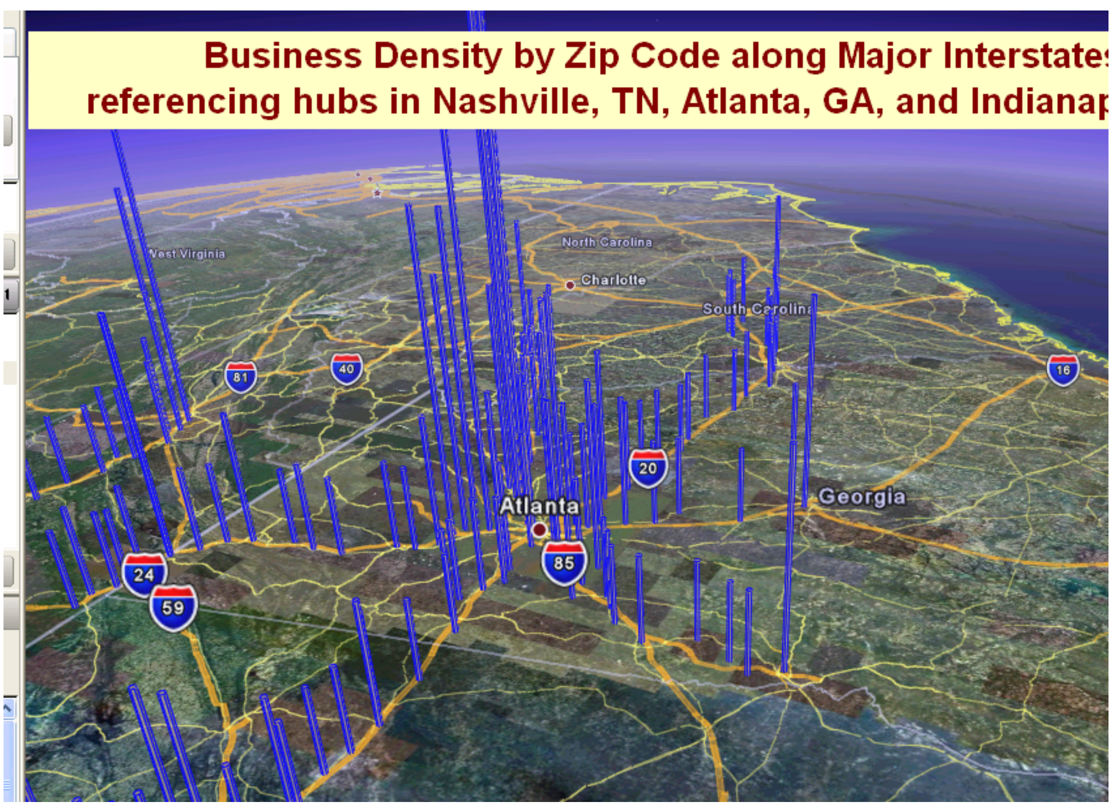
Item 2



Item 3


Business Density by Zip Code along Major Interstates
referencing hubs in Nashville, TN, Atlanta, GA, and Indianapolis, IN
Kentucky
Lexington
Louisville
Cincinnati
Indianapolis
Indiana
Google

Item 4


Business Density by Zip Code along Major Interstate
referencing hubs in Nashville, TN, Atlanta, GA, and Indianap
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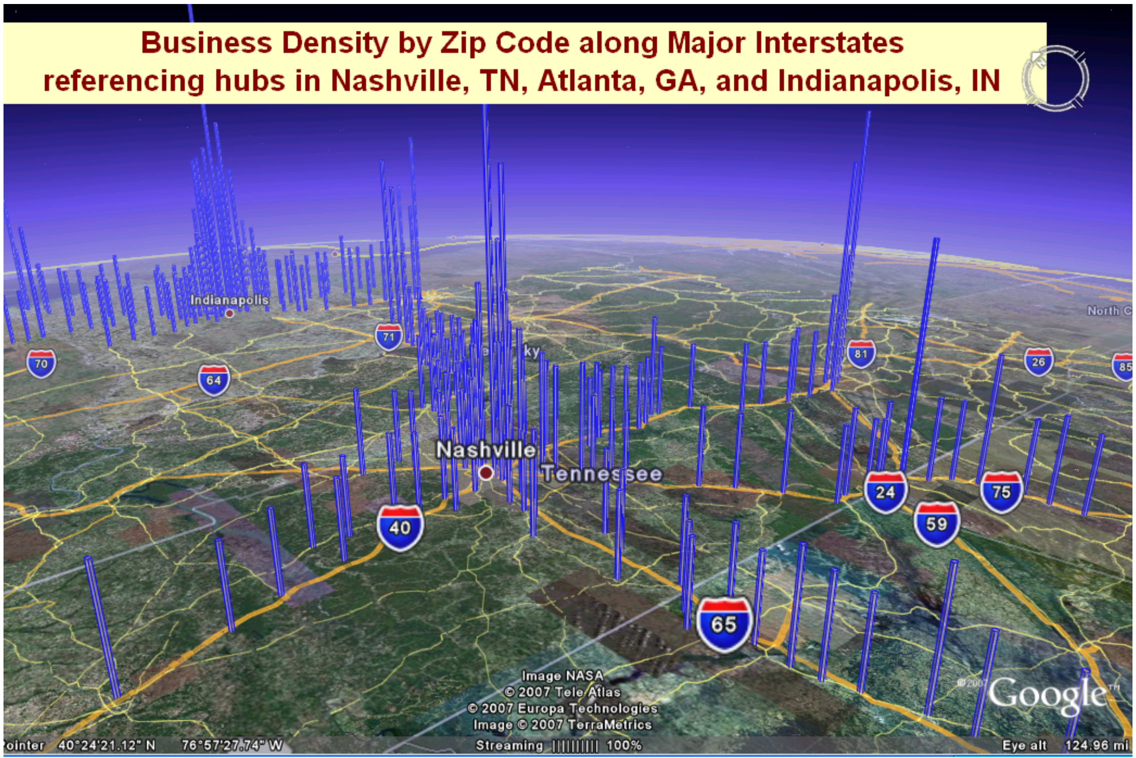
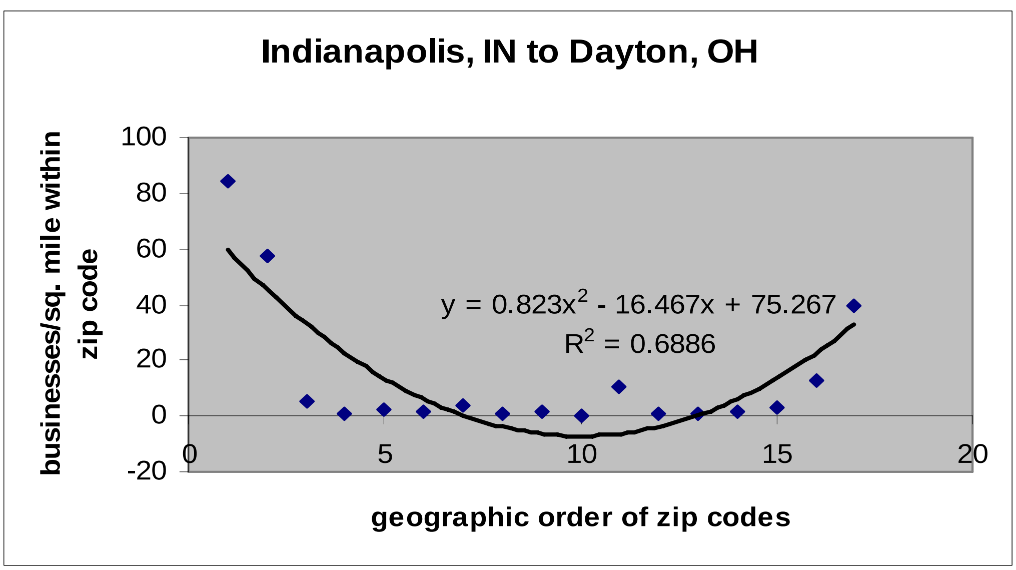
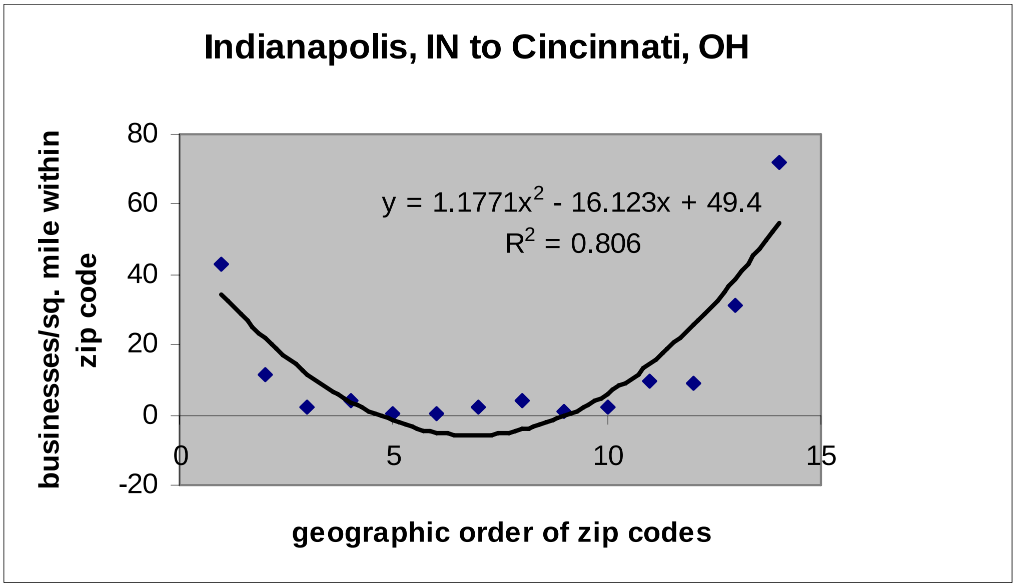
North Carolina
Charlotte
South Carolina
Atlanta
Georgia

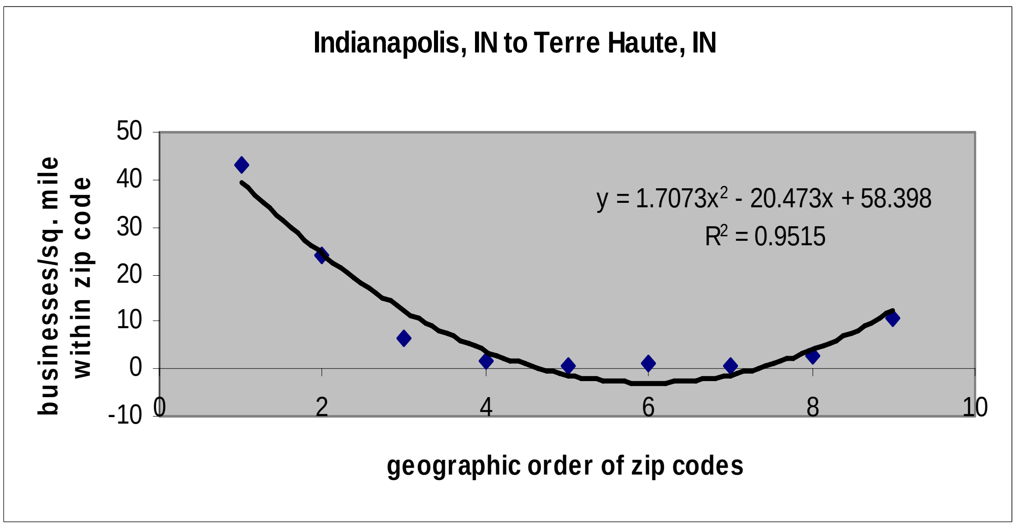
Item 5

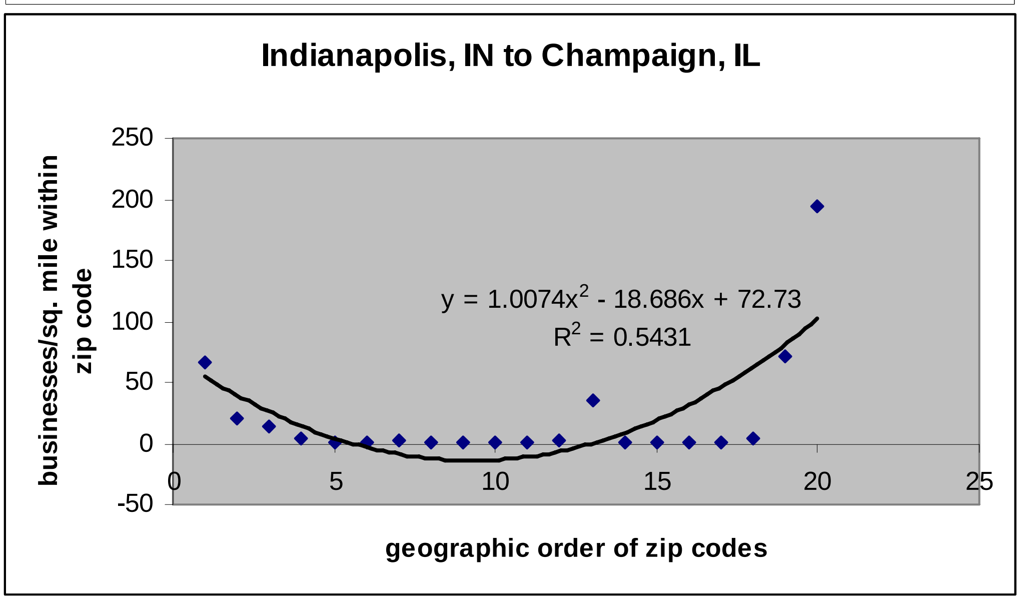


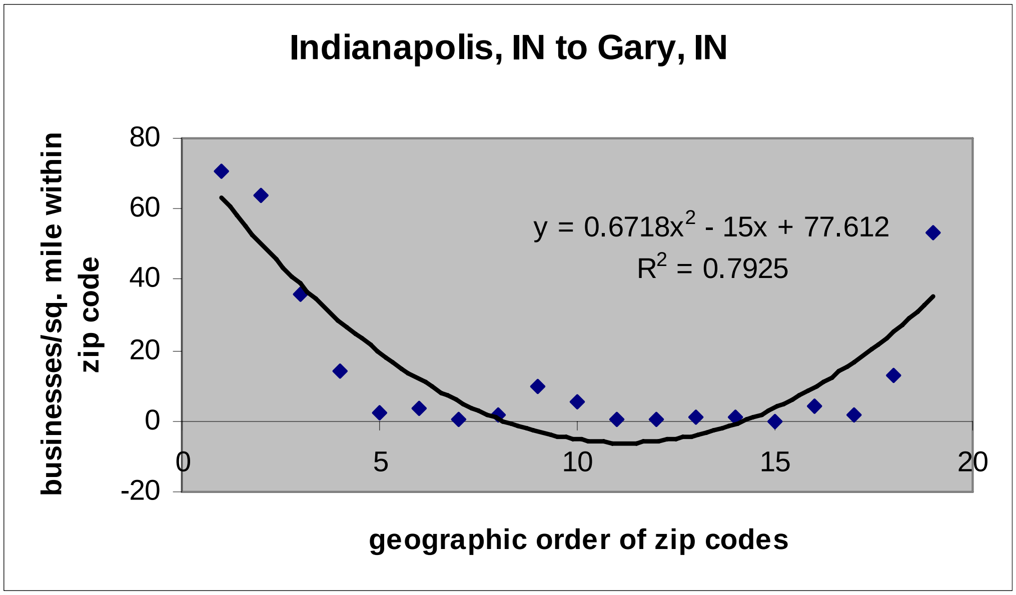
Appendix B




Indianapolis, IN to Cincinnati, OH
businesses/sq. mile within zip code
y = 1.1771x2 - 16.123x + 49.4
R2 = 0.806
80
60
40
20
0
-20
0
5
10
15
geographic order of zip codes


Indianapolis, IN to Terre Haute, IN
businesses/sq. mile within zip code
y = 1.7073x2 - 20.473x + 58.398
R2 = 0.9515
50
40
30
20
10
0
-10
0
2
4
6
8
10
geographic order of zip codes


Indianapolis, IN to Champaign, IL
businesses/sq. mile within zip code
y = 1.0074x2 - 18.686x + 72.73
R2 = 0.5431
250
200
150
100
50
0
-50
0
5
10
15
20
25
geographic order of zip codes


Indianapolis, IN to Gary, IN
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R^2 = 0.7925
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geographic order of zip codes
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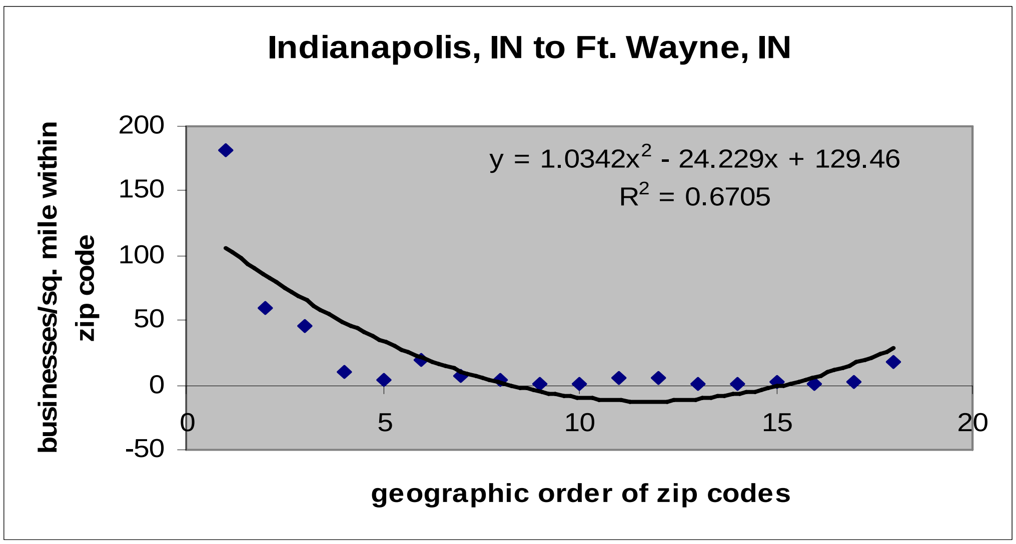
40
20
0
-20
0
5
10
15
20


Indianapolis, IN to Ft. Wayne, IN
y = 1.0342x^2 - 24.229x + 129.46
R^2 = 0.6705
businesses/sq. mile within zip code
geographic order of zip codes
200
150
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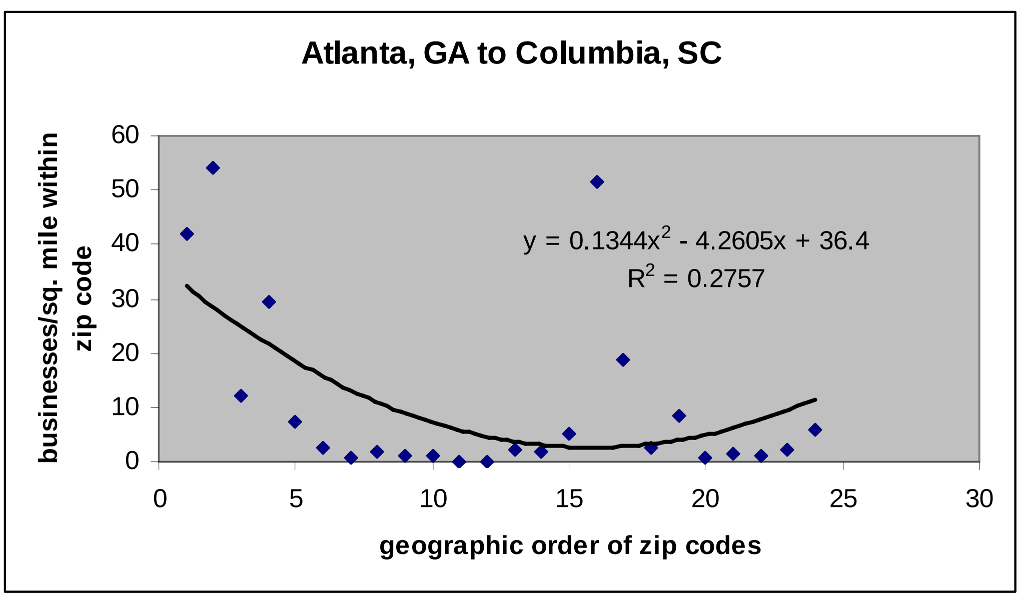
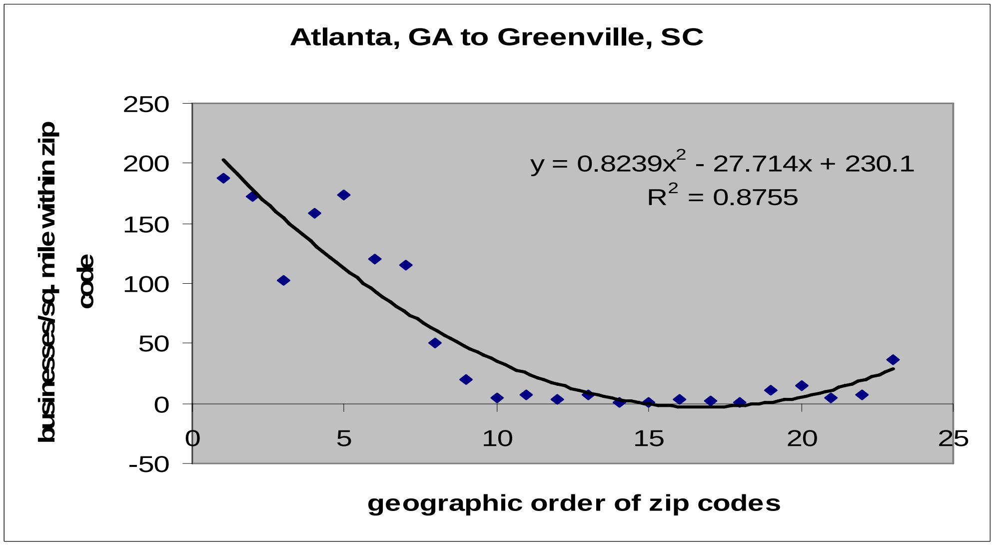
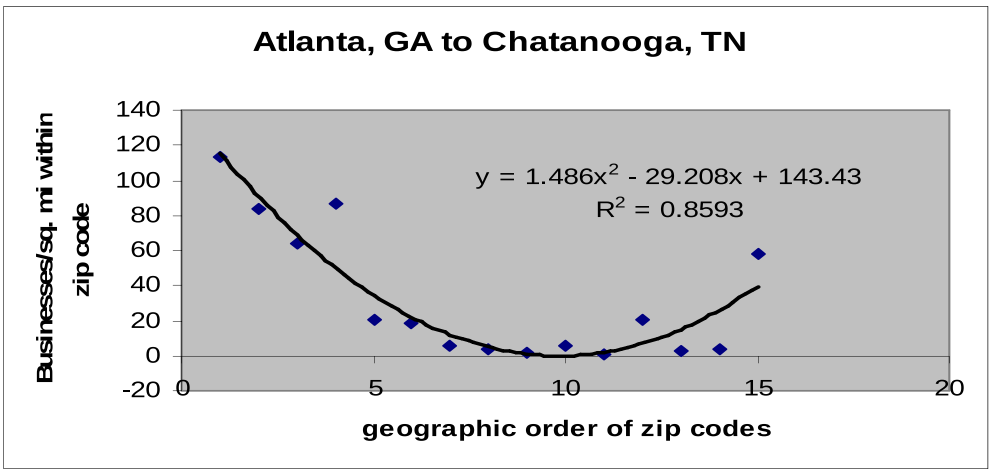
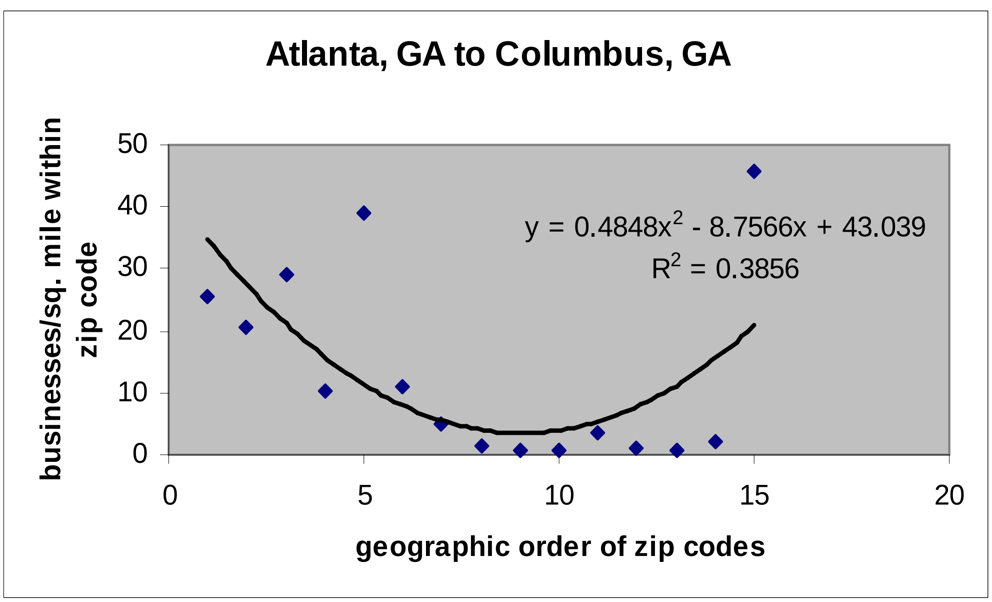
50
0
-50
0
5
10
15
20


Atlanta, GA to Columbia, SC
y = 0.1344x^2 - 4.2605x + 36.4
R^2 = 0.2757
businesses/sq. mile within zip code
geographic order of zip codes
60
50
40
30
20
10
0
0
5
10
15
20
25
30


Atlanta, GA to Greenville, SC
y = 0.8239x2 - 27.714x + 230.1
R2 = 0.8755
businesses/sq. mile within zip code
geographic order of zip codes
250
200
150
100
50
0
-50
0
5
10
15
20
25


Atlanta, GA to Chatanooga, TN
y = 1.486x2 - 29.208x + 143.43
R2 = 0.8593
Businesses/sq. mi within zip code
geographic order of zip codes
140
120
100
80
60
40
20
0
-20
0
5
10
15
20


Atlanta, GA to Columbus, GA
y = 0.4848x2 - 8.7566x + 43.039
R2 = 0.3856
businesses/sq. mile within zip code
geographic order of zip codes
50
40
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20
10
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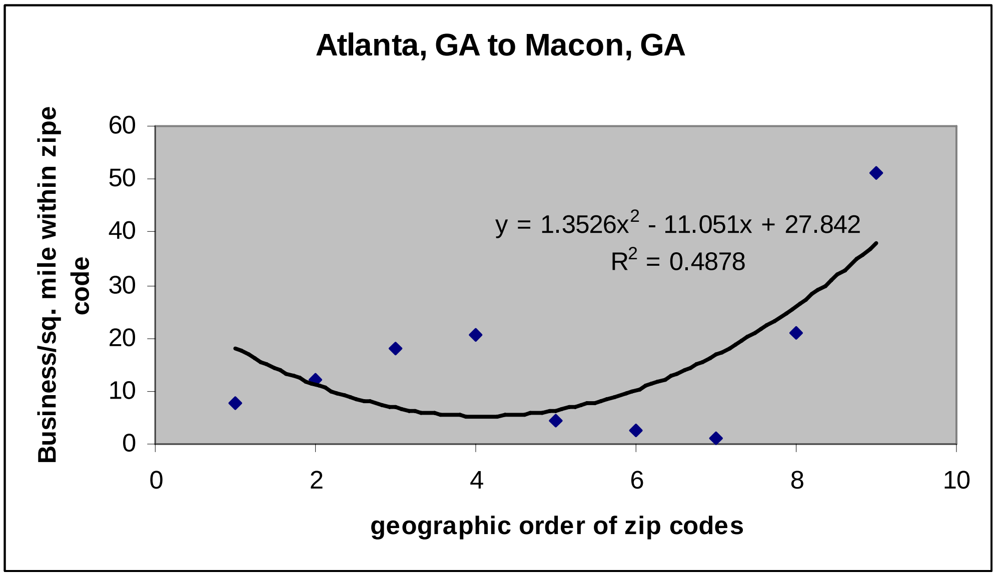
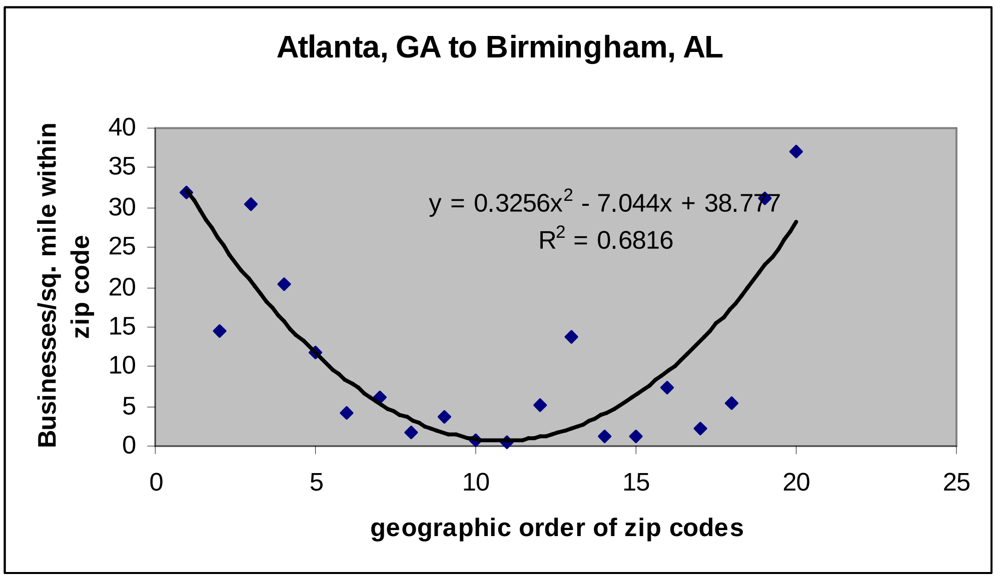
0
5
10
15
20


Atlanta, GA to Macon, GA
Business/sq. mile within zipe code
60
50
40
30
20
10
0
y = 1.3526x2 - 11.051x + 27.842
R2 = 0.4878
0
2
4
6
8
10
geographic order of zip codes


Atlanta, GA to Birmingham, AL
Businesses/sq. mile within zip code
40
35
30
25
20
15
10
5
0
y = 0.3256x2 - 7.044x + 38.777
R2 = 0.6816
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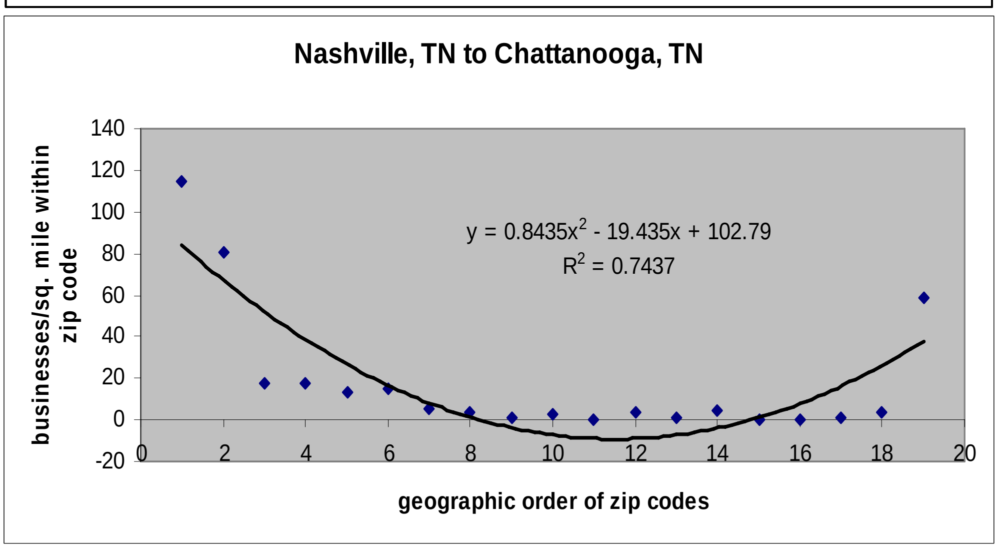
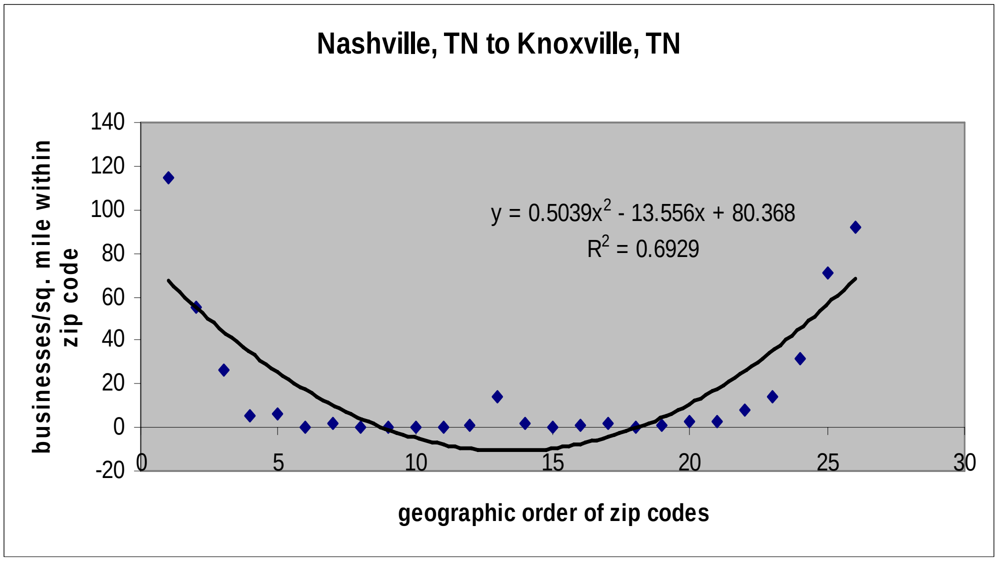
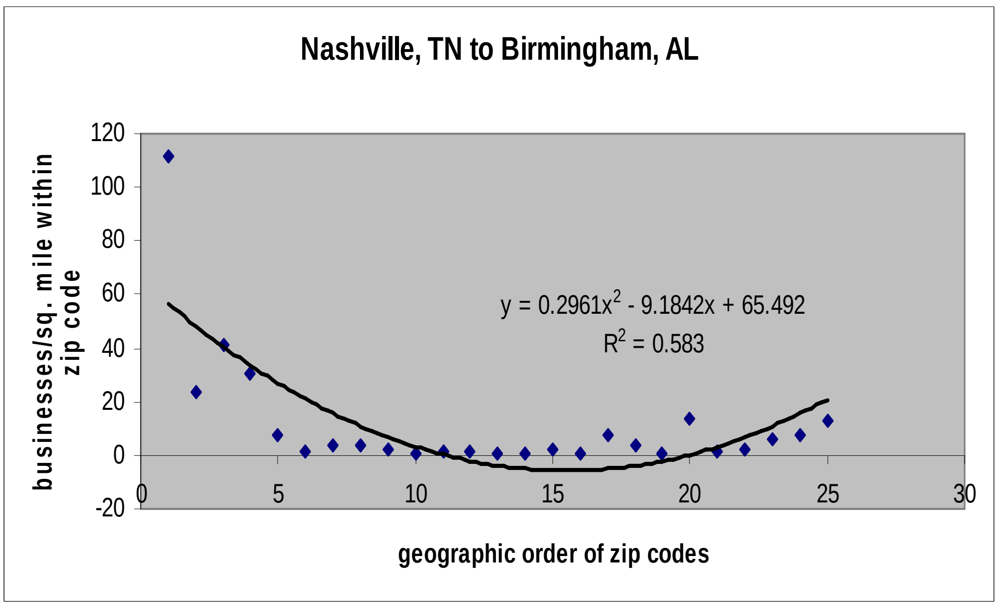
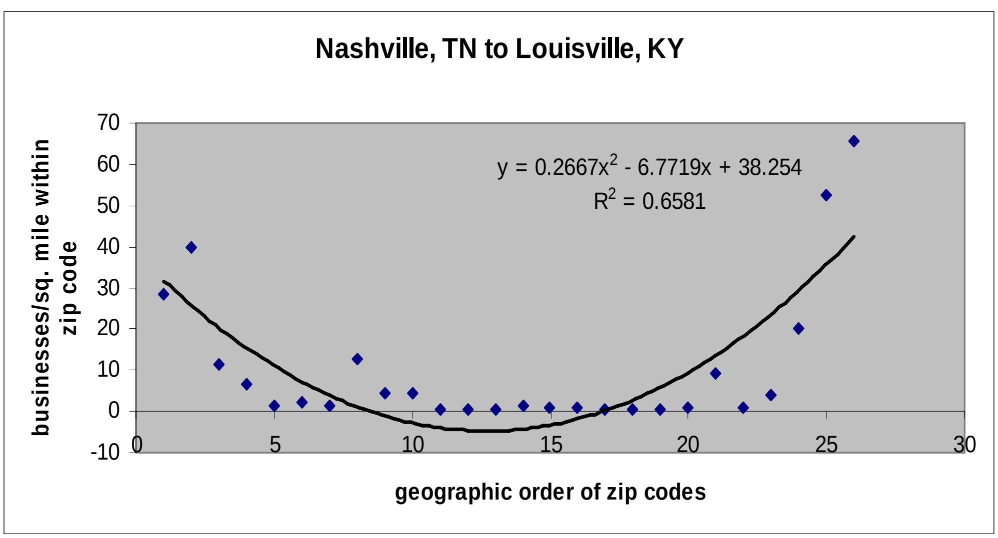
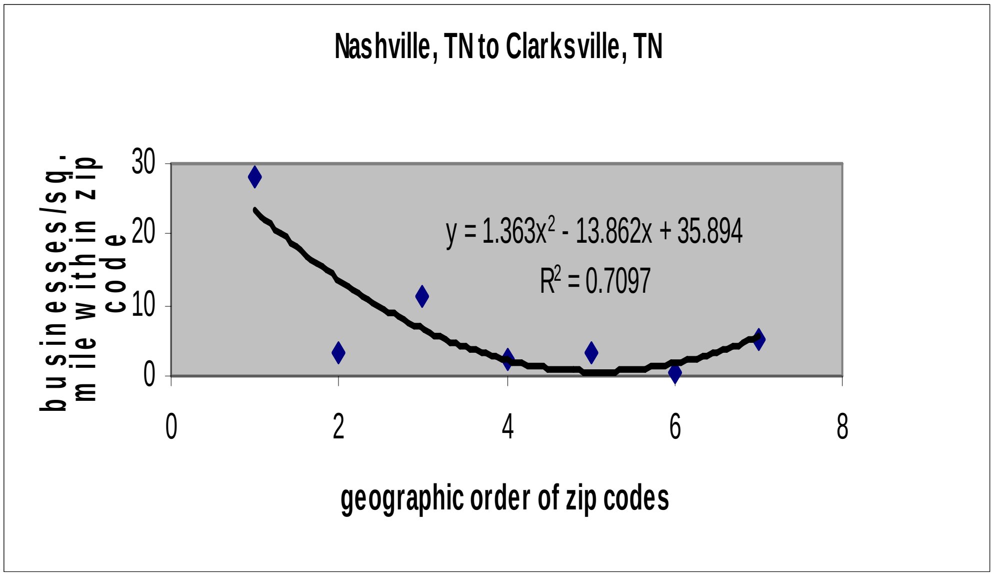
5
10
15
20
25
geographic order of zip codes

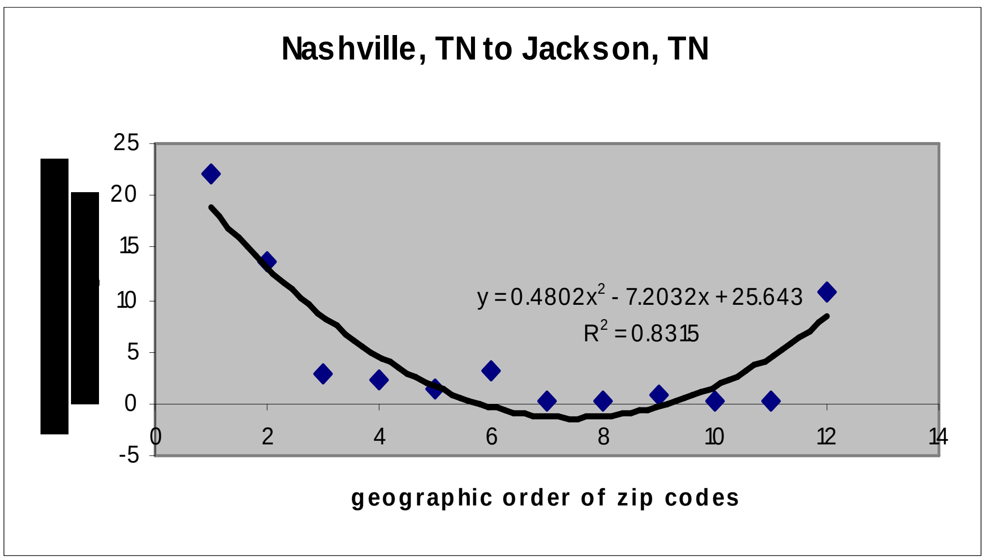

Nashville, TN to Chattanooga, TN
businesses/sq. mile within zip code
140
120
100
80
60
40
20
0
-20
y = 0.8435x2 - 19.435x + 102.79
R2 = 0.7437
0
2
4
6
8
10
12
14
16
18
20
geographic order of zip codes


Nashville, TN to Knoxville, TN
y = 0.5039x2 - 13.556x + 80.368
R2 = 0.6929
businesses/sq. mile within zip code
geographic order of zip codes
140
120
100
80
60
40
20
0
-20
0
5
10
15
20
25
30


Nashville, TN to Birmingham, AL
y = 0.2961x2 - 9.1842x + 65.492
R2 = 0.583
businesses/sq. mile within zip code
geographic order of zip codes
120
100
80
60
40
20
0
-20
0
5
10
15
20
25
30


Nashville, TN to Louisville, KY
y = 0.2667x2 - 6.7719x + 38.254
R2 = 0.6581
businesses/sq. mile within zip code
geographic order of zip codes
70
60
50
40
30
20
10
0
-10
0
5
10
15
20
25
30


Nashville, TN to Clarksville, TN
businesses/sq. mile within zip code
30
20
10
0
y = 1.363x2 - 13.862x + 35.894
R2 = 0.7097
0
2
4
6
8
geographic order of zip codes


Nashville, TN to Jackson, TN
[redacted]
25
20
15
10
5
0
-5
y = 0.4802x2 - 7.2032x + 25.643
R2 = 0.8315
0
2
4
6
8
10
12
14
geographic order of zip codes

Appendix C

Indianapolis, IN to Dayton, OH

	zip codes	businesses	square mileage	business density
1	46219	1082	12.8532	84.18139
2	46229	588	10.17465	57.79071
3	46140	898	173.5412	5.174565
4	46117	9	10.45598	0.860751
5	46148	114	49.17789	2.318115
6	47385	28	14.10204	1.985528
7	47362	585	149.4469	3.914434
8	47387	9	16.20439	0.555405
9	47327	115	57.96506	1.983954
10	47345	13	30.67806	0.423756
11	47374	1250	120.5122	10.3724
12	45347	62	51.95553	1.193328
13	45321	17	14.26499	1.191729
14	45338	103	52.576	1.959069
15	45309	209	66.03205	3.16513
16	45315	126	10.11855	12.45238
17	45414	871	21.98046	39.62611

Indianapolis, IN to Cincinnati, OH

	zip codes	Businesses	square mileage	business density
1	46241	1037	24.10621	43.01796
2	46239	348	29.64689	11.73816
3	46126	79	33.89122	2.330987
4	46176	713	172.1892	4.140795
5	46182	24	35.82039	0.670009
6	47272	24	35.96908	0.66724
7	47240	573	295.0377	1.942125
8	47006	381	96.48918	3.948629
9	47041	106	83.40536	1.270902
10	47060	117	59.71882	1.959181
11	45030	440	44.83136	9.814558
12	45002	242	26.55223	9.114111
13	45248	341	11.02027	30.94299
14	45211	658	9.151979	71.89702

Indianapolis, IN to Terre Haute, IN

	zip codes	businesses	square mileage	business density
1	46241	1037	24.10621	43.01796
2	46168	680	28.54131	23.82512
3	46158	496	77.76275	6.378375
4	46118	80	51.82429	1.543678
5	46180	21	24.04077	0.873516
6	46120	108	94.64835	1.141066
7	46171	21	38.86662	0.540309
8	47834	390	148.6707	2.623247
9	47803	384	35.09892	10.94051

Indianapolis, IN to Champaign, IL

	zip code	businesses	square mileage	business density
1	46224	519	7.88541	65.81776
2	46234	271	13.61083	19.91061
3	46112	622	42.25236	14.72107
4	46167	105	29.53703	3.55486
5	46149	30	25.26929	1.187212
6	46147	42	57.62685	0.728827
7	47933	733	240.5672	3.046965
8	47990	24	41.95116	0.572094
9	47949	18	41.54295	0.433287
10	47987	67	121.5298	0.551305
11	47932	140	110.0162	1.27254
12	61834	167	100.3067	1.664894
13	61832	970	27.79175	34.90245
14	61858	35	29.30304	1.194415
15	61844	10	59.57755	0.167848
16	61859	24	31.08765	0.772011
17	61873	84	67.18572	1.250266
18	61802	322	82.09392	3.922337
19	61801	453	6.337564	71.47857
20	61820	1270	6.528899	194.5198

Indianapolis, IN to Gary, IN

	zip codes	businesses	square mile	business density
1	46208	451	6.391296	70.56472
2	46254	798	12.50129	63.8334
3	46278	485	13.47427	35.99452
4	46077	610	43.58108	13.9969
5	46075	78	31.86888	2.447529
6	46052	608	177.4272	3.426757
7	46071	53	72.0461	0.73564
8	46041	502	262.2491	1.914211
9	47905	1185	120.6155	9.824607
10	47906	711	136.0056	5.227726
11	47923	69	94.9449	0.726737
12	47995	51	79.57953	0.640868
13	47977	85	83.64707	1.016174
14	47978	338	260.4782	1.297614
15	47943	9	60.14983	0.149626
16	46310	279	69.35265	4.022918
17	46341	176	92.57856	1.901088
18	46307	1095	84.50036	12.95852
19	46410	1651	30.9412	53.35928

Indianapolis, IN to Ft. Wayne, IN

	zip codes	businesses	square miles	business density
1	46250	1391	7.693548	180.8008
2	46256	718	12.16691	59.01253
3	46038	1174	25.89116	45.34366
4	46060	1292	125.8645	10.26501
5	46064	266	63.78968	4.169954
6	46013	413	21.09089	19.58192
7	46017	108	16.89997	6.390543
8	47334	87	22.71859	3.829464
9	47342	44	51.38263	0.856321
10	46928	75	72.30471	1.037277
11	46953	453	90.88131	4.984523
12	46952	653	106.0687	6.156385
13	46991	19	31.05897	0.61174
14	46792	72	101.3023	0.710744
15	46750	708	220.8171	3.206273
16	46770	50	33.33354	1.499991
17	46783	131	56.75029	2.308358
18	46809	422	24.31235	17.35743

Atlanta, GA to Chattanooga, TN

	zip codes	businesses	square mileage	business density
1	30067	1717	15.14996	113.3336
2	30062	2208	26.24053	84.14465
3	30066	1737	27.34477	63.5222
4	30144	1969	22.71536	86.68145
5	30101	888	43.29829	20.50889
6	30102	526	28.92303	18.1862
7	30121	296	55.62749	5.32111
8	30137	19	5.11704	3.713084
9	30103	182	104.8846	1.735241
10	30701	842	160.8743	5.233899
11	30735	40	52.22331	0.765942
12	30720	1192	57.60461	20.69279
13	30755	95	34.33083	2.767192
14	30736	503	122.9859	4.089898
15	37412	494	8.453253	58.43904

Atlanta, GA to Greenville, SC

	zip codes	businesses	square mileage	business density
1	30324	986	5.239191	188.197
2	30329	977	5.684448	171.8724
3	30345	739	7.203963	102.5824
4	30341	1691	10.66669	158.5309
5	30340	1481	8.504624	174.1406
6	30093	1464	12.16012	120.3935
7	30096	2584	22.37353	115.4936
8	30024	1879	37.54809	50.04249
9	30519	691	34.86865	19.81723
10	30548	207	40.37847	5.126494
11	30517	211	27.21209	7.753907
12	30549	331	106.4251	3.11017
13	30529	428	54.6995	7.824568
14	30530	43	72.042	0.596874
15	30521	80	93.3676	0.856828
16	30553	218	61.28327	3.557251
17	29643	48	27.00084	1.777722
18	29689	45	35.19736	1.278505
19	29625	440	41.96297	10.48544
20	29621	1280	88.51168	14.46137

21	29697	170	38.39595	4.427551
22	29673	511	72.39991	7.05802
23	29605	900	24.83615	36.23751

Atlanta, GA to Columbia, SC

	zip codes	businesses	square mileage	business density
1	30032	590	14.03581	42.03535
2	30035	451	8.325109	54.17346
3	30058	554	46.02881	12.03594
4	30013	838	28.5772	29.32408
5	30014	839	116.5713	7.197314
6	30025	150	61.29447	2.447203
7	30663	44	53.49143	0.822562
8	30650	368	216.5582	1.699312
9	30625	44	44.89649	0.980032
10	30642	305	236.8093	1.287956
11	30631	25	192.1103	0.130134
12	30821	10	97.8112	0.102238
13	30824	459	207.2048	2.215199
14	30814	95	53.8222	1.765071
15	30813	258	50.83686	5.075058
16	30909	1311	25.36749	51.68032
17	29841	595	31.96119	18.61633
18	29829	92	34.49719	2.666884
19	29801	760	89.08102	8.53156
20	29805	72	99.03945	0.726983
21	29006	206	145.6347	1.414498
22	29070	202	163.4042	1.236198
23	29054	127	57.69677	2.201163
24	29073	455	78.88521	5.767874

Atlanta, GA to Macon, GA

	zip codes	businesses	square mileage	business density
1	30294	259	33.41265	7.751556
2	30273	77	6.35607	12.1144
3	30281	1312	72.26672	18.15497
4	30253	996	48.64022	20.47688
5	30248	290	65.38077	4.435555
6	30233	397	157.8047	2.515768
7	31029	289	258.5289	1.117863
8	31210	946	45.11421	20.969
9	31204	768	14.98551	51.24952

Atlanta, GA to Columbus, GA

	zip code	businesses	square mileage	business density
1	30337	302	11.81727	25.55583
2	30349	967	47.23612	20.47162
3	30291	302	10.4208	28.9805
4	39213	331	32.51334	10.18044
5	30269	1100	28.17295	39.04455
6	30265	518	46.59616	11.1168
7	30263	987	197.2614	5.003512
8	30259	47	34.62872	1.357255
9	30220	39	47.78008	0.81624
10	30230	84	139.9033	0.600415
11	30241	360	106.2452	3.388387
12	31822	117	113.6049	1.029885
13	31811	75	126.4026	0.593342
14	31808	105	50.91231	2.06237
15	31909	729	15.9442	45.72197

Atlanta, GA to Birmingham, AL

	zip codes	businesses	square mileage	business density
1	30314	150	4.715404	31.81064
2	30331	565	38.79012	14.56556
3	30168	372	12.24527	30.37907
4	30122	482	23.62055	20.40596
5	30135	995	84.10232	11.83083
6	30187	133	30.97691	4.293521
7	30180	462	76.67761	6.025227
8	30179	135	73.96013	1.825308
9	30110	252	68.48929	3.679407
10	30182	25	35.02188	0.71384
11	36264	129	237.4002	0.543386
12	36207	379	73.25368	5.173801
13	36203	535	38.77058	13.79912
14	36260	36	27.10578	1.32813
15	35096	98	77.27271	1.268236
16	35125	348	46.81894	7.432889
17	35128	124	56.62273	2.189933
18	35094	303	57.40149	5.278609
19	35210	732	23.45326	31.21101
20	35212	227	6.110904	37.14671

Nashville, TN to Clarksville, TN

	zip codes	businesses	square mileage	business density
1	37207	596	21.04845	28.31563
2	37189	58	18.40048	3.152091
3	37072	853	75.89985	11.23849
4	37080	117	49.69866	2.354188
5	37146	95	29.4917	3.221246
6	37032	37	73.54204	0.503114
7	37043	580	112.7999	5.141847

Nashville, TN to Jackson, TN

	zip codes	businesses	square mileage	business density
1	37209	780	35.52354	21.95727
2	37221	628	46.47861	13.51159
3	37082	111	37.19939	2.98392
4	37062	152	69.99155	2.171691
5	37029	70	46.9181	1.491961
6	37055	659	207.4459	3.176732
7	37101	63	202.202	0.31157
8	37078	23	83.58917	0.275155
9	37185	214	236.7363	0.903959
10	38341	33	138.9886	0.237429
11	38388	11	74.77633	0.147105
12	38305	1414	130.4686	10.83786

Nashville, TN to Chattanooga, TN

	zip codes	businesses	square mileage	business density
1	37210	1067	9.300964	114.7193
2	37211	1734	21.42535	80.93218
3	37013	736	41.44358	17.75908
4	37086	467	26.31071	17.74942
5	37167	722	53.84076	13.40991
6	37129	1237	84.93429	14.5642
7	37128	261	51.55168	5.062881
8	37127	158	49.51539	3.190927
9	37037	45	78.1302	0.575962
10	37355	470	197.4914	2.37985
11	37342	31	74.88893	0.413946
12	37356	81	25.24845	3.208117
13	37380	122	126.9061	0.961341
14	37347	224	47.36879	4.728852

15	37340	7	14.07921	0.497187
16	37396	2	11.65798	0.171556
17	30757	25	20.45663	1.222098
18	37419	134	36.52029	3.669193
19	37412	494	8.453253	58.43904

Nashville, TN to Knoxville, TN

	zip codes	businesses	square mileage	business density
1	37210	1067	9.300964	114.7193
2	37214	1137	20.48532	55.50317
3	37076	665	25.61569	25.96065
4	37122	635	113.982	5.571056
5	37087	1052	163.7196	6.42562
6	37184	51	134.553	0.379033
7	38563	57	26.77231	2.129065
8	38547	10	28.39243	0.352207
9	38567	10	22.71078	0.440319
10	38569	4	13.01283	0.307389
11	38582	19	46.01779	0.412884
12	38544	60	79.36899	0.755963
13	38501	1278	88.59581	14.42506
14	38506	286	166.5963	1.716725
15	38574	89	171.0527	0.520307
16	38571	126	127.2673	0.990042
17	38555	739	323.9799	2.281006
18	37723	15	44.9168	0.333951
19	37854	156	137.0383	1.138368
20	37748	278	105.3614	2.638538
21	37763	233	98.1132	2.374808
22	37771	385	47.78793	8.056427
23	37932	406	29.40755	13.80598
24	37922	1446	45.49016	31.78709
25	37923	830	11.70296	70.92223
26	37919	1750	18.98325	92.18651

Nashville, TN to Birmingham, AL

	zip codes	businesses	square mileage	business density
1	37204	816	7.293197	111.8851
2	37220	179	7.67656	23.31774
3	37027	2231	54.07767	41.25547
4	37067	1058	34.28093	30.86264
5	37064	1359	182.7234	7.437471
6	37179	80	56.0471	1.427371
7	37174	244	65.60573	3.719187
8	38401	1174	300.5947	3.905592

9	37091	402	212.5226	1.891564
10	37047	26	62.82829	0.413826
11	38478	421	256.7681	1.639612
12	38449	64	59.09058	1.083083
13	35620	57	108.922	0.52331
14	35614	42	64.15693	0.654645
15	35613	163	72.82132	2.238356
16	35671	35	52.78364	0.663084
17	35603	527	70.32991	7.493256
18	35640	425	108.4876	3.917499
19	35622	61	98.79138	0.617463
20	35055	870	64.18947	13.55362
21	35077	186	159.725	1.164501
22	35180	184	97.61717	1.884914
23	35071	359	59.01594	6.083103
24	35068	103	13.9948	7.359878
25	35207	151	11.48	13.15331

Nashville, TN to Louisville, KY

	zip codes	businesses	square mileage	business density
1	37207	596	21.04845	28.31563
2	37115	830	20.93872	39.63948
3	37072	853	75.89985	11.23849
4	37188	209	30.89337	6.765205
5	37049	37	28.85481	1.282282
6	37148	297	136.8211	2.170719
7	42134	317	217.4499	1.457807
8	42104	757	60.10139	12.59538
9	42103	338	73.29447	4.611535
10	42101	1313	285.4765	4.599327
11	42159	9	21.97038	0.409642
12	42171	78	113.1326	0.689456
13	42160	21	74.69872	0.281129
14	42127	106	87.43977	1.212263
15	42749	91	101.8992	0.893039
16	42765	111	109.3885	1.014732
17	42713	16	43.83772	0.364982
18	42784	34	62.75736	0.541769
19	42776	25	67.44504	0.370672
20	42740	35	34.00108	1.029379
21	42701	1339	146.1217	9.163597

22	40150	55	75.68835	0.726664
23	40165	516	126.5297	4.078095
24	40229	371	18.49215	20.06257
25	40219	798	15.20642	52.47785
26	40213	755	11.49285	65.69299

Nashville, TN to Knoxville, TN

	zip codes	businesses	square mileage	business density
1	37210	1067	9.300964	114.7193
2	37214	1137	20.48532	55.50317
3	37076	665	25.61569	25.96065
4	37122	635	113.982	5.571056
5	37087	1052	163.7196	6.42562
6	37184	51	134.553	0.379033
7	38563	57	26.77231	2.129065
8	38547	10	28.39243	0.352207
9	38567	10	22.71078	0.440319
10	38569	4	13.01283	0.307389
11	38582	19	46.01779	0.412884
12	38544	60	79.36899	0.755963
13	38501	1278	88.59581	14.42506
14	38506	286	166.5963	1.716725
15	38574	89	171.0527	0.520307
16	38571	126	127.2673	0.990042
17	38555	739	323.9799	2.281006
18	37723	15	44.9168	0.333951
19	37854	156	137.0383	1.138368
20	37748	278	105.3614	2.638538
21	37763	233	98.1132	2.374808
22	37771	385	47.78793	8.056427
23	37932	406	29.40755	13.80598
24	37922	1446	45.49016	31.78709
25	37923	830	11.70296	70.92223
26	37919	1750	18.98325	92.18651

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