Retail Food Location Gravity Model (Retail Coverage)
ArcGIS - Python Script Tool Development
Preliminary Testing and Documentation – Version 1

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Background:

This gravity model was originally developed for my Master's Thesis at the University of New Mexico (UNM), Department of Geography that was completed during 1982. At that time it was developed using SAS and FORTRAN along with an early Environmental Systems Research (ESRI) product AUTOMAP II. A paper "Retail Coverage and Market Equilibrium – The Case of Food Stores in Albuquerque, New Mexico" presented at the Applied Geography Conference during 1985 expanded on the earlier work. No work was undertaken on this research project until my retirement from UNM during 2012. At that time I continued development of this research mostly as a requirement for some graduate level geography classes I completed. This recent research used more recent food store and population data and was developed with modern GIS (ArcGIS-ArcPy , QGIS-PyQGIS, and R with QGIS) and computing facilities. This documentation describes developments using ArcGIS-ArcPy and includes geographically weighted regression (GWR) to display relative levels of retail servicing. Other version describes development using QGIS-PyQGIS and R with QGIS.

Instructions for Use:

1. Prepare a point based feature class for food store locations containing items that can be used as weighting variables such as store size, store sales, and number of employees. Note: The 2013 infogroup data is used for this example.
2. Prepare a census block group feature class with population (count and density) data. Note: this is a point based feature class and population estimates from Esri Demographics is used for this example.
3. Prepare a major roads based feature class useful for locational reference. Note this is a line based feature class.
4. Prepare a census block group feature class for displaying the gravity model results. Note: this is a polygon based feature class.
5. Optional – Prepare a feature class with the outline of the study area. Note this is just a single polygon based feature class.
6. Prepare a ArcGIS ArcMap document (mxd) containing the above feature classes.
7. Open and run the Retail Gravity Model Python Tool from the Gravity Model Test Tool Box (Retail Gravity Model V1).
8. Review the results point based feature class with measure of retail coverage (retcover) from the retail gravity model.
9. Review and create display of results (Std. Residual) from the geographically weighted regression. Note: This is a point based feature class. The automated display still needs to be developed (see manual results below). The next step will join to the polygon census block group feature class (step 4) to display results.

10. Review and create display of results (Std. Residual) from the geographically weighted regression. Note: This is a polygon based feature class. The join and automated display still need to be developed (see manual results below).

Food Store Feature Class (1):

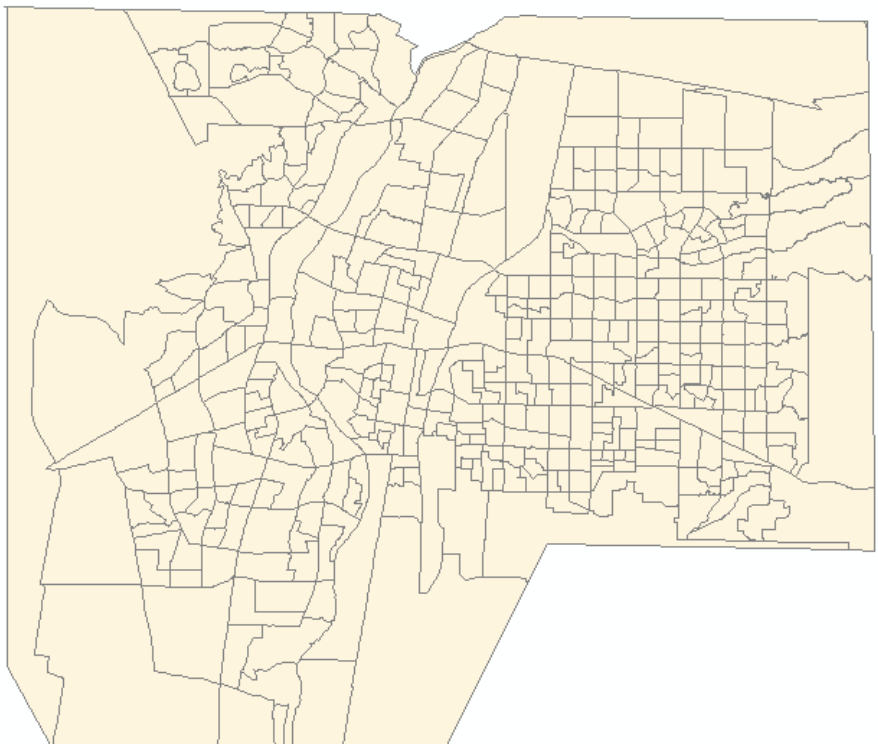
NAICS3DES2	EST_AREA	EST_SALES	EMPLOYEES
Food and Beverage Stores	1249.5	749500	2
Food and Beverage Stores	1249.5	749500	2
Food and Beverage Stores	40000	34999500	150
Food and Beverage Stores	40000	34999500	115
Food and Beverage Stores	40000	34999500	100
Food and Beverage Stores	6249.5	34999500	80
Food and Beverage Stores	40000	34999500	125
Food and Beverage Stores	1249.5	1749500	6
Food and Beverage Stores	40000	34999500	121
Food and Beverage Stores	40000	34999500	100
Food and Beverage Stores	40000	34999500	120
Food and Beverage Stores	6249.5	14999500	75
Food Services and Drinking Places	6249.5	250000	10
Food and Beverage Stores	1249.5	749500	2
Food and Beverage Stores	6249.5	7499500	24
Food and Beverage Stores	1249.5	749500	2
Food and Beverage Stores	1249.5	749500	2
Food and Beverage Stores	1249.5	749500	3
Food and Beverage Stores	6249.5	7499500	30

Block Group Feature Class (2):

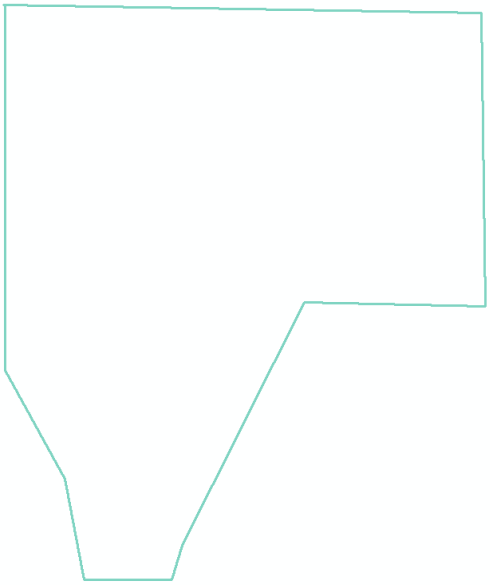
LANDAREA	TOTPOP_CY	POPDENS_CY	SqFeet_Per	Feet_Per_P	ENRICH_FID	ID_1	sourceCoun	HasData	TOTPOP_CY_	ORIG_FID	POPDENKM2
1.7016	1285	755.2	36915.25	192.133408	236	35	US	1	1227	0	272.603844
0.5861	2305	3932.8	7088.689941	84.194359	402	31	US	1	2267	1	1518.3453
1.1471	2397	2089.6	13341.5	115.505402	332	11	US	1	2414	2	806.609012
0.1537	873	5679.9	4908.254883	70.058937	94	43	US	1	765	3	2193.467337
0.441	1944	4408.2	6324.213867	79.524933	218	17	US	1	1866	4	1701.978638
0.5222	2211	4234	6584.412109	81.144386	191	40	US	1	2135	5	1634.87134
0.2428	972	4003.3	6963.85498	83.449707	216	15	US	1	1030	6	1545.555732
0.2651	883	3330.8	8369.880859	91.487053	36	35	US	1	876	7	1286.047189
0.0644	944	14658.4	1901.871948	43.610458	138	37	US	1	992	8	5659.472422
0.1971	1039	5271.4	5288.61377	72.722862	92	41	US	1	998	9	2035.658307
0.1285	2036	15844.4	1759.510986	41.946529	307	6	US	1	2050	10	6115.950736
0.1535	1012	6592.8	4228.612793	65.027786	310	9	US	1	1015	11	2545.27163
0.4728	1073	2269.5	12283.94043	110.832901	386	15	US	1	1141	12	876.276031
0.2806	2095	7466.1	3733.998047	61.106449	381	10	US	1	2032	13	2883.292045
0.1642	1566	9537.1	2923.153076	54.066189	384	13	US	1	1560	14	3682.106748
0.7028	3837	5459.6	5106.308105	71.458443	408	37	US	1	3867	15	1914.575121
0.5051	1431	2833.1	9840.246094	99.198013	404	33	US	1	1426	16	1043.459239
0.3422	2197	6420.2	4342.293945	65.896088	405	34	US	1	2247	17	2478.564982
0.1752	883	5040	5531.429199	74.373573	406	35	US	1	1107	18	1945.791097

ArcMap Basemap (3):

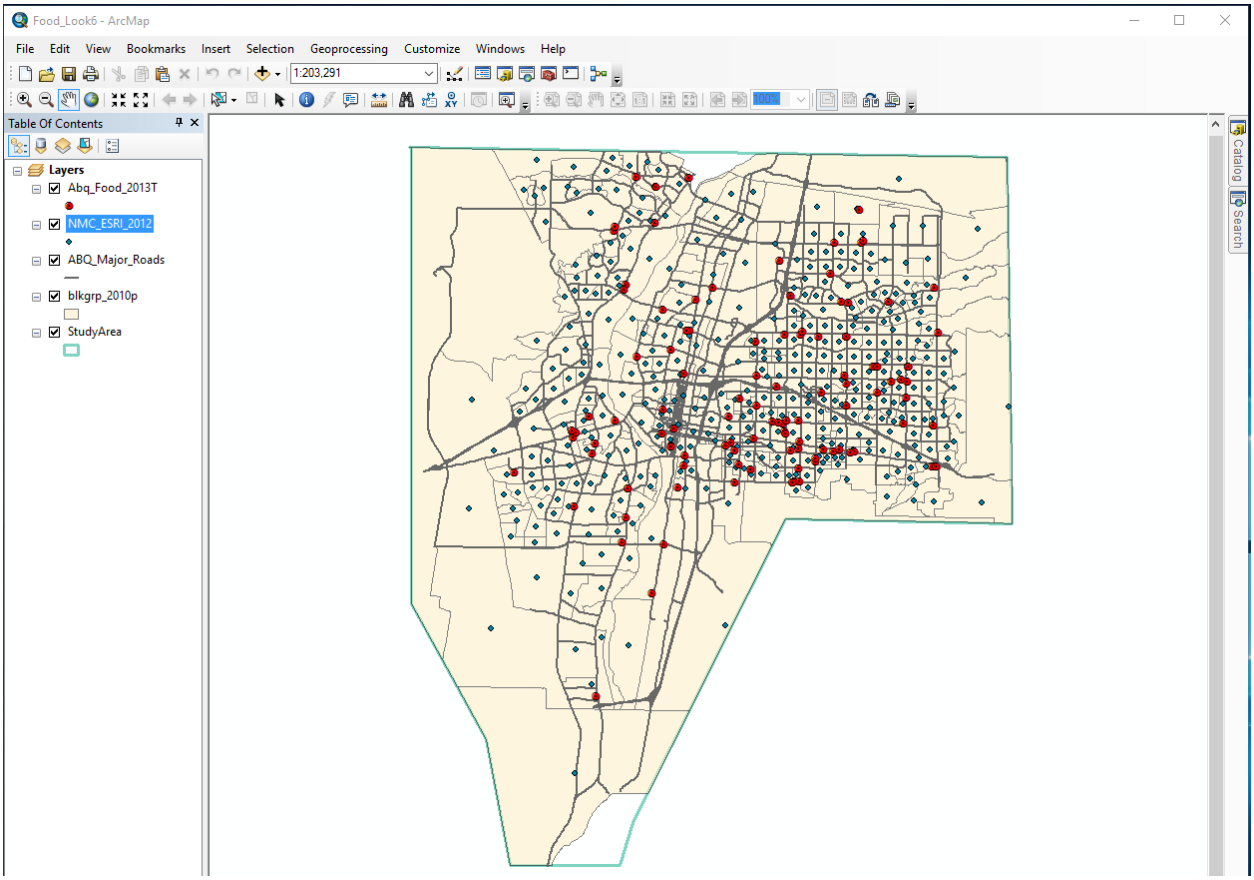
Census Block Group Feature Class (4)



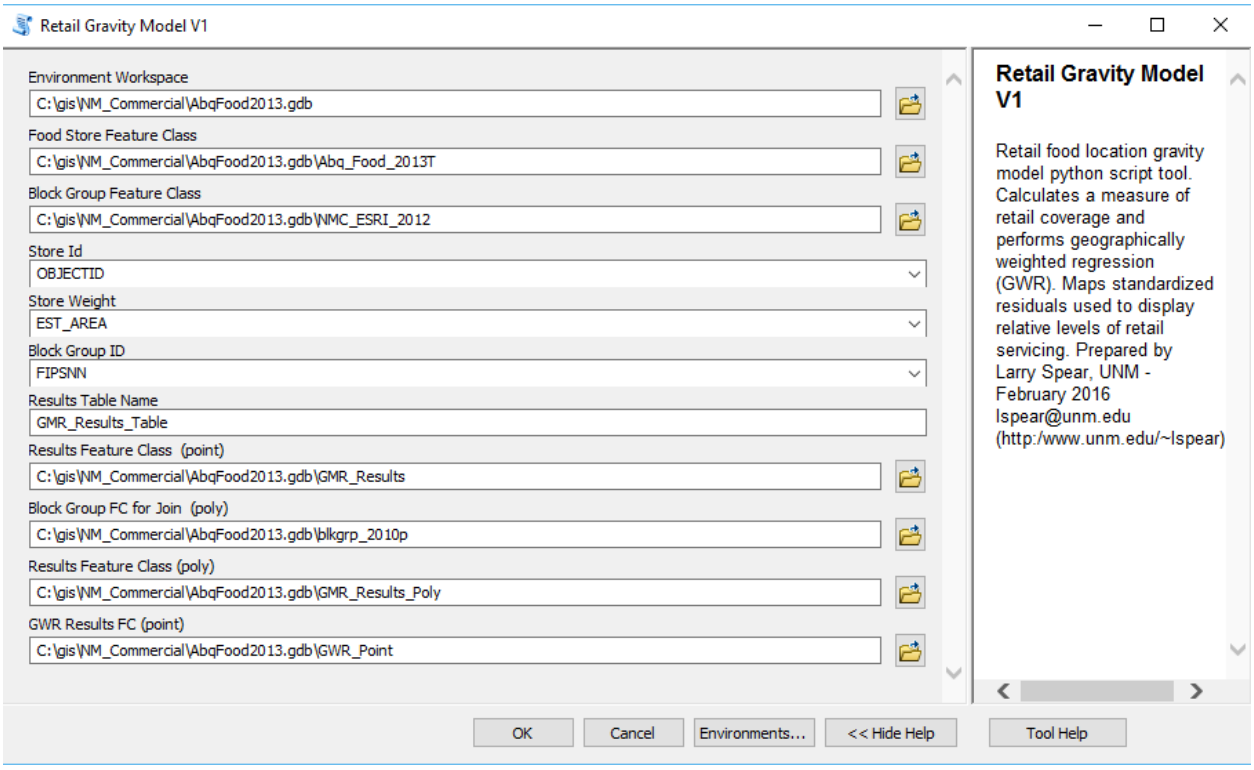
Study Area Feature Class - Optional (5):



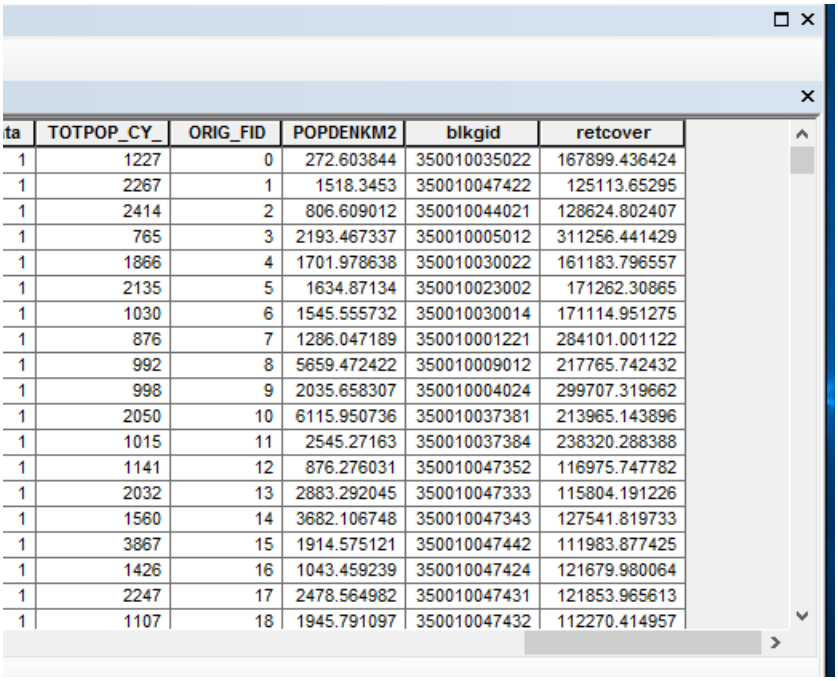
ArcGIS ArcMap Document – mxd: (6)



Script Tool Dialog Box (7):



Review the Results Feature Class (point) (8):



ta	TOTPOP_CY_	ORIG_FID	POPDENKM2	blkgid	retcover
1	1227	0	272.603844	350010035022	167899.436424
1	2267	1	1518.3453	350010047422	125113.65295
1	2414	2	806.609012	350010044021	128624.802407
1	765	3	2193.467337	350010005012	311256.441429
1	1866	4	1701.978638	350010030022	161183.796557
1	2135	5	1634.87134	350010023002	171262.30865
1	1030	6	1545.555732	350010030014	171114.951275
1	876	7	1286.047189	350010001221	284101.001122
1	992	8	5659.472422	350010009012	217765.742432
1	998	9	2035.658307	350010004024	299707.319662
1	2050	10	6115.950736	350010037381	213965.143896
1	1015	11	2545.27163	350010037384	238320.288388
1	1141	12	876.276031	350010047352	116975.747782
1	2032	13	2883.292045	350010047333	115804.191226
1	1560	14	3682.106748	350010047343	127541.819733
1	3867	15	1914.575121	350010047442	111983.877425
1	1426	16	1043.459239	350010047424	121679.980064
1	2247	17	2478.564982	350010047431	121853.965613
1	1107	18	1945.791097	350010047432	112270.414957

Review and Display GWR Results Feature Class (point) (9):

Residual	Standard Error	Standard Error Intercept	Standard Error Coefficient #1 POPDENKM2	Std. Residual	Source ID
-4146.885918	32803.480019	6742.370546	3.372425	-0.126416	1
-34575.323017	33562.691959	7663.033695	3.817984	-1.030171	2
-15780.426251	33311.766717	6820.349737	3.046661	-0.473719	3
59038.406359	33919.22367	5325.715205	2.001119	1.740559	4
-19796.960916	33816.477241	5713.315751	2.561514	-0.585424	5
6435.575479	33778.00423	5842.994162	2.550635	0.190526	6
-15027.176886	33809.454683	5610.277356	2.483999	-0.444467	7
12889.52913	33783.101041	5209.470355	1.995444	0.381538	8
-28328.514104	32759.547373	5712.042069	2.15579	-0.864741	9
52446.20845	33935.615565	4974.836394	1.900447	1.545462	10
-104597.115651	27629.499903	7292.748125	3.243216	-3.785704	11
-27661.90841	33801.127635	7214.532768	3.181659	-0.818372	12
-22757.008114	33270.878119	7231.460682	3.363625	-0.683992	13
-20347.629536	33448.928009	7453.09659	3.507738	-0.608319	14
-12956.26561	32784.707152	7096.169313	3.318394	-0.395192	15
-35775.21911	33479.964779	8141.919174	3.70486	-1.068556	16
-34115.718067	33214.63563	7603.319927	3.606639	-1.027129	17
-27282.15364	33423.125463	7676.738174	3.520744	-0.816266	18
-31800.203062	33493.063523	8086.428377	3.637211	-0.949456	19

Review and Display GWR Results Feature Class (poly) (10):