DGR's Healthcare Providers and Facilities Gravity Model
ArcGIS - Python Script Tool Development
Preliminary Testing and Documentation
ArcPy Version without ArcGIS ModelBuilder

Larry Spear, GISP – November 21, 2015

Background:

The healthcare gravity model was originally developed during 1998 for the New Mexico Health Policy Commission (NM HPC) by the Division of Government Research at the University of New Mexico (DGR, UNM) as part of several contract funded research projects. The primary goal of this work was to develop and illustrate a reliable measurement method that considered that patients traveled beyond the boundaries of arbitrary data collection units (counties, ZIP codes and census tracts) to obtain healthcare services. Also, to incorporate traditional federal and state service capacity standards (usually county based) and guidelines as part of this proposed method.

There was never an academic publication describing this work as funding to do so was not provided by the NM HPC as part of existing contracts. However, a limited distribution report (Quick Facts 2002) was published by the NM HPC and DGR prepared a PowerPoint presentation for an internal HPC audience. The gravity model poster received an award for best analytical content at the 2002 ESRI Southwest User Group Conference (SWUG) held in Taos New Mexico.

This discussion will document recent developments to build upon and expand this original work. It is currently being conducted as an unfunded research project using student versions of ArcGIS, QGIS, and SAS along with open source versions of Python and R. This documentation describes a mostly ArcPy version developed after initial work that used ArcGIS ModelBuilder. Currently only older already publicly available data used during these previous projects has been tested. It is hoped that future versions will have access to more recent data.

As this work progresses, some conference presentations will be prepared and hopefully more recent results will be published with the collaboration of other researchers. My focus has been primarily the technical GIS (Geographic Information System) development and evaluation of a gravity model method. Experts in the area of health policy can aid in the interpretation of future results.

Instructions for Use:

1. Prepare a census tract feature class or shapefile with populations and provider (or facility) data. Note: this is a point based feature class.
2. Also prepare a polygon based census tract feature class or shapefile to be joined (spatial) with results (tract points) and for data display. A symbology layer file (.lyr) with desires data class breaks can also be prepared (will be necessary in next version).
3. Create an ArcMap (.mxd) with additional desired basemap layers such as cities and towns, county boundaries, and the polygon census tract (or other data collection unit*) feature class or shapefile from step 2.

4. Open and run the Healthcare Gravity Model Python Tool dialog box from the Gravity Model Tool Box (GravityModelH.tbx).
5. Review the Initial ArcMap and resulting attribute table. A spatial join with census tract polygon layer (Base Layer) was performed.
6. Modify the initial class breaks and modify display as necessary (not yet automated).
7. Create a map composition and PDF if desired (not yet in this Python Script Tool version).

Census Tract Feature Class or Shapefile Example – *Input Layer* (1):

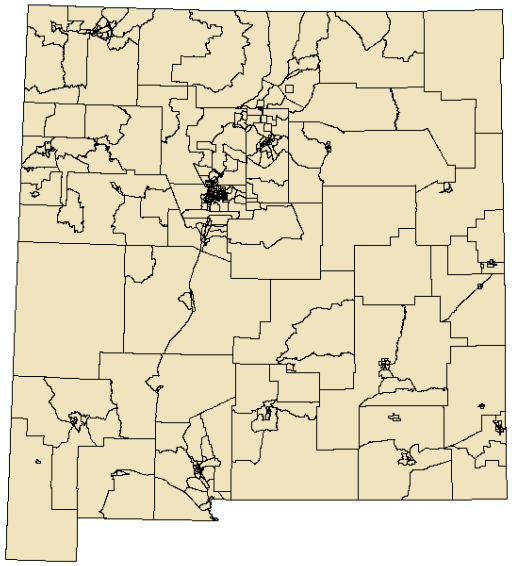
Contents | Preview | Description

FID	Shape	COUNTYFP	GEOID	NAME	Shape_Leng	Year_2002	Year_2010	PCSUM
0	Point	045	35045000302	3.02	0.071322	3377	3484	0
1	Point	057	35057963600	9636	2.714043	7256	6841	1
2	Point	057	35057963700	9637	4.365856	2246	2295	1
3	Point	001	35001004402	44.02	0.100807	4054	4058	0
4	Point	001	35001004501	45.01	0.075078	3596	3522	0
5	Point	001	35001004712	47.12	0.142892	5221	7209	0
6	Point	001	35001004713	47.13	0.072926	3427	7004	0
7	Point	001	35001004724	47.24	0.087961	3338	3186	0
8	Point	001	35001004726	47.26	0.073765	2714	2450	0
9	Point	001	35001004728	47.28	0.083828	3709	5089	0
10	Point	001	35001004729	47.29	0.114773	2738	3635	0
11	Point	001	35001004725	47.25	0.067239	3366	3729	0
12	Point	001	35001004717	47.17	0.089693	6206	7596	0
13	Point	001	35001004720	47.20	0.073017	3720	3517	0
14	Point	001	35001000714	7.14	0.080923	3244	4716	0
15	Point	045	35045943201	9432.01	3.454613	5595	5707	33
16	Point	045	35045000205	2.05	0.12861	6524	6705	0
17	Point	045	35045943100	9431	1.957683	2270	1936	0
18	Point	045	35045000100	1	0.205475	4877	5120	0
19	Point	045	35045000201	2.01	0.192732	3431	4375	6
20	Point	045	35045000702	7.02	1.426839	1154	1236	1
21	Point	037	35037958602	9586.02	0.338634	3337	2931	0
22	Point	037	35037958601	9586.01	0.444565	3242	3075	0
23	Point	039	35039944100	9441	0.334579	6675	6298	0
24	Point	001	35001004744	47.44	0.238087	3493	5126	0
25	Point	001	35001004739	47.39	0.059845	3763	6840	0
26	Point	001	35001004733	47.33	0.064441	1501	7398	0
27	Point	001	35001004753	47.53	0.093843	775	3675	0

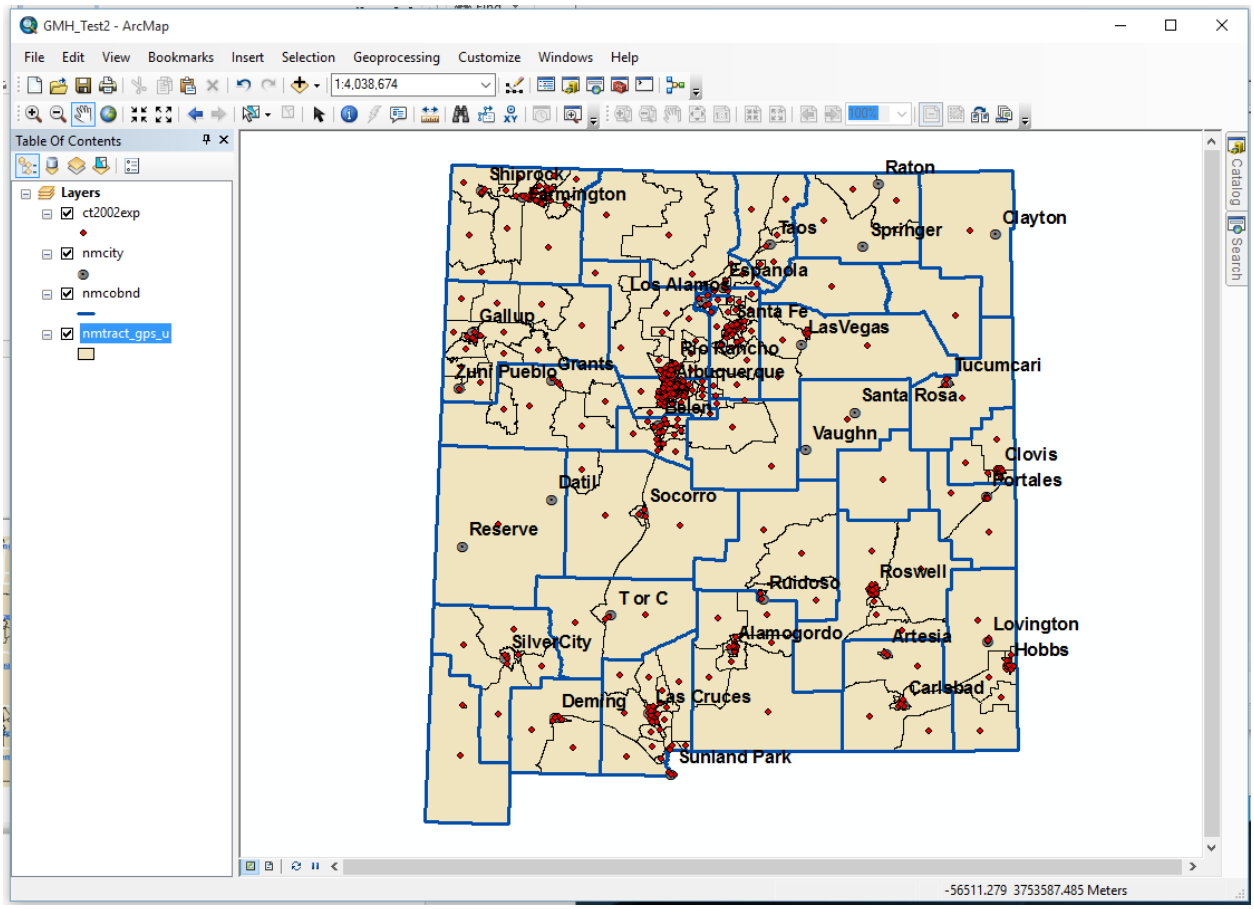
0 (of 499)

Preview: Table

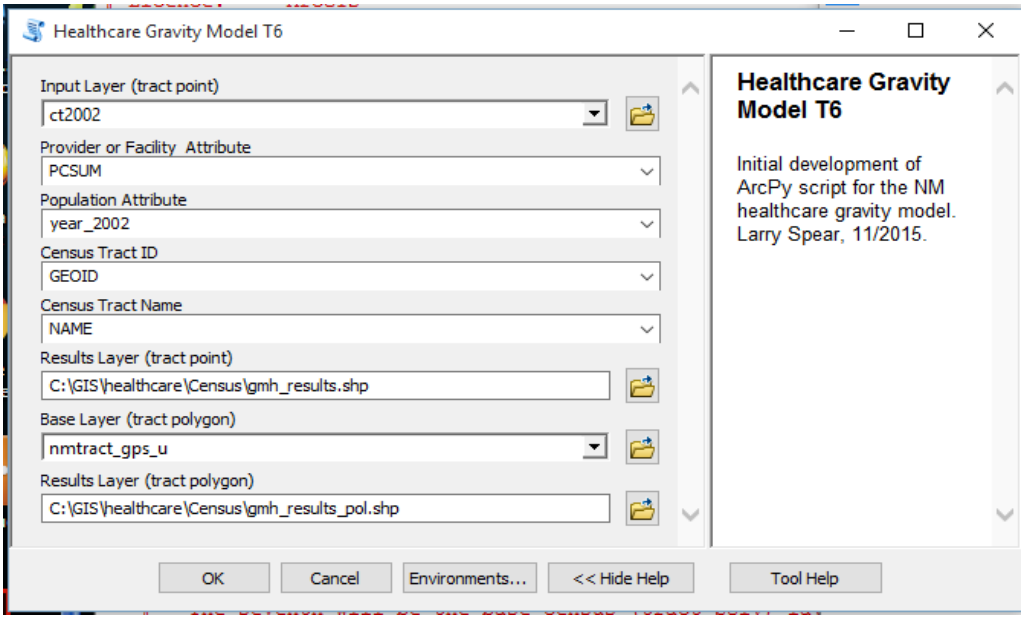
Polygon based Feature Class for Data Display – *Base Layer* (2):



ArcMap (.mxd) with Basemap Layers (3):



Script Tool Dialog Box (4):



Review Results Attribute Table and Spatial Join, *Results Layer(s)* – Note: GMResults Item (5):

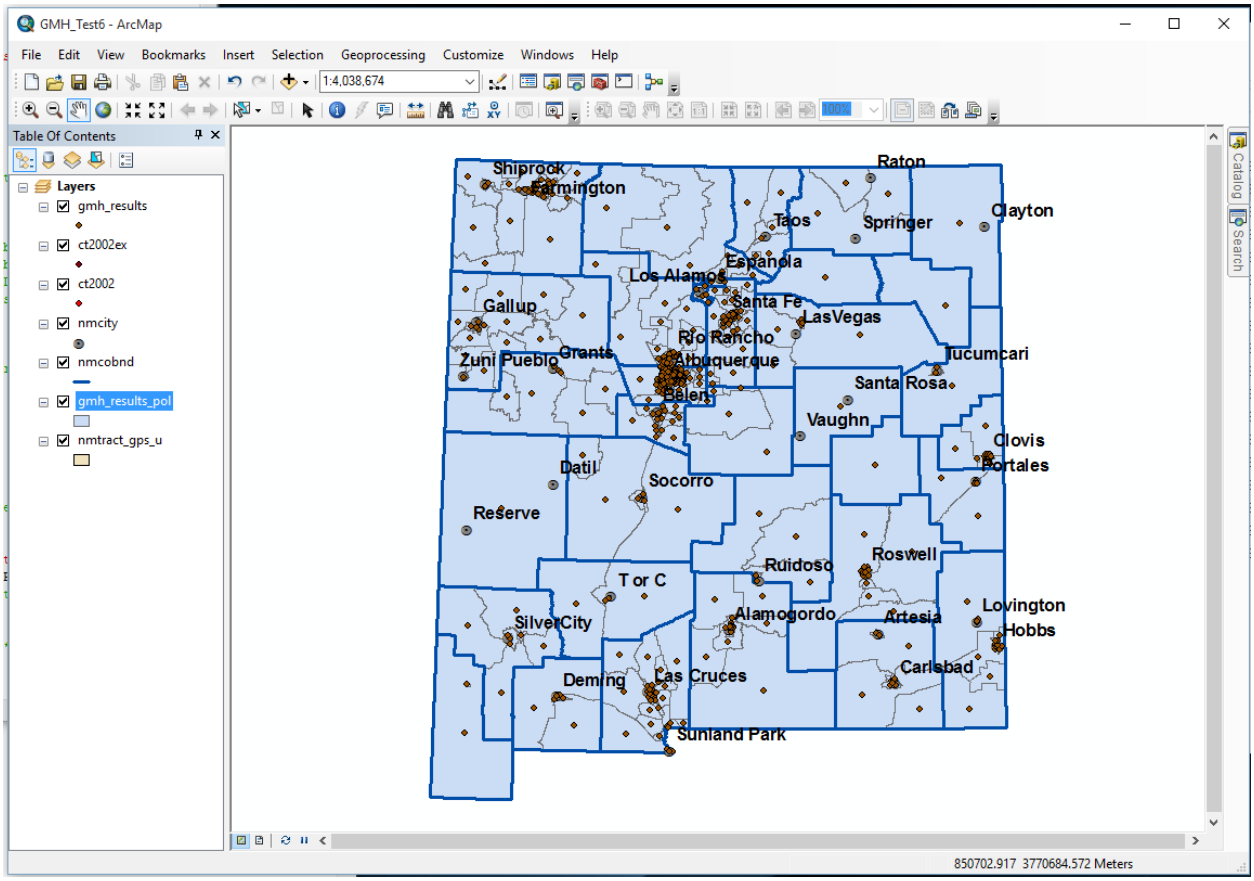
Table

gmh_results

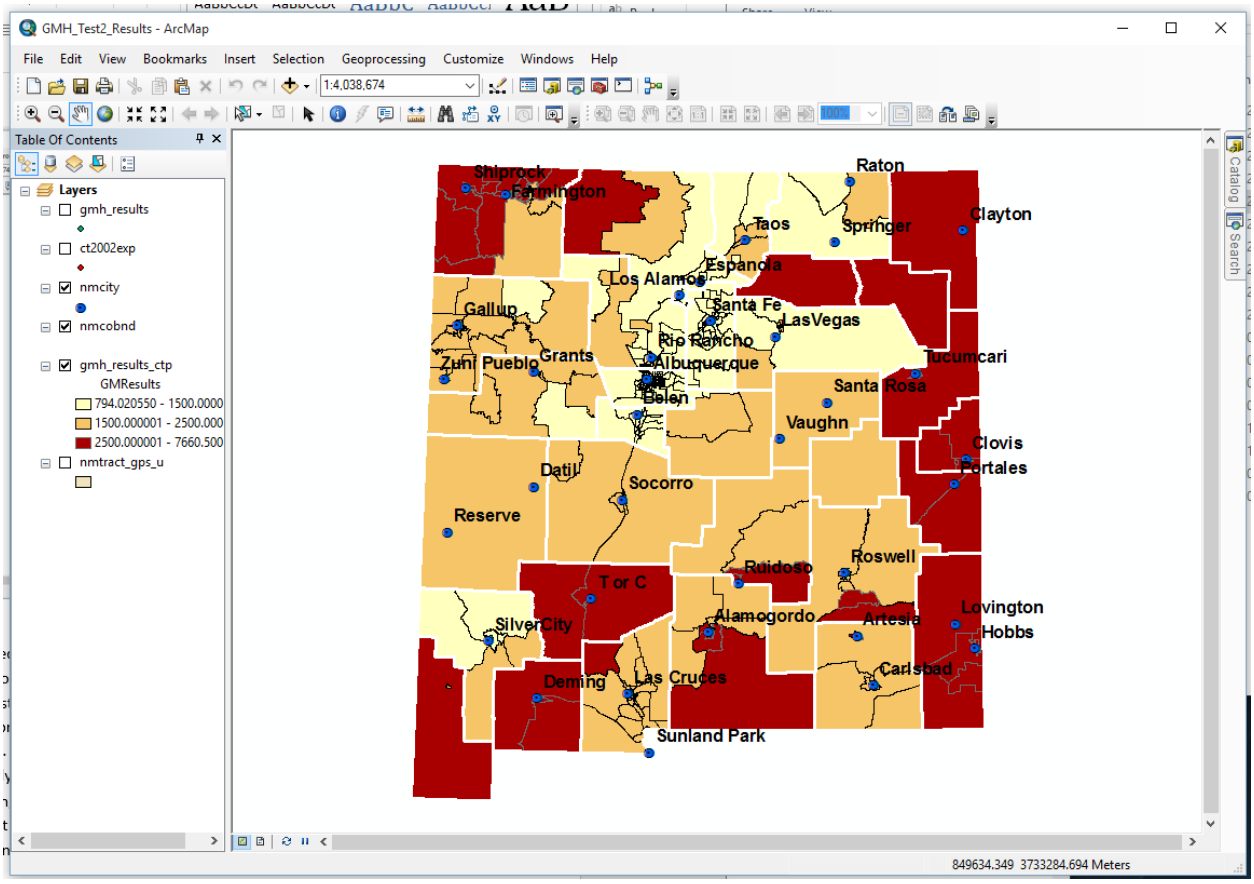
FID	Shape *	COUNTYFP	GEOID	NAME	Shape_Leng	Year_2002	Year_2010	PCSUM	PopSum	PrvSum	GMResults
0	Point	045	35045000302	3.02	0.071322	3377	3484	0	109927.71675	42.124868	2609.568205
1	Point	057	35057963600	9636	2.714043	7256	6841	1	198251.764938	121.022611	1638.138229
2	Point	057	35057963700	9637	4.365856	2246	2295	1	35321.348597	21.108082	1673.356647
3	Point	001	35001004402	44.02	0.100807	4054	4058	0	757265.484968	603.681925	1254.411393
4	Point	001	35001004501	45.01	0.075078	3596	3522	0	756675.128939	603.916134	1252.947365
5	Point	001	35001004712	47.12	0.142892	5221	7209	0	759523.081301	604.002214	1257.483937
6	Point	001	35001004713	47.13	0.072926	3427	7004	0	758802.157906	603.571753	1257.186332
7	Point	001	35001004724	47.24	0.087961	3338	3186	0	757938.38978	605.456229	1251.846712
8	Point	001	35001004726	47.26	0.073765	2714	2450	0	762855.172317	606.595148	1257.601837
9	Point	001	35001004728	47.28	0.083828	3709	5089	0	762557.127557	606.827172	1256.629833
10	Point	001	35001004729	47.29	0.114773	2738	3635	0	760789.793164	606.17384	1255.068667
11	Point	001	35001004725	47.25	0.067239	3366	3729	0	760042.013852	606.940201	1252.25189
12	Point	001	35001004717	47.17	0.089693	6206	7596	0	752745.236572	603.05471	1248.220475
13	Point	001	35001004720	47.20	0.073017	3720	3517	0	752698.255345	602.853459	1248.559237
14	Point	001	35001000714	7.14	0.080923	3244	4716	0	765389.714767	601.855287	1271.717191
15	Point	045	35045943201	9432.01	3.454613	5595	5707	33	98309.265365	43.780729	2245.491727
16	Point	045	35045000205	2.05	0.12861	6524	6705	0	109789.84405	42.050432	2610.908804
17	Point	045	35045943100	9431	1.957683	2270	1936	0	39505.30413	6.887341	5735.929686
18	Point	045	35045000100	1	0.205475	4877	5120	0	109961.016555	42.074514	2613.482721
19	Point	045	35045000201	2.01	0.192732	3431	4375	6	109393.478443	41.546765	2633.020341
20	Point	045	35045000702	7.02	1.426839	1154	1236	1	100204.695167	41.731152	2401.196459
21	Point	037	35037958602	9586.02	0.338634	3337	2931	0	13377.134311	6.568612	2036.523819

1 (0 out of 499 Selected)

gmh_results



Modify Class Breaks (6):



Current Problems:

- Process for automated symbology needs future development.
- Joined files do not work with some tools especially layer symbology.
- Layer symbology must not be updated with layer based on manual classification.
  Note: Initial natural breaks or other classifications can't be updated automatically with a manual classification. This problem needs to be resolved with ESRI and subsequent versions will hopefully allow for automated symbology.
- Data cursors (including new da – data access) seem to work as a stand-alone script but not as a python script tools when accessing a simple geodatabase file of statistics needed for automating symbology. This problem also needs to be resolved with ESRI.

Credits:

The original idea for DGR's healthcare gravity model was developed by James W. "Jim" Davis the principal investigator for these projects. Several students at DGR assisted with the development; John "Jack" Ruggerio researched ZIP Code boundaries and developed the ZIP Code base map, and Judith Van der Elst prepared some maps and the poster presentation. I was the GIS project manager at the time and worked with Jim Davis to prepare the SAS Macro and performed the data analyses in both SAS and ArcGIS.

Larry Spear
Sr. Research Scientist (Ret.)
Division of Government Research
University of New Mexico
Email: lspear@unm.edu
Web: http://www.unm.edu/~lspear