DGR's Health Care Providers and Facilities Gravity Model
QGIS - Python Processing (PyQGIS) Script Development
Preliminary Testing and Documentation

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Background:

The health care 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 health care 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 and SAS along with open source versions of QGIS. 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.

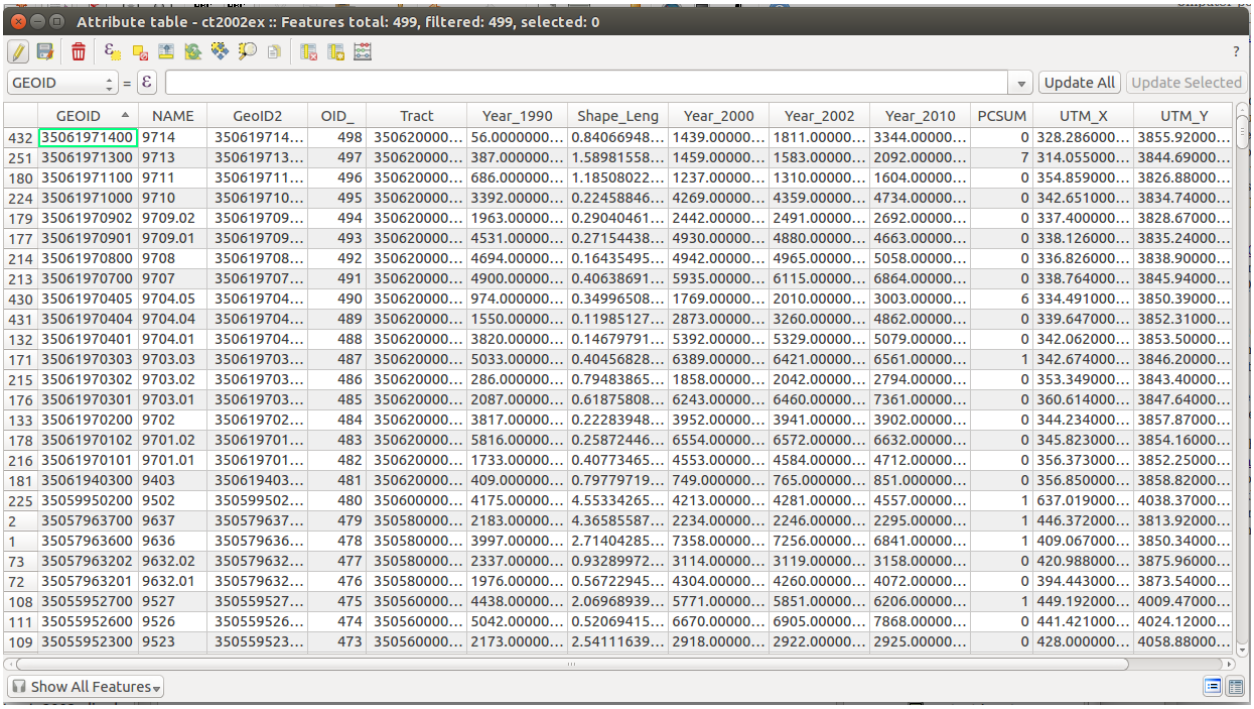
See a recent geography class presentation that illustrates current developments using ArcGIS and some problems that were encountered. There is also a ArcGIS Online - story map (being developed) that shows additional results using SAS. This documentation describes more recent developments of the DGR gravity model using QGIS.

Note: This research project clearly illustrates that there is usually more that one way to accomplish a task using various computing facilities (hardware and software). No way is actually much better than the other. Although the QGIS development was performed using Ubuntu-Linux, it has been tested and works using Windows and the Mac environments.

Instructions for Use:

1. Prepare a census tract (or other data collection unit) shapefile with populations and provider (or facility) data. Note: this is a point based shapefile.
2. Also prepare a polygon based census tract(or other data collection unit) and county boundary shapefiles for resulting data display.
3. Open an empty QGIS project (.qgis) and add the point based census tract shapefile with initial data. Open Python Console (Plugins menu)
4. Click on the DGR gravity model processing script (must be loaded into your (.qgis2/processing/scripts folder) currently called GravMod_QGIS_v1.py in the Processing Toolbox – Scripts – Gravity Model location. Fill in the required fields and run.
5. Review the Initial results including the Processing – History and Log …
6. Use the Join Attributes by Location tool (Vector – Data Management Tools) to get the point based gravity model results joined into the polygon census tract layer. (Note: not yet in this version of the Python Processing Script).
7. Create a map composition and a PDF if desired (Note: not yet in this version of the Python Processing Script).

Census Tract Shapefile Example (1):



	GEOID	NAME	GeoID2	OID_	Tract	Year_1990	Shape_Leng	Year_2000	Year_2002	Year_2010	PCSUM	UTM_X	UTM_Y
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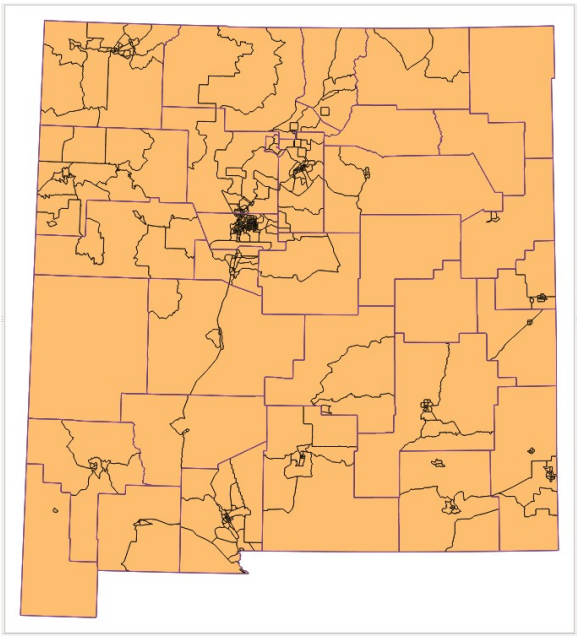
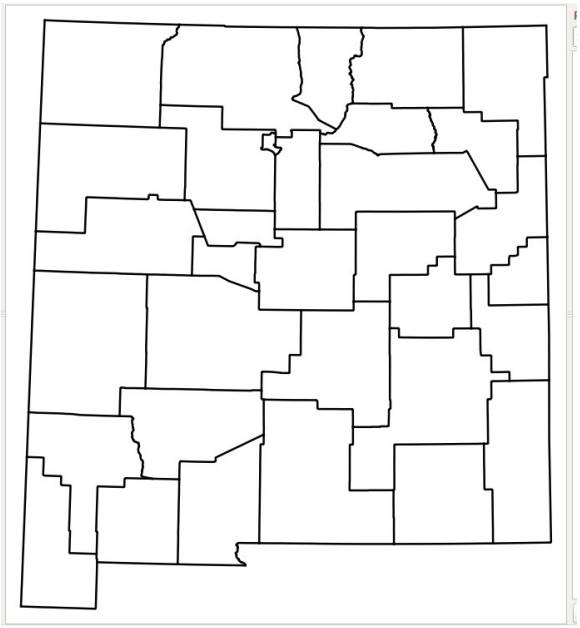
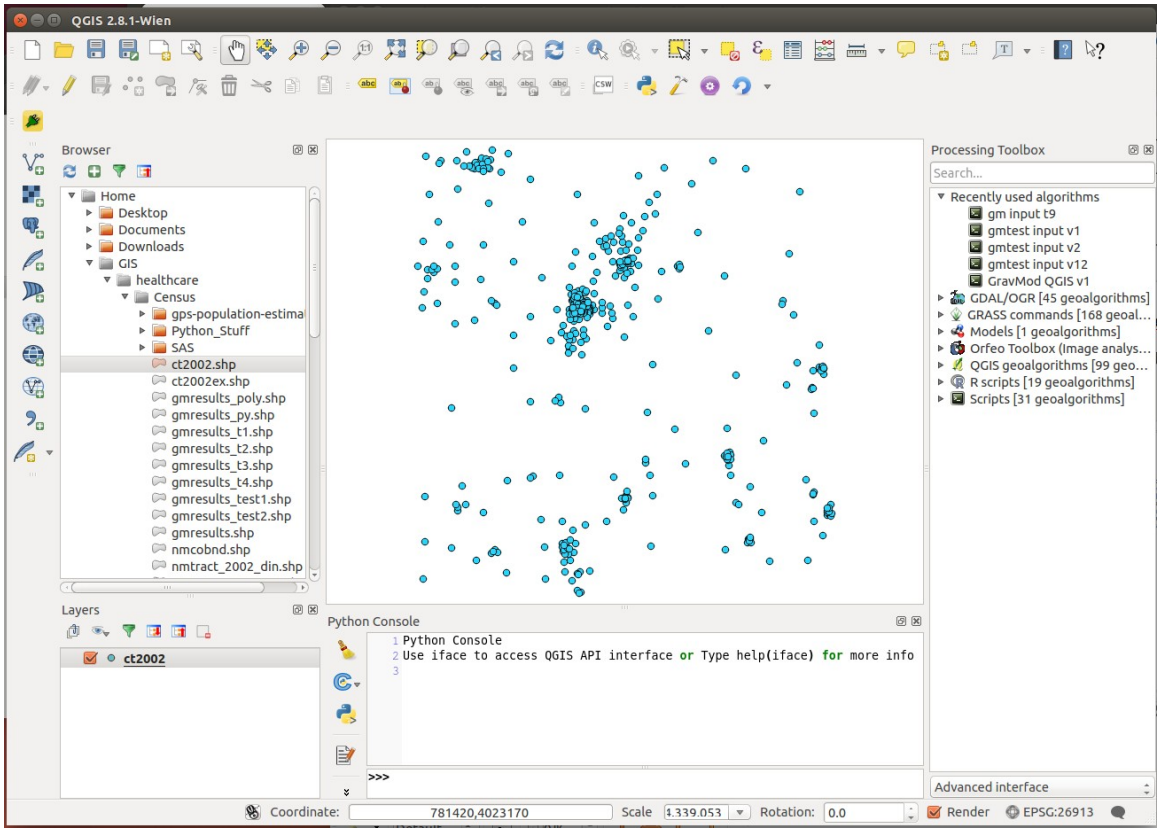
251	35061971300	9713	350619713...	497	350620000...	387.000000...	1.58981558...	1459.00000...	1583.00000...	2092.00000...	7	314.055000...	3844.69000...
180	35061971100	9711	350619711...	496	350620000...	686.000000...	1.18508022...	1237.00000...	1310.00000...	1604.00000...	0	354.859000...	3826.88000...
224	35061971000	9710	350619710...	495	350620000...	3392.00000...	0.22458846...	4269.00000...	4359.00000...	4734.00000...	0	342.651000...	3834.74000...
179	35061970902	9709.02	350619709...	494	350620000...	1963.00000...	0.29040461...	2442.00000...	2491.00000...	2692.00000...	0	337.400000...	3828.67000...
177	35061970901	9709.01	350619709...	493	350620000...	4531.00000...	0.27154438...	4930.00000...	4880.00000...	4663.00000...	0	338.126000...	3835.24000...
214	35061970800	9708	350619708...	492	350620000...	4694.00000...	0.16435495...	4942.00000...	4965.00000...	5058.00000...	0	336.826000...	3838.90000...
213	35061970700	9707	350619707...	491	350620000...	4900.00000...	0.40638691...	5935.00000...	6115.00000...	6864.00000...	0	338.764000...	3845.94000...
430	35061970405	9704.05	350619704...	490	350620000...	974.000000...	0.34996508...	1769.00000...	2010.00000...	3003.00000...	6	334.491000...	3850.39000...
431	35061970404	9704.04	350619704...	489	350620000...	1550.00000...	0.11985127...	2873.00000...	3260.00000...	4862.00000...	0	339.647000...	3852.31000...
132	35061970401	9704.01	350619704...	488	350620000...	3820.00000...	0.14679791...	5392.00000...	5329.00000...	5079.00000...	0	342.062000...	3853.50000...
171	35061970303	9703.03	350619703...	487	350620000...	5033.00000...	0.40456828...	6389.00000...	6421.00000...	6561.00000...	1	342.674000...	3846.20000...
215	35061970302	9703.02	350619703...	486	350620000...	286.000000...	0.79483865...	1858.00000...	2042.00000...	2794.00000...	0	353.349000...	3843.40000...
176	35061970301	9703.01	350619703...	485	350620000...	2087.00000...	0.61875808...	6243.00000...	6460.00000...	7361.00000...	0	360.614000...	3847.64000...
133	35061970200	9702	350619702...	484	350620000...	3817.00000...	0.22283948...	3952.00000...	3941.00000...	3902.00000...	0	344.234000...	3857.87000...
178	35061970102	9701.02	350619701...	483	350620000...	5816.00000...	0.25872446...	6554.00000...	6572.00000...	6632.00000...	0	345.823000...	3854.16000...
216	35061970101	9701.01	350619701...	482	350620000...	1733.00000...	0.40773465...	4553.00000...	4584.00000...	4712.00000...	0	356.373000...	3852.25000...
181	35061940300	9403	350619403...	481	350620000...	409.000000...	0.79779719...	749.000000...	765.000000...	851.000000...	0	356.850000...	3858.82000...
225	35059950200	9502	350599502...	480	350600000...	4175.00000...	4.55334265...	4213.00000...	4281.00000...	4557.00000...	1	637.019000...	4038.37000...
2	35057963700	9637	350579637...	479	350580000...	2183.00000...	4.36585587...	2234.00000...	2246.00000...	2295.00000...	1	446.372000...	3813.92000...
1	35057963600	9636	350579636...	478	350580000...	3997.00000...	2.71404285...	7358.00000...	7256.00000...	6841.00000...	1	409.067000...	3850.34000...
73	35057963202	9632.02	350579632...	477	350580000...	2337.00000...	0.93289972...	3114.00000...	3119.00000...	3158.00000...	0	420.988000...	3875.96000...
72	35057963201	9632.01	350579632...	476	350580000...	1976.00000...	0.56722945...	4304.00000...	4260.00000...	4072.00000...	0	394.443000...	3873.54000...
108	35055952700	9527	350559527...	475	350560000...	4438.00000...	2.06968939...	5771.00000...	5851.00000...	6206.00000...	1	449.192000...	4009.47000...
111	35055952600	9526	350559526...	474	350560000...	5042.00000...	0.52069415...	6670.00000...	6905.00000...	7868.00000...	0	441.421000...	4024.12000...
109	35055952300	9523	350559523...	473	350560000...	2173.00000...	2.54111639...	2918.00000...	2922.00000...	2925.00000...	0	428.000000...	4058.88000...

Census Tract Polygon and County Boundary Shapefiles (2):

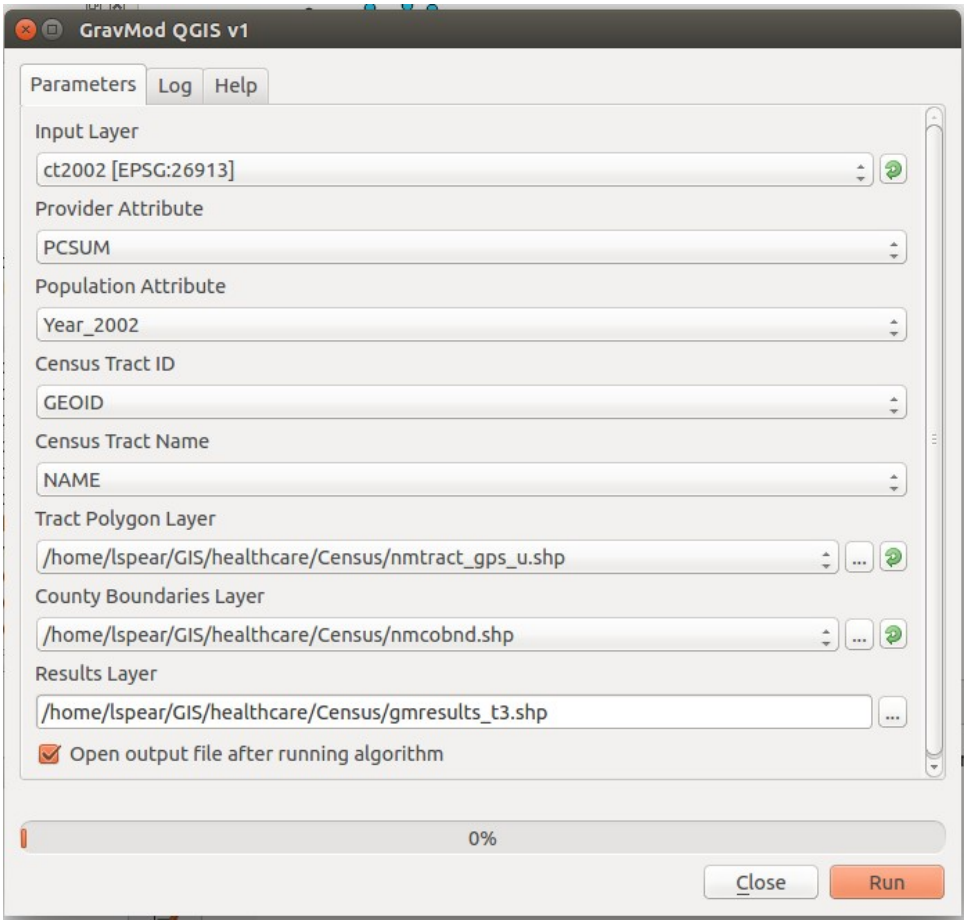




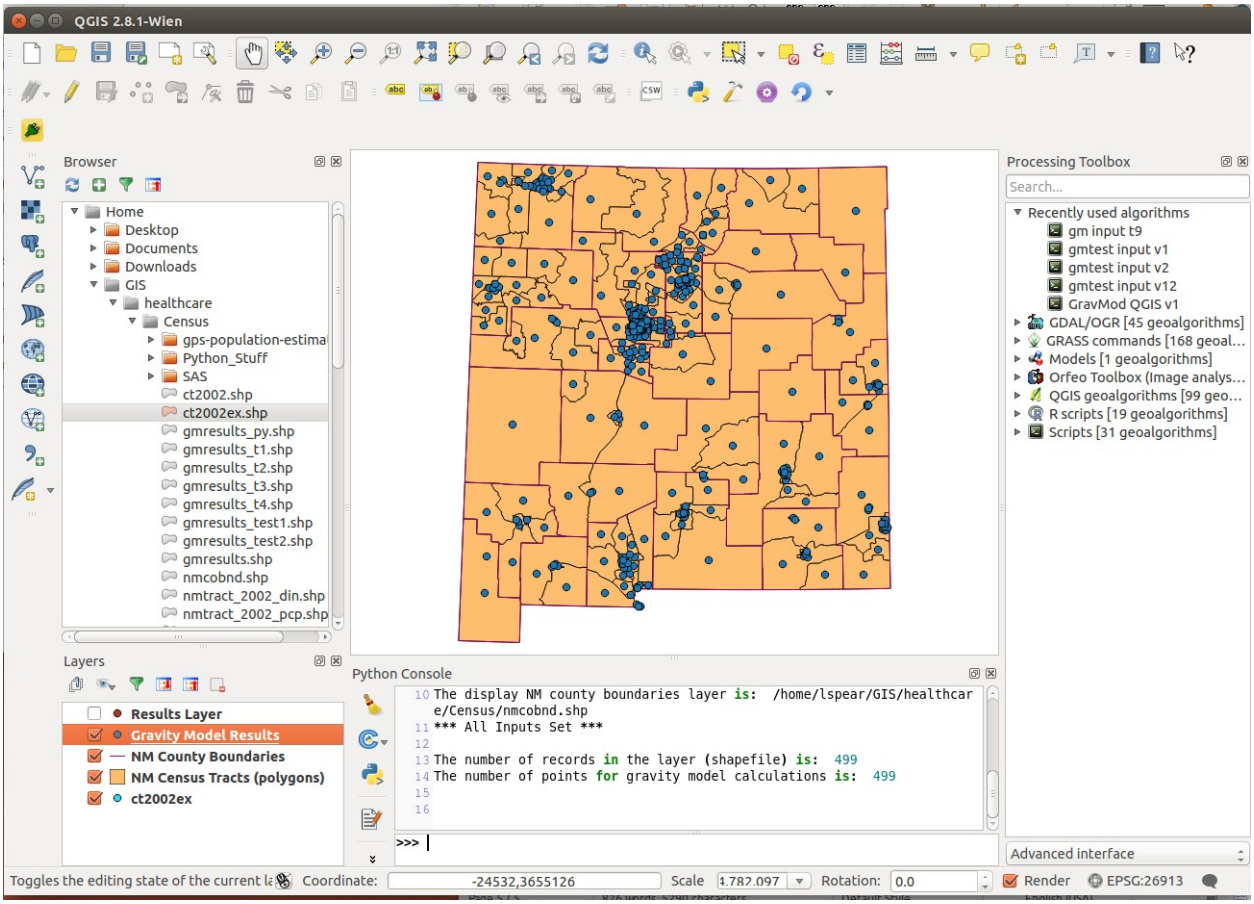
Open an Empty QGIS Project - add Census Tract (point) Shapefile (3):

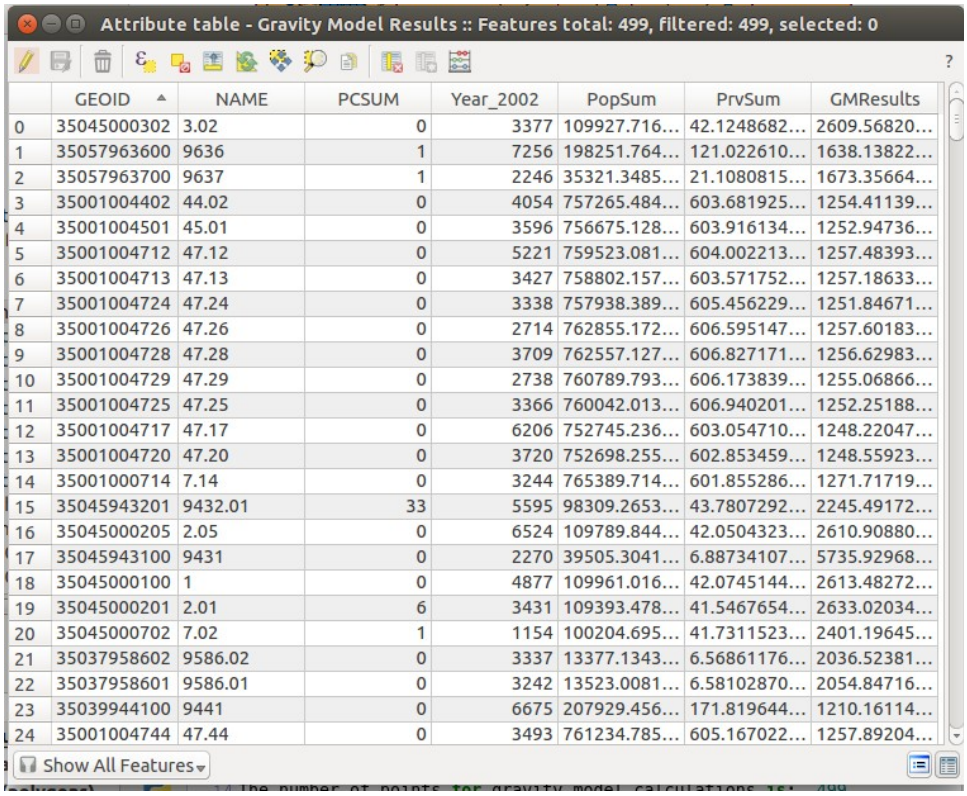


Run DGR Gravity Model Processing Script (4):



Review Initial Results Display (5):

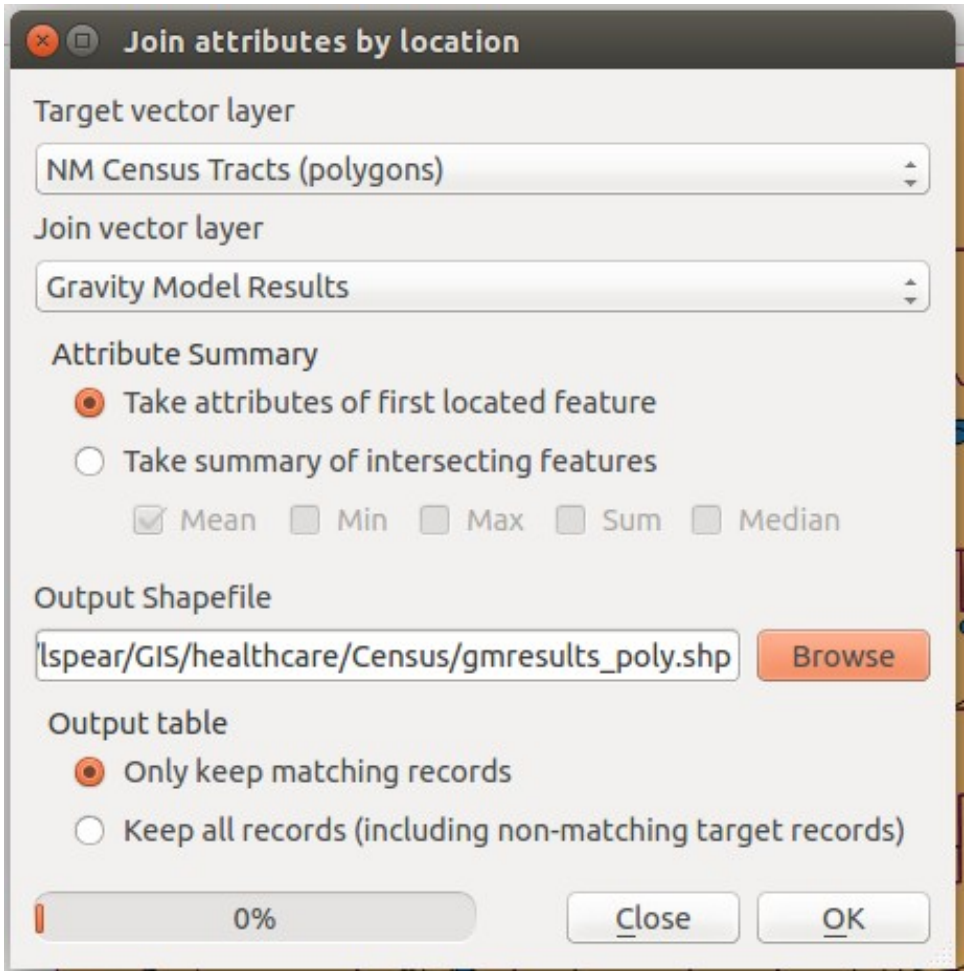




	GEOID	NAME	PCSUM	Year_2002	PopSum	PrvSum	GMResults
0	35045000302	3.02	0	3377	109927.716...	42.1248682...	2609.56820...
1	35057963600	9636	1	7256	198251.764...	121.022610...	1638.13822...
2	35057963700	9637	1	2246	35321.3485...	21.1080815...	1673.35664...
3	35001004402	44.02	0	4054	757265.484...	603.681925...	1254.41139...
4	35001004501	45.01	0	3596	756675.128...	603.916134...	1252.94736...
5	35001004712	47.12	0	5221	759523.081...	604.002213...	1257.48393...
6	35001004713	47.13	0	3427	758802.157...	603.571752...	1257.18633...
7	35001004724	47.24	0	3338	757938.389...	605.456229...	1251.84671...
8	35001004726	47.26	0	2714	762855.172...	606.595147...	1257.60183...
9	35001004728	47.28	0	3709	762557.127...	606.827171...	1256.62983...
10	35001004729	47.29	0	2738	760789.793...	606.173839...	1255.06866...
11	35001004725	47.25	0	3366	760042.013...	606.940201...	1252.25188...
12	35001004717	47.17	0	6206	752745.236...	603.054710...	1248.22047...
13	35001004720	47.20	0	3720	752698.255...	602.853459...	1248.55923...
14	35001000714	7.14	0	3244	765389.714...	601.855286...	1271.71719...
15	35045943201	9432.01	33	5595	98309.2653...	43.7807292...	2245.49172...
16	35045000205	2.05	0	6524	109789.844...	42.0504323...	2610.90880...
17	35045943100	9431	0	2270	39505.3041...	6.88734107...	5735.92968...
18	35045000100	1	0	4877	109961.016...	42.0745144...	2613.48272...
19	35045000201	2.01	6	3431	109393.478...	41.5467654...	2633.02034...
20	35045000702	7.02	1	1154	100204.695...	41.7311523...	2401.19645...
21	35037958602	9586.02	0	3337	13377.1343...	6.56861176...	2036.52381...
22	35037958601	9586.01	0	3242	13523.0081...	6.58102870...	2054.84716...
23	35039944100	9441	0	6675	207929.456...	171.819644...	1210.16114...
24	35001004744	47.44	0	3493	761234.785...	605.167022...	1257.89204...

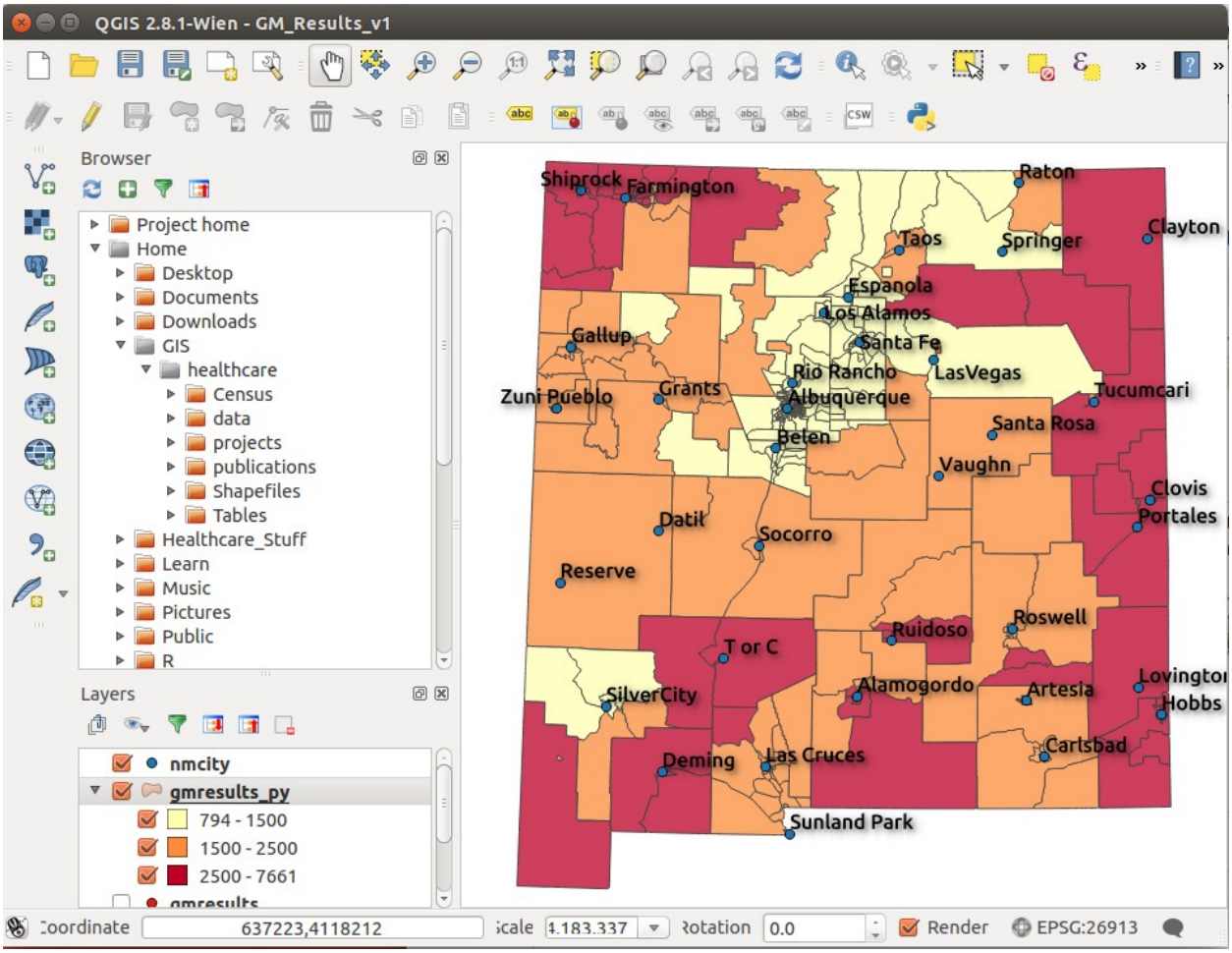
Join Attributes by Location (6):

Note: Currently having problems getting the Join Attributes by Location tool working in a Python (PyQGIS) processing script. This step can be done manually / interactively until this problem is resolved.



Create a Map Composition and PDF (7):

Note: Currently this is also a manual / interactive process and subsequent versions of this processing script will attempt to automate (set class breaks and symbology) this procedure.



Current Problems:

- Need to resolve how to get the Join Attributes by Location tool to work in subsequent versions of this processing script.
- Need to finish this processing script by automating the map composition process (class breaks and symbology) and PDF creation. .

Credits:

The original idea for DGR's healthcare gravity model was developed by James W. "Jim" Davis the principal investigator for the projects performed by DGR for the NM HPC. 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.

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