



Forensic Geography
Lab: Hot Spot Analysis 3
Getis-Ord Gi* Testing
(adapted from ESRI)

Background

Hot spot analysis is a commonly used tool in crime analysis and the goal of this technique is to identify clusters of criminal activity on a map. This would allow authorities to better allocate resources and protect potential victims of crime.

The Getis-Ord Gi* test, named for its creators, Arthur Getis and Keith Ord, and pronounced (G-I-Star) finds the locations and extents of point clusters in two-dimensional space. You will be using the Getis-Ord Gi* test for hot spot analysis in this lab. A single block may have a high crime count, but it is not considered a hot spot unless there are other nearby blocks that also have high crime counts (that is, there is significant positive spatial autocorrelation—near places are similar).

You should know a bit about how this tool works. The Getis-Ord Gi* test identifies clusters of points that have higher values than expected by chance. This test requires data aggregated from individual crime point locations to crime counts for *small areas* represented by centroid points, so you must essentially collect all neighborhood crimes into a single point for each neighborhood. This is useful for a number of other GIS needs. If you had just addresses, there would be too many “1 crime here” instances in the data set. Essentially the test seeks to find if a neighborhood’s crime count is high and nearby neighborhoods’ crime counts are also high. If that is the case, then the Getis-Ord Gi* test concludes that these areas are part of a hot spot.

A **city block** is a good-size area to use for many types of crime analysis, and it will be used for this test because the hot spots used for directing patrols or other police interventions need to be for small areas, and crime problems related to the hot spots are often at the scale of blocks.

Skills

You will demonstrate that you understand of the principles behind the Getis-Ord Gi* as well as how to run this statistical test in ArcMap10 and how to display the results of the test on a map.

1. Students explain when the Getis-Ord Gi* is an appropriate test and why it should be used.
2. Students calculate the Getis-Ord Gi* using software
3. Students map the result of the Getis-Ord Gi* as a graduated color map.

Your Task: Calculate and map clustering occurring at the block level using the Getis Ord Tool

Step 1: Open the HotSpot 3 Lab map document

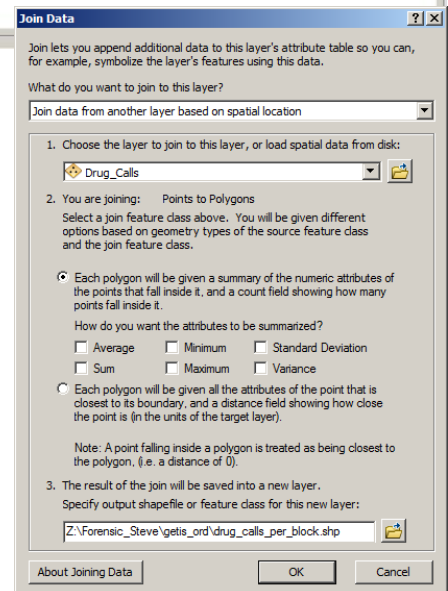
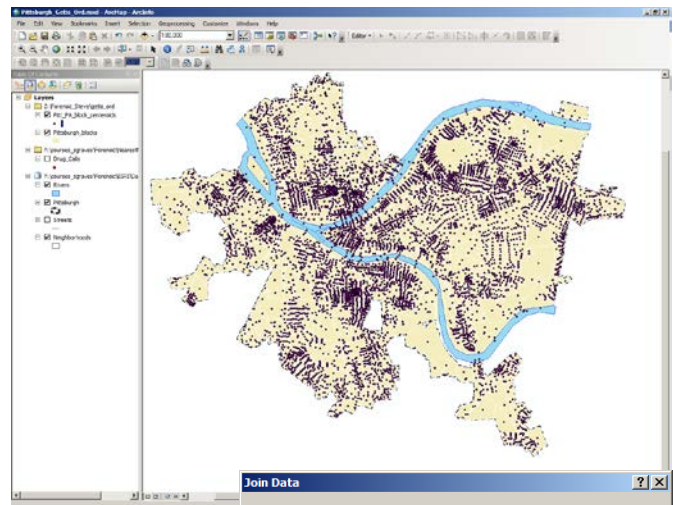
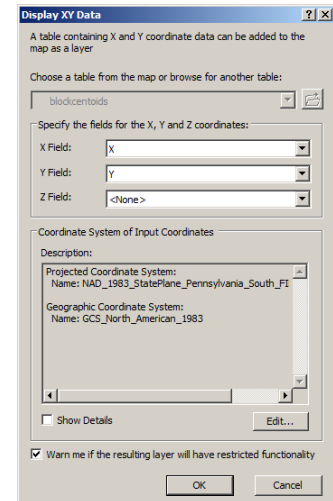
1. The file is in the following location: Y:\courses_sgraves\Forensic\Getis_Ord\Pittsburgh_Getis_Ord.mxd
2. Make sure the Table of Contents is set to “List by Drawing Order”.
3. Save the map document to your own folder on the Z drive.
4. Export the “Block” layer to your Z drive, so you will have write access to this file. You will not be able to add a field (new column of data) to the attribute table unless it is YOUR file.
 - a. Right click on Blocks, click on Data> Export Data
 - b. Use the data frame option in the Export Window
 - c. Name the file Pittsburgh_Blocks.shp. Click OK
 - d. You may want to remove the old “Blocks” layer on the server drive.

Step 2: Add XY centroid coordinates to a polygon attribute table

The centroid of a polygon is the point from which the polygon would balance if it were cut from cardboard and placed on a pencil point. (The case of a quarter-moon-shaped polygon is an exception because its centroid is not

inside its boundary.) So, a centroid is a kind of center of a polygon that makes a handy map layer for displaying certain kinds of polygon information. In this exercise, you add centroid coordinates to the Blocks attribute table. You need to do this task just once to have the results available for future use. The freeware GIS program GeoDA (for Geographic Data Analysis) is reputed to have a better centroid-making tool; and some other cool functions, so it might be worth your effort to investigate/download it (<http://geodacenter.asu.edu/>)

5. In the table of contents, right-click Pittsburgh Blocks and select Open Attribute Table.
6. Click Table Options > Add Field. Type X for Name and select Double for Type. Click OK.
7. Repeat the step above to create the Y field.
8. Right-click on your new X column heading and select Calculate Geometry. Click Yes. Select X Coordinate of Centroid and click OK.
9. Repeat the steps above to compute the Y Coordinate of Centroid. Note that this coordinate system is in feet.
10. Click Table Options > Export. Click the Browse button and go to your Z drive where you have been saving files.
11. Select "dbf" from the "Save as type" menu, change name to BlockCentroidsTable, and click Save.
12. Click OK > Yes.
13. You should see your new BlockCentroidsTable in your Table of Contents now.
14. Right click on BlockCentroidsTable and select "Display XY data"
15. The window (see right) should appear. Click OK. Click Yes.
16. Now you have an "event file" appearing in your Table of Contents and a large number of small dots appearing on your map.
17. This is an EVENT file. It's like a ghost file, so you need to make it solid.
18. Right click on BlockCentroids... Events in the Table of Contents and chose Data>Export Data.
19. Rename the file BlockCentroidPoints.shp and save it in your Z drive.
20. You can remove your EVENTS file and your block centroid table at this point if you'd like.
21. You may want to reduce the size of the points representing block centroids to 2 in the symbology tab (see right)



Now, you'll count the drug calls by block and attach the counts to the block centroids point layer you just created.

Step 3: Join your points to polygons

Every time you have new data for hot spot analysis, you'll need to perform this task and the remaining ones in this section. In this exercise, you use spatial join, then table join to assign a block ID to each crime point.

Note that when you do a spatial join, the program arbitrarily assigns crime points located at a street intersection to a single block, and thus does not double-count these points. There is no "correct answer" for assigning such points to blocks, so this is the best solution. Crime points with street addresses have a 20 ft offset from street centerlines, and thus fall within the correct blocks. Note there are other ways of doing this procedure. For example, you

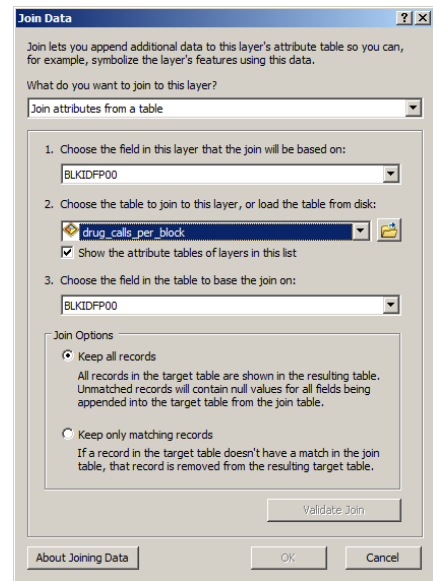
could use the Overlay tool, in the ArcTool Box in the Analysis toolset, but we're not using a geodatabase for this assignment.

22. Right click on Pittsburgh_Blocks, then select Joins & Relates> Join
23. From the Join Data window, make sure the join option is set to "Join data from another layer based on spatial location"
24. Select Drug Calls as the point layer to join into your Pittsburgh Blocks layer. (see image right).
25. Rename the layer from Join_Output to "drug_calls_per_block.shp" Click OK
26. Give the software a moment to work...and a new layer will appear.
27. The new layer will have a "Count_" column that represents the number of drug calls for each block inside of Pittsburgh.
28. You could make a choropleth map of "Count_"

Step 4: Join the Table Data

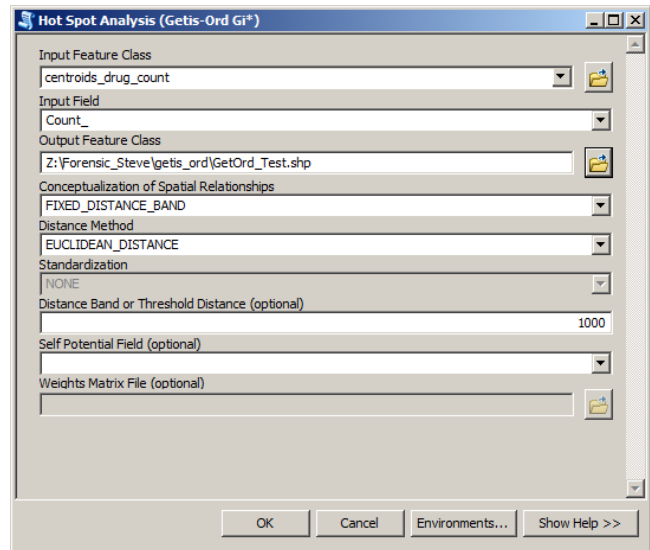
In order to get the crimes per block data to the block centroid map you have to do a "table join".

29. Right click on the BlockCentroids layer in the Table of Contents. Select Joins and Relates>Joins.
30. This time you want to switch the first option window to "Join attributes from table"
31. Join the table "drug calls per block" to the centroid map by the field "BLKIDFP00" in both attribute tables. Click OK and Yes at the nag window.
32. Open the attribute table for the block centroid map. Note a new "Count_" column has appeared.
33. Table joins, such as this are temporary unless you export them, so right click on your BlockCentroids layer in the Table of Contents, and from the drop down menu, select Data>Data Export.
34. Export the feature to your Z drive and name the new layer "centroid_drug_count.shp". Click Yes to add the layer.



Step 4: Run the Getis-Ord Gi* Test

35. From the ArcToolbox/Spatial Statistics Tools, pick Hot Spot Analysis (Getis-Ord) from the Mapping Clusters Tools.
36. Use the image on right to guide your completion of the parameters in the dialog box.
37. Pick 1000 feet as your distance threshold, since that's the distance you've been using in this series of crime maps.
38. Click OK and examine your results, especially the Attribute Table where you'll see the Z/P scores for each point.



For Credit:

1. Zoom in on the block with the highest Z score. Grab a screen capture of this block.
2. Paste that into a word document.
3. Write a paragraph explaining why this block is included in this hotspot analysis, even though it may not have the crime totals one would expect. Use your distance tool (ruler) to measure distance between centroids.