

Proximity Analysis - ArcGIS Functions Guide

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November 5, 2007

Requirements for spatial analysis in GIS – read and do these before you begin any spatial analysis!

All data and the data frame must be in the same coordinate system:

Before doing any analysis functions in ArcGIS, make sure that all the data layers you will be using are in the same map projection/coordinate system, and that the data frame is also in that coordinate system. For ANY analysis in ArcGIS, the layers you are using in your analysis MUST be in the same coordinate system, and this must match the coordinate system of the data frame. If you don't do this, you'll either get errors, or it will appear to run, but nothing will happen. If your data is in a different coordinate system, the easiest way to convert it to set the data frame to the correct one (e.g., Mass State Plane, Mainland, NAD 83, meters), then right-click on the layer that is not in that coordinate system and choose Data-Export. In the dialog box, say you want the new file to have the same as the data frame's coordinate system, and proceed from there. This creates a copy of the original shape file in the correct coordinate system. See my tip sheets concerning projections if you need more help.

Set the Geoprocessing Environment Settings

For most or all of these analysis functions, it will also help things if you set the Environment Settings. I recommend you set these before you do anything by going to the main toolbar in ArcGIS and clicking on Tools - Options, then clicking on the Geoprocessing tab, and finally clicking on the "Environments" button there. The critical things for you to set are:

1. Under the *General Settings* area;
 - a. Set the *current workspace* to be where you are pulling data from (just click on a folder, not a file - the folder within which most of your GIS data is located)
 - b. Set the *scratch workspace* to a temp folder on your local computer that you have write access to. If you don't have write access, this will cause errors. Create a temp folder on the local computer under your user name if you have to.
 - c. Most important, set the Output Coordinate System to be the one you want all your analysis to be in
 - d. Set the *Output Extent* to be the largest extent of your study area – use an existing file that covers the study area or create a new one. This is critical for raster analysis – you must use the same extent for all your raster work The Extent will always be rectangular even if you use an irregular polygon area to set it. Also use the Snap Raster function to ensure alignment.
2. Under the *Raster Analysis Settings* area:
 - a. Set the cell size (use this for all your raster analysis, so think about the cell size carefully)
 - b. Set a mask if you want (a polygon layer that represents the study area – the area outside this layer will not be included in the analysis – if you use an irregular polygon layer to set this, the mask will reflect that.

Proximity Analysis

For a good discussion and good graphic illustrations of proximity analysis in GIS, see *The ESRI Guide to GIS Analysis, volume 1: Geographic Patterns and Relationships*, chapter 6 – Finding What’s Nearby.

Please see the ArcGIS 9.2 online help for a fuller explanation of the individual functions - <http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=welcome>

Note that **Hawth’s Tools** ArcGIS extensions can be downloaded for free from Spatial Ecology.com - <http://www.spatalecolology.com/htools/index.php>

Questions to be answered	Example	Data/tool set	Functions you can use
What’s within a set distance?	Characterize the demographics of ¼ mile around parks	Vector – Selection <i>Vector – Analysis Tools - Proximity</i>	<ul style="list-style-type: none"> Select by location Buffer (then perform spatial join or intersect/union overlay)
<p>What’s the closest facility in terms of straight line distance (crow flies)?</p> <p>On average, how far is one set of points from the closest point or line in another layer?</p>	<p>Distance between parcel points and the nearest grocery store as the crow flies (one result per parcel point)</p> <p>Distance between schools and the closest Toxic Release Inventory reporting facility.</p> <p>On average, how close are Boston area schools to a TRI facility? Which schools are within ¼ mile of a facility?</p>	<i>Vector – Analysis Tools-Proximity</i>	<p><i>Near</i> tool (ArcInfo only) – works on points to points or points to line - (for polygons, need to convert polygons to centroid points first¹)</p> <p>The result is that two new fields are added to the input feature data layer, a NEAR_FID recording the feature ID of the nearest feature, and a NEAR_DIST field containing the distance to that facility. You can create a table join between the input layer (e.g., parcel centroids) and the “near features” (e.g., grocery stores) based on the Near_FID and original FID of the near features. You could also get statistics from the Near_Dist field to know max, min, mean, and standard deviation for distances between these points.</p>

¹ To convert a polygon or line to centroid points, use ArcToolbox – Data Management Tools – Features – Feature to Point tool (ArcInfo only). This creates a new point data layer with all the attributes of the original polygon or line file. The point is the centroid of the polygon, or the center point of the line feature.

<p>What's the closest facility along a street or other set path?</p> <p>What is the closest facility along a path/street in terms of time or other cost?</p>	<p>Distance between parcel points and the nearest grocery store along a street network (one result per parcel point)</p>	<p><i>Vector – Network Analyst</i> (you must first set up a network first using existing street or other line data²)</p>	<p>Network Analyst extension - Closest Facility function</p> <p>You can specify only distance as the cost of travel, or time or other cost.</p>
<p>What is the straight line distance between all points in one layer to all points in another layer?</p>	<p>Distance between parcel points and <i>all</i> grocery stores in an area (you can specify a maximum search radius)</p> <p>Distance between schools and all nearby TRI reporting facilities?</p> <p>How many Boston metro schools are within ¼ mile of more than one TRI facility?</p>	<p><i>Vector – Analysis Tools-Proximity</i></p> <p>Hawths Tools</p>	<p><i>Point Distance</i> tool – output is a table with the input layer FID and the Near_ID (“near” layer FID) and Near_Dist for every point to every point.</p> <p>Alternatively, use Hawth Tools – Distances Between Points (Between Layers) – with this you can specify a unique ID other than FID. Output is a table.</p>
<p>What is the straight line distance between all or selected points <i>within</i> a layer?</p>	<p>How far is each school in a layer from every other school?</p>	<p><i>Vector – Analysis Tools-Proximity</i></p> <p>Hawths Tools – Analysis Tools</p>	<p><i>Point Distance</i> tool – output is a table with the input layer FID and the Near_ID (“near” layer FID) and Near_Dist for every point to every point.</p> <p><i>Distances Between Points (Within a Layer)</i> – output is a matrix of distances between points, or summary stats</p>
<p>What is the distance at any given location on a map to the nearest feature type of interest?</p>	<p>Visualize distance from roads or parks or TRI facilities across a surface.</p> <p>Create a distance preference grid for use in another model (e.g., for affordable housing, the shorter distance to a transit station the better)</p>	<p><i>Raster – Spatial Analyst - Distance</i></p>	<p>Euclidean Distance is the tool for straight line distance.</p> <p>Cost Distance can incorporate variables that make travel more difficult (e.g., slope, crime, forest)</p>

² To create a network from an existing street centerline file, open ArcCatalog, right-click on the street centerline file, and choose New Network Data Set. See help for the Network Analyst extension for full instructions.

<p>How far are points from the edge of the nearest polygon, point, or line?</p>		<p><i>Raster – Spatial Analyst – Distance, then Extraction – Extract Values to Points</i></p>	<p>Use one of the distance tools, then extract the values of that grid to points. This is a variation of some of the earlier questions. Using a raster distance grid and extracting point values will be a rougher approximation of distance than doing a true point-to-point distance. But this function works for distance to polygons where as the point functions do not.</p>
<p>Delineate the service area of a facility or facilities, as defined by straight-line distance.</p> <p>Identify gaps in service areas</p>	<p>Show all the areas within ¼ mile of a park to estimate the area served by parks.</p> <p>Show all areas not within the park buffer, and thus outside the intended service area of parks.</p>	<p><i>Vector – Analysis Tools – Proximity - Buffer</i></p>	<p>Use the Buffer tool to create a new polygon data set that buffers existing point, line or polygon features to a specified distance or to a distance given in the attribute table.</p> <p>The gaps in service areas would be those not covered by the buffers.</p>
<p>Delineate the service area of a facility or facilities, as defined by a road or other linear network</p>	<p>Show the areas that are within a 30-minute driving time of a hospital emergency room.</p> <p>Show the areas that are within walking distance of schools, based on walking along roads.</p>	<p><i>Vector – Network Analyst (you must first set up a network first using existing street or other line data³)</i></p>	<p><i>Network Analyst extension – Service Area function</i></p>

³ To create a network from an existing street centerline file, open ArcCatalog, right-click on the street centerline file, and choose New Network Data Set. See help for the Network Analyst extension for full instructions.