

ArcGIS Spatial Analyst

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This document provides a brief overview of ArcGIS Spatial Analyst, an extension to ArcGIS 8.x for spatial modeling and analysis. Most of the information contained in this Resource Document comes from the ESRI manual [Using ArcGIS Spatial Analyst](#) by J. McCoy and K. Johnston (2001), as well as www.esri.com.

Basics

Spatial Analyst is one of the many tools that can be added to ArcGIS 8.x as a separate module, or “extension”. Spatial Analyst can be used in conjunction with other ArcGIS extensions like Geostatistical Analyst ([GIS RD 02-19](#)).

With ArcGIS Spatial Analyst, the user has access to many tools for spatial modeling and analysis. With this extension, the user can create, query, map, and analyze cell-based raster data; perform integrated raster/vector analysis; derive new information from existing data; query information across multiple data layers; and fully integrate cell-based raster data with traditional vector data sources. Additionally, the user can derive information about data such as terrain analysis, spatial relationships, suitable locations, and the accumulated cost of traveling from one point to another.

In terms of data, Spatial Analyst works with any raster format supported by ArcGIS, as well as any ArcGIS feature themes (like ArcInfo coverages, shapefiles, geodatabases, CAD files, and Internet data). Spatial Analyst also gives you the capability to convert feature classes to raster format for more advanced spatial analysis. (Users can employ ArcToolbox to convert other types of data to usable forms. See [GIS RD 02-15](#)).

Types of Questions Spatial Analyst Can Help Answer

Simple spatial questions, such as “What direction is this location facing?” or “How steep is the road at this spot?” can be answered using Spatial Analyst, as well as more complex ones like “What is the least-cost path from home to work?” or “Where is the best location for a new school?” Using data such as elevation, road networks, traffic volume, waterways, and neighborhood data (like demographics, economic data, and so forth), the user can integrate what is known about a given location and use Spatial Analyst to answer questions. The “Using ArcGIS Spatial Analyst” manual provides a guide to modeling spatial problems (Chapter 3), as well as a quick-start tutorial example (Chapter 2).

Raster Data

Spatial Analyst works primarily with raster-based data. This means that a dataset is made up of cells, arranged in columns and rows, each of which is a square that represents a specific portion of an area. In any given raster dataset, all cells are the same size (that is, they represent equal areas of the earth’s surface), and each holds a particular value of a given variable. For example, a

cell may contain the population, population density, crime rate, and other demographic facts of a given location. The higher the resolution of a raster dataset, the smaller the cell size, and the greater the detail. Further explanation of raster data is given in Chapter 4 of the manual.

Performing Spatial Analysis

Chapter 7 of the manual discusses many of the types of spatial analysis the extension performs. These include:

- mapping distance, including straight line and cost weighted distance functions
- allocation, identifying which cells belong to which source based on proximity
- mapping density, for showing greater detail about where people live or where roads exist, etc.
- interpolating to raster, which predicts values for cells with missing data
- inverse distance weighted, which puts more weight in an analysis on a cell that is nearer a cell of interest than one farther away

An Example

A basic example of the things Spatial Analyst can do is creating a population density map for a given area. To do this, one would need a layer of point features (like cities or Census Places), and, for visualization and reference purposes, a shapefile representing the boundaries of the area of interest (*e.g.*, a layer of Census Places in Pennsylvania, along with a shapefile of PA's state borders.) Using the Spatial Analyst Toolbar (turned on in the View Menu) and the "Density" function, the user selects the point file as the "Input data", and specifies which field in the attribute data contains population information. The user can specify a value in the Search radius text box to determine the distance to search for points or lines from each cell in the output raster. (*Tip: By clicking the Measure tool on the Tool toolbar and measuring the distance from a certain point, the user can reach a decision on how big to make the search radius*). The user can also specify an output cell size (*the smaller the number, the smaller the cell created, and the more cells that will be created*), and then choose a name for the result, or leave the default to create a temporary result.

After calculation, a new layer will appear in raster form. Calculated on the population information the user specifies, this layer represents the spatial distribution of people across a given area as a continuous surface.

Resources

All of the computers in the GIA Core and the PRI Computer Lab have the Spatial Analysis extension available, but to use it you must select (check mark) it from Tools- Extension menu. Copies of the "Using ArcGIS Spatial Analyst" manual are available in the GIA Core Library in 8th floor of Oswald.

For more information and greater detail, ESRI has a useful section on their website at www.esri.com/software/arcgis/arcgisxtensions/spatialanalyst/index.html which includes an easy-to-understand FAQ section at www.esri.com/software/arcgis/arcgisxtensions/spatialanalyst/faqs.html