REGRESSION ANALYSIS TOOLS FOR GIS MODELING

MODELING COMPLEX SPATIAL RELATIONSHIPS HAS BECOME EASIER WITH ARCGIS 9.3 TOOLS

The ability to model complex spatial relationships and to predict spatial trends are important for planning and decision making. Regression analysis, new with ESRI's ArcGIS 9.3, provides effective tools for exploring, examining, and measuring spatial relationships, identifying key factors contributing to particular spatial outcomes, such as urban growth, predicting future scenarios, and illustrating, through cartographic visualization, the impacts of policy and proposed urban planning projects.

Two regression techniques Ordinary Least Squares Regression (OLS) and Geographically Weighted Regression (GWR) have been added to the ArcGIS Spatial Statistics toolbox. OLS is the best known of all regression techniques. It generates a global model of the variable or process the researcher is trying to understand or predict. GWR provides a local model that accounts for spatial variation in model relationships.

By using these new tools together to identify, measure, and model spatial relationships, researchers are in a better position to understand what is going on in a place, to predict where something is likely to occur, and to investigate why things occur where they do. Here are some examples of how GIS regression analysis can be used in various disciplines to answer a wide range of relationship questions.

- Public Health: Why are diabetes rates exceptionally high in particular regions of a country?

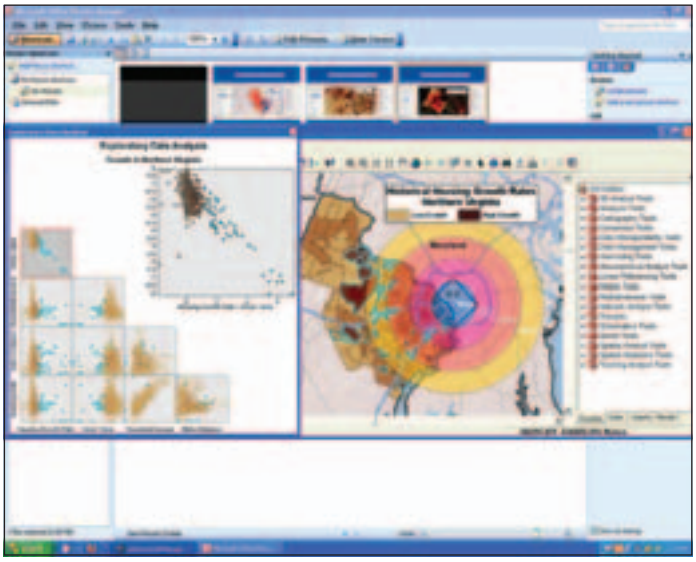

FIGURE 1. New graphing capability in ArcGIS 9.3 helps the researcher examine relationships between multiple variables in the data.]

FIGURE 2. Geographically Weighted Regression in the ArcToolbox can be employed to understand relationships between variables impacting city growth such as how distance from mass transit impacts growth, and how complex that relationship is over space.

- Public Safety: What environmental factors are associated with an increase in search and rescue event severity?
- Transportation: What demographic characteristics contribute to high rates of public transportation usage?
- Education: Why are literacy rates so low in particular regions?
- Market Analysis: What are the predicted annual sales for a proposed store?
- Economics: Why do some communities have so many home foreclosures?
- Natural Resource Management: What are the key variables promoting high forest fire frequency?
- Ecology: Which environments should be protected to encourage reintroduction of an endangered species?

Consider, for example, how GIS regression tools can predict urban growth. Data provided by Loudoun County, in Northern Virginia is useful in describing how GIS statistical tools can assess this situation. Loudon County is one of the fastest growing regions of the United States. Imagine that a city analyst is using GIS to anticipate the need to expand urban facilities. The analyst might consider variables that impact an area's population such as property values, household incomes, and neighborhood distances from mass transit. GIS statistical modeling can be used to identify relevant variables that would significantly affect the rate of growth and rule out those that would not.

The analyst takes advantage of three new statistical tools in ArcGIS 9.3. To begin the task, the analyst uses one of the new graphing tools, a scatterplot matrix, which looks at the relationships between variables in the data. The scatterplot matrix helps find some of the best variables to use in a regression analysis of urban growth (Figure 1).

The analyst uses both OLS and GWR to explore the data and understand the phenomenon of urban growth. GWR provides the most accurate prediction. The analyst uses these results to evaluate various planning decisions such as the extension of the mass transit system. By rerunning the model to determine how the extension would affect growth, the analyst singles out the spatial relationship between distance from mass transit and residential growth (Figure 2).

The analyst can use the GWR tool to add predictive accuracy to determine how extending the local metro transit system could affect the siting of proposed schools in the county. Using GWR within GIS reveals that the planned metro will probably increase population in an area that will accordingly need a school in a neighborhood that would not otherwise have been considered (Figure 3).

By using these advances in GIS spatial statistics researchers can understand and predict complex phenomena and make better decisions.

Web sites to learn more

Find out more about Regression Analysis in ArcGIS here:
http://webhelp.esri.com/arcgisdesk
top/9.3/index.cfm?TopicName=Regression_analysis_basics
Learn more about other tools in the Spatial Statistics toolbox at the sites below.
The 911 Emergency Call Analysis 5 minute demo:
http://www.esri.com/software/arcgis/arcinfo/about/demos.html
A Virtual Campus Free Web Seminar:
http://training.esri.com/gateway/index.cfm

Article by Barbara Shields, a writer at ESRI whose writing focus is predominantly about GIS and the use of natural resources. Her ESRI industry publications include Energy Currents and Environmental Observer.

FIGURE 3. ArcGIS Spatial Analyst helps the researcher see how a proposed metro extension will affect urban growth. This aids planning decisions such as highlighting where new schools will be needed.

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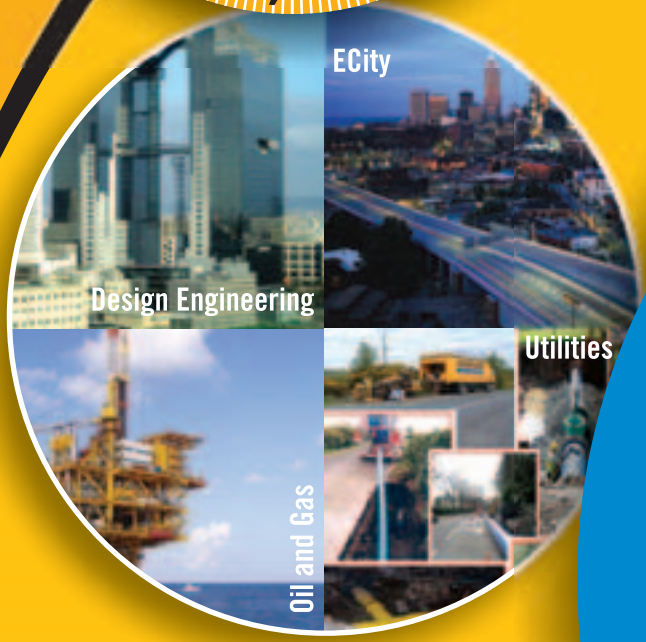

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