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Spatial analysis & modelling

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The advantage that a GIS can provide is the capability of representing spatial data in order to answer user specified queries. Such presentation transformation of spatial data are often referred to as "Data Analysis" capabilities in a GIS context. Analysis is the process to resolve and separate the reference system into its parts to illuminate their nature and inter-relationships, and to determine general principles of behavior.

Results of geographical data analysis can be communicated with maps reports or both. A map is used to display geographical relationships whereas a report is most appropriate for summarizing the tabular data and documenting any calculated or analyzed value.

Analysis functions with vector based GIS are not quite the same as with raster GIS. Vector GIS operations are more accurate compared to raster GIS.

GIS provide special facilities for storing and manipulating spatial data much of the functionality offered by GIS software is shared with conventional database software. Indeed most GIS systems have at their core the conventional database management system (DBMS). The main aim of spatial analysis is to generate information that better supports a decision maker.

GIS Systems in reality only support three basic feature types - points, lines and areas. Spatial data modeling process, therefore, is usually to decide how best the real-world features can be represented as sets of GIS point, line and area database entities. But for better information of spatial data models points, lines, areas networks and surfaces are considered together.

Data analysis has the means of understanding spatial data and carrying out analysis using the most up to date statistical methods, which have come from the areas of spatial mathematics and geostatistics.

Modeling
Statistical models allow life phenomena to be represented in a mathematical or statistical way. The advantage of modeling real life phenomena include:

- The determination of factors or variables which most influence the behaviors of the phenomena;
- The ability to predict or forecast the long term behaviour of the phenomena.

The ability to predict the behaviors of the phenomena when changes are made the factors influencing it.

Once a statistical model has been developed, simulations of the real life phenomena can be performed. The modeler can construct a wide range of scenarios by changing the influential factors. The key advantage of conducting simulations is that the phenomena's predicted behavior can be observed without placing the phenomena.

The Vector Model
The vector model, the spatial locations of features are defined on the basis of coordinate pairs. These can be discrete, taking the from of points (Point or Node data) linked together to form discrete sections of line (Arc or line data); linked together to form closed boundaries encompassing an area (Area or polygon data) Attribute data pertaining the individual spatial features is maintained in an external database.

In dealing with vector data any important concept is that Topology. Topology derived from geometrical

mathematics, is concerned with order, contiguity and relative position rather than with actual linear dimensions.

Topology is useful in GIS because many spatial modeling operations do not require coordinate locations, only topological information - for example to find an optimal path between two points requires a list of the arcs or lines that connect to each other and the cost to traverse them in each direction. It is also possible to perform the same spatial modeling and interrogation processes without using stored topology, by processing the geometrical data directly by generating topology on the fly or using vector object model as and when it is required.

The following information should always be recorded when assembling, compiling and utilizing vector data.

The data type: Point, line or Area Type of topology, which the file contains such as line, network, closed area or arc-node. Details of any automatic vector processing applied to the theme (Such as snap-to-nearest-node) State of the topology in the file, particularly whether it is 'Clean' (Topologically consistent) or contains inconsistencies that may require further intervention or processing. This is particularly important where arc-node data is concerned Projection system Co-ordinate system

The Raster Model

The spatial representation of an object and its related non-spatial attribute are merged into a unified data file. In practice the area under study is covered by a fine mesh or matrix of grid cells and particular ground surface attribute value of interest occurring at the center of each cell point is recorded as the value for that cell. It should be noted that while some raster models support the assignment of values to multiple attribute per discrete cell, others strictly to a single attribute per cell structure.

Within this model spatial data is not continuous but is divided into discrete units. In terms of regarding where individual cells are located in space, each is referenced according to its row and column position within the overall grid. To fix the relative spatial according to its row and column position within the overall grid. To fix the relative spatial position of the overall grid i.e. to geo-reference it, the four comers are assigned planar co-ordinates. An important concept concerns the size of the component grid cells and referred to as grid-resolution.

The following information should always be recorded when assembling, compiling and utilizing raster data.

- Grid size (Number of rows and columns)
- Grid resolution
- Georeferencing information e.g. comer co-ordinates, source projection.

Scope of future work

Since the two set of data model viz. Vector and raster has its own advantages and different methods of storing and analyzing of spatial and attribute data, scope really exists to visualize a data model which contains both spatial and attribute data together in a data file format of 'Geodatabases'. Recent trends, where more and more maps are put on web and digital media, a unique data model containing both spatial and attribute information in a compressed form is needed. These data can be easily and quickly transformed and visualized in the digital data world.