First semester Test
GIS 310 – Advanced GIS
Department of Geography, Geoinformatics and Meteorology
23 March 2011

Time 1h30min

1. **STUDY UNIT 1: REVIEW**

1.1 Explain the difference between the spatial and non-spatial elements of a GIS

(2)

Position (where – location in geographic space)
Attribute (what – characteristic of the object in space)

1.2 Name and define the different scales of measurements that can be used to record attribute data in a GIS.

(8)

Nominal – descriptive values
Ordinal - Give data an specific order
Interval – No absolute zero
Ratio- Absolute zero

1.3 Name the model mostly used to represent attribute data in a GIS

(1)

Relational Database Model

1.4 Name the 5 main steps that should be followed when doing a GIS process.

(5)

1. Define the Information Product
2. Design the GIS model of Reality
3. Acquire the Data
4. Analyse the Data
5. Communicate the Results

1.5 Explain the difference between cartographic models and spatial temporal models

(4)

Cartographic models: Involve the application of spatial operations to solve problems. Mostly temporally static
Spatial temporal models: Dynamic in both space and time. Time passes explicitly within running of the model. Changes in time driven processes cause changes in spatial variables

2. STUDY UNIT 2: DATA ANALYSIS

2.1 Make a list of five vector and five raster analysis methods available in a GIS for the analysis of data. Define each method and state whether it is a vector or raster analysis method. Also give a practical example of when you will use each analysis method. (You may give your answer in a tabular form) e.g.:

Method	Definition	Raster/Vector
On Screen Query	Are selected by human operator using pointing device.	Raster/Vecor
Attribute selection	Based on Attribute Data	Vector
Spatial Selection	Based on spatial relationship or location	Vector
Dissolve	combining like features within a data layer	Vector
Proximity Functions and Buffering	Are of interest around a feature	Raster/vector
Overlays	Combining spatial and attribute data from two or more spatial data layers	Raster/Vector
Network Analysis Route selection Resource allocation Traffic modelling	Analyses using a set of connected features	Vector
Geocoding	Process of spatially referencing point features based on the address of the feature	Vector
Map Algebra	Cell by cell combination of raster data layers	Raster
Mathematical	Any Mathematical calculation	Raster

Functions		
Reclassification	Assigns output values that depend on specific set of input values	Raster
Logical Operators	Typically involves comparison with scalar value and output is binary	Raster
Neighborhood functions	Used by many operations e.g. slope and aspect Based 'moving window' idea	Raster
Zonal Functions	Apply operations based on defined regions (zones) in an area	Raster
Cost Surfaces	Cost to move from source to destination	Raster
Contours	connected lines of uniform elevations that run at right angles to the local slope	Raster/Vector
Slope	change in elevation with a change in horizontal position. Often reported in degree (sometimes percentages)	
Aspect	Define the direction in which water will flow, amount of sunlight a site may receive and which direction a slope faces	
Hydrologic Functions Flow directions	May be on or below the surface of the earth. Water will flow in direction of steepest descent (Same as local aspect	
Watershed	Also called basins, contributing areas, catchments, drainages, sub drainages or sun catchments	
Drainage network	set of cells through which surface water flows	
Viewsheds	areas visible from a point	
Profile Plots	sample elevation along a profile path. Display elevation against distance on	

	a graph	
Shaded Relief Maps (Hillshade)	brightness of terrain reflections given a terrain surface and sun location	

(40)

2.2 Explain the difference between high and low spatial covariance. How can the spatial covariance of spatial data be improved?

(4)

- Cells near each other are likely to have the same value – high spatial covariance
- Values of nearby cells are unrelated – low spatial covariance

Many functions influence spatial covariance e.g. Mean filter will increase spatial covariance

2.3 Name and illustrate 4 different sampling patterns that may be used to determine the location of sampling points. Name one advantage for each sampling pattern

(12)

1. Systematic sampling pattern – spread uniformly at specified x and y intervals
   - ⊡ Ease in planning and description
   - ⊡ Easy to understand
   - ⊡ Quick to lay out
   - ⊡ Little subjective judgement
2. Cluster sampling – Groups samples in clusters. Clusters may be random or systematic
   - ⊡ Reduced travel times
3. Random sampling – selecting point locations based on random numbers
   - ⊡ Unlikely to match any pattern in landscape
   - ⊡ Points do not need to be visited in specific order – travelling costs less
4. Adaptive sampling – more frequent in areas with high variation and less frequent in areas with less variation
   - More efficient pattern
   - Sample points can made according to what is seen in the field

2.4 Name and discuss the four spatial interpolation methods that can be used when estimating values at unsampled points.

(8)

1. Nearest Neighbor
   - Also known as Thiessen polygons
   - Assign value for unsampled location that is equal to value of nearest sample location
   - Provide exact interpolator
   - Value for each sample locater is preserved – no difference between calculated and measured value
2. Fixed Radius – Local Averaging
   - Estimation of cell values are based on average of nearby samples
   - Samples used to calculate values are depend on search radius

- Circle is drawn around a cell and values inside search radius is calculated based on values of samples inside circle
- Radius of circle affect the values
    - Too small – many cells with no values
    - Too big – may smooth data too much

3. Inverse Distance Weighted Interpolation (IDW)
    - Estimates values at unkown points using samples values and distance from nearby known points
    - Weight of each sample point is an inverse proportion to the distance
    - Further away a point the less weight the point has in defining the value at unsampled locations
    - Various parameters can be set when calculating this surface
    - Exact interpolator
    - Smooth interpolated surfaces
4. Spline
    - Spline = flexible ruler
    - Interpolation along a smooth curve that pass through a set of points
    - May be used for lines or surfaces

2.5 Explain the difference between spatial interpolation, spatial prediction and core area as spatial estimation methods. Give a practical example of when you will use each estimation method.

(6)

- **Spatial Interpolation:** - prediction of variables at unmeasured locations based on a sampling of the **SAME** variables at known locations
- **Spatial Predictions:** Estimation of variables at unsampled locations but estimation is based on **OTHER VARIABLES**
- **Core Area** – defined from a set of samples to predict the **frequency of likelihood** of occurrence of an object or event. Characterised by high use, density, intensity or probability

TOTAL (90)