First semester Test
GIS 310 – Advanced GIS
Department of Geography, Geoinformatics and Meteorology
03 March 2010

Time 1h30min

1. STUDY UNIT 1: REVIEW

   1.1 Define a GIS and give a practical example of how you will apply GIS in your field of study

- "A GIS is a computer system that can hold and use data describing places on the earth 's surface" (Rhind, 1989)
- "A geographical information system is a group of procedures that provide data input, storage and retrieval, mapping and spatial analysis for both spatial and attribute data to support the decision-making activities of the organisation. "(Grimshaw, 1994)
- "...a computerized system for the collection, storage, manipulation (analysis), and output of information that is spatially referenced."....
- "What sets GISs apart from all other types of information systems are their reliance on spatial referencing as their organizing framework and their ability to perform geographic analysis." (Obermeyer and Pinto, 1994)

   2 for definition and 1 for PRACTICAL example

   (3)

   1.2 Explain the difference between the spatial and non-spatial data of a GIS
   Position (where – location in geographic space)
   Attribute (what – characteristic of the object in space)

   (2)

   1.3 Name the 5 components necessary for the effective use of a GIS.
   Application Area, People and Organisation, Hardware and Software, Management and Analysis Procedures, Data

   (5)

   1.4 Name the 5 main steps that must be followed when doing a GIS process.
   Define the information {Product
   Design the GIS model of Reality
   Acquire the Data
   Analyse the Data
   Communicate the results

   (5)

2. STUDY UNIT 2: DATA ANALYSIS

   2.1 Scenario: The University of Pretoria's department of Astronomy has to establish a new observation centre in South Africa. The location of the new observation centre must comply with the following conditions:

   - It must be in an undeveloped area.
   - It must be situated higher than 1500m above sea level.
   - The total area required is 10 ha.
   - The area must be further than 3 km from any highways or major roads.
   - The area must be further than 5 km from any land uses that can cause air pollution. (i.e. Mines, Industrial and Built up areas with a population of more than 100 000 people)

- The rainfall of the area must be below 200mm per year.

The following datasets are available for the project:

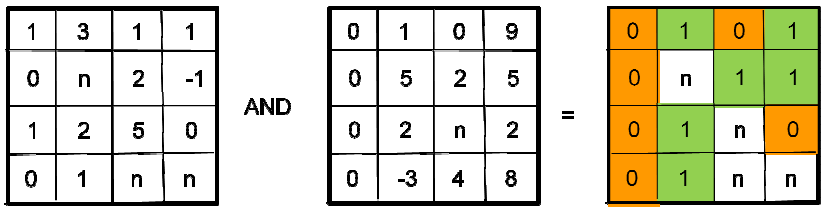
Spatial Data	Attribute Data	Data Format
Land coverage	Land use types, Population	Vector
Digital elevation model	Height above sea level	Raster
Farms portions	Area, Owner	Vector
Roads	Road Classification	Vector
Weather stations (points)	Temperature, Humidity, Rainfall	Vector

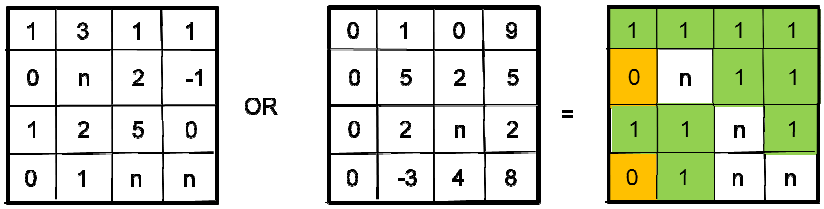
Draw an analysis model to indicate how you will analyse the above data to find a possible location(s) for a new observation centre.

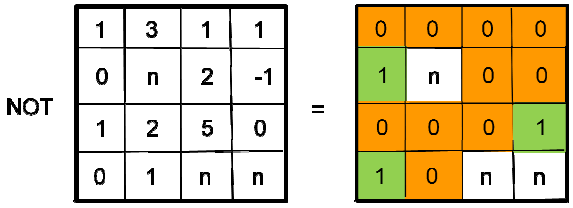
(30)

2.2 Explain how logical operators (AND, OR, NOT) is applied in a raster GIS to analyse data. Use an example to illustrate your answer.

- Large number of local functions that applies Logical Operators to raster data.
- Typically involves comparison with scalar value and output is binary (True/False)
- Three basic Logic Operators:
  - AND
  - OR
  - NOT
- AND,OR -> Binary input
- AND both input values must be true for assignment of 'true 'value (Typically non zero = true, zero = false)
- OR assigns true if either one of cells are true.
- NOT switches true for false and false for true







(8)

5 for explanation and 3 for example

2.3 Define the following terminology and analysis methods:

- Classification - Can also be used to groups objects for display or map production – similar objects are identified as a group. Will categorise features based on a set of conditions
- Reclassification - Assigns output values that depend on specific set of input values
- Network analysis - Analyses using a set of connected features
- Cost surface analysis – cost to move over a surface measured in time, money, likelihood or obstructions
- Neighbourhood functions - Apply operations to neighbouring cells or features
- Zonal functions - Apply operations based on defined regions (zones) in an area
- High spatial covariance - Cells near each other are likely to have the same value
- Low spatial covariance - Values of nearby cells are unrelated

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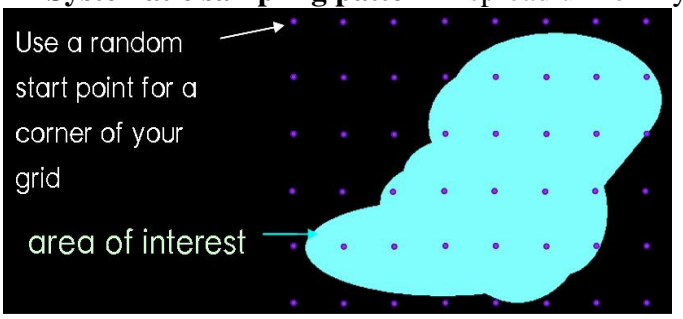
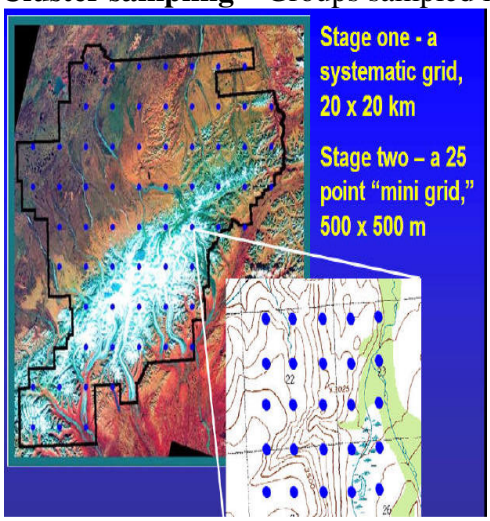
2.4 Name, explain and illustrate the different sampling patterns that can be applied when collecting data in the field.

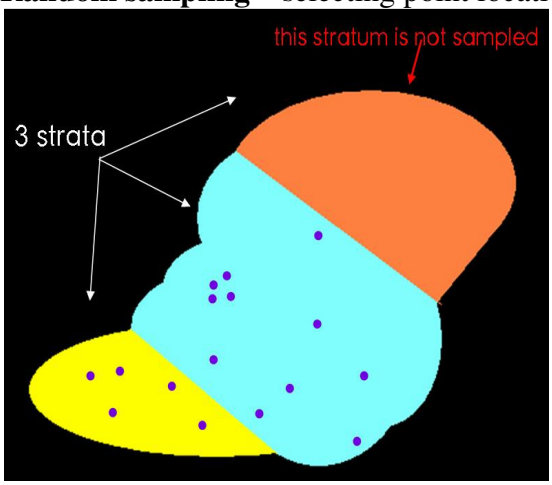
⊡ **Systematic sampling pattern** – spread uniformly at specified x and y intervals



⊡ **Cluster sampling** – Groups sampled in clusters



- **Random sampling** – selecting point locations based on random numbers



- **Adaptive sampling** – more frequent in areas with high variation and less frequent in areas with less variation
  No example can be given?

(12)

2.5 Name the terrain analysis method that you will apply if you want to:

- Connect points with uniform elevations. – Contour lines
- Determine the steepness of an area. - slope
- Determine the amount of sunlight an area will receive. - aspect
- Determine the set of cells through which surface water will flow. - Drainage network
- Calculate areas visible from a point for the location of cell phone towers - Viewshed
- Display elevations against distance on a graph. – profile plot

(6)

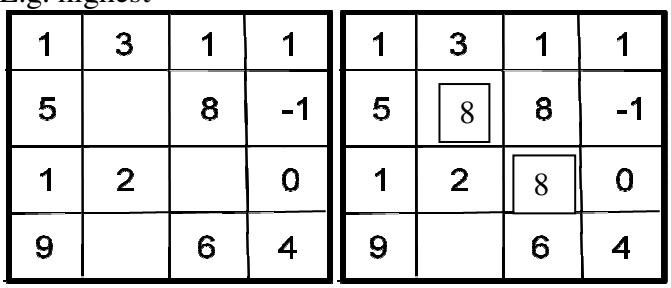
2.6 Explain the difference between spatial interpolation, spatial prediction and core area as spatial estimation methods. Give a practical example of when you will use each estimation method. 2 for definition and 1 for example

- Spatial Interpolation: - prediction of variables at unmeasured locations based on a sampling of the SAME variables at known locations
  Routinely used for estimation of:
  Air and water temperature
  Soil moisture
  Elevation
  Population density etc
- **Spatial Predictions:** Estimation of variables at unsampled locations but estimation is based on **OTHER VARIABLES**
  Example:
  use elevation to estimate temperature
  Weather predictions
  Disease outbreaks
  Land use change
- **Core Area** – defined from a set of samples to predict the **frequency of likelihood** of occurrence of an object or event
  Example:
  Home ranges of individual animals
  Concentration of business activity

Centres of criminal activity

(9)

2.7 You are working with a raster data set indicating noise pollution of an area. The dataset is incomplete. You want to estimate the missing values by using neighbourhood functions. Explain and illustrate how this will be done when using a highest value kernel.

- Neighbourhood functions offer substantial analytical power and flexibility
- Used by many operations e.g. slope and aspect
- Based 'moving window' idea
- Any size or shape (3x3 most common)
- Moving window defined by Kernel
- Is the set of constants for each cell in a given window
- E.g. highest
- 

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3. GUEST LECTURES

3.1 Write a short paragraph on the importance of standards when working with Geographical data.

support the understanding and usage of geographic information
_increase the availability, access, integration, and sharing of geographic information, enable interoperability of geospatially enabled computer systems

(4)

TOTAL (100)