GEO 463-Geographic Information Systems Applications

Lecture 1

Rules of engagement

- No Mobile
- Submit course work- scratch my back….I..?

- Software- Quantum GIS vrs ArcGIS
- Open source vrs Commercial
- Free vrs paid
- KAAF – Sambus- ESRI representative in Ghana.

- Submit your Course work in exchange for 30 marks or less!
- Start early.

ARCGIS

- ARC TOOL BOX
- ARC CATALOG- NOW INTEGRATED
- ARCMAP

Introduction

- Geographical Information Systems are systems that provide users the capabilities, amongst others, to store, manage and to retrieve at will data that is geographically referenced!

Monitoring Wells

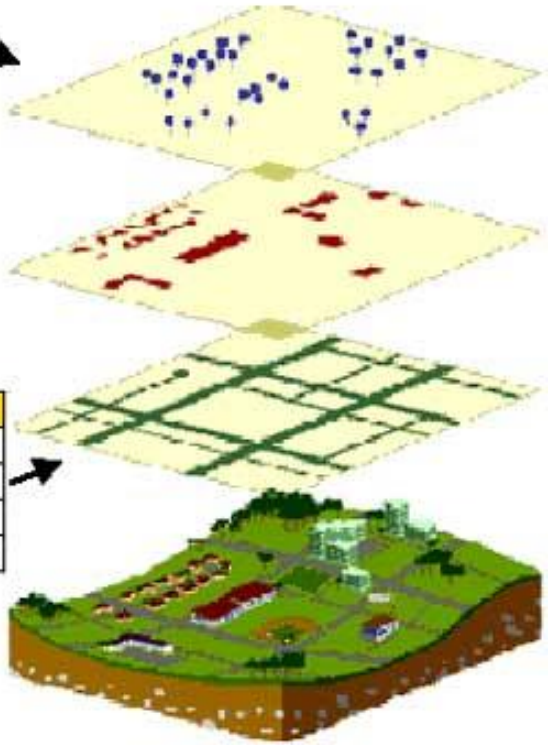
Well ID	Date Sampled	Concentration
C-6A	5/8/94	300
C-8A	5/8/94	20
C-13A	5/8/94	120
C-17A	5/8/94	560

Industries

Facility	Address
Acme	3029 Convington Dr.
Fox	742 West Lake St.
TPC	90 Aspen Dr.

Population

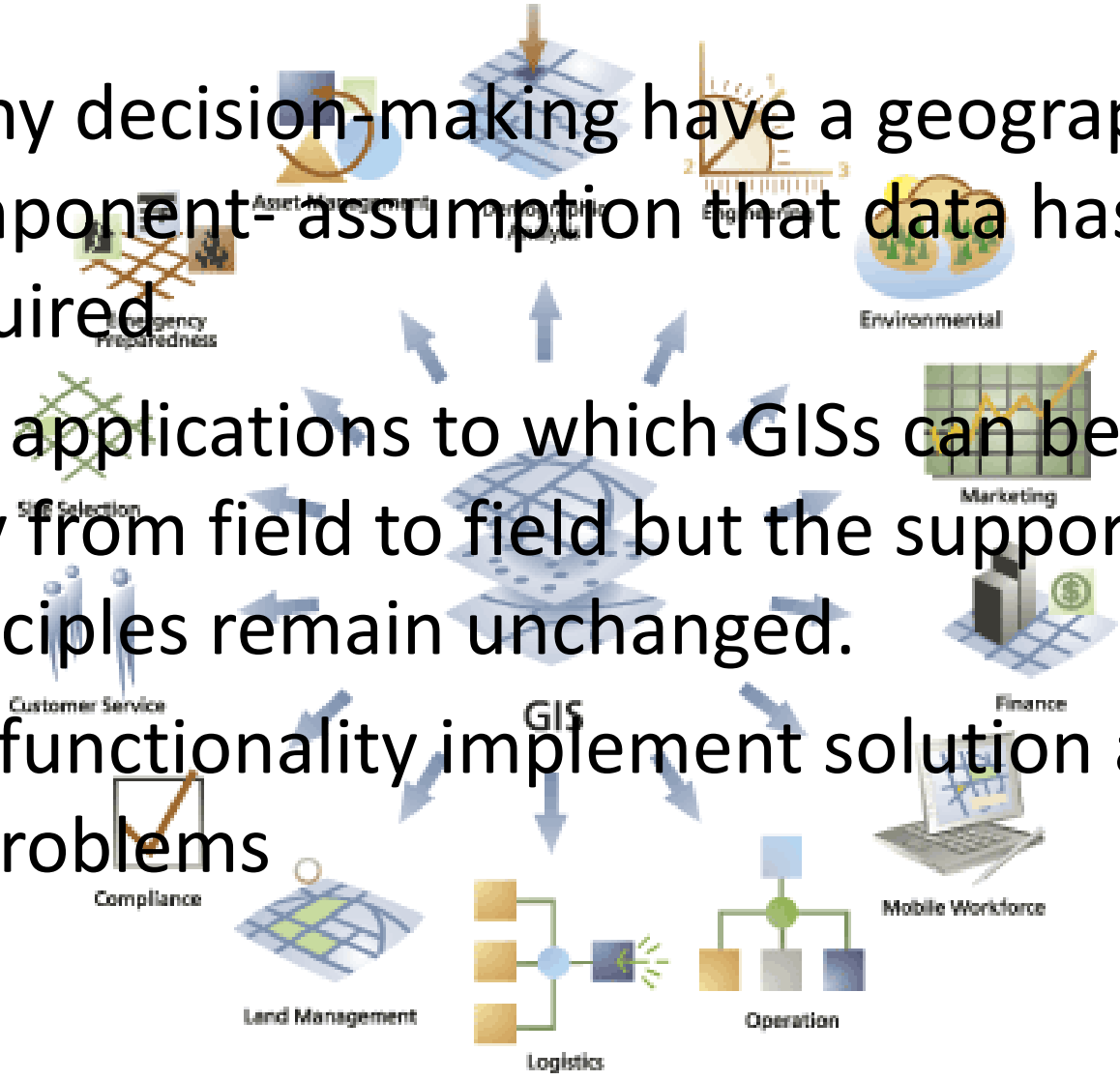
Family Name	Occupants	Addresss
Blake	6	79 Circuit St
Hernandez	2	148 Plain St.
Joy	4	18 Webster St.
Smith	5	4321 Tecumseh Dr.



Not much has changed GIS and GISA

Introduction

- Many decision-making have a geographical component- assumption that data has been acquired
- The applications to which GISs can be utilised vary from field to field but the supporting principles remain unchanged.
- GIS functionality implement solution approach to problems



Introduction- GIS Application Areas

- Land Management (LIS)
- Logistics(location allocation)
- Marketing(Travelling salesman problem)
- Finance(Banks/Mortgages etc)
- Demographic analysis()
- Environmental(suitability- mce)
- Engineering
- Asset Management
- Site Selection (Urban Planning)
- Health

Point Pattern Analysis

- Formally, a point pattern may be thought of as consisting of a set of locations (s1, s2, etc.) in a defined ‘study region’, R, at which ‘events’ of interest have been recorded.
- vector, si, refers to the location of the ith observed event,
- ‘x’ coordinate, si1, and the ‘y’ coordinate, si2
- , of an event.

Point Pattern Analysis

- Use of the term ‘event’ has become standard in spatial point process analysis as a means of distinguishing ->
- The location of an observation from any other arbitrary location within the study region (Diggle, 1983).
- The study region R might be a rectangular or complex polygonal region.

Point Pattern Analysis

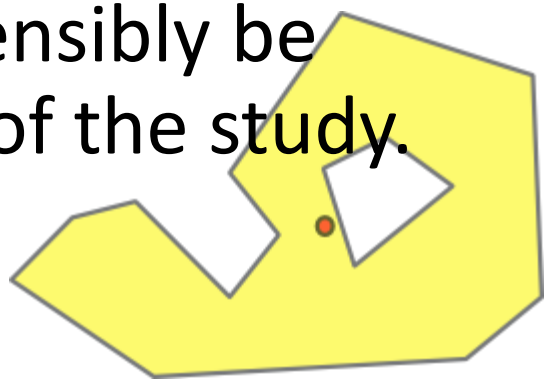
- We must be aware of possible edge effects in the analysis
- leave a suitable guard area between the perimeter of the original study region and a sub-region
- OR analytical tools to take account of boundary shape
- What are the requirements for a set of points to contribute to a point pattern?

Point Pattern Analysis

- 1. The pattern should be *mapped on the plane.*
- 2. The study area should be *determined objectively.*
- 3. The pattern should be an enumeration or *census of the entities or interest, not a sample:*
- *that is, all relevant entities in the study region should be included.*
- 4. There should be *a one-to-one correspondence between objects in the study area and* events in the pattern.

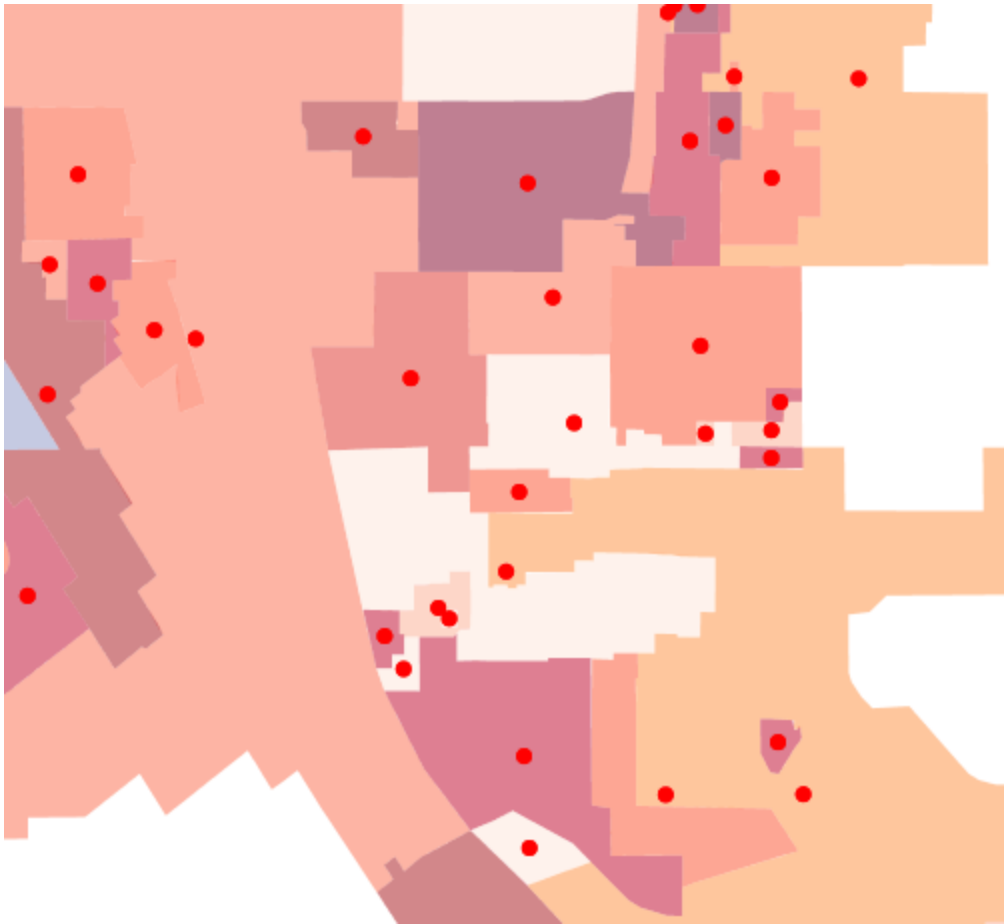
Point Pattern Analysis

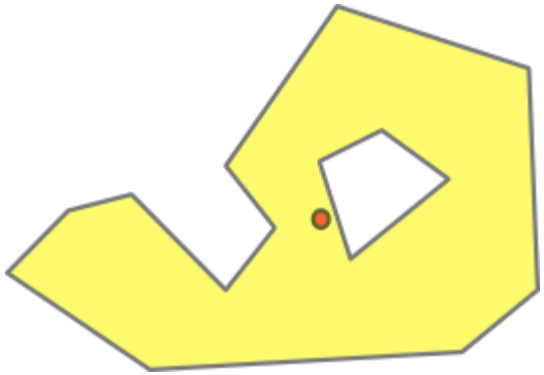
- 5. Event locations must be *proper. They should not be, for example,*
- *the centroids of areal* units chosen as representative,
- nor should they be arbitrary points on line objects.
- They really should represent the point locations of entities that can sensibly be considered points at the scale of the study.



Point Pattern Analysis

...They should not be, for example, the centroids of areal units chosen as representative…





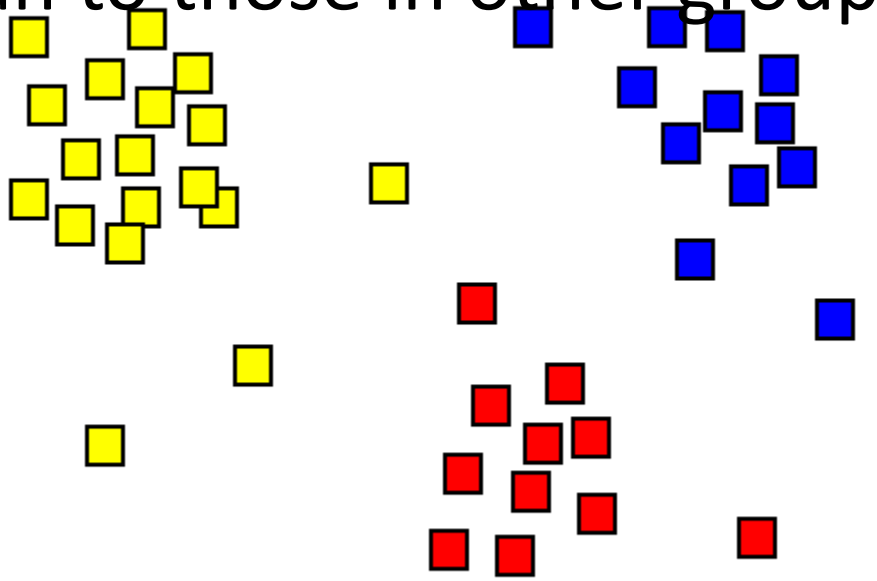
Dr. John Snow's

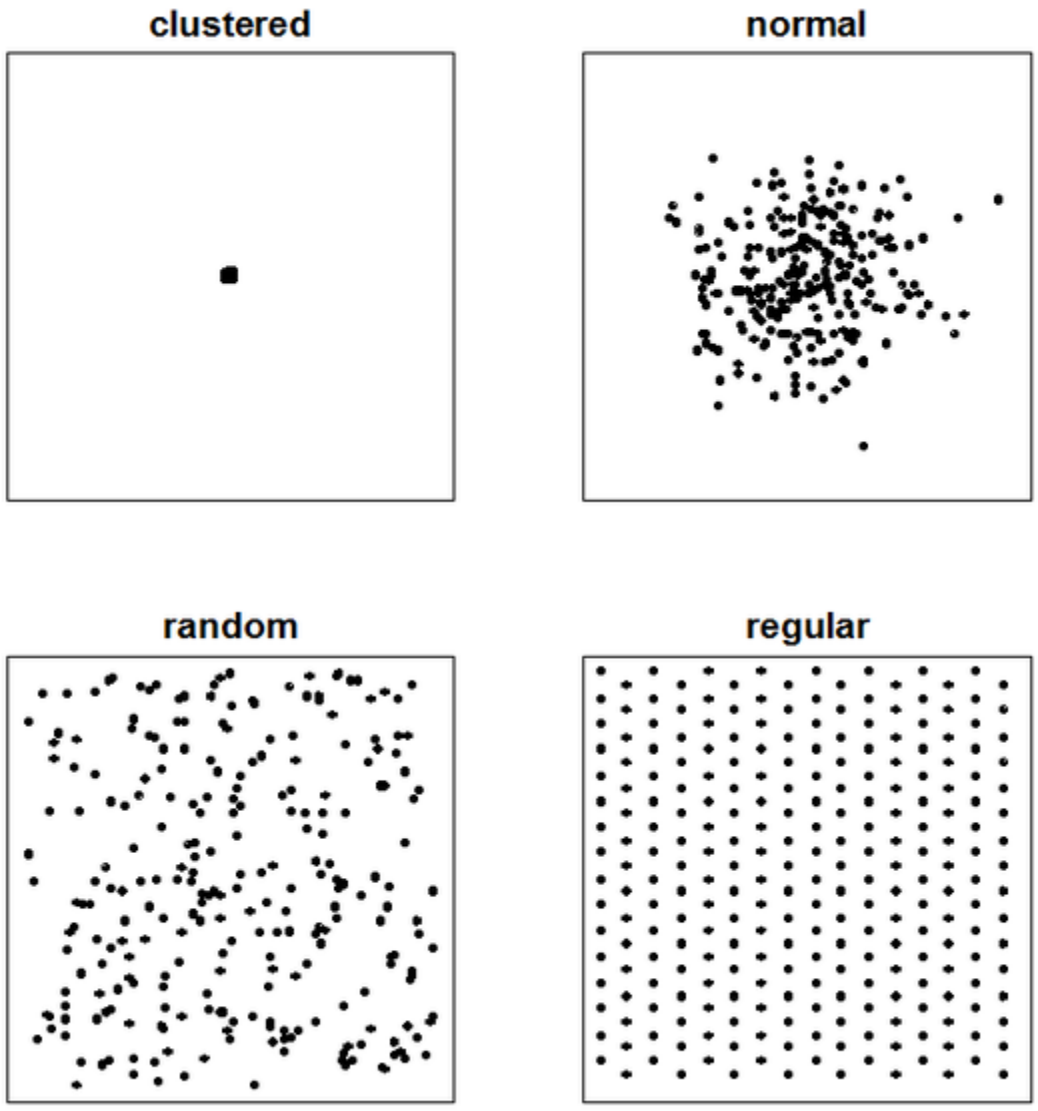
- Map showing :
- the location of the Broad Street pump and other water pumps in the vicinity,
- as well as the points where each of the cholera victims died.
- By establishing that each of the residences that drew water from the Broad Street pump was also the location of a cholera death, Snow proved the source of the contamination.

Mapping spatial (location) and temporal (timing) relationships between things

Cluster Analysis- Clustering

- **Cluster analysis** or **clustering** is the task of grouping a set of objects in such a way that objects in the same group (called **cluster**) are more similar (in some sense or another) to each other than to those in other groups (clusters).




clustered
normal
random
regular

Cluster analysis-achieved by various algorithms

- Connectivity models: for example hierarchical clustering builds models based on distance connectivity.
- Centroid models: for example the k-means algorithm represents each cluster by a single mean vector.
- Distribution models: clusters are modeled using statistical distributions, such as multivariate normal distributions used by the Expectation-maximization algorithm.

Clustering Algorithm and parameters

- The appropriate clustering algorithm and parameter settings
- (including values such as the distance function to use, a density threshold or the number of expected clusters) depend on

➢ the individual data set and

➢ intended use of the results.

Clustering Algorithm and parameters

- Cluster analysis as such is not an automatic task, but
- an iterative process of knowledge discovery or interactive multi-objective optimization that involves trial and failure.
- The notion of a "cluster" cannot be precisely defined,

CrimeStat® *III*

VERSION 3.2a

A Spatial Statistics Program for the Analysis of Crime Incident Locations

Ned Levine & Associates

Houston, TX

The National Institute of Justice

Washington, DC

October 2009

Crimestat

- A spatial statistics software specifically designed for analysis of crime incidents
- I. The mode (Mode)
- 2. The fuzzy mode (F mode)
- 3. Nearest-neighbor analysis(Nna)

Mode

- The mode calculates the frequency of incidents for each unique location, defined by an X and Y coordinate.
- It will output a list of all unique locations and their X and Y coordinates and
- the number of incidents occurring at each, ranked in decreasing order from most frequent to least frequent.

Fuzzy Mode

- the frequency of incidents for each unique location within a user- specified distance.
- The user must specify the search radius and the units for the radius (miles. nautical miles. feet. kilometers, meters).
- The routine will identify each unique location, defined by its X and Y coordinates, and will calculate the number or incidents that fall within the search radius.
- It will output a list of all unique locations and their X and Y coordinates and the number or incidents that fall within the search radius

Nearest Neighbor Analysis (Nna)

- The nearest neighbor index provides an approximation about whether points are more clustered or dispersed than would be expected on the basis of chance.
- It compares the average distance of the nearest other point (nearest neighbor) with a spatially random expected distance by
- Dividing the empirical average nearest neighbor distance by the expected random distance (the nearest neighbor index).

Nearest Neighbor Analysis (Nna)

- I. The sample size
- 2. The mean nearest neighbor distance
- 3. The standard deviation of the nearest neighbor distance
- 4. The minimum distance
- *5. The maximum distance*
- 6. The mean random distance (for both the bounding rectangle and the user input area, if provided

Nearest Neighbor Analysis (Nna)

- 7. The mean dispersed distance (for both the bounding rectangle and the user input area, if
- provided)
- 8. The nearest neighbor index (ior both the bounding rectangle and the user input area, if
- provided)
- *9. The standard error of the nearest neighbor index (for both the bounding rectangle and the* user input area. if provided)
- 10. A significance test of the nearest neighbor index (Z-test)

Crimestat: Center of Minimum Distance (Mcmd)

The center of minimum distance defines the point at which the distance to all other points is at a minimum.

1. The sample size
2. The mean of the X and Y coordinates
3. The number of iterations required to identify a center
4. The degree of error (tolerance) for stopping the iterations
5. The X and Y coordinates defining the center of minimum distance.

Tabular output ArcView shp'. MapInfo mif or Atlas-GIS binaries. A root name should be provided. The center of minimum distance is output as a point