An Introduction to Mapping and Spatial Analysis using GIS

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What is GIS?

Geographical Information Systems...

• *Software* or apps which can capture, store, manipulate, analyse and visualize *spatial data*

What is spatial data?

• *Data that has some information that links it directly or indirectly to a location*
Why use GIS?

• Create maps – report maps, web maps
  • Create maps to add depth and context to a report or publications
  • Highlight key locations and patterns by styling
  • Overlay multiple layers to display complex spatial variation

Why use GIS?

Spatial analysis

- Distance based analysis and statistics
- Uncover trends and patterns manipulating and comparing multiple layers

- Store and manage data
- Automate tasks
Types of Maps

Location Maps

- Map key locations of features
- Overlay different multiple datasets
Types of Maps

Choropleth

- Thematic map using shading to represent different categories of data
e.g. socioeconomic data

- Importance of choosing the appropriate categories of data
Types of Maps

Heat maps

- Density surface of values or features across map

Proportional symbols

- Size of point represents a value

Link maps

- Map connections and routes

Types of Maps

3D maps
• Maps displaying elevation

Web maps and apps
• Display, share and analysis data online

Combine maps with other analysis
• Multiple maps
• Graphs, interactive dashboards

GIS Software

Desktop GIS
- Design maps with appropriate colour schemes, legends and annotations
- Filter, query, create and edit data
- Perform analysis on data
- **ArcMap or ArcGIS Pro** - access through University
- **QGIS** - open source

Cloud GIS
- **ArcGIS Online**

Spatial Data
- Spatial data is added into GIS software
Spatial Data

Spatial data must have a location related to a real world coordinate system

Geographic coordinate systems
• 3D representation of the world e.g Latitude, Longitude

Projected coordinate systems
• British National Grid (OS) e.g. Northings, Eastings
Vector data

**Point** - one pair of coordinates \((x,y)\), single entity

- trees, place, power plant

**Line** - each vertex has a coordinate, join together to create a linear feature with length

- rivers, roads, fences

**Polygon** - each vertex has a coordinate, join together to create an enclosed feature with an area.

- buildings, lakes, admin boundaries
Raster data

• Each cell has a value, for example in a terrain dataset each cell has a value of elevation in metres

• Use different colour ramps to shade data

• Terrain, density grids, flood depths

• GeoTIFF, JPEG, ESRI GRID + world file
Feature Class

- Homogeneous collection of common features
- Vector Data – Points, lines, polygons
- Formats:
  - Shapefile (.shp) feature class (.shp, .shx, .dbf, .prj)
  - Feature class within in a FileGeodatabase (ArcGIS Desktop – ArcMap/Pro)
Attribute Table

Contains information or ‘attributes’ for each feature or cell.

- The table consists of rows – one per feature
- And columns or ‘fields’ – storing specific types of data
- There can be multiple fields and multiple types of information associated with a feature
Sources of spatial data

- Numerous shapefiles available online – some are more accurate than others

- Filter or query datasets e.g. placenames or boundaries

- DigiMap – free to register members of University

- UK Data – OS, ONS, DEFRA

- Natural Earth – open global physical and cultural data

- ArcGIS Online - living atlas
Create spatial data

- Create feature classes in GIS software
- Find and trace locations using basemaps already provided by GIS software or data has a geospatial information
- Convert an excel with a list of features which have latitude/longitude
- Use Geocoders to batch convert addresses to points
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Spatial Analysis

- Proximity – Distance based analysis
- Overlay – Multi-criteria analysis
- Statistics – density of features, centres, areas
- Surface manipulation
Spatial Analysis Tools

**BUFFER**

Which areas are within 500m from the point of interest?

**CLIP OR INTERSECT**

Count how many points and the area of land that falls within a boundary?

**NEAR**

Distances from one feature to all the others?
Spatial Analysis

Complex analysis

Remote sensing

Collect source layers
Data is first digitized into either polygon or raster layers. This housing suitability data is raster.

Create suitability layers
Each layer is now classified to use a common suitability scale: for example, low suitability could be assigned a value of 1 (dark red) and high suitability a value of 5 (dark green).

Calculate weighted overlay
Suitability layers are overlaid so that each cell gets an overall suitability rating. Weights of relative importance are assigned to each layer.

Data Management

• Store, organise and share geospatial data

• Important when working as project team or for complex tasks

• Databases vs Cloud technologies

Automation of repetitive GIS tasks

• Model Builder (ArcGIS)
• Python (ArcPy)

Web maps, apps and dashboards

- Often data prepared in desktop GIS or processes very similar
- Create apps in ArcGIS Online – templates
- Combine data with graphs and statistics creating interactive dashboard
GIS Support

Consultations can be arranged at the Weston Library

- Advice on specific mapping tasks and step-by-step help using GIS
- Help sourcing data and assessing accuracy and appropriateness for the tasks
- Error checking and problem solving when installing or using GIS

Bodleian Map Room website – links to tutorials, software and how to get support [https://www.bodleian.ox.ac.uk/maps/making-maps](https://www.bodleian.ox.ac.uk/maps/making-maps)

Email: maps@bodleian.ox.ac.uk

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