

What is GIS?

Ian Gregory

Digital Humanities

Lancaster University

Structure of talk

- 1. Define GIS and related terms
 - Geographic Information
 - GIS as:
 - a type of software
 - a set of tools
 - an approach to analysis
- 2. Data in GIS
 - Spatial and attribute
 - Geo-referencing data
 - Raster and vector
 - Layers of data
- 3. Querying a GIS database
- 4. Integrating data with GIS

Geographical Information (GI)

- Information that refers to a location on the Earth's surface
 - Has both a spatial and a thematic component
 - Census data
 - Hospitals admissions data
 - Relief data (e.g. from contours)
 - Information on transport networks
 - A text about a specific place (egST Coleridge's tour of the Lake District)
 - A collection of photographs or paintings of buildings
 - Locational component can be an explicit (e.g. a co-ordinate or a precisely defined administrative unit) or vaguer (e.g.. "The area around London" or "In Gaelic speaking areas")

Geographical Information Systems (GIS)

- 1. GIS: A type of software
 - A computer system that allows us to handle information about the location of features or phenomena on the Earth's surface
 - Has the functionality of a conventional DBMS PLUS functionality to handle the spatial component of the data (manipulating, mapping analysing).
 - GIS as a DBMS that allows us to explicitly handle the spatial
 - Common examples:
 - ArcView
 - ArcGIS
 - MapInfo

Geographical Information Systems (2)

- 2. GIS: A tool-kit
 - Manipulate spatially:
 - Calculate distances and adjacencies
 - Change projections and scales
 - Integrate disparate sources
 - Analyse spatially:
 - Quantitative analysis
 - Exploratory spatial data analysis
 - Qualitative analysis
 - Visualise data:
 - Maps!
 - Tables, graphs, etc.
 - Animations
 - Virtual landscapes

Geographical Information Systems (3)

- 3. Approach:
 - Explore the database:
 - In conventional ways
 - AND geographically
 - Allows us to think about the implications of location
 - Allows us to think holistically
 - Should not be restricted by vendor-provided functionality
 - Should be used imaginatively taking into account :
 - the advantages and limitations of geographical information
 - the traditions of your discipline

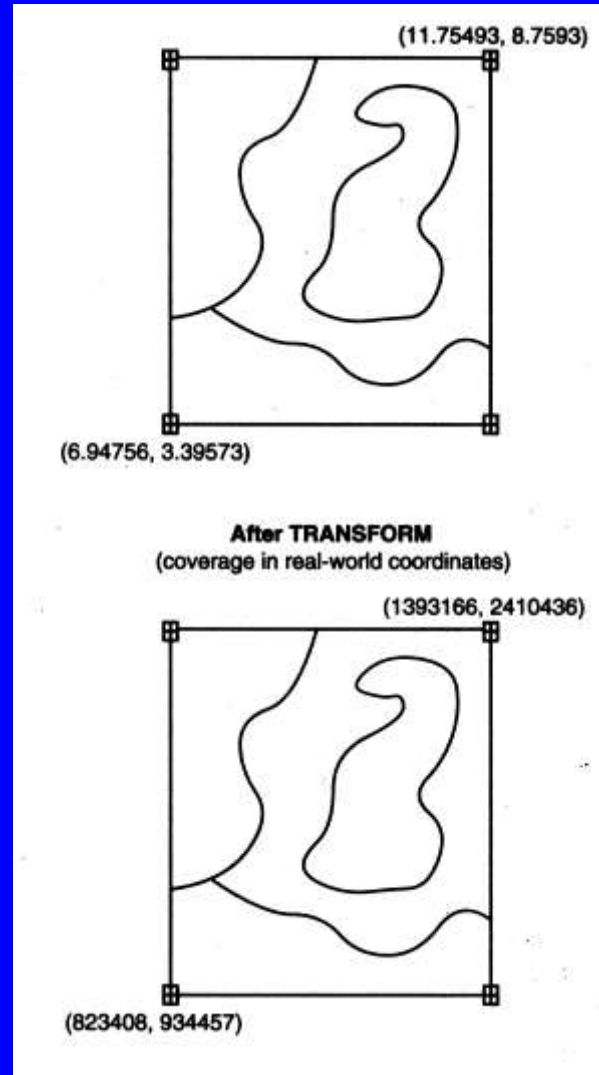
Types of data

- Two types of data are stored for each item in the database
- 1. Attribute data:
 - Says *what* a feature is
 - Eg. statistics, text, images, sound, etc.
- 2. Spatial data:
 - Says *where* the feature is
 - Co-ordinate based
 - Vector data – discrete features:
 - Points
 - Lines
 - Polygons (zones or areas)
 - Raster data:
 - A continuous surface

Geo-referencing data

- Capturing data
 - Scanning: all of map converted into raster data
 - Digitising: individual features selected from map as points, lines or polygons
- Geo-referencing
 - Initial scanning digitising gives co-ordinates in inches from bottom left corner of digitiser/scanner
 - Real-world co-ordinates are found for four registration points on the captured data
 - These are used to convert the entire map onto a real-world co-ordinate system

Example of geo-referencing



Source: ESRI (1997)

Layers

- Data on different themes are stored in separate “layers”
- As each layer is geo-referenced layers from different sources can easily be integrated using location
- This can be used to build up complex models of the real world from widely disparate sources

Raster data: Hastings



Example: Vector data

The screenshot displays the ArcMap interface with the following components:

- Layers Panel:** Shows three layers: 'stations' (red dots), 'lines' (yellow lines), and 'par1911rd polygon' (tan polygons).
- Attributes of stations Table:**

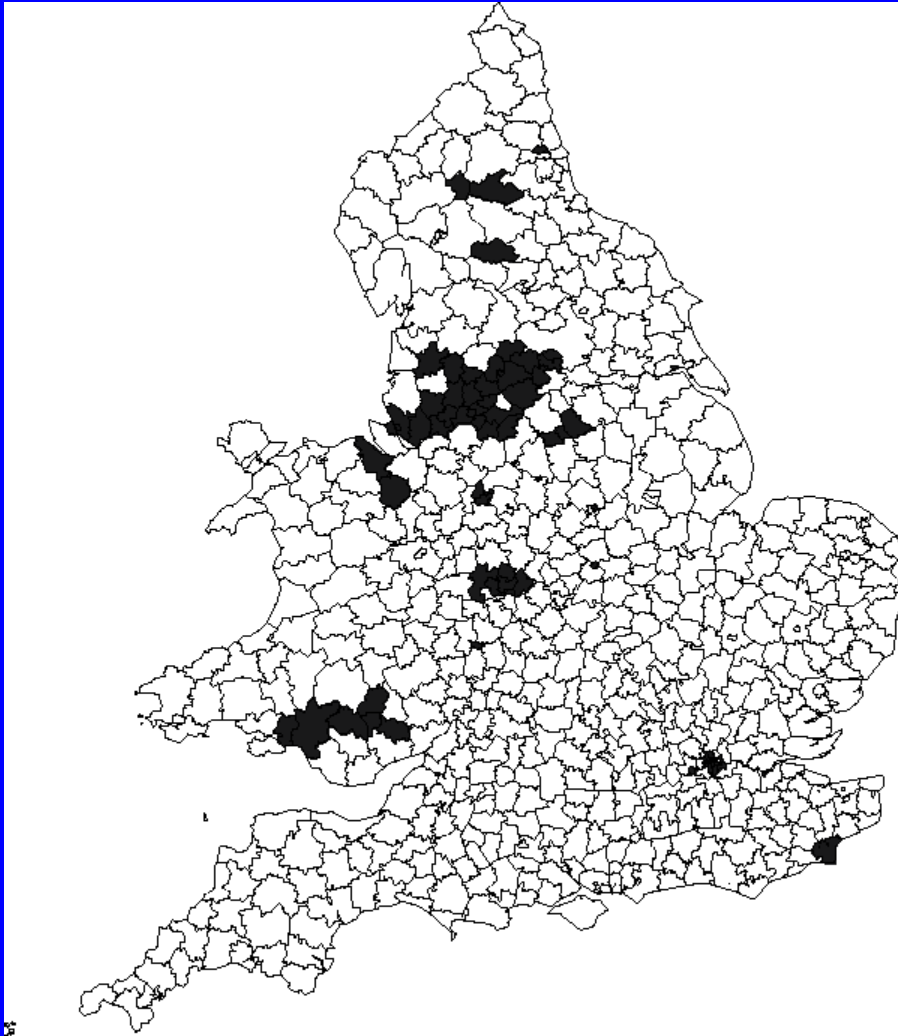
STAT_NO	REF	LINE	STATION	NAME
W132005S5	W132	W132005	S5	HAVANT
W132006S1	W132	W132006	S1	SOUTHAMPTON MILLBROOK
W132006S2	W132	W132006	S2	SOUTHAMPTON CENTRAL
W132006S3	W132	W132006	S3	SOUTHAMPTON BLECHYNDEN
W132007S1	W132	W132007	S1	HAVANT
W132007S2	W132	W132007	S2	BEDHAMPTON
W132007S3	W132	W132007	S3	FARLINGTON
W132008S1	W132	W132008	S1	FRATTON AND SOUTHSEA
W132008S2	W132	W132008	S2	PORTSMOUTH TOWN LL
W132009S1	W132	W132009	S1	BLECHYNDEN
W132010S1	W132	W132010	S1	COSHAM
W132012S1	W132	W132012	S1	PORTCHESTER
W132012S2	W132	W132012	S2	COSHAM
W132014S1	W132	W132014	S1	COSHAM AND
- Attributes of par1911rd polygon Table:**

PARISH	POP1901	POP1911	MALE1911	FEMALE1911	IHS
PORTISHEAD	2544	3329	1632	1697	
PORTLAND	15199	17011	12379	4632	
PORTSKEVETT	868	958	474	484	
PORTSLADE (EAST)	287	427	263	164	
PORTSLADE BY SEA (EAS	5217	6454	3158	3296	
PORTSMOUTH	188928	231141	115160	115981	
PORTSWOOD	17958	22501	10255	12246	
POSENHALL	18	23	12	11	
POSTLINGFORD	285	304	165	139	
POSTLING	88	92	40	52	
POSTWICK	315	340	171	169	
POSTWICK	315	340	171	169	
POTSGROVE	114	108	60	48	
POTT SHRIGLEY	313	326	154	172	

Querying GIS data

- Attribute query
 - Select features using attribute data (e.g. using SQL)
 - Results can be mapped or presented in conventional database form
 - Can be used to produce maps of subsets of the data or choropleth maps
- Spatial query
 - Clicking on features on the map to find out their attribute values
 - Which features on one layer intersect with features from another?
- Used in combination these are a powerful way of exploring spatial patterns in your data

Attribute query: Lung disease in the 1860s



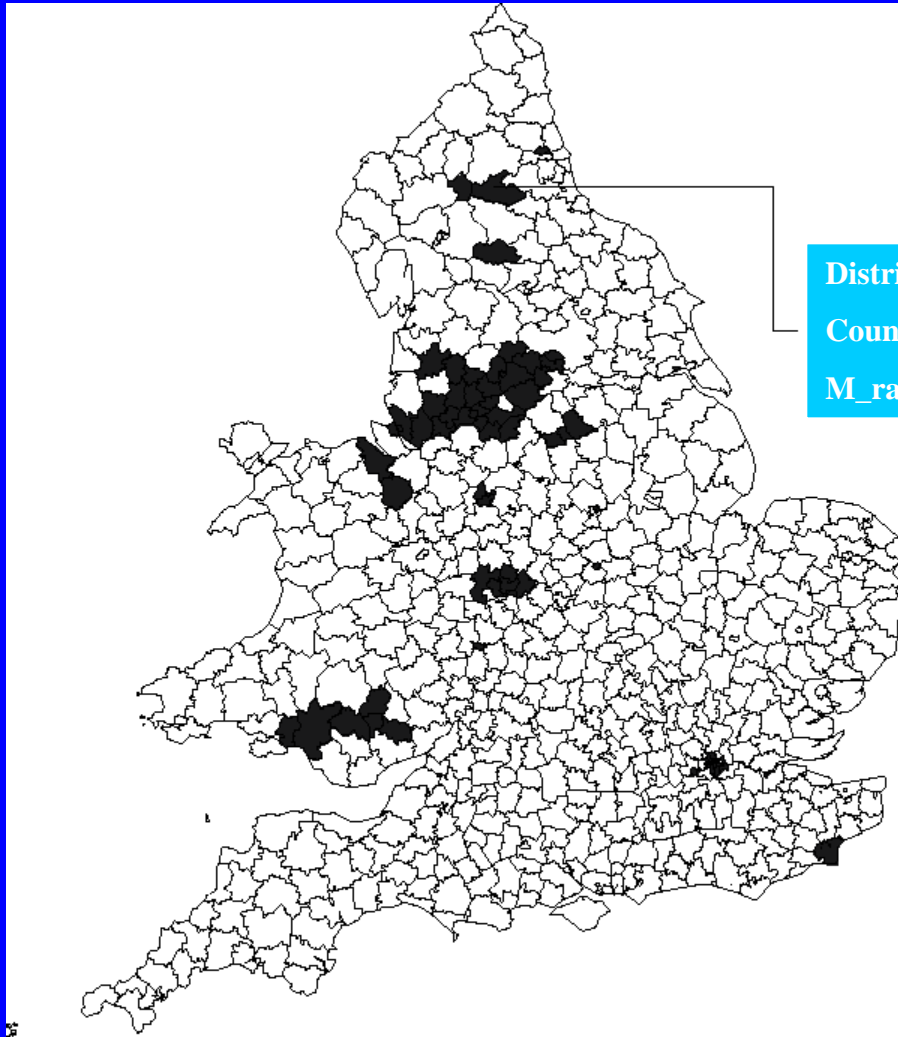
Spatial data: Registration Districts, 1/1/1870

Attribute data: Mortality rate per 1,000 from lung disease among men aged 45-64

Source: Registrar General's Decennial Supplement, 1871

Query: Select areas where mortality rate > 58.0

Spatial query: Lung disease in the 1860s



District: Alston with Garrigill

County: Cumberland

M_rate: 68.4

Combined spatial and attribute querying

The screenshot displays the ArcMap interface with a map of Portsmouth. The map shows railway lines (yellow) and stations (red dots). A light blue polygon highlights the Portsmouth parish. Two attribute tables are overlaid on the map:

Selected Attributes of stations

REF	LINE	STATION	NAME	OPEN
W132	W132008	S1	FRATTON AND SOUTHSEA	
W132	W132008	S2	PORTSMOUTH TOWN LL	
W132	W132010	S1	COSHAM	
W132	W132012	S2	COSHAM	
W132	W132021	S1	PORTSMOUTH HL	
W132	W132023	S1	HALT	
W132	W132023	S2	HALT	
W132	W132023	S3	EAST SOUTHSEA	

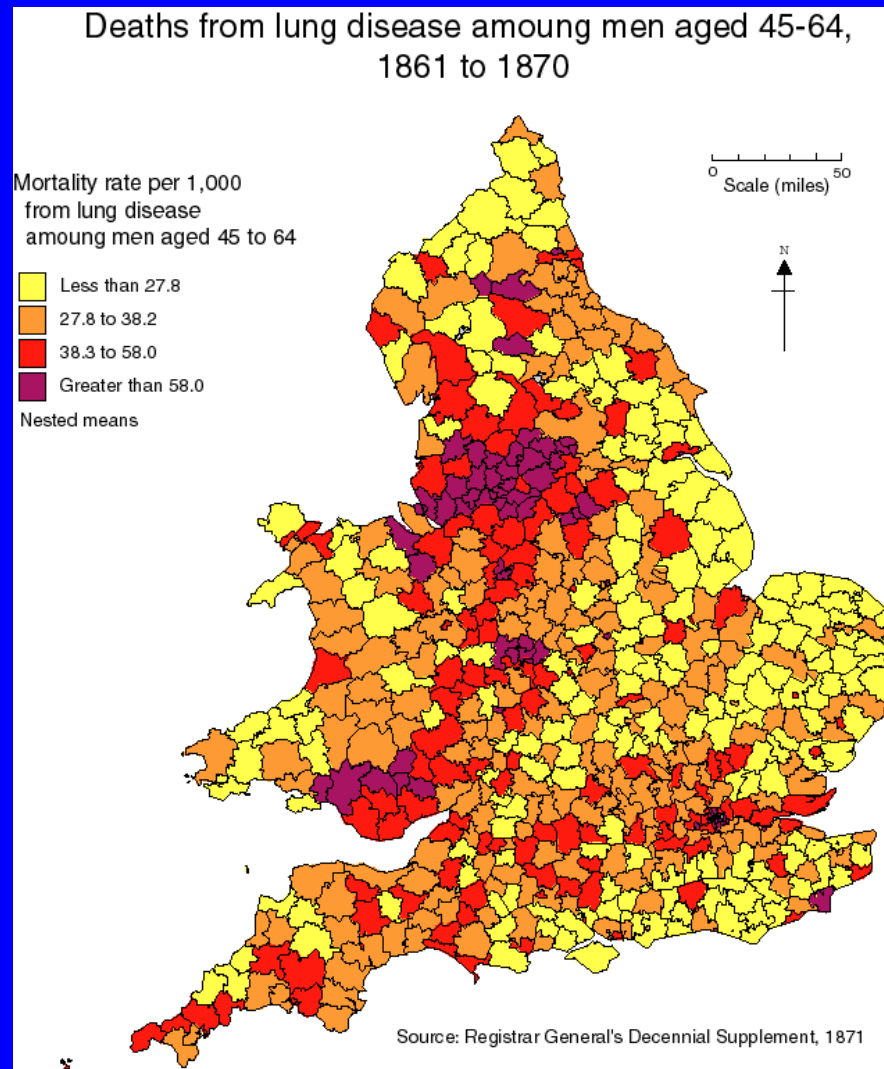
Attributes of par1911rd polygon

PARISH	POP1901	POP1911	MALE1911	FEMALE19	IIS
PORTISHEAD	2544	3329	1632	1697	
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POTSGROVE	114	108	60	48	
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Par1911: Select parish = 'PORTSMOUTH' (Attribute)

Stations: Select stations that intersect with Par1911 (Spatial)

Mapping through attribute query



Conclusions

- Advantages of GIS
 - Exploring both geographical and thematic components of data in a holistic way
 - Stresses geographical aspects of a research question
 - Allows handling and exploration of large volumes of data
 - Allows integration of data from widely disparate sources
 - Allows analysis of data to explicitly incorporate location
 - Allows a wide variety of forms of visualisation
- Limitations of GIS
 - Data are expensive
 - Learning curve on GIS software can be long
 - Shows spatial relationships but does not provide absolute solutions
 - Origins in the Earth sciences and computer science. Solutions may not be appropriate for humanities research

From GIS to Historical GIS

Components of data

- 1. Attribute (theme)
 - Says what the data is
 - Statistical, textual, image, etc.
- 2. Temporal
 - Says when the data existed/are relevant for
- 3. Spatial
 - Say where the data refer to
 - Can be precisely defined “at grid reference (x,y)”
 - Can be vague “in the west of Ireland”
 - Difficult to handle
 - On paper
 - In a database
 - Neglected

Advantages of GIS

- 1. Structures a database
- 2. Data integration
- 3. Data visualisation
- 4. Spatial analysis

1. Structuring a database

- The Staffordshire Past-Track
 - <http://www.staffspastrack.org.uk/>
 - Database of images of Staffordshire's past
 - 7,000 photographs
 - 3,000 images of artwork
 - 75 videos
 - 3 audio files
 - Can be searched by:
 - Theme: eg. Agriculture, Health & Welfare, Parks & Gardens
 - Text: Key words, dates, media types, etc.
 - Maps

Staffordshire Past-Track

The screenshot shows a web browser window titled "Staffordshire Past-Track - Map Explorer - Microsoft Internet Explorer". The address bar contains the URL: <http://www.staffsh.pasttrack.org.uk/engine/CGI/default.asp?set=0&inGo=Go&scale=1>. The website header features the "Staffordshire PAST-TRACK" logo and navigation links: Home, Featured Content, News & Events, Links, and Quick search. Below the header are tabs for Theme Explorer, Map Explorer, Text Search, and My Albums.

The main content area is divided into two columns. The left column contains instructions for using the map explorer, including "Step One" (defining an area) and "Step Two" (viewing records). It includes a "View Records" button and a "Historic Mapping" section with a date range selector set to "1899 to 1904". A note mentions that UK-wide historic mapping is available at www.old-maps.co.uk. The right column displays a detailed historical map of Stafford, showing streets and buildings. The map is titled "STAFFORD S T A F A CRES" and includes a compass rose and navigation controls. Below the map, there is a search box for "Search Postcodes and Place" and a copyright notice: "© Landmark Information Group / Ordnance Survey (LH000028) (200204, 112300)".

At the bottom of the page, there are links for "Copyright Statement", "Privacy Statement", and "Terms and Conditions". A logo for "New Opportunities Fund LOTTERY FUNDED" is also present, along with the copyright notice "© Staffordshire County Council, 2003".

Staffordshire Past-Track

Staffordshire Past-Track - Map Explorer (Results) - Microsoft Internet Explorer

http://www.search.staffspasttrack.org.uk/engine/002/default_fmsh.asp

Staffordshire PAST-TRACK

Home Featured Content News & Events Links Quick Search

Themed Explorer Map Explorer Text Search My Album

View records within your current map search or each "No-Define Map Area".

80 resource(s) found 1 / 7

KEYWORD:

TYPE:

PERIOD:

DATE FROM:

DATE TO:

23 Greengate Street, Stafford.
This house has now been demolished. It stood opposite the Post Office, Chalford House. [\[Add to Album \]](#)

Aerial View of Stafford from St. Mary's Church Tower
View looking towards Greengate Street. The church tower belongs to St Chad's. The timber framed building in the foreground is the Ancient High... [\[Add to Album \]](#)

Aerial View of Stafford from St. Mary's Church Tower, (2)
In the top right are the new County Buildings on Market Street, built 1995, with the Borough Hall behind them on Greengate Street, near the Dethouse... [\[Add to Album \]](#)

Aerial High House, Stafford.
View of the High House on Greengate Street from St. Mary's Gate. The High House was built by Richard Dornington in 1339. The timber was sold to... [\[Add to Album \]](#)

Aven's Entry, Stafford.
Aven's Entry runs between Greengate Street and St. Mary's Grove. Originally the passage came out by Aven's church door, a 16th century... [\[Add to Album \]](#)

Borough Hall, Stafford.
The Borough Hall on Greengate Street was designed by Henry Ward. The Borough architect. It opened on 20 June 1877. Borough Council offices. The... [\[Add to Album \]](#)

Bobcock's Factory Fire, Stafford.
Bobcock's shoe factory was originally in Foregate Street, Stafford, but was destroyed by fire in 1902. The result in a new factory being... [\[Add to Album \]](#)

Boy with a Bicycle, Stafford. [\[Add to Album \]](#)

Bricklayer's Arms, Stafford.
The Bricklayer's Arms in... [\[Add to Album \]](#)

Bricklayers, Stafford.
Three workers at St... [\[Add to Album \]](#)

Staffordshire Past-Track - Introduction: Fire Brigade Coronation Medal - Microsoft Internet Explorer

http://www.search.staffspasttrack.org.uk/engine/resources/ef4a16a101standard/default.asp?to1a1words=StaffContact+4...

Staffordshire PAST-TRACK

Home Featured Content News & Events Links Quick Search


Themed Explorer Map Explorer Text Search My Album

[\[Back to Results \]](#)


1 / 1

Reverse of Fire Brigade Coronation Medal

Medal commemorating the coronation of King Edward VII on 26 June 1902, presented to members of St...



1 / 1



Introduction: fire Brigade Coronation Medal

Date: 26 June 1902

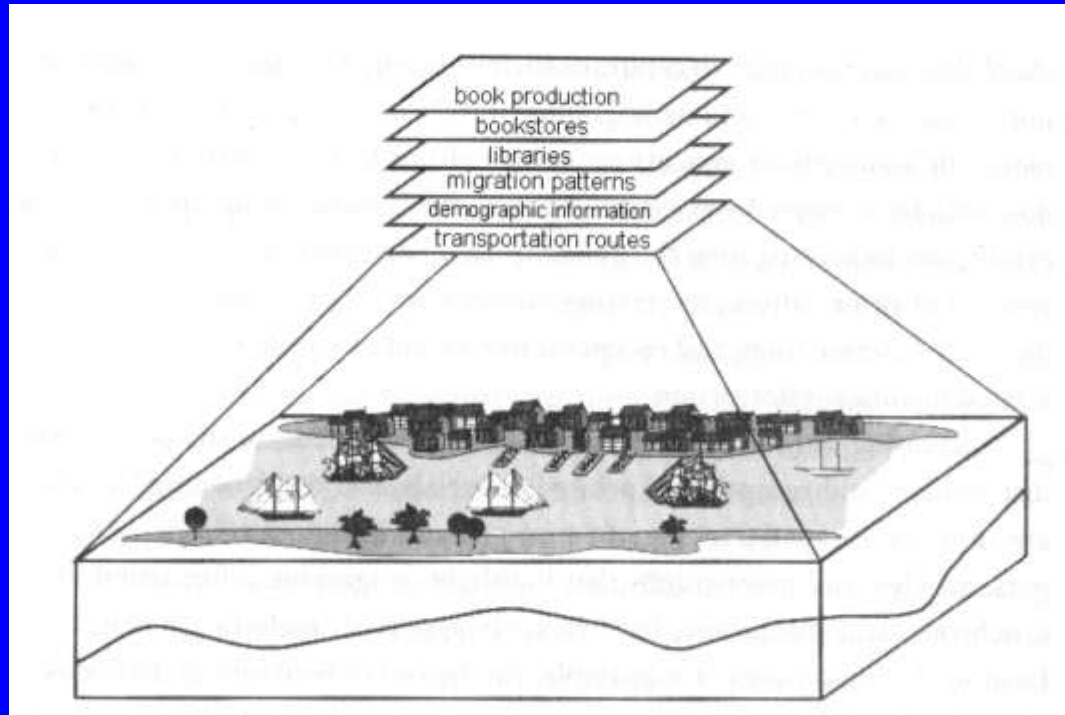
Description: Medal commemorating the coronation of King Edward VII on 26 June 1902, presented to members of Stafford Fire Brigade.

Obverse side of copper alloy medal with raised lettering, coat of arms and busts of King Edward VII and Queen Alexandra, Consort.

Diameter: 39mm.

2. Data Integration

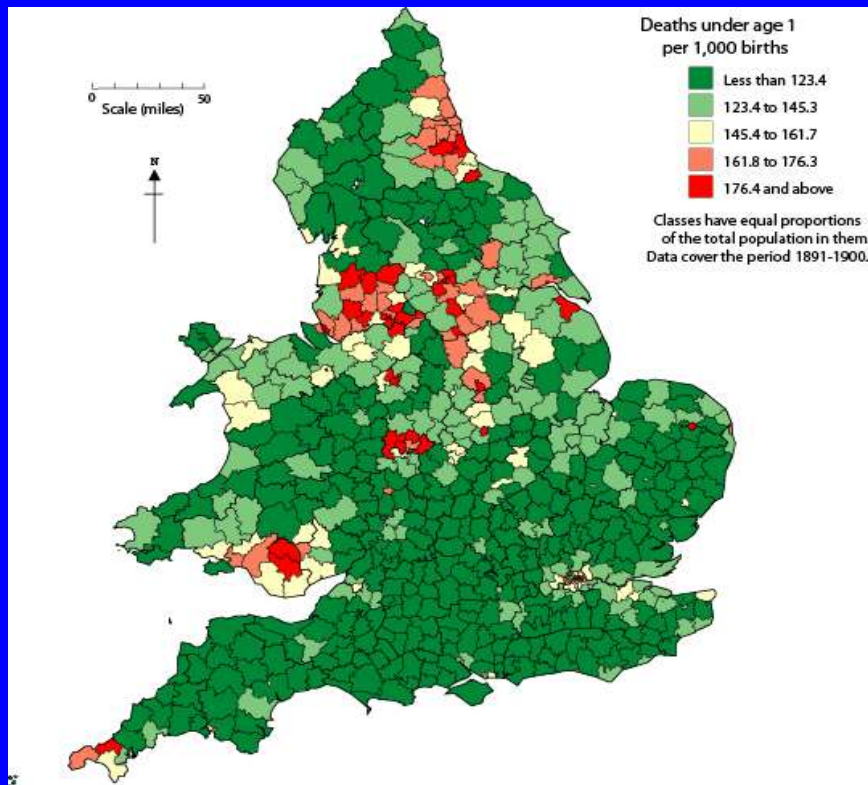
History of the book



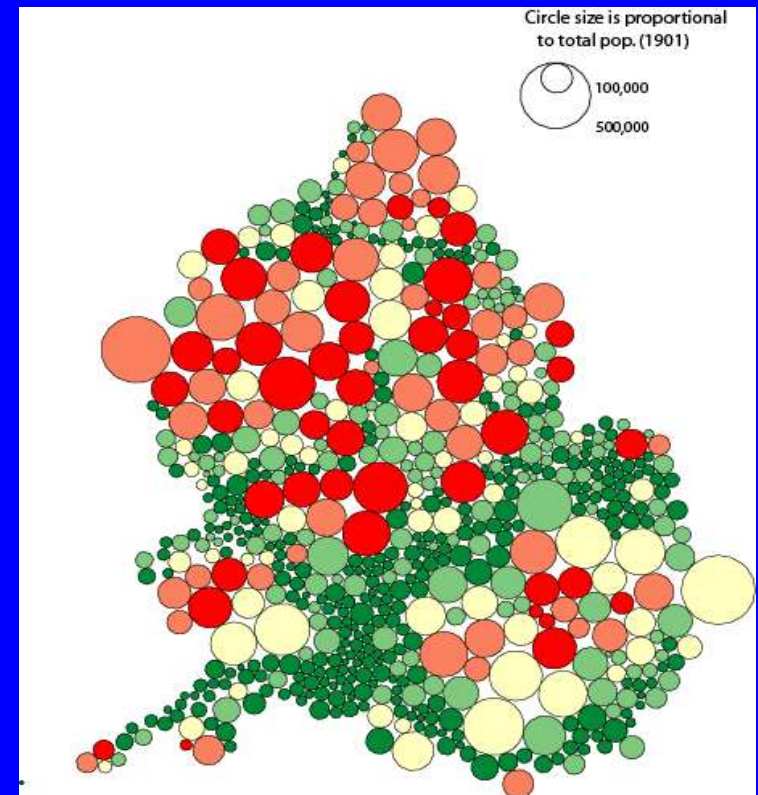
Source: MacDonald B and Black F (2000) “Using GIS for spatial and temporal analyses in print culture studies” Social Science History, 24, pp. 505-536

3. Data Visualisation

Infant mortality, 1900s



Choropleths



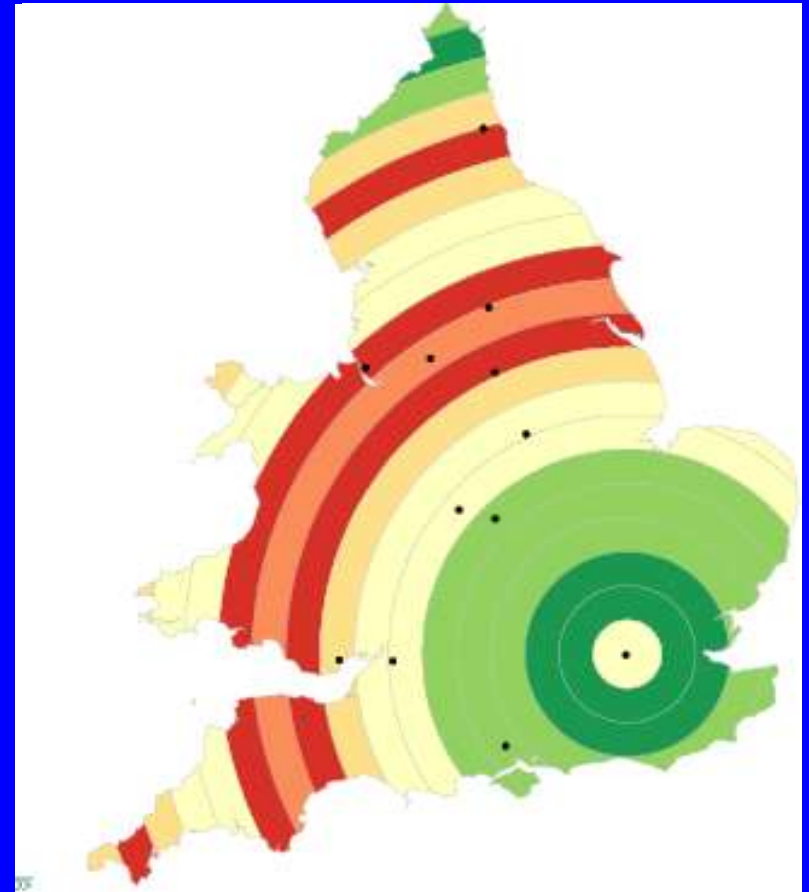
Cartograms

4. Spatial analysis

Infant mortality and the Core-Periphery Divide



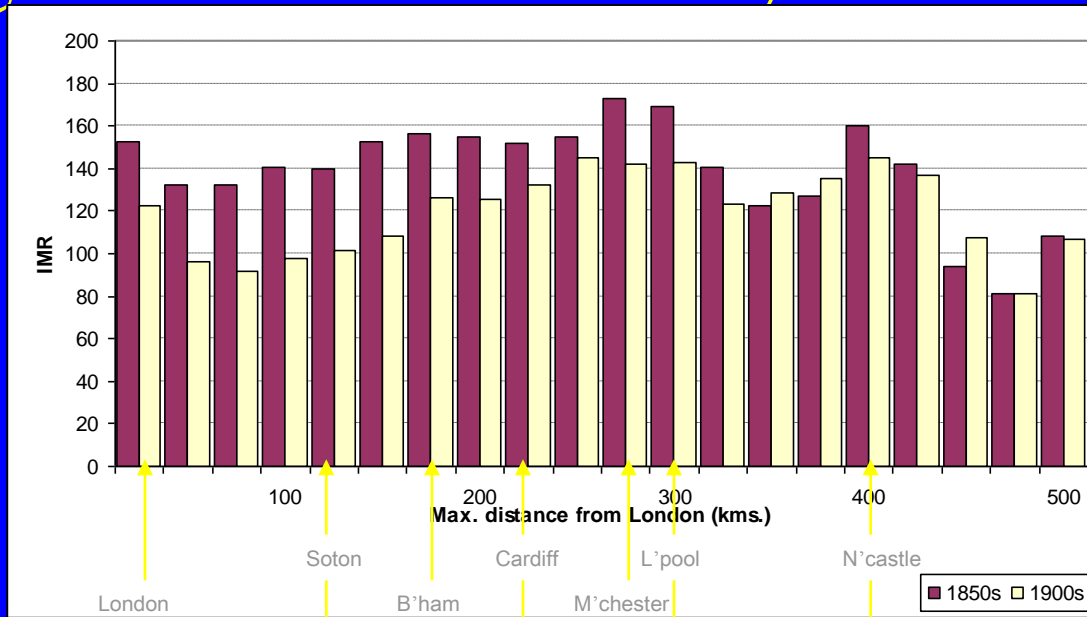
1850s



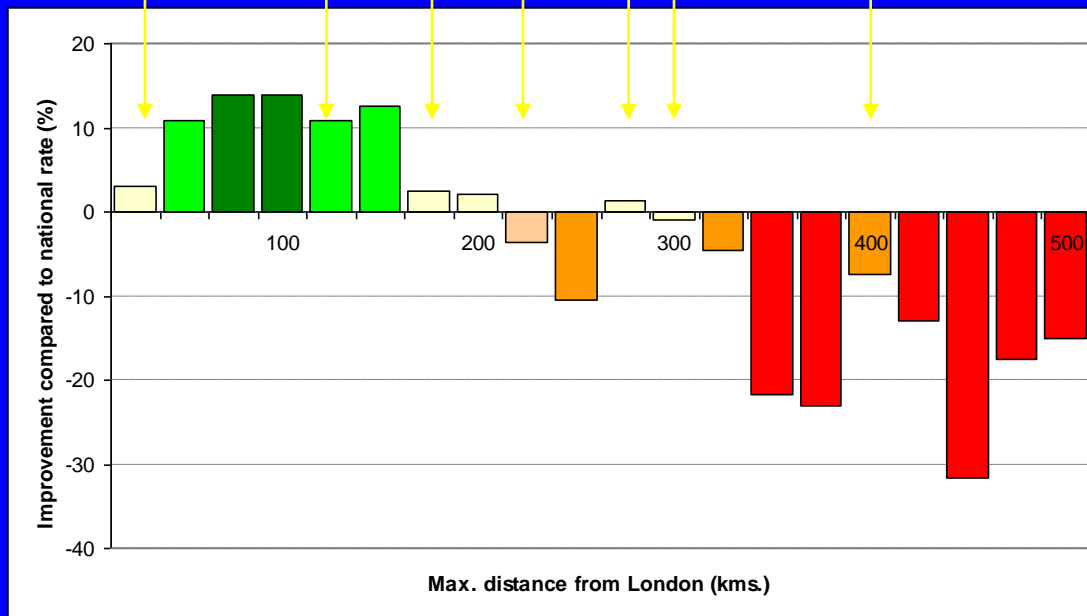
1900s

Change in Infant Mortality 1850s-1900s

Overall



Proportional to national rate



National rate dropped from 153.25 to 127.59 – an improvement of 16.74%

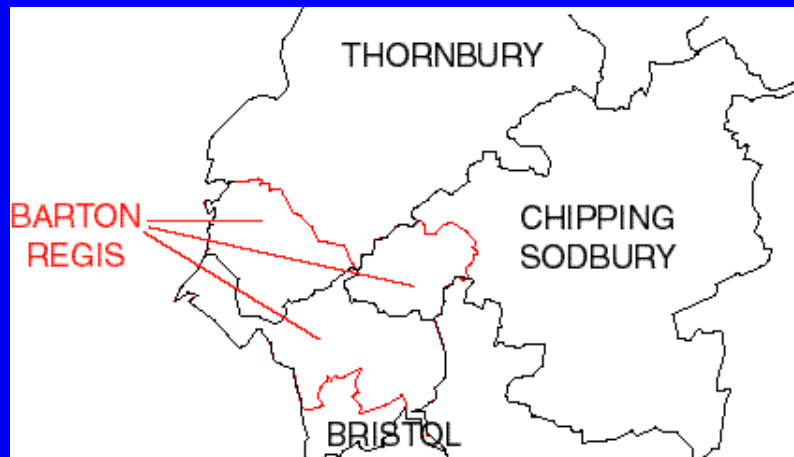
Shading indicates population deciles

Areal interpolation

- **Standardising administrative geographies over time**
- Areal interpolation: “the transfer of data from one set (source units) to a second set (target units) of overlapping, non-hierarchical areal units” (Langford *et al*, 1991: p. 56)

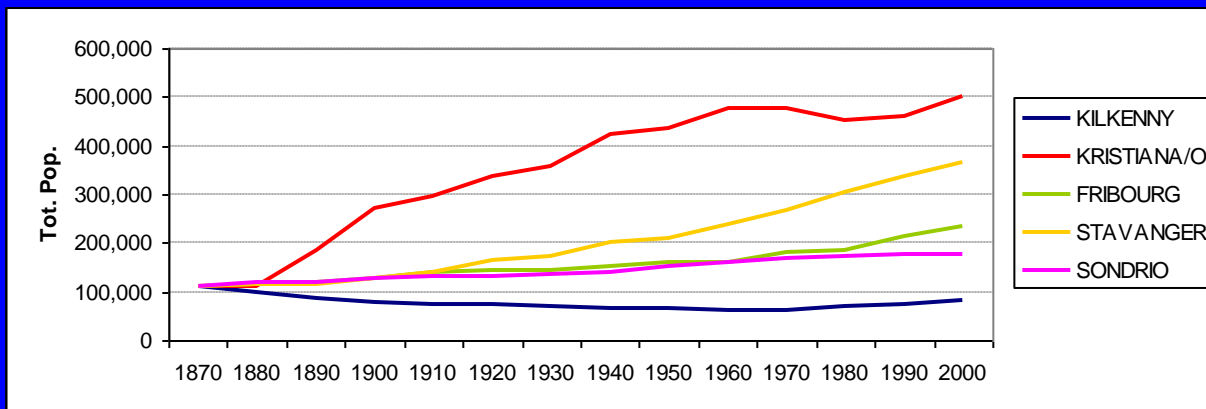
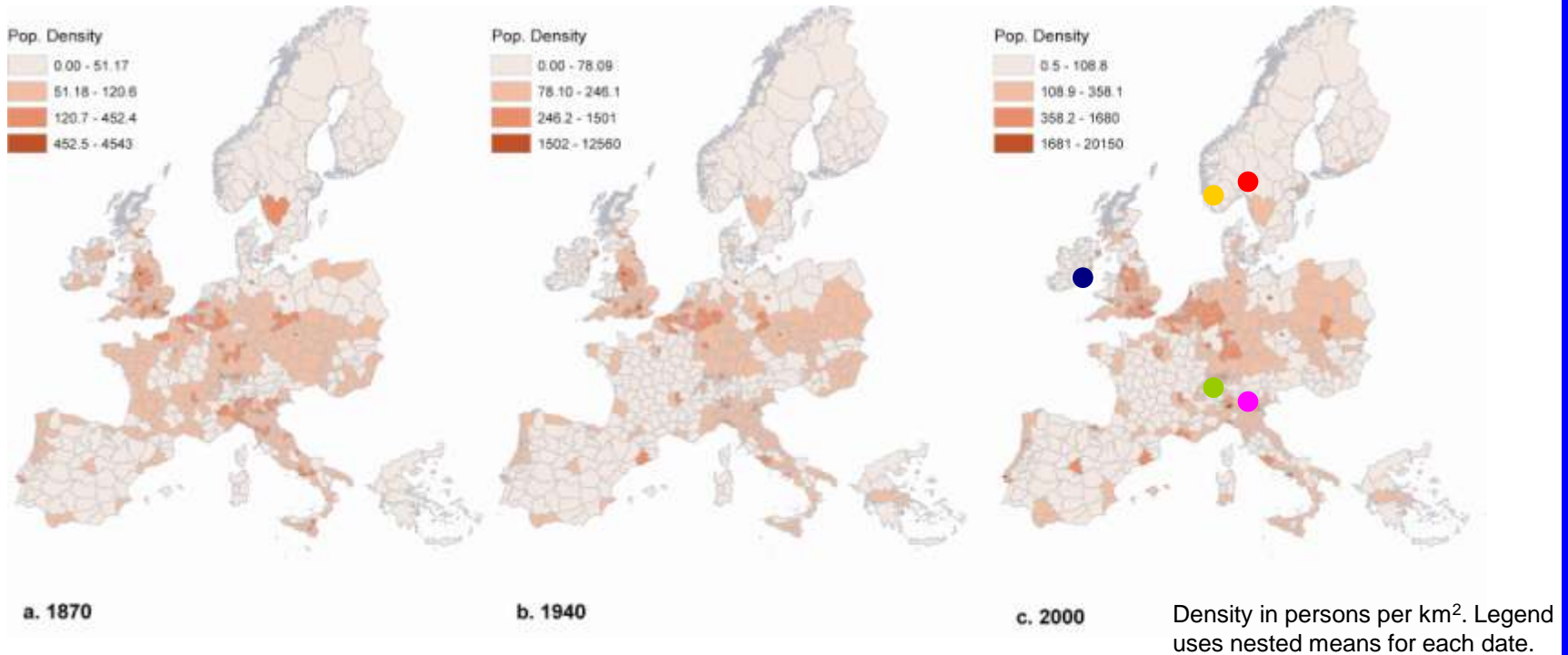
- Areal Weighting:
$$\hat{y}_i = \sum_s \left(\frac{A_{st}}{A_s} \times y_s \right)$$

- Assumption – Variable y is homogeneously distributed across the source zones
- Using this:

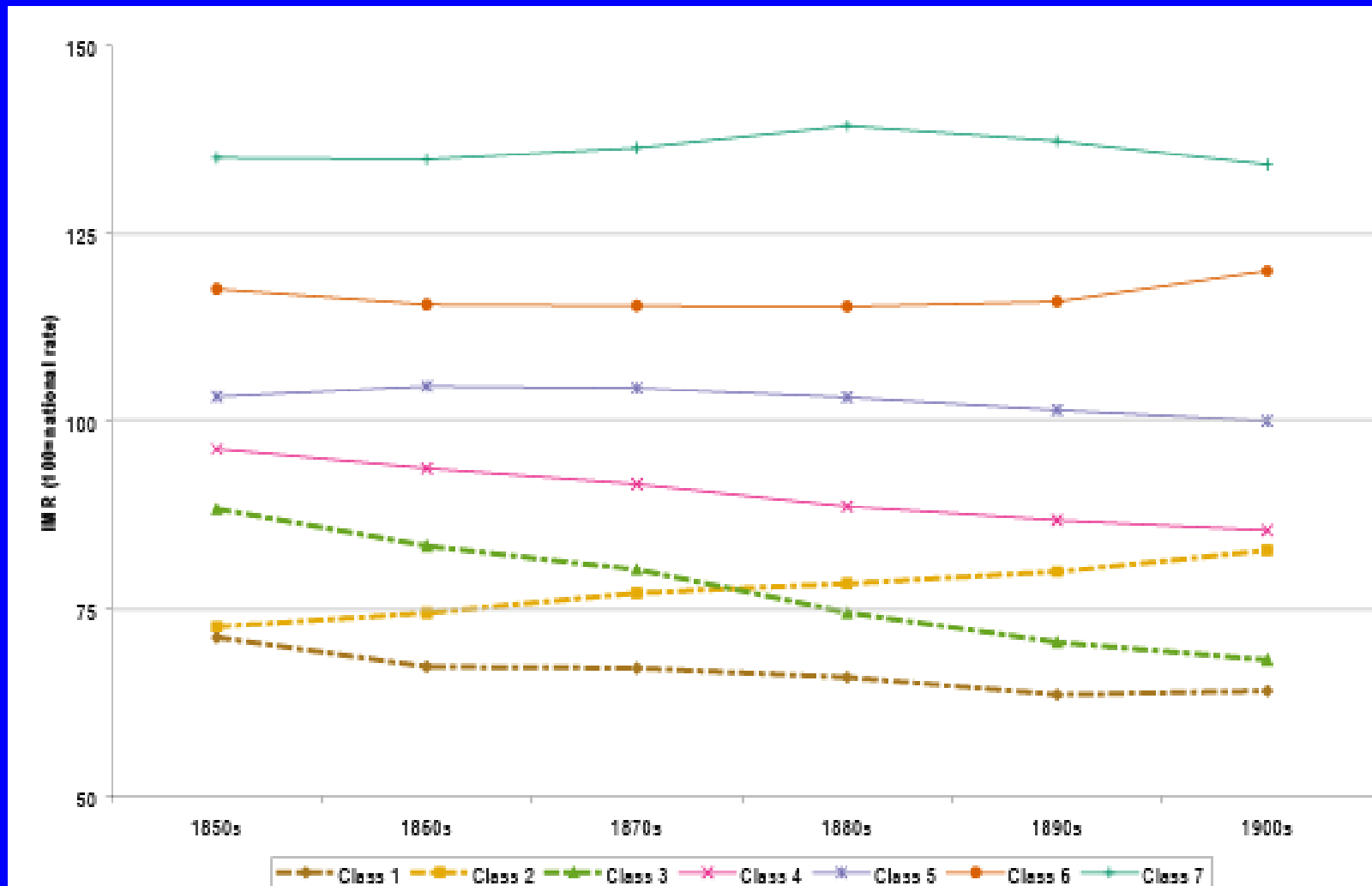


- BUT: Very unrealistic assumption.

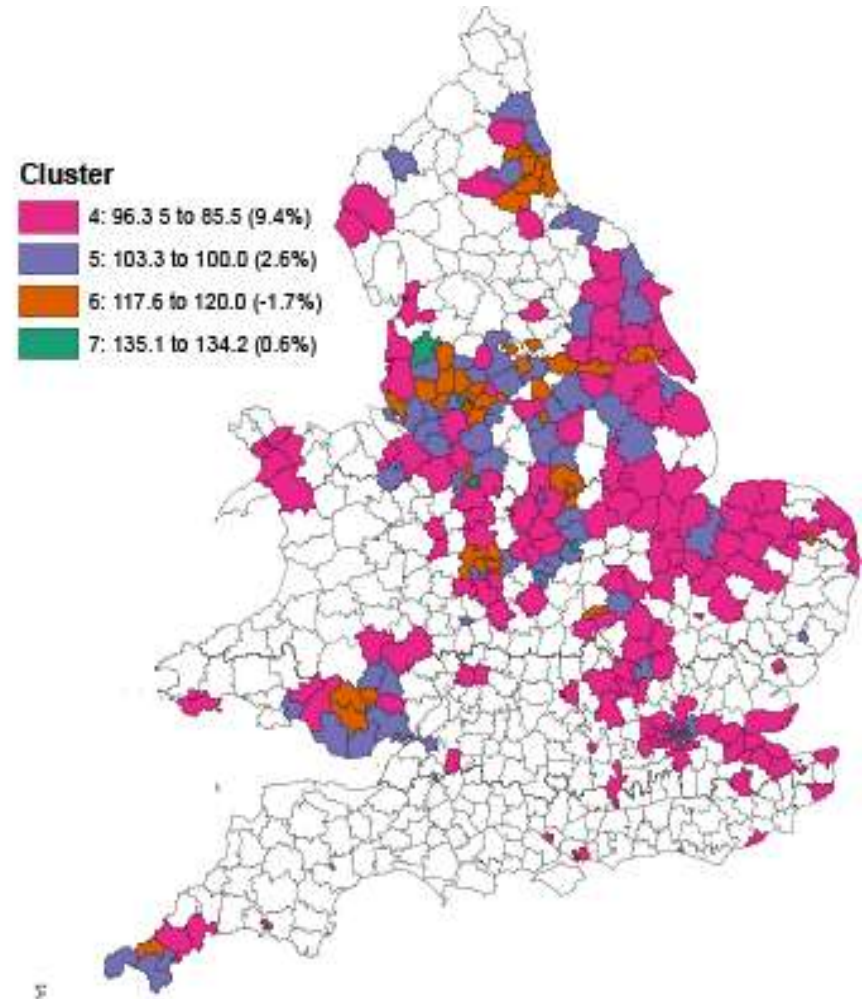
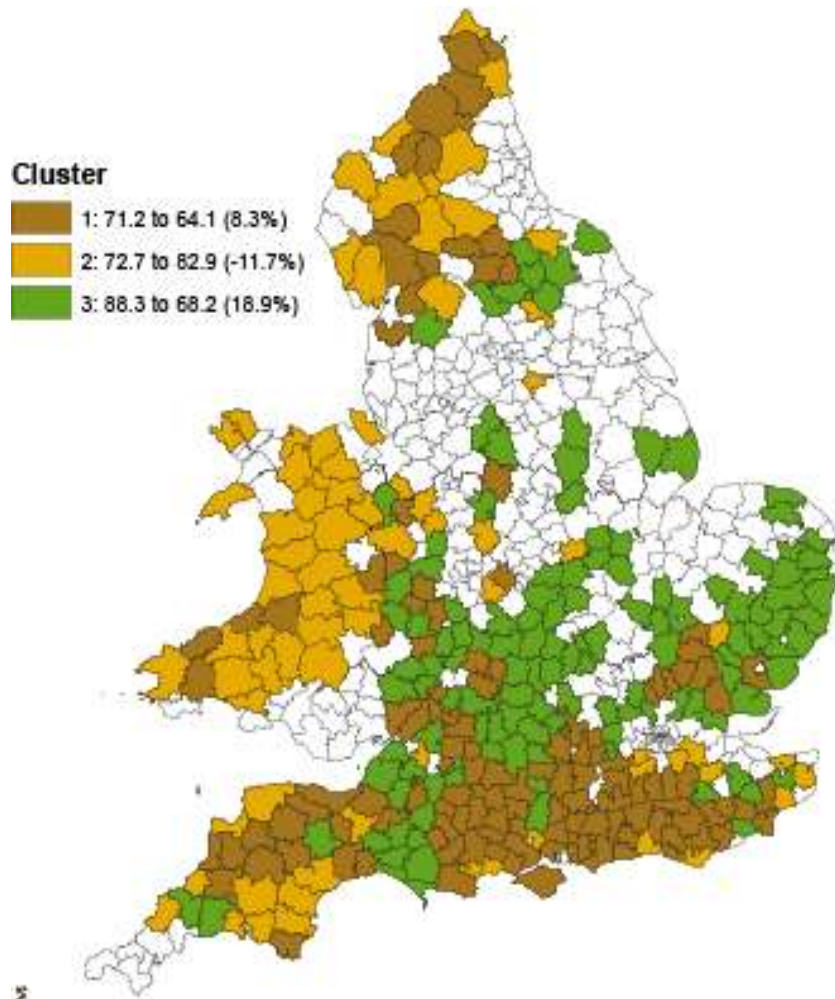
Long-term population change in Europe



Cluster Analysis: Infant mortality in England & Wales



Maps of Clusters



1. Low – slight improvement
2. Low – gets worse
3. Below average – big improvement

4. Average – slight improvement
5. Average – stays the same
6. High – stays the same
7. Very high – stays the same

Conclusions

- GIS allows improved handling of spatially-referenced data
- Improved understanding of space allows:
 - Structuring
 - Integration
 - Visualisation
 - Analysis
- It does not solve all the problems – in fact it creates many new ones
- “With experience, GIS becomes simply an extension of one’s analytical thinking... The system has no inherent answers, only those of the analyst. It is a tool for thought”
Eastman J.R. (1992) IDRISI Users’ Guide (p. 32)