

GIS Assignment 1 Final Submission P145484

by Cerys Bethan Nickels

FILE	2645_CERYB_BETHAN_NICKELS_GIS_ASSIGNMENT_1_FINAL_SUBMISSION_P145484_94366_1386196996.DOCX (1.99M)		
TIME SUBMITTED	19-JAN-2018 11:54 PM (UTC+0000)	WORD COUNT	3360
SUBMISSION ID	82128068	CHARACTER COUNT	23801

Assignment Report

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Course: BSc (Hons) Software
Engineering

Module Name: Geographic
Information Systems (Level 6)

Module Code: M6X01098

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Assignment Number: 1

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1.0 Introduction to Visual Perception

Visual perception refers to the brain's ability to interpret the visual information that surrounds us (what the eyes see) to give some meaning or context. This is important for most everyday skills, such as reading, writing, hand-eye coordination, learning, driving, dressing, playing/working and noticing objects, such as cars and other people [1]. Visual perception is based on eight key skills:

1. Sensory Processing
2. Visual Attention
3. Visual Form Constancy/ Discrimination
4. Visual Memory
5. Visual Spatial Relationships
6. Visual Sequential-Memory
7. Visual Figure Ground (Foreground-Background Differentiation)
8. Visual Closure [1], [2]

When this is perceived or processed incorrectly, it is not integrated with the other senses, so can distract or interfere with learning experiences, or cause accidents, such as a collision with objects [1], [2]. Psychologists recognise two types of processes:

- **Bottom-up or data-driven processing** – Perception starts with the stimulus, with the processing occurring in one direction from the retina to the visual cortex. Each of the successive stages in the visual pathway carries out increasingly more complex analysis of the input. It relies on past experiences to achieve this.
- **Top-down processing** – The use of contextual information in pattern recognition. For example, understanding difficult handwriting is easier when reading complete sentences than single and isolated words, due to the context being used to aid understanding [3].

2.0 Cartographic Visualisation & Maps as a Visual Information System

Maps can provide an instant and complete view of spatial phenomena, allowing users to locate geographic objects, such as roads, places (such as towns, cities and places of interest), and county and country borders (depending on the level of detail, which is determined by the scale and the map's purpose) [4]. These are often used alongside GIS-based visualisation techniques, and new technologies, to help communities and land planners understand and manage their resources, especially in rocky or mountainous terrain, where careful planning is required to make faster and better decisions, and avoiding potentially negative implications [5].

The increase in GIS has massively changed the use of maps (and those who produce them), or those who work with spatial data, as maps are no longer the final products that they used to be. This is due to technological developments, user-orientated developments, and new concepts and ways of thinking/ analysing data. There are many models of cartographic visualisation, including DiBiase's model of the role of maps in scientific visualisation (1990) introduces two components: 'private visual thinking' and 'public visual communication'. Private visual thinking refers to situations where scientists explore their own data. Public visual communications are designed for wide audiences, such as well-designed maps e.g. OS maps [6].

Maps are often generalised when used as a visual information system. This becomes a challenge as there can be large areas with lots of data or information to place, especially when the user is using a small screen, such as a portable GPS, satellite navigation system, or on a mobile device [4, pp. 3–4], [7]. There are many types of generalisation including [4, pp. 9–31], [7]:

- Simplification, Collapsing and Merging – simplifying object's geometry and omitting unnecessary details, such as similar types of objects, e.g. roads, lakes and building areas
- Smoothing – removes small variations in the geometry of a feature (such as a line) to improve its appearance
- Refinement – sets of features are reduced as the scale of the map decreases
- Exaggeration – important details are shown and emphasised over the scale
- Displacement – moving objects to visualise certain characteristics
- Classification – the organisation of features are changed to improve map legibility

3.0 The Origins of Cartographic Representation

Cartography (c. 1808-1830), the study of maps, is a combination of the Greek words *chartēs* (sheet or map) and *graphei* (to describe), with origins in classical Greek and Roman times. The Greeks used the term *pinax* for map. The term originally meant plank, as the map was either a painted plank, or one with written information on it. The Romans (and other Latin speakers) used *pinax* (in all its meanings) from the Greeks, or *tabula*, or *picta*, which was from *pingere* - meaning to paint, or *forma*. In medieval Latin, it was known as *tabula* (c. 1318) and *mappa* (c. 1400), meaning cloth/ canvas or signal flag in classical Latin. Map was first used in 1527, as an abbreviation of the Middle English *mapemounde* (c. 1380), an English derivative of *mappa mundi* (world map) [8, pp. 1–4], [9]–[11].

Chorographia, or place description, was defined by Ptolemy in his book *Chorographia* (ca. 160 C.E.) as a representation of 'localities such as harbours, farms, villages, river courses and such to paint a

true likeness and not merely to give exact positions and size'. Therefore, chorography is a visual representation of the geological and physical properties of a location [8, pp. 1–4], [9]–[11].

4.0 The Origins of GIS

Ian McHarg (1920-2001) is credited as the “Father of GIS”, with the introduction of map overlays, which had a major impact on GIS. He wrote *Design with Nature* in 1969, which pioneered ecological design and planning. He argued that: ‘form must not follow function, but must also respect the natural environment in which it is placed’ [12], [13]. His four M’s: Measurement, Mapping, Monitoring and Modelling, explain his map layering concept:

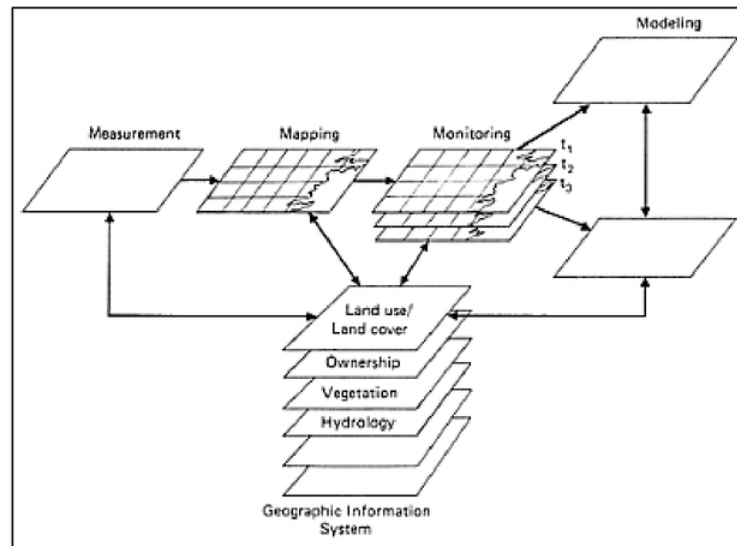


Figure 1: McHarg's 4 M's Map Layering Diagram [13]

According to [4, p. 9], [14, pp. 3–7], some of the most significant advances in GIS are:

- 1950's – first computerised maps
- 1960's and 70's – automation of existing tasks, such as line drawings, and distribution of address matching software
- 1967 – first demonstrations of address matching, computer mapping and small area data analysis. This was used for the New Haven Census Use Study
- 1980's – computer-assisted map production with closely coupled spatial statistics and geographical displays
- 1990's – full integration of maps in geographic information (scientific) visualisation, and the move from supply to demand-driven environments, such as the web
- 2000's – location-based services in mobile environments e.g. GPS

5.0 The Principles of Thematic Mapping

According to Becony  [15], the main principles of thematic mapping are:

- Decomposition – Objects are divided into smaller components and all processes are applied to each one separately.
- Abstraction – An object is reviewed several times with different levels of abstraction. The higher the level, the more details are ignored.
- Structural design – All objects created for thematic maps consists of pre-designed and approved standard components.
- Unification – All map or atlas components are designed and implemented using the accepted rules and standards.
- User's comfort – All thematic maps are created based upon the users' needs and wants, thus determining the amount of information, complexity, and the design of the map.

6.0 Data Visualisation Within a Software Environment

Data visualisation is the ability to visually represent data to enhance someone's understanding of the data, such as the use of graphs and charts, to increase the ability to identify trends and patterns from the data [16]. Taylor believes the basic aspects of cognition (analysis and applications), communication (new display techniques), and formalism (new computer technologies) are connected through interactive visualisation (see Figure 2). There are three visualisation strategies:

- Can be used to present spatial information – Spatial analysis operation results can be displayed in well-designed maps, which are easy to understand by a wider audience. Answerable questions include: 'what is?', 'where is?' and 'what belongs together?'. The use of design rules can help answer these through functions used to create well-designed maps.
- Can be used for analysis or manipulation of known data – Planning environments can be used to understand the nature of two separate datasets, but not their relationship. Spatial analysis operations, such as visual overlay, combines the datasets and determines their possible spatial relationship. Answerable questions include: 'what the best site is?' and 'what the shortest route is?'. Accessing individual map components require the creation of functions, which can be used to extract, process, manipulate, or summarise information.
- Can be used to explore raw and unknown data – In several applications, such as remote sensing data, there is abundant (temporal) data available to attempt to answer questions such as: 'what the nature of the dataset is?', or 'which datasets reveal patterns related to the current problem studied?', and 'what if . . .?'. These must be answered before the data can be

used in spatial analysis, where the user requires the use of functions to visually use the spatial data [6].

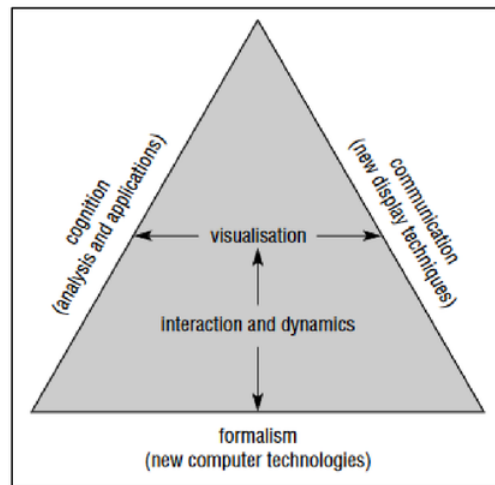


Figure 2: Taylor's Cartographic Visualisation [6, p. 158]

7.0 Types of Data in Geo-Information Systems

There are three main types of data used in geo-information systems. These can be used on their own, or act as single layers which have been integrated onto a single map. These are:

- Raster data is stored in a .JPG, .TIF, .GIF or another similar format, which have been scanned using a flatbed scanner, or taken with a digital camera.
- Vector data has a spatial component, or coordinates assigned to it. These files often contain sets of points, lines or polygons which are referenced in a geographic space.
- Numerical data is statistical data with geographical information, which allows the data to be joined with vector files to allow the data to be queried and displayed as a GIS map layer [17].

8.0 Case Study: MMR Immunisation Uptake in Wales 2013 to 2016

8.1 Case Study Introduction

This case study looks at the uptake of the MMR vaccination between 2013 and 2016 within Wales. This case study consists upon research for data collection (see section 8.2), data analysis to calculate the Townsend Index (see section 8.3), and data visualisation via the use of GIS software (see section 8.4) to display the spatial data effectively. The immunisation data collected is for each of the 22 counties and the 7 health boards within Wales. These health boards are:

- Aneurin Bevan Health Board

- Abertawe Bro Morgannwg University Health Board
- Cardiff & Vale University Health Board
- Hywel Dda Health Board
- Cwm Taf Health Board
- Betsi Cadwaladr University Health Board
- Powys Teaching Health Board [18]

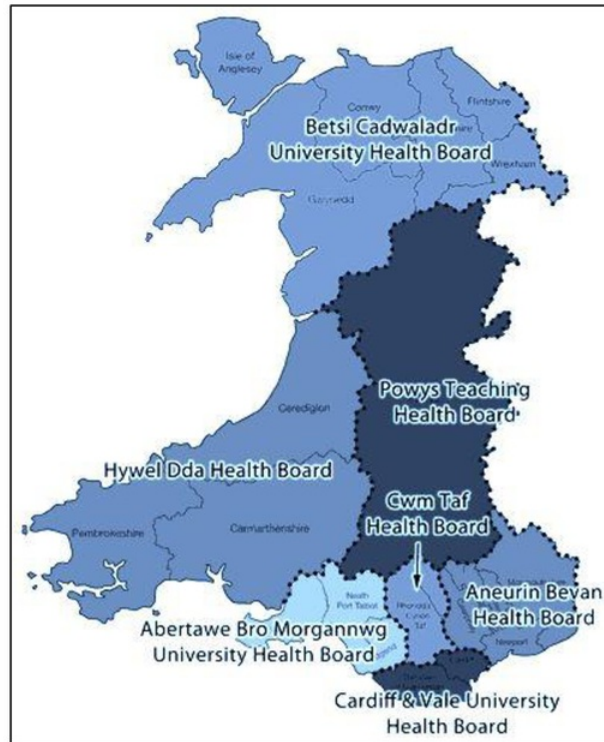


Figure 3: The Welsh NHS Health Boards Map [18]

8.2 Collecting the Immunisation Data

The immunisation record data was collected from the Health Maps Wales website [19].



Figure 4: Health Maps Wales Immunisation Data

		LocalAuthority.xlsx - Excel																Cerys Nickels	
		File Home Insert Page Layout Formulas Data Review View Developer Add-ins Font PDF Team Tell me what you want to do																	
		G38																	
		A B C D E F G H I J K L M N O P Q R S T U																	
		4 in 1 pre-school booster in 1 teenage boost Hib/HenC booster by age 5 in 1 primary 1st dose MMR by age 2 (2 up to 2nd dose MMR by age 5 (% up to coverage (1 dose) cover																	
		rate rate rate rate rate rate rate rate rate rate rate rate rate rate rate rate rate rate rate																	
		FY 13/14 FY 14/15 FY 15/16 FY 14/15 FY 15/16 FY 14/15 FY 15/16 FY 13/14 FY 14/15 FY 15/16 FY 13/14 FY 14/15 FY 15/16 FY 13/14 FY 14/15 FY 15/16 FY 13/14 FY 14/15 FY 15/16 FY 13/14																	
		Codes Names																	
		001A Isle of Anglesey 93.0 93.7 93.1 93.8 93.3 93.4 93.5 93.8 93.1 93.4 93.1 93.9 93.0 93.6 93.0 93.2 93.8 93.5 93.2																	
		001C Gwynedd 94.8 94.4 94.2 96.1 97.0 94.7 96.3 97.1 97.4 97.1 98.9 98.0 98.6 98.2 98.7 98.8 98.5 98.2																	
		001E Conwy 94.5 94.0 94.4 94.8 97.2 94.9 94.1 96.8 96.8 96.0 96.3 98.9 98.6 98.9 98.7 98.8 98.8 98.0																	
		001G Denbighshire 94.3 94.9 94.8 94.7 94.8 94.9 94.4 94.6 94.4 94.1 94.2 95.3 95.3 95.2 93.9 93.2 96.1 91.5																	
		001H Flintshire 95.2 95.5 95.9 96.1 97.4 96.3 96.4 97.2 98.2 96.8 97.7 97.3 97.2 94.0 94.2 93.9 97.0 95.5																	
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		001N Powys 92.3 92.4 92.1 93.1 96.9 95.6 94.7 96.9 96.5 96.2 96.3 95.4 94.3 90.7 90.4 90.4 92.7 97.8																	
		001Q Ceredigion 92.6 95.2 94.0 95.9 97.4 96.2 93.0 97.1 95.3 96.5 97.2 95.1 92.5 92.2 94.5 92.1 94.7 94.5																	
		001S Pembrokeshire 92.2 92.6 92.2 96.1 97.0 93.7 93.7 95.8 95.2 95.4 95.5 94.6 93.8 98.9 92.0 98.2 92.5 93.2																	
		001U Carmarthenshire 93.0 93.4 92.6 93.5 95.8 94.2 94.0 97.2 96.9 96.7 97.2 95.5 94.4 92.7 93.7 91.3 95.3 93.8																	
		001X Swansea 94.3 93.0 91.7 95.4 93.8 97.6 97.0 97.3 97.3 96.6 94.9 93.0 92.2 96.2 96.2 94.6 99.2																	
		001Z Neath Port Talbot 92.5 93.9 92.9 94.9 94.8 94.5 94.5 96.6 97.5 97.4 96.0 96.4 94.1 92.3 94.6 93.4 97.9 96.3																	
		001B Bridgend 93.5 92.5 92.8 97.7 93.5 96.0 96.1 97.6 97.7 97.2 97.7 96.9 96.8 93.7 94.2 91.8 96.6 93.3																	
		001D The Vale of Glamorgan 94.6 95.1 93.6 92.4 93.5 96.0 96.1 96.1 96.4 96.9 96.0 96.0 95.8 93.3 93.9 92.2 94.1 93.4																	
		001F Rhondda Cynon Taf 94.9 95.2 93.6 97.8 92.2 96.5 96.9 97.8 98.3 98.1 97.2 96.7 96.9 94.1 94.6 92.6 97.7 96.6																	
		001H Merthyr Tydfil 94.2 95.0 94.5 99.6 91.4 97.4 97.6 98.2 99.1 99.0 97.5 97.3 97.6 93.5 94.3 93.8 96.3 95.6																	
		001K Caerphilly 94.4 94.2 91.2 91.7 92.8 96.6 96.7 97.5 98.3 97.6 97.3 97.1 96.7 93.4 94.5 92.9 97.2 97.8																	
		001L Blaenau Gwent 92.8 94.1 92.8 90.5 93.6 97.1 97.2 98.1 98.4 98.1 97.5 97.5 97.0 93.6 93.2 91.4 98.0 96.7																	
		001M Torfaen 94.7 93.0 92.5 91.9 92.8 96.3 96.7 97.9 98.5 97.4 97.5 96.6 96.6 94.8 93.0 92.1 97.2 97.8																	
		001P Monmouth 92.1 91.7 97.2 95.3 91.6 92.2 95.5 96.1 96.1 95.0 94.9 94.6 91.9 91.4 98.2 93.9 93.4 91.9																	
		001R Newport 90.1 90.2 92.0 92.6 92.5 93.6 93.2 96.1 96.0 95.4 95.7 95.3 94.7 90.4 90.9 98.0 94.1 94.4																	
		001T Cardiff 91.5 91.3 90.2 96.0 94.2 92.2 91.7 91.9 91.2 93.6 94.8 94.3 94.0 90.1 90.7 98.7 93.2 92.4																	
		Wales 93.2 93.5 92.2 92.0 92.9 93.1 94.9 94.7 96.9 96.8 96.5 96.0 95.3 92.5 93.2 91.6 95.3 94.6																	
		7A1 Betsi Cadwaladr 94.3 93.0 95.3 95.7 95.4 95.8 96.0 97.2 97.3 96.8 96.9 96.6 96.4 94.4 93.5 96.5 94.4																	
		7A2 Hywel Dda 92.0 93.4 91.0 91.3 92.4 94.4 93.7 96.7 96.1 96.2 96.6 95.1 93.9 91.2 93.2 96.4 94.2 93.7																	
		7A3 Abertawe 93.6 93.0 91.0 93.1 94.6 95.4 94.6 97.3 97.3 97.3 97.1 96.6 95.2 93.5 93.8 94.6 96.8 95.1																	
		7A4 Cardiff and Vale 92.3 92.2 91.0 97.8 97.8 93.1 92.6 94.4 94.7 95.9 95.3 94.7 94.5 90.9 91.5 98.6 93.4 92.7																	
		7A5 Cwm Taf 94.8 93.4 93.7 98.2 90.4 96.7 97.1 97.9 98.5 98.3 97.3 96.9 97.1 94.0 94.5 92.9 97.4 96.4																	
		7A6 Anhefnedd 92.4 92.6 90.8 99.3 90.5 95.5 92.6 97.0 97.6 96.8 96.6 96.3 95.9 92.6 92.7 91.0 95.1 96.6																	
		7A7 Porth Teifi 92.3 92.4 92.1 93.1 95.9 95.6 94.7 96.9 96.5 96.2 95.2 95.4 94.2 90.7 90.4 90.4 92.7 92.1																	

Figure 5: Immunisation Data Downloaded from Health Maps Wales

This data was separated into the health board and county data using separate Excel files, and the unnecessary data removed for ease of use within MapInfo. This can be seen below.

	A	B	C	D	E
	Codes	Names	MMR Uptake FY 13/14	MMR Uptake FY 14/15	MMR Uptake FY 15/16
2	00NA	Isle of Anglesey	96.7	98.3	96.9
3	00NC	Gwynedd	95.9	95.0	96.6
4	00NE	Conwy	96.3	95.9	95.6
5	00NG	Denbighshire	96.2	95.3	95.3
6	00NJ	Flintshire	97.7	97.3	97.2
7	00NL	Wrexham	97.5	97.5	97.2
8	00NN	Powys	95.2	95.4	94.3
9	00NQ	Ceredigion	97.2	95.1	92.5
10	00NS	Pembrokeshire	95.5	94.6	93.8
11	00NU	Carmarthenshire	97.2	95.5	94.4
12	00NX	Swansea	97.3	96.6	94.9
13	00NZ	Neath Port Talbot	96.0	96.4	94.1
14	00PB	Bridgend	97.7	96.9	96.8
15	00PD	The Vale of Glamorgan	96.8	96.0	95.8
16	00PF	Rhondda Cynon Taf	97.2	96.7	96.9
17	00PH	Merthyr Tydfil	97.5	97.3	97.6
18	00PK	Caerphilly	97.3	97.1	96.7
19	00PL	Blaenau Gwent	97.5	97.5	97.0
20	00PM	Torfaen	97.5	96.8	96.6
21	00PP	Monmouthshire	95.0	94.9	94.6
22	00PR	Newport	95.7	95.3	94.7
23	00PT	Cardiff	94.8	94.3	94.0

Figure 6: The County MMR Immunisation Data

	A	B	C	D	E
	Codes	Names	MMR Uptake FY 13/14	MMR Uptake FY 14/15	MMR Uptake FY 15/16
2	#7A1	Betsi Cadwaladr University Health Board	96.9	96.6	96.6
3	#7A2	Hywel Dda University Health Board	96.6	95.1	93.9
4	#7A3	Abertawe Bro Morgannwg University Health Board	97.1	96.6	95.2
5	#7A4	Cardiff and Vale University Health Board	95.3	94.7	94.5
6	#7A5	Cwm Taf University Health Board	97.3	96.9	97.1
7	#7A6	Aneurin Bevan University Health Board	96.6	96.3	95.9
8	#7A7	Powys Teaching Health Board	95.2	95.4	94.3

Figure 7: The Health Board MMR Immunisation Data

8.3 Calculating the Townsend Index Using the UK Data Service Infuse Site

To calculate the Townsend Index, the data is collected using the UK Data Services Infuse site [20]. The steps to calculate the Townsend Index can be found in Appendix 1, but the information required to perform these calculations are:

- All households (Population)
- Households with an occupancy rating of -1 or less
- People aged 16-74: Economically active: Employees Part-time
- People aged 16-74: Economically active: Employees Full-time
- People aged 16-74: Economically active: Self-employed
- People aged 16-74: Economically active: Unemployed
- People aged 16-74: Economically active: Full-time student

- Households: Owner occupied: Owns outright
- Households: Owner occupied: Owns with a mortgage or loan
- Households: No cars or vans

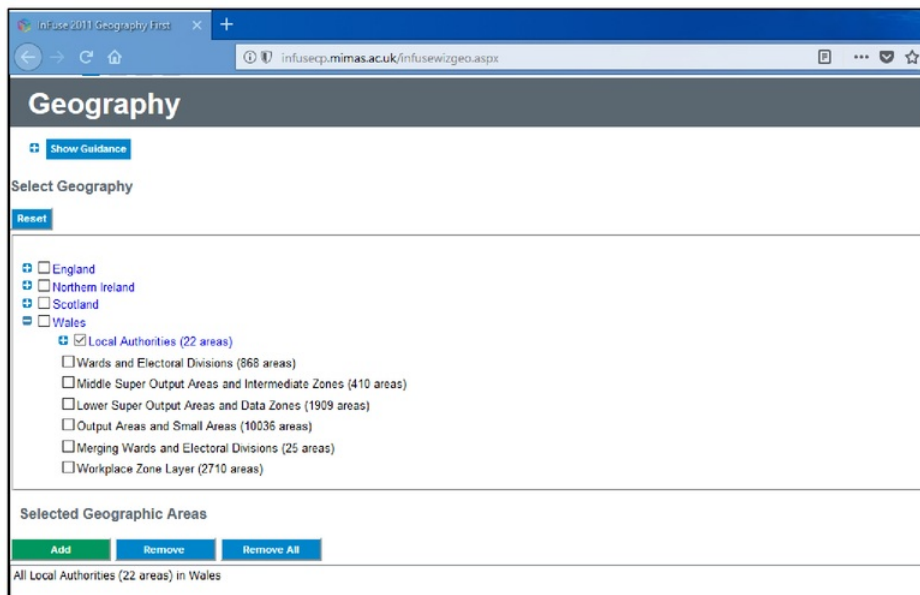


Figure 8: Selecting the Welsh Local Authorities on InFuse

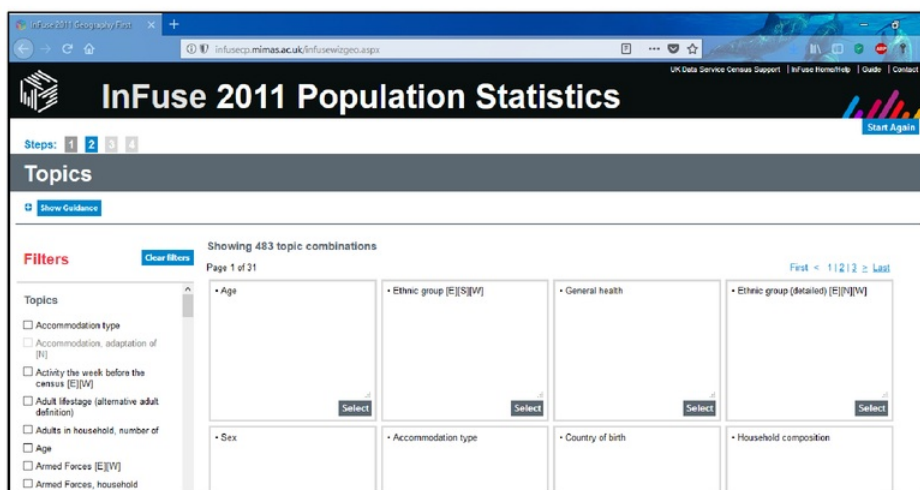


Figure 9: Selecting the Topics for Exporting from InFuse [20]

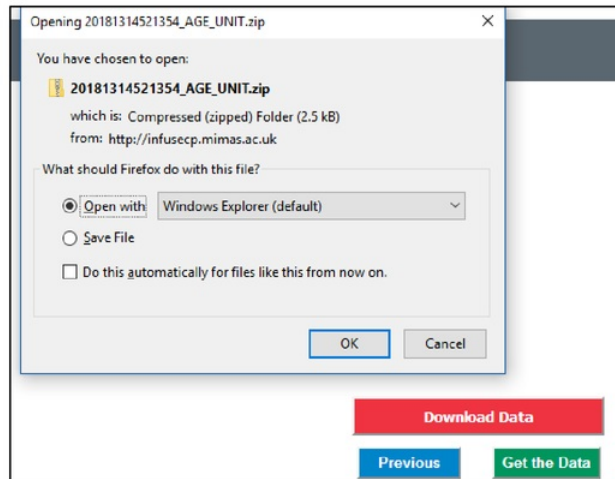


Figure 10: Downloading the Infuse Data

	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	%Overcrowding	%Unemployed	%NotHomeOwners	%NoCar	Log%Overcrowding	Log%Unemployed	Log%NotHomeOwn	Log%NoCar	ZOvercrowding	ZUnemployed	ZNotHomeOwners	ZNoCar	Zscore
2	32.32006276	6.963413564	31.45287985	18.0329476	1.522705811	0.901099271	1.511266624	1.279506053	0.762468481	0.409490336	-0.131163387	-0.91471471	0.1260
3	35.34770265	5.295628106	34.58731157	21.4014827	1.560476966	0.799030066	1.551295181	1.550276764	1.947178492	-0.781021092	0.689498658	-0.09617544	1.7594
4	33.79838599	6.016679194	30.6309475	21.7441429	1.541559101	0.846131621	1.500112201	1.356869575	1.353810777	-0.231696061	-0.359850406	-0.01992249	0.7423
5	31.35697726	6.229150769	31.45563064	21.0008386	1.509967944	0.859087282	1.511290052	1.342439234	0.362939307	-0.080570918	-0.130683061	-0.18681488	-0.0351
6	27.40157727	5.374889884	27.17101111	16.9862498	1.452342459	0.804470687	1.449803822	1.254940621	-1.413345577	-0.717639003	-1.391268486	-1.19884031	-4.7108
7	29.48850585	5.914209576	36.39727156	22.1744855	1.4841186141	0.839742539	1.573839918	1.365046685	-0.447287789	-0.366233891	1.131207012	0.07468481	0.4528
8	33.1284456	4.112541993	32.44090996	18.3860338	1.531116509	0.708636888	1.524278086	1.287488966	1.0893049	-1.835544011	0.135959505	-0.82238374	-1.4333
9	30.85727194	5.83782186	31.18105493	17.875813	1.501208583	0.834917782	1.507602277	1.275906126	0.15092878	-0.362503195	-0.206330515	-0.95631573	-1.3742
10	30.15387738	5.569523638	28.54660087	18.8077992	1.493512106	0.81753388	1.470507526	1.296836224	-0.153205755	-0.565282866	-0.966802935	-0.71427267	-2.3995
11	33.51980637	6.05102312	35.97978885	25.7592007	1.535544829	0.848252139	1.587964404	1.427473188	1.165170509	-0.205960654	1.051249642	0.79668553	2.7861
12	30.23363635	7.108313503	31.31819913	25.5112347	1.49462255	0.908930532	1.509447153	1.423429955	-0.118376179	0.500840401	-0.168466034	0.74991979	0.9639
13	28.150047	6.921861386	27.62881312	21.9072033	1.464639259	0.898827239	1.456803344	1.35997207	-1.058816142	0.382987552	-1.247764899	0.01596119	-1.9076
14	29.62526867	6.053743037	27.76936735	19.3776283	1.486079907	0.848419635	1.458930312	1.309153635	-0.386320159	-0.205006848	-1.204157984	-0.57180858	-2.3672
15	33.06817624	6.577907195	40.89241496	29.0410152	1.532348885	0.879549282	1.622135397	1.477714605	1.064928036	0.158114128	2.14185871	1.57778006	4.7426
16	29.97601918	7.350166884	29.00073247	27.0692233	1.491025605	0.921695155	1.477131858	1.448230395	-0.231196044	0.649737121	-0.830991435	1.03676351	0.6243
17	27.11636837	7.790238765	30.67576095	24.3518507	1.448959225	0.944000672	1.500727057	1.404009319	-1.550627781	0.909926412	-0.34724469	0.525299956	-0.4526
18	31.58863756	10.92243444	37.91425565	28.9683062	1.513056024	1.076364943	1.590108728	1.476662197	0.4601177	2.455928978	1.485250681	1.36560783	5.764
19	28.97674177	7.115060173	33.7607251	23.5958606	1.478784427	0.905017444	1.541089419	1.390858845	-0.677877166	0.50505387	0.480261015	0.37319902	0.6806
20	27.70381608	4.719531666	26.9342976	15.1884498	1.457939639	0.757360409	1.437646411	1.209205262	-1.268952888	-1.267193403	-1.640518696	-1.72781886	-5.9044
21	30.81317171	7.807048029	35.80069313	27.9147322	1.502606224	0.944820365	1.565855999	1.461119175	0.132035523	0.919604611	0.988023301	1.18581609	3.225
22	31.46627817	4.172604458	31.28802811	15.0089982	1.511482505	0.71370927	1.509041528	1.204864156	0.408875971	-1.776875717	-0.176782228	-1.78881145	-8.3280
23	27.08181668	8.772053884	34.70576889	29.7271678	1.447851244	0.869858583	1.552788	1.487521532	-1.591653197	1.446834151	0.71079227	1.46121927	2.0646
24					Mean	1.408399642	0.865994409	1.51766414	1.358591009				
25					StdDev	0.021891195	0.085718005	0.048775913	0.086459762				

Figure 11: Calculating the Townsend Index

To calculate the Townsend Index, the following calculations were performed on the data collected:

Step 1: Calculating the Percentages

- %Overcrowding: $= (\text{One Person Household} / \text{Total Household Composition}) * 100$
- %Unemployed: $= (16-74 - \text{Unemployed} / \text{SUM}(\text{Employees (Part-time and Full-time), Self-employed, Unemployed, Full-time student})) * 100$
- %NotHomeOwners = $100 - ((\text{Owns outright} + \text{Owns with mortgage or loan} / \text{Total Household Composition}) * 100)$
- %NoCar = $(\text{No Household Cars or Vans} / \text{Total Household Composition}) * 100$

Step 2: Calculating the Base 10 Logarithms from the Percentages

- $\text{Log}\% \text{Overcrowding} = \text{Log}10(\% \text{Overcrowding} + 1)$
- $\text{Log}\% \text{Unemployed} = \text{Log}10(\% \text{Unemployed} + 1)$
- $\text{Log}\% \text{NotHomeOwners} = \text{Log}10(\% \text{NotHomeOwners})$
- $\text{Log}\% \text{NoCar} = \text{Log}10(\% \text{NoCar})$

Stage 3: Calculating the Mean and Standard Deviation For Each of the Log Results

- Mean: $=\text{AVERAGE}(\text{All Log Results for that column})$
- Standard Deviation: $=\text{STDEVA}(\text{All Log Results for that column})$

Step 4: Calculating the Z Scores

- $Z_{\text{Overcrowding}} = (\text{Log}\% \text{Overcrowding Var1} - \text{Mean}(\text{Log}\% \text{Overcrowding}) / \text{S.D.}(\text{Log}\% \text{Overcrowding})$
- $Z_{\text{Unemployed}} = (\text{Log}\% \text{Unemployed} - \text{Mean}(\text{Log}\% \text{Unemployed})) / \text{S.D.}(\text{Log}\% \text{Unemployed})$
- $Z_{\text{NotHomeOwners}} = (\text{Log}\% \text{NotHomeOwners} - \text{Mean}(\text{Log}\% \text{NotHomeOwners})) / \text{S.D.}(\text{Log}\% \text{NotHomeOwners})$
- $Z_{\text{NoCar}} = (\text{Log}\% \text{NoCar} - \text{Mean}(\text{Log}\% \text{NoCar})) / \text{S.D.}(\text{Log}\% \text{NoCar})$

Step 5: Calculating the Townsend Index

- Townsend Index: $=\text{SUM}(\text{Z Scores})$

8.4 Using the MapInfo Software

Just like the data, there are two MapInfo Workspace files to account for the different needs. One of the maps displays data about the county, such as their immunisation records and the Townsend Index, whilst the health board map only displays the immunisation data. This is due to a lack of available data for the health boards to conduct the Townsend Index.

8.4.1 The County Map and Townsend Deprivation Index

Some of the county names are missing from the map due to geo-visualisation. Some of the county names are long, and although abbreviations can be used, such as RCT for Rhondda Cynon Taff, a key may need to be added to explain the abbreviations, unless the map user is familiar with the county names. Some of the counties in the South are smaller, therefore, there is less room to accommodate the names, even abbreviations. These could be added, but could result in the map becoming cluttered.

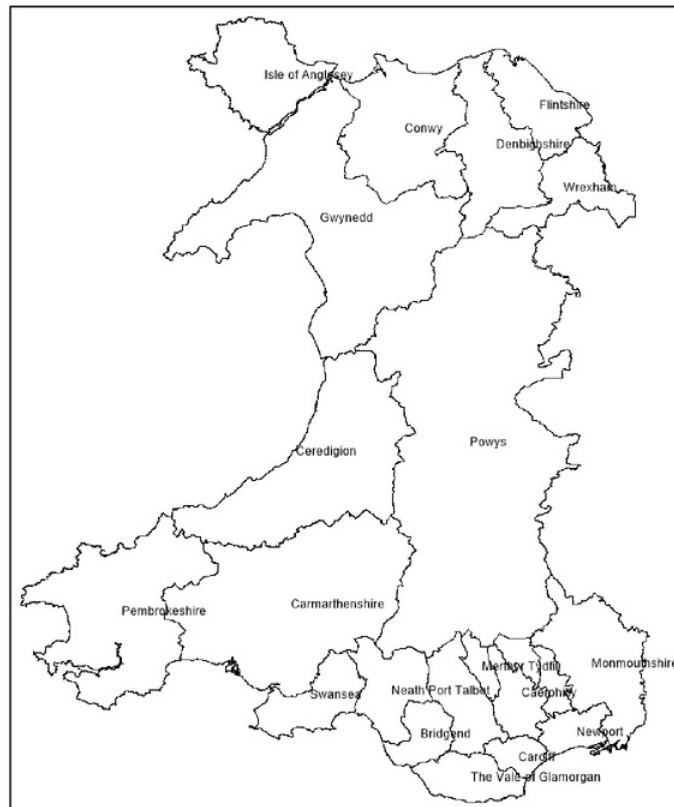


Figure 12: County Map in MapInfo Displaying County Names

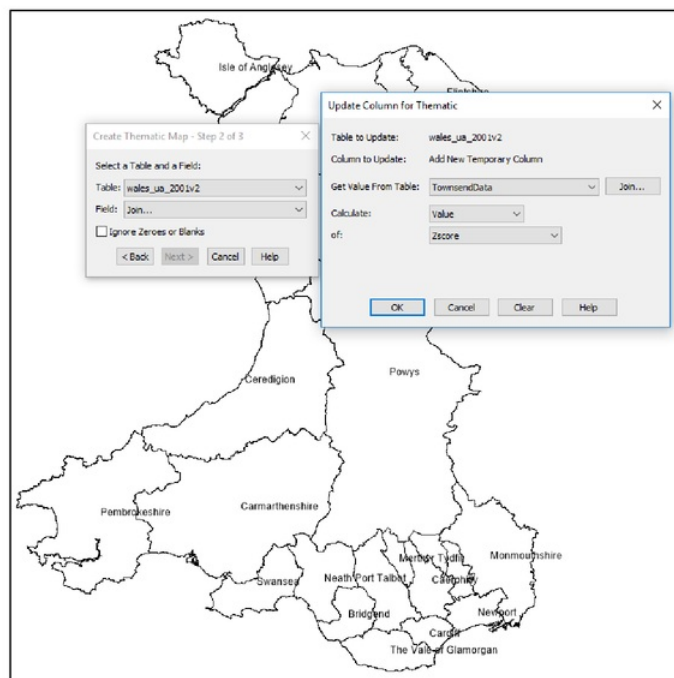


Figure 13: Creating a Thematic Map for the Townsend Index Z Scores

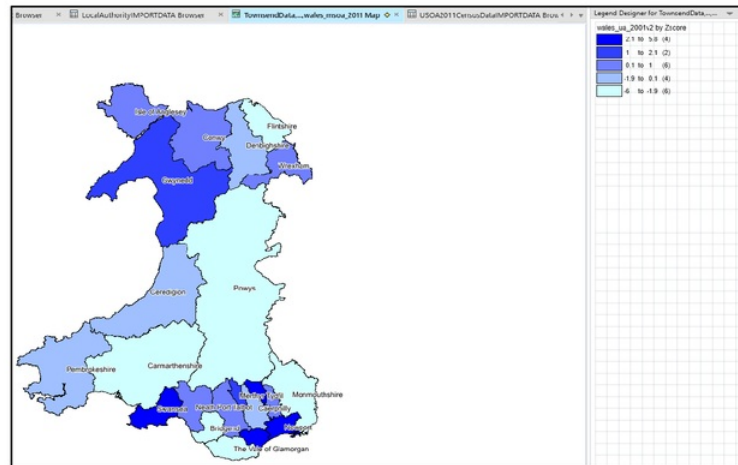


Figure 14: The Townsend Index Scores Thematic Map

The Townsend Index is shown on the map in different shadings of blue. The higher the score, the more deprivation there is within the county. According to this map, this includes Gwynedd, Swansea, Newport, and Cardiff. For the city counties, this can be attributed to high numbers of students, and a greater economic inequality that can be found within the boundaries, while in Gwynedd, this can be attributed to a lack of employment opportunities, such as in higher-paying jobs.

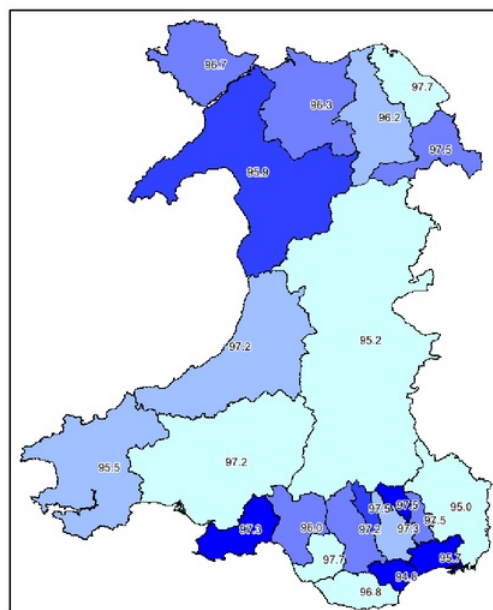


Figure 15: County MMR Immunisation Data for Financial Year 2013/4

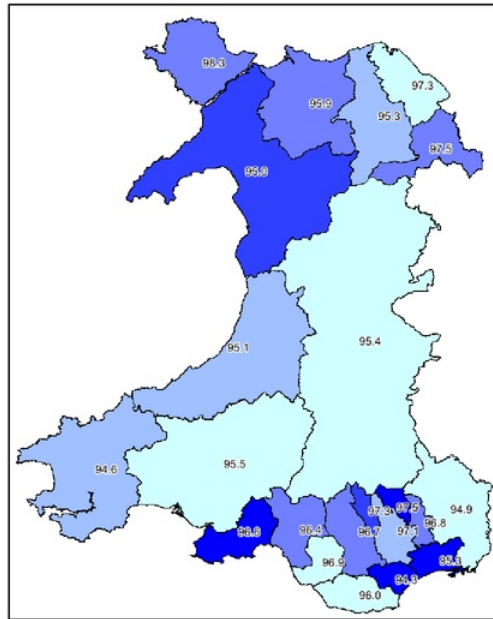


Figure 16: County MMR Immunisation Data for Financial Year 2014/5

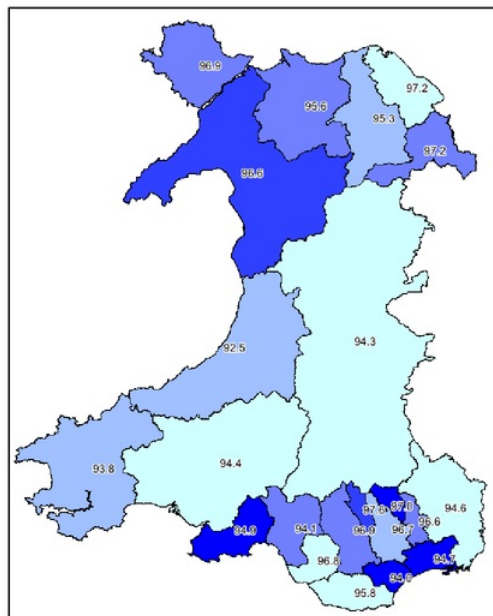


Figure 17: County MMR Immunisation Data for Financial Year 2015/6

8.4.2 The Health Board Map

A colour was added to each of the health boards to emphasise the boundary lines. This can also make the data easier to read, and is more visually appealing to the user. This map was harder to implement as there is little support to create the map using the Welsh Health Boards. These have been shaded using the thematic map tool, similar to the Townsend Index map.

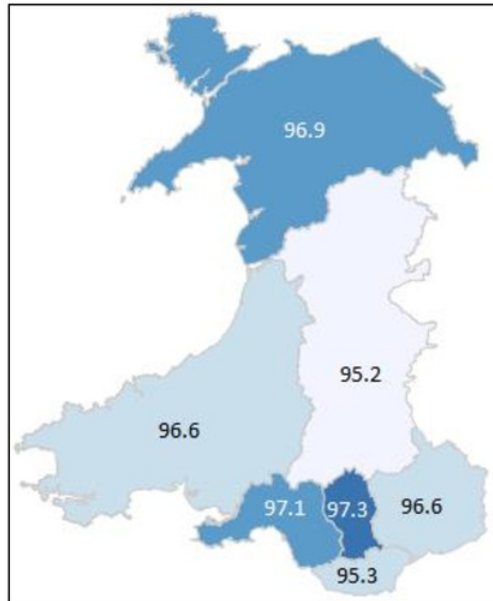


Figure 18: Health Board MMR Immunisation Data for Financial Year 2013/4

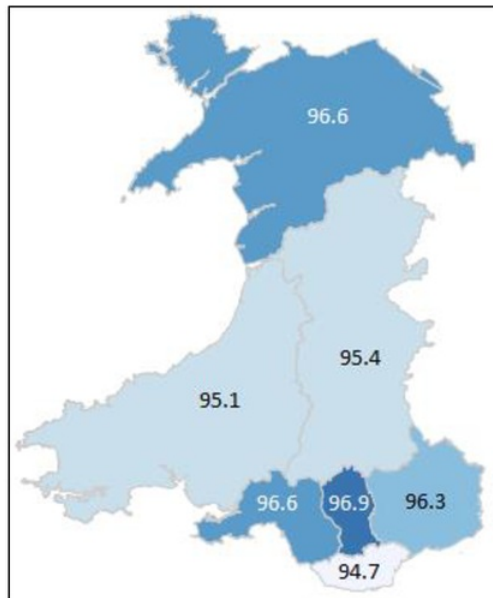


Figure 19: Health Board MMR Immunisation Data for Financial Year 2014/5

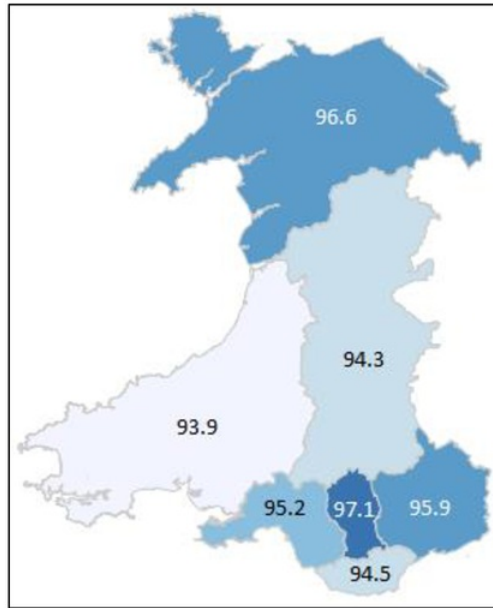


Figure 20: Health Board MMR Immunisation Data for Financial Year 2015/6

9.0 References

- [1] Advanced Vision, 'Visual Perception', *Advanced Vision*, 2017. [Online]. Available: http://www.advancedvisiontherapycenter.com/services/assessments/binocular_vision_assessment/visual_perception/. [Accessed: 08-Dec-2017].
- [2] Kid Sense Child Development, 'Visual Perception', *Kid Sense Child Development*, 2017. [Online]. Available: <https://childdevelopment.com.au/areas-of-concern/fine-motor-skills/visual-perception/?print=pdf>. [Accessed: 08-Dec-2017].
- [3] S. McLeod, 'Visual Perception | Simply Psychology', *Simply Psychology*, 2008. [Online]. Available: <https://www.simplypsychology.org/perception-theories.html>. [Accessed: 08-Dec-2017].
- [4] A. Guszlev, 'Cartographic visualisation in GIS', *University of West Hungary*, 2006. [Online]. Available: http://uhulag.mendelu.cz/files/pagesdata/eng/socrates_ip/teaching_materials/cartography.pdf. [Accessed: 10-Dec-2017].
- [5] T. Panagopoulos, 'Geographic Information Systems in the Context of Visual Landscape Management', 8005-139 Faro, Portugal.
- [6] M.-J. Kraak, 'Visualizing Spatial Distributions', in *Geographic Information Systems: Principles and Technical Issues*, 1999, pp. 157–173.
- [7] R. E. Roth, M. Stryker, and C. A. Brewer, 'The ScaleMaster Typology: Literature Foundation', *Penn State University*, 2008. [Online]. Available: http://www.personal.psu.edu/cab38/ScaleMaster/ScaleMaster_Typology_Literature_Review_booklet_Roth_final.pdf. [Accessed: 10-Dec-2017].
- [8] P. Van Der Krogt, 'The Origin of the Word "Cartography"', *e-Perimtron*, vol. 10, no. 3, pp. 124–142, 2015.
- [9] J. F. Moffitt, 'Medieval Mappaemundi and Ptolemy's Chorographia', *Gesta*, vol. 32, no. 1, pp. 59–68, Jan. 1993.
- [10] J. F. Moffitt, 'Ptolemy's Chorographia in the New World: Revelations from the Relaciones Geograficas de la Nueva Espana of 1579-1581', *Art Hist.*, vol. 21, no. 3, pp. 367–392, Sep. 1998.

- [11] Harvard University, '04-P1 Ptolemy-Geography', *Harvard University*, 2010. [Online]. Available: http://sites.fas.harvard.edu/~hsci161/Sci_Rev_Reader/04-P1_Ptolemy-Geography.pdf. [Accessed: 10-Dec-2017].
- [12] The Cultural Landscape Foundation, 'Ian McHarg | The Cultural Landscape Foundation', *The Cultural Landscape Foundation*, 2016. [Online]. Available: <https://tclf.org/pioneer/ian-mcharg>. [Accessed: 10-Dec-2017].
- [13] D. A. Rogers, 'BRIEF HISTORY OF GEOGRAPHICAL INFORMATION INFORMATION SYSTEMS SYSTEMS', *Missouri S&T*, 2004. [Online]. Available: <https://web.mst.edu/~rogersda/gis/History of GIS.pdf>. [Accessed: 10-Dec-2017].
- [14] D. W. Coppock, J. T., and Rhind, 'The history of GIS', in *Geographical Information Systems: Principles and Applications*, vol. 1., New York, New York, USA: John Wiley and Sons, 1991, pp. 21–43.
- [15] G. Beconyté, 'THE PARADIGMS AND PRINCIPLES IN THEMATIC CARTOGRAPHY DESIGN', *Geod. ir Kartogr.*, vol. 26, no. 3, pp. 133–139, Jan. 2000.
- [16] A. Flowers, 'Data Visualisation: the space where design and technology collide | Victoria and Albert Museum', *Victoria and Albert Museum*, London, May-2016.
- [17] Syracuse University, 'GIS (Geographic Information Systems), Geospatial Data: Types of GIS data', *Syracuse University Libraries*, 2017. [Online]. Available: <https://researchguides.library.syr.edu/c.php?g=258118&p=1723814>. [Accessed: 12-Dec-2017].
- [18] NHS Wales, 'NHS Wales | Structure', *NHS Wales*, 2017. [Online]. Available: <http://www.wales.nhs.uk/nhswalesaboutus/structure>. [Accessed: 20-Dec-2017].
- [19] Health Maps Wales, 'Home | Data | Immunisations', *Health Maps Wales*, 2017. [Online]. Available: <https://www.healthmapswales.wales.nhs.uk/IAS/dataviews/view?viewId=149>. [Accessed: 15-Dec-2017].
- [20] UK Data Service, 'UK Data Service - Infuse', *UK Data Service*, 2017. [Online]. Available: <http://infusecp.mimas.ac.uk/>. [Accessed: 15-Dec-2017].

Appendix 1: Calculating the Townsend Index

Step 1: Calculating the Percentages

- %Overcrowding: $= (\text{One Person Household} / \text{Total Household Composition}) * 100$
- %Unemployed: $= (16-74 - \text{Unemployed} / \text{SUM} (\text{Employees (Part-time and Full-time), Self-employed, Unemployed, Full-time student})) * 100$
- %NotHomeOwners = $100 - ((\text{Owns outright} + \text{Owns with mortgage or loan} / \text{Total Household Composition}) * 100)$
- %NoCar = $(\text{No Household Cars or Vans} / \text{Total Household Composition}) * 100$

Step 2: Calculating the Base 10 Logarithms from the Percentages

- Log%Overcrowding: $= \text{Log10} (\text{\%Overcrowding} + 1)$
- Log%Unemployed: $= \text{Log10} (\text{\%Unemployed} + 1)$
- Log%NotHomeOwners: $= \text{Log10} (\text{\%NotHomeOwners})$
- Log%NoCar: $= \text{Log10} (\text{\%NoCar})$

Stage 3: Calculating the Mean and Standard Deviation for Each of the Log Results

- Mean: $= \text{AVERAGE} (\text{All Log Results for that column})$
- Standard Deviation: $= \text{STDEVA} (\text{All Log Results for that column})$

Step 4: Calculating the Z Scores

- ZOvercrowding = $(\text{Log\%Overcrowding} - \text{Mean} (\text{Log\%Overcrowding}) / \text{S.D.} (\text{Log\%Overcrowding}))$
- ZUnemployed = $(\text{Log\%Unemployed} - \text{Mean} (\text{Log\%Unemployed})) / \text{S.D.} (\text{Log\%Unemployed})$
- ZNotHomeOwners = $(\text{Log\%NotHomeOwners} - \text{Mean} (\text{Log\%NotHomeOwners})) / \text{S.D.} (\text{Log\%NotHomeOwners})$
- ZNoCar = $(\text{Log\%NoCar} - \text{Mean} (\text{Log\%NoCar})) / \text{S.D.} (\text{Log\%NoCar})$

Step 5: Calculating the Townsend Index

- Townsend Index: $= \text{SUM} (\text{Z Scores})$

GIS Assignment 1 Final Submission P145484

GRADEMARK REPORT

FINAL GRADE

68/100

GENERAL COMMENTS

Instructor

22,26,7,7,6 (68)

1) The report has a good overall flow. Good introduction demonstrating a sound understanding of visualisation and furthermore visualisation using a map. An interesting section on generalisation – we haven't studied this as such as it is a very vast topic and nowadays software will really do much of this for you.

Some excellent research has been presented and this section flows well and demonstrate a sound understanding of mapping GIS and how the layers work culminating in the historical taxonomy of events.

2) You demonstrate, through your research, a good understanding of the context of thematic mapping and the requirements of the structured dataset to build themes on your maps. Good introduction to case study.

3/4) Through your case study build, you demonstrate a sound understanding of the software. You have presented some clear definitions of deprivation using the Townsend index map of Wales

Your Townsend themes are easy to follow. However, by placing percentage information onto the map in the relevant area to demonstrate the MMR uptake we do not instantly gain a visual of good and bad regions – therefore we do not gain insight into data correlation. You presented some suitable images throughout report however you come to an abrupt stop with no conclusion. Use of Excel is good perhaps you could describe the data in little bit more detail.

5) Generally this was a very well presented report with a great start. You need to think about the way you represent data bit more in terms of thematic mapping. However, because you came such an abrupt stop with no conclusion you have lost marks there.

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