

JE - Report - GIS - ACCA5027 - Geodemographic Analysis Using GIS Software - v1.0

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Geodemographic analysis using GIS software

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ACCA5027

Geographic Information Systems

UWTSD – Computing

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I. Declaration

I declare that this report is the product of my own work and is not being submitted for any other degree etc.

James Evans

II. Abstract

The following Report contains:-

- An account of how a Geographical Information System was compiled to inform Healthcare Professionals on the uptake of vaccinations.
- Analysis of the Geographical Information System to this end.

These have been completed by James Evans.

III. Introduction

This report will contain:-

Task 1: A detailed account of the steps that were taken to collate the information required, and the formation of the system.

Task 2: Analysis of the Geographical Information System to determine the extent to which the vaccination programme has been a success.

IV. Task 1: Development Log

Task 1: Assemble Base Data

The two key sets of data which were used as the primary sources for this paper were:-

Rapid Covid-19 surveillance data.xls (source:
<https://public.tableau.com/app/profile/public.health.wales.health.protection/viz/RapidCOVID-19virology-Public/Headlinesummary>)

Covid Vaccination data download.xls (source:
<https://public.tableau.com/app/profile/public.health.wales.health.protection/viz/RapidCOVID-19virology-Public/Headlinesummary>)

Task 2: Assemble Additional Data

In order to successfully map the data above; a base map was required. The map chosen was Wales Local Authorities. This was taken from the UK data Service.

In addition to this map; the following data was also obtained from the UK Data Service:-

- For the country of Wales, by Local Authority:-
 - Local Authority Boundaries
 - Employment
 - Automobile ownership
 - Home Ownership
 - Spare Bedrooms

Task 3: Augment Base Data

In order to successfully bring the base data into the GIS software; the data first had to be cleansed.

The following actions were taken for each data set in question:-

- Local Authority Immunisation Data
 - Reduce the data set to Local Authorities only.
 - Cross reference the Local Authorities with those in the Map Info Data to retrieve the definitive geo codes for thematic purposes.
- Local Authority Covid Case Data
 - Reduce the data set to Local Authorities only.
 - Create sumif functions to yield a table which contains the case data (rate per population of 100,000) by approximate vaccination window, by Local Authority.
 - The following windows were used:-
 - Pre vaccination
 - Dose 1 – June 2021
 - Dose 2 – September 2021
 - Booster – February 2022
 - The same technique was also used to collate Testing data, held in the same table.
 - Cross reference the Local Authorities with those in the Map Info Data to retrieve the definitive geo codes for thematic purposes.
- Covid Deaths by Local Authority Data
 - Reduce the data set to Local Authorities only.
 - Cross reference the Local Authorities with those in the Map Info Data to retrieve the definitive geo codes for thematic purposes.
- Townsend Index
 - As per the GIS materials [1], the Townsend Index was calculated by taking the following from Welsh Local Authorities:-
 - Employment
 - Automobile ownership
 - Home Ownership
 - Spare Bedrooms

- Then using these to create the Townsend Index as follows:-
 - Var 1 = Log (Overcrowding % +1)
 - Var2 = Log (Unemployed % +1)
 - Var3 = Line Entry Percentage without residence ownership.
 - Var4 = Line Entry Percentage without car ownership.
 - Zscore1 = Var1 line entry – (average of all Var1/Standard Variation of all Var1)
 - Zscore2 = Var2 line entry – (average of all Var2/Standard Variation of all Var2)
 - Zscore3 = Var3 line entry – (average of all Var3/Standard Variation of all Var3)
 - Zscore4 = Var4 line entry – (average of all Var4/Standard Variation of all Var4)

Task 4: Upload into Mapping Tool

Using Map info, this information was uploaded into Map info as follows:-

- Wales Local Authority Map
 - Boundaries for the Welsh Local Authorities.
 - Uploaded as a table and then opened as a map to create the visual outline of our the Local Authorities.
- Wales Covid Case Data
 - Uploaded as a table.
 - Each set of data was added as a separate theme (with the same thematic colour) to the main map.
- Wales Immunisation Data
 - Uploaded as a table.
 - Each set of data was added as a separate theme (with the same thematic colour) to the main map.
- Townsend Index
 - Uploaded as a table.
 - Added as a theme and as spatial data, to the main map.

- Death Data
 - Uploaded as a table.
 - Added as a heat map to the main map.

Task 5: Assemble Visuals

Visuals were then added as layers within Map Info as follows:-

- Map Thematics
 - Covid Case Data (Red scale)
 - by Local Authority
 - Pre Vaccination
 - Dose 1
 - Dose 2
 - Booster
 - Vaccination Data (Purple scale)
 - by Local Authority
 - Dose 1
 - Dose 2
 - Booster
 - Townsend Index (Diverging Brown – Teal)
 - by Local Authority
 - Household Does Not Own a Car
 - by Local Authority
 - Residence is Not Owned by Occupier
 - by Local Authority
 - Unemployed
 - by Local Authority
- Heat Maps
 - Covid Death Data
 - by Local Authority
- Spatial Data
 - Townsend Index

This has been exported to a layered PDF document.

V. Task 2: Results of the GIS Build

5.01 Introduction

The following report will detail the findings of the Geographical Information System created during Task 1.

The findings from the death, vaccination and case data will be discussed first. This will then be considered alongside sociodemographic data which has been obtained before offering a formal conclusion and recommendations for the future.

For the purposes of this Report; the effectiveness of the vaccine will be viewed in terms of:-

- Infection Prevention
- Infectiousness Prevention

5.02 Pre Vaccination

Cases

Please see Cases/100,000 – Pre_Vaccination for the associated Visual.

This window was considered to be from the start of the pandemic to the 1st of June 2021.

This is effectively the starting position from which our onward data analysis shall hinge.

Based on the data which is related to the cases, by local authority; we can observe the following:-

- Case rates are highest in the North East and South of Wales.
- Case rates are at their lowest in mid Wales.

In order for the vaccinations of Dose 1 to have been effective and taken to have made a material impact to the pandemic; the uptake should be correspondingly high in these areas.

5.03 Vaccination Dose 1

Here we shall discuss the rate of vaccinations and the corresponding impact on case rates.

As the first dose of the vaccination was issued between December 2020 and June 2021, we will use the case data between June 2021 and September 2021 (the closure of the second dose window) to measure the impact of the first round of vaccinations.

Vaccination Uptake

Please see Uptake_Dose 1 for the associated Visual.

Here we can see that Dose 1 vaccination uptake was highest in some areas of South Wales, but not necessarily in areas where the virus was most prevalent (based on our analysis of the baseline position).

If the vaccine does in fact affect the infectiousness and contagiousness of the virus; it will likely have a lesser impact in areas of high prevalence but relatively lower uptake. Notably Swansea and South East Wales.

Conversely, in mid West Wales where case rates were considerably lower; take up was high by comparison.

Cases

Please see Cases/100,000 – Dose1 for the associated Visual.

This window was considered to be from the 1st of June 2021 to the 1st of September 2021, to view the impact of the 1st vaccination dose.

Based on the data which is related to the cases, by local authority; we can observe the following:-

- Case rates are highest in the North East and South of Wales.
- Case rates are at their lowest in mid Wales.

However; the number of cases is in fact lower than in our first view; albeit with larger numbers of cases still occurring in the South, South East and North East.

5.04 Vaccination Dose 2

We will use the case data between September 2021 and January 2022 (the closure of the second dose window) to measure the impact of the second round of vaccinations.

Vaccination Uptake

Please see Uptake_Dose 2 for the associated Visual.

Here we can see that Dose 2 vaccination uptake was higher than they were for dose 1; with key areas in the South and North East receiving the greatest proportion of vaccinations.

It is possible that the reason for this might be:-

- Continued high rate of cases was responsible for the drive at an individual level to receive the vaccines.
- Lower numbers of individuals received a second dose from other areas.
- A combination of the reasons above.
- Another reason.

Similarly to Dose 1, in mid West Wales where case rates were considerably lower; take up was high by comparison.

Cases

Please see Cases/100,000 – Dose2 for the associated Visual.

This window was considered to be from the 1st of September 2021 to 1st of February 2022, to view the impact of the 2nd vaccination dose.

These case data will include Winter of 2020/2021; and so the magnitude of the data will be higher.

Effectiveness of the vaccine, however, is visible as the rate of infections is at a more similar level across more of the country.

Whilst the areas in South Wales mentioned previously are still higher than the rates throughout the rest of the country; it is to a lesser extent than following the first dose of the vaccination.

Based on the data which is related to the cases, by local authority; we can observe the following:-

- Case rates in the North East are now lower when compared to the previous intervals.
- Case rates are at their lowest in mid Wales.
- Case rates across the country are now comparably similar.

The number of cases is higher than our second snapshot. With larger numbers of cases still occurring in the South, South East.

5.05 Vaccination Booster

We will use the case data between January 2021 and the most recent data (the closure of the booster window) to measure the impact of the second round of vaccinations.

Vaccination Uptake

Please see Uptake_Booster for the associated Visual.

Here we can see that Booster vaccination uptake was yet again comparably high throughout South Wales compared to the first dose.

A number of areas did not achieve rates this high; notably in the Cardiff area, when compared to more recent vaccine uptake.

Similarly to Dose 2, in mid West Wales where case rates were considerably lower; take up was high by comparison.

Cases

Please see Cases/100,000 – Booster for the associated Visual.

This window was considered to be from the 1st February 2022 to present day, to view the impact of the Booster vaccination dose.

These case data exclude the Winter of 2020/2021, and is a short window; and so the magnitude of the data will be lower.

Effectiveness of the vaccine is most visible in section, with case rates having fallen dramatically across the country from the end of the Booster Dose window.

All areas have improved based on the visual associated with this section.

Based on the data which is related to the cases, by local authority; we can observe the following:-

- Case rates are more similar across the whole of the country.
- Case rates are still at their lowest in mid Wales.
- Case rates are still at their highest in the South and North East..

Larger numbers of cases are still occurring in the South and South East; albeit to a lesser extent than they were previously.

5.06 Covid Deaths

Please see Wales Death Data Heatmap for the associated Visual.

We can see here that, as is possibly expected, the highest number of deaths can be seen in the South of the country, around the Cardiff area.

However; what is possibly surprising is that the magnitude of deaths in the North East are comparably lower when compared to the mid West (in terms of magnitude). The mid-West had the lowest case numbers and one of the largest vaccine take-ups.

It is the author's opinion that this chart requires further analysis. Before taking this chart into consideration; the data and associated infographic mechanics must be analysed to ensure that it can be relied upon. (It is possible that there is either an issue with the data itself or the use of the software).

5.07 Socio Demographic Considerations

To further understand why vaccine uptake and case rates appear as they do; the author will use socio-demographic data to ascertain whether there is a link between the two.

Unemployment

Please see Unemployed for the associated Visual.

We can observe from this visual that unemployment is in fact at its highest in some of the locations where case rates were also at their highest. There is a potential link between unemployment and case rates.

Based on the data assembled; we can conclude that there was little or no affect on the take up of the vaccine based on this criterion.

Transportation

Please see Residence Without Car for the associated Visual.

We can observe from this visual that residences without transportation are in fact at their highest in a number of places where case rates were also at their highest. There is a potential link between owning one's own vehicle and case rates.

We can draw a tenuous conclusion that these areas contain higher availability of public transport; which does not appear to have impacted the take up of the vaccine.

Home Owner

Please see Does Not Own Residence for the associated Visual.

In this graphic; we can draw a clear link between areas where people do not own their own homes and case rates. This is potentially linked to the number of cases that are continuing even with vaccine take up.

Based on the data assembled; we can conclude that there was little or no affect on the take up of the vaccine based on this criterion.

Townsend Index

Please see Wales IA Townsend and Townsend Index for the associated Visuals.

The Townsend Index shows that, in line with our three previous criteria, that there is indeed a link between high case rates and areas where individuals are less likely to live in affluent areas.

We can also see that where population centres are closer together (observing the spatial mapping of the Townsend Indexes); it increases the likelihood that the individuals residing therein will live in considerable affluence.

Based on the data assembled; we can conclude that there was little or no affect on the take up of the vaccine based on this criterion.

5.08 Conclusion

Following the three rounds of vaccination; we can observe that, whilst the magnitude of cases is lower than before the vaccination process began; there is still considerable infection taking place.

The question one might ask is whether the infections are due to the vaccines being more ineffective than we had hoped, or whether they are in fact due to a lack of take up.

The take up of the vaccines was considerably high across all three doses and across each of the local authorities.

With the percentages often entering the mid-nineties; we can conclude that, while some areas were less proactive than others at getting vaccinated, this should have been enough to achieve herd immunity.

So, the question is why are case rates still higher in particular urban populated areas even though the take up of the vaccine was as high as was needed to achieve herd immunity?

There is a possible explanations based on the data that we have observed. One is that the rate of infectiousness is not curbed significantly enough for highly populated areas to stop infecting one another. If this is the case; we can expect the rate of infections to continue to be considerably higher in densely populated urban areas. This will lead to the virus becoming endemic within the population.

Densely populated areas, with large numbers of people that live less affluent lives will likely increase the social interactions between individuals and, as a result, cause increases in all infections; particularly covid, based on its virulence.

This report has exposed a definite link between deprivation and increased covid case rates. Whilst it is possible for the increased rates to be linked to the higher density population levels; we can see that this is not necessarily the case with Swansea; where the rates were comparatively lower compared with neighbouring areas that had lower levels of deprivation.

Herd immunity is will most likely NOT be achieved.

Recommendations can be found for resolving the number of cases, in conjunction with boosters, below.

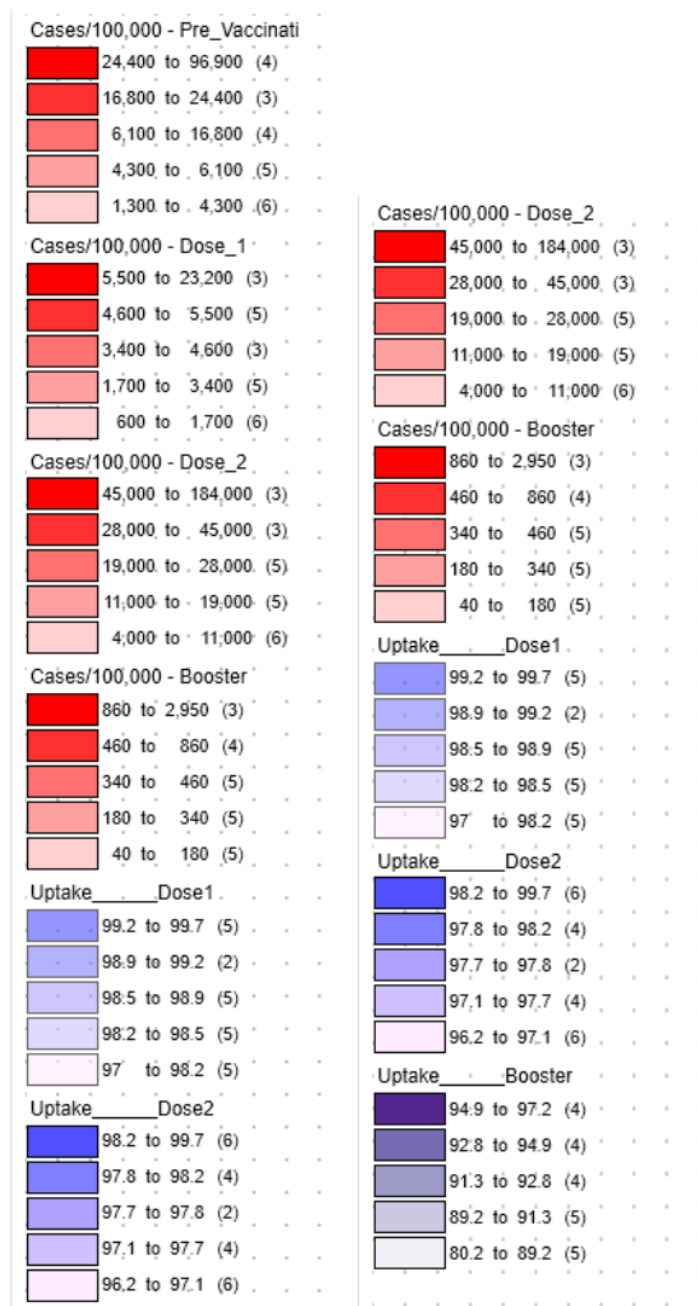
5.09 Recommendations

This report formally makes the following recommendations:-

- Increased support for less affluent areas.
- Monitoring of the covid severity across the country. In the event that individuals are no longer at risk; it is possible that the virus becoming endemic is in fact the preferred option.
- Increase awareness of measures that can be taken to limit infections (including vaccinations). These should include:-
 - Social distancing is possible.
 - Fresh air whenever possible.
 - Fewer social interactions if possible.
 - Lateral flow testing before meeting.
 - Reintroduction of free lateral flow tests for those that are less fortunate.
- Analyse the data and supporting infographic for Covid Deaths. There is likely to be an error.

VI. Appendices

6.01 Legends



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GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

78/100

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
2. Knowledge and Understanding Skills		
Although you have presented a dialogue of events carried out to build your case study I would have liked to have seen some visuals here maybe some screenshots from MapInfo and some of the data that you have cleansed for example a little snapshot from excel to highlight what you have done.	25	17

3. Cognitive and Intellectual Skills		
Again, to emphasise your understanding some screenshots would have improved still read of task one however it is clear that you have an excellent plan and you have thought about the way in which you want to analyse the data and what that should bring to the table when you write up your review of the case study in task two.	25	19
4. Practical Application Skills		
Your PDF document provides insight into your workspace and it is very clear and very organised have utilised the data well and provided extensive thematic maps. Again here I would have liked to have seen a few screenshots within your documentation and perhaps you could have explored other avenues of data entry for example point data or looking at top of graphic data roads location of vaccination centres and so on.	40	31

5. Transferable Skills for Life and Professional Practice		
Taking the above into consideration the layout and your timeline of tasks worked well, well referenced and well written.	10	7

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
. If you have used the literature well to highlight your points of fact and demonstrate a sound understanding of the map as a visual information system. You've explored the different layers and use them to emphasise your discussion points as we travel through to your conclusion..	25	20
2. Knowledge and Understanding Skills		

Although an unusual way to pen task 2 it was very clear and very informative and your direction through your PDF almost gave the reader a presentation feel which I liked. With clear discussion and clear directive it was easy to navigate and you presented some good arguments throughout.	20	18
3. Cognitive and Intellectual Skills		
Suitable additional data has been added to emphasise and highlight possible reasons behind high or low uptake particularly like the heat map though I note your comments on the North East of Wales we know heat map generates from the highest point source in terms of value therefore it radiates out of the Cardiff area we know from evidence and data that Powys are in mid Wales has a lower death rate but you would need to adjust this to then perhaps allow the map to filter from the north downwards. That said it does provide quite a dramatic visual which draws in the attention of the reader.	25	21

4. Practical Application Skills		
From your PDF it's clear that you have gained some very good practical skills within the GIS software and you've presented a clear workspace for your analysis	20	15
5. Transferable Skills for Life and Professional Practice		
well random represented throughout.	10	7

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