NHS Wales Data

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# Web Scraping NHS Wales

This report will go over the steps taken to web scrape data from an NHS Wales website. This involves:

* Downloading the files into rstudio
* Carrying out some EDA
* Plotting the data
* Feature Extraction/Creation

This report will also try to keep to a Gold Standard, which will be adapted from this [blog post.](https://towardsdatascience.com/the-gold-standard-of-data-science-project-management-13d68c9e85d6)

## 0 - Set a Working Directory

Usually when working within R, I start by creating a new folder and a project file, this can be done via the gui (top right of rstudio) or via the console.

Create Project Via RStudio

Create Project Via RStudio

Whilst I often switch between operating systems (Linux & Windows) this isn’t always an ideal way of setting the project, especially when using online cloud storage. This works much better via Git && Github.

## 1 - EDA

Firstly, when working with scripts and data science coding, it is usually very helpful to set the seed, for reproducibility.

For the seed I set it as my student number from USW - but can be anything.

Next would be to set the libraries which could be useful throughout this report, most jobs within r can be done with the base set libraries, but sometimes it’s fun to explore other methods which make some tasks a lot easier/faster. These packages aren’t set in stone, and are dynamic for this report.

## Loading required package: Hmisc

## Loading required package: lattice

## Loading required package: survival

## Loading required package: Formula

## Loading required package: ggplot2

##   
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:base':  
##   
## format.pval, units

## funModeling v.1.9.4 :)  
## Examples and tutorials at livebook.datascienceheroes.com  
## / Now in Spanish: librovivodecienciadedatos.ai

## -- Attaching packages ------------------------------------------------------------------------------------------------------------------------------ tidyverse 1.3.1 --

## v tibble 3.1.4 v dplyr 1.0.7  
## v tidyr 1.1.3 v stringr 1.4.0  
## v readr 2.0.1 v forcats 0.5.1  
## v purrr 0.3.4

## -- Conflicts --------------------------------------------------------------------------------------------------------------------------------- tidyverse\_conflicts() --  
## x dplyr::combine() masks gridExtra::combine()  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()  
## x dplyr::src() masks Hmisc::src()  
## x dplyr::summarize() masks Hmisc::summarize()

Next would be to import the data, this part proved to be quite difficult as I kept getting different errors when trying to download the files locally. I will add the code just in case I find something which sparks an idea.

## 2 - Meta Data

[GP Practice Analysis and Patient Registrations by Practice](https://nwssp.nhs.wales/ourservices/primary-care-services/general-information/data-and-publications/gp-practice-analysis/)

The data shows the number of items prescribed by each practice by month and the number of patients registered with each practice. Data relating to patient registrations by practice is extracted from NHAIS (National Health Application and Infrastructure Services) system each quarter. The Health Board, practice code, postcode and count by age band and gender are included. Please note that patients 95 and over have been grouped together due to potential risk of disclosure.

* Whilst also keeping a note of patient transfers.

With a better idea of the data after looking at the meta data above, this will give us a better idea of what to look for within the dataset - and a good reminder for us throughout the report.

The above snippet (which is all commented out and won’t be be printed) looks like it worked, however when I try to import the data and have a look at it, the data has been squashed together into 2 columns - My thought is that the file is failing to download correctly, but I’m unsure why (as I can download the package via the command line (Bash) or by clicking on it.)

This is the best I could do whilst trying to download a file from the NHS Wales website, this was done with the extension ‘.xlsx’ and without. So I will download them **manually** by just clicking the links on the website and saving them to a data folder within my project.

After creating a data folder and an *img* folder (for screenshots), now we can read the saved datasets from that data folder with read\_excel. Doing them all at once is quite demanding, but it’s not too bad.

Now that we have created 6 data frames each containing a month of GP visits, these are taken quarterly by the look at: - Jan - April - July - October

## 2 - Data Wrangling

[Data Wrangling](https://xseedcap.com/news-article/big-data-scientists-janitor-work-key-hurdle-insights/) - Accessed 01/08/2021

Data Wrangling has been described as the Janitor Work for data scientists, and is said to take up to 50 - 80 percent of any data scientists time (Ref). With this being the case, this part of the report could become quite large and possibly overwhelming. To over come this, lets break down each part and focus on one stage at a time.

Here we now have 6 datasets from the same source, whilst these 6 datasets could be explored one at a time, lets try to combine these datasets and explore the data as a whole. First we would need to inspect the datasets to make sure they’re following the same structure throughout. An easy way to check the columns is by using the function *names*.

## [1] "Period" "PracticeCode" "PostCode"   
## [4] "OrgCode" "AgeBand" "MaleCount"   
## [7] "FemaleCount" "IndeterminateCount" "Count"

## [1] "Period" "PracticeCode" "PostCode"   
## [4] "OrgCode" "AgeBand" "MaleCount"   
## [7] "FemaleCount" "IndeterminateCount" "Count"

## [1] "Period" "PracticeCode" "PostCode"   
## [4] "OrgCode" "AgeBand" "MaleCount"   
## [7] "FemaleCount" "IndeterminateCount" "Count"

## [1] "Period" "PracticeCode" "PostCode"   
## [4] "OrgCode" "AgeBand" "MaleCount"   
## [7] "FemaleCount" "IndeterminateCount" "Count"

## [1] "Period" "PracticeCode" "postcode"   
## [4] "OrgCode" "HAName" "AgeBand"   
## [7] "MaleCount" "Femalecount" "Indeterminatecount"  
## [10] "count"

## [1] "Period" "PracticeCode" "postcode"   
## [4] "OrgCode" "HAName" "AgeBand"   
## [7] "MaleCount" "Femalecount" "Indeterminatecount"  
## [10] "count"

Here we can see that the last 2 data frames have an additional column, *HAName*. From what I can tell, this is the Local Health Board which is also denoted by the OrgCode - To make things easier, lets grab the Local Health Boards, figure out which one refers to which code, and replace the code with the LHB.

To begin, lets create a data frame and get the unique Health Boards.

## [1] "Aneurin Bevan" "Betsi Cadwaladr Uni" "Hywel Dda"   
## [4] "Cardiff And Vale Uni" "Cwm Taf Morgannwg UHB" "Swansea Bay UHB"   
## [7] "Powys Teaching"

Now we can see the LHBs, we can use these to filter one of the newer data frames which has the HAName/LHB.

Above we have filtered out the LHBs from the latest data frame, next we can check each filtered data frame for the OrgCode.

## [1] "AB = 7A6"

## [1] "BC = 7A1"

## [1] "HD = 7A2"

## [1] "CV = 7A4"

## [1] "CTM = 7A5"

## [1] "SB = 7A3"

## [1] "PT = 7A7"

Now we know: - 7A1 - Betsi Cadwaladr Uni - 7A2 - Hywel Dda - 7A3 - Swansea Bay UHB - 7A4 - Cardiff And Vale Uni - 7A5 - Cwm Taf Morgannwg UHB - 7A6 - Aneurin Bevan - 7A7 - Powys Teaching

Now that we have the HBs saved and filtered, we can drop those columns from the newer datasets, combine the datasets and then add the HBs back in (in place of the OrgCode). This is a bit over the top, and there is bound to be a better way of doing things.

Here we have dropped the 5th column which is HAName. Next lets look at getting the column names from the older datasets (double check they’re the same for the others) and make sure all column names are the same. *(I noticed the modern datasets didn’t have the same capitalization on the columns, hence the next steps.)*

Before combining the datasets into something massive, lets try and create a new column for year and month (This was very difficult doing it within a loop on the joined dataset.)

With the Year and Month cols created (and much easier than trying to run it in a conditional loop), we can merge the dfs with rbind and drop the period col.

Here we can see that the data frame was created without any issues. Lets replace the column OrgCode for the Health Board - and rename the column name afterwards.

## [1] "Aneurin Bevan" "Betsi Cadwaladr Uni" "Hywel Dda"   
## [4] "Cardiff And Vale Uni" "Cwm Taf Morgannwg UHB" "Swansea Bay UHB"   
## [7] "Powys Teaching"

Lets quickly rename OrgCodes to Health Board so it is a bit easier to understand.

## [1] "PracticeCode" "PostCode" "healthboard"   
## [4] "AgeBand" "MaleCount" "FemaleCount"   
## [7] "IndeterminateCount" "Count" "Year"   
## [10] "Month"

Great - now we have a combined dataset (More datasets could be added to make things better, for example lsoa which will hopefully be explored later.) lets remove the older data frames to clear up some memory.

## [1] 2020 2021

## [1] "April" "July" "October" "January"

This next part will be omitted

Preparing the dataset for additional data, first the dataset needs to follow a few rules which I tend to follow:

* remove spaces between postcodes (you’ll see why soon)
* all lowercase

Next I want to try and add the Welsh Index of Multiple Deprivation - this dataset could be used to get a better understanding of each LSOA. From the dataset I found on [Postcode to WIMD rank lookup](https://statswales.gov.wales/Download/File?fileId=637) the postcodes don’t have any white-space, hence why we just removed the white-space above.

I’ve also noticed that the dataset is formatted as an **ods** file, which can be converted with Excel. After getting the file into an XLSX format, we can import the dataset.

## [1] "postcode" "lsoa code" "lsoa name"   
## [4] "lsoa name (cymraeg)" "wimd lsoa rank" "wimd overall decile"   
## [7] "wimd overall quintile" "wimd overall quartile"

## # A tibble: 50 x 8  
## postcode `lsoa code` `lsoa name` `lsoa name (cymra~ `wimd lsoa rank`  
## <chr> <chr> <chr> <chr> <dbl>  
## 1 LL309EF W01000187 Tudno 2 Tudno 2 78  
## 2 LL319XX W01000176 Pensarn 1 Pen-sarn 1 759  
## 3 NP64AT W01001542 Caerwent Caer-went 1505  
## 4 SY225DH W01000461 Llanfyllin Llanfyllin 888  
## 5 SA659BA W01000566 Fishguard North West Abergwaun Gogledd~ 936  
## 6 LL414UG W01000114 Trawsfynydd Trawsfynydd 1119  
## 7 NPT6JQ W01001653 Malpas 3 Malpas 3 1627  
## 8 CF103ZG W01001759 Grangetown 1 Grangetown 1 796  
## 9 NP166SY W01001583 St. Arvans St. Arvans 1382  
## 10 CF311BE W01001021 Morfa 1 Morfa 1 397  
## # ... with 40 more rows, and 3 more variables: wimd overall decile <dbl>,  
## # wimd overall quintile <dbl>, wimd overall quartile <dbl>

## # A tibble: 6 x 17  
## practicecode postcode healthboard ageband malecount femalecount  
## <chr> <chr> <chr> <dbl> <dbl> <dbl>  
## 1 W00005 CF834AZ Aneurin Bevan 0 33 35  
## 2 W00005 CF834AZ Aneurin Bevan 1 42 47  
## 3 W00005 CF834AZ Aneurin Bevan 2 41 42  
## 4 W00005 CF834AZ Aneurin Bevan 3 43 56  
## 5 W00005 CF834AZ Aneurin Bevan 4 36 56  
## 6 W00005 CF834AZ Aneurin Bevan 5 51 48  
## # ... with 11 more variables: indeterminatecount <dbl>, count <dbl>,  
## # year <dbl>, month <chr>, lsoa\_code <chr>, lsoa\_name <chr>,  
## # lsoa\_name\_(cymraeg) <chr>, wimd\_lsoa\_rank <dbl>, wimd\_overall\_decile <dbl>,  
## # wimd\_overall\_quintile <dbl>, wimd\_overall\_quartile <dbl>

Next I would like to merge a dataset which found the *County* for the postcodes & LSOA. I’ve added this with the hopes of adding housing dataset. This was done by looking at the LSOAs found within the dataset and creating an If Else script within Excel to pull out the County per LSOA.

This was from [GOV.Wales](https://gov.wales/docs/statistics/lsoamaps/lsoa.htm) and can be found within “../data/tidy/lsoa-to-county.xlsx” with the the code in the first column which helped a lot.

This dataset has a best fit Area maps for each LSOA within Wales, with 1896 LSOAs in Wales each with an estimates population of around 1500 people.

## [1] "Caerphilly" "Caerphilly" "Caerphilly" "Caerphilly" "Caerphilly"  
## [6] "Caerphilly"

Another dataset which could be added now would be *New dwellings started by local authority*. Based on the suggestion that it takes an average of two years to build a house in the UK, I have taken the earliest point in the dataset (April 2020) and backtracked two full years to take a sample from the ‘New dwellings started by local authority area and dwelling type’ dataset (Stats Wales ref).

This is based on the assumption that houses recorded as being in the process of being built then, would be becoming available on the market approximately April 20202. The alternative was to use the dataset ‘New dwellings completed by period and tenure’ and measure houses that were available on the market, but this was more difficult as the dataset was not available by county and requires significant effort to combine and clean.

[Link to dataset](https://statswales.gov.wales/Catalogue/Housing/New-House-Building/newdwellingsstarted-by-area-dwellingtype) with the [Link to alternative dataset found here.](https://statswales.gov.wales/Catalogue/Housing/New-House-Building/newdwellingscompleted-by-period-tenure)

## # A tibble: 6 x 21  
## practicecode postcode healthboard ageband malecount femalecount  
## <chr> <chr> <chr> <dbl> <dbl> <dbl>  
## 1 W00005 CF834AZ Aneurin Bevan 0 33 35  
## 2 W00005 CF834AZ Aneurin Bevan 1 42 47  
## 3 W00005 CF834AZ Aneurin Bevan 2 41 42  
## 4 W00005 CF834AZ Aneurin Bevan 3 43 56  
## 5 W00005 CF834AZ Aneurin Bevan 4 36 56  
## 6 W00005 CF834AZ Aneurin Bevan 5 51 48  
## # ... with 15 more variables: indeterminatecount <dbl>, count <dbl>,  
## # year <dbl>, month <chr>, lsoa\_code <chr>, lsoa\_name <chr>,  
## # lsoa\_name\_(cymraeg) <chr>, wimd\_lsoa\_rank <dbl>, wimd\_overall\_decile <dbl>,  
## # wimd\_overall\_quintile <dbl>, wimd\_overall\_quartile <dbl>, county <chr>,  
## # total <dbl>, houses <dbl>, flats <dbl>

## Warning: `current\_vars()` was deprecated in dplyr 0.8.4.  
## Please use `tidyselect::peek\_vars()` instead.  
## This warning is displayed once every 8 hours.  
## Call `lifecycle::last\_warnings()` to see where this warning was generated.

## # A tibble: 6 x 21  
## ageband count county femalecount flats healthboard houses indeterminateco~  
## <dbl> <dbl> <chr> <dbl> <dbl> <chr> <dbl> <dbl>  
## 1 0 68 Caerphilly 35 4 Aneurin Bevan 15 0  
## 2 1 89 Caerphilly 47 4 Aneurin Bevan 15 0  
## 3 2 83 Caerphilly 42 4 Aneurin Bevan 15 0  
## 4 3 99 Caerphilly 56 4 Aneurin Bevan 15 0  
## 5 4 92 Caerphilly 56 4 Aneurin Bevan 15 0  
## 6 5 99 Caerphilly 48 4 Aneurin Bevan 15 0  
## # ... with 13 more variables: lsoa\_code <chr>, lsoa\_name <chr>,  
## # lsoa\_name\_(cymraeg) <chr>, malecount <dbl>, month <chr>, postcode <chr>,  
## # practicecode <chr>, total <dbl>, wimd\_lsoa\_rank <dbl>,  
## # wimd\_overall\_decile <dbl>, wimd\_overall\_quartile <dbl>,  
## # wimd\_overall\_quintile <dbl>, year <dbl>

Whilst I try to do things efficiently, it is also important to be mindful of tidy data. There are a few rules to tidy data as stated by Hadley Wickham:

1 - Every column is a variable 2 - Every row is an observation 3 - Every cell is a single value

This was adapted from the [R for Data Science](https://r4ds.had.co.nz/index.html). This is where I got the idea for Year and Month to be separate, but did it before the binding of the data frames above. Seeing as that part was done, lets begin some actual EDA.

## 3 - Exploratory Data Analysis

Lets now go through the dataset and get a better understanding of the structure, the data, and just explore the data.

## tibble [224,804 x 21] (S3: tbl\_df/tbl/data.frame)  
## $ ageband : num [1:224804] 0 1 2 3 4 5 6 7 8 9 ...  
## $ count : num [1:224804] 68 89 83 99 92 99 85 92 88 92 ...  
## $ county : chr [1:224804] "Caerphilly" "Caerphilly" "Caerphilly" "Caerphilly" ...  
## $ femalecount : num [1:224804] 35 47 42 56 56 48 43 42 38 38 ...  
## $ flats : num [1:224804] 4 4 4 4 4 4 4 4 4 4 ...  
## $ healthboard : chr [1:224804] "Aneurin Bevan" "Aneurin Bevan" "Aneurin Bevan" "Aneurin Bevan" ...  
## $ houses : num [1:224804] 15 15 15 15 15 15 15 15 15 15 ...  
## $ indeterminatecount : num [1:224804] 0 0 0 0 0 0 0 0 0 0 ...  
## $ lsoa\_code : chr [1:224804] "W01001331" "W01001331" "W01001331" "W01001331" ...  
## $ lsoa\_name : chr [1:224804] "Aber Valley 2" "Aber Valley 2" "Aber Valley 2" "Aber Valley 2" ...  
## $ lsoa\_name\_(cymraeg) : chr [1:224804] "Cwm Aber 2" "Cwm Aber 2" "Cwm Aber 2" "Cwm Aber 2" ...  
## $ malecount : num [1:224804] 33 42 41 43 36 51 42 50 50 54 ...  
## $ month : chr [1:224804] "April" "April" "April" "April" ...  
## $ postcode : chr [1:224804] "CF834AZ" "CF834AZ" "CF834AZ" "CF834AZ" ...  
## $ practicecode : chr [1:224804] "W00005" "W00005" "W00005" "W00005" ...  
## $ total : num [1:224804] 19 19 19 19 19 19 19 19 19 19 ...  
## $ wimd\_lsoa\_rank : num [1:224804] 633 633 633 633 633 633 633 633 633 633 ...  
## $ wimd\_overall\_decile : num [1:224804] 4 4 4 4 4 4 4 4 4 4 ...  
## $ wimd\_overall\_quartile: num [1:224804] 2 2 2 2 2 2 2 2 2 2 ...  
## $ wimd\_overall\_quintile: num [1:224804] 2 2 2 2 2 2 2 2 2 2 ...  
## $ year : num [1:224804] 2020 2020 2020 2020 2020 2020 2020 2020 2020 2020 ...

From the structure (str) we can see that there are 15 variables with 321140 observations, these variables are as follows:

* ageband - the patients age.
* count - the total number of visits (males, female, intersex maybe).
* county - the local county.
* femalecount - the number of female visits.
* healthboard - the gps health board (aneurin bevan, cardiff etc).
* indeterminatecount - the number of intersex visits.
* lsoa\_code - the lower layer super output area code.
* lsoa\_name - lower layer super output area.
* lsoa\_name(cymraeg) - lower layer super output area.
* malecount - the number of male visits.
* month - the month.
* postcode - the gps postcode.
* practice\_code - the gps practice code.
* wimd\_lsoa\_rank - welsh index of multiple deprivation lsoa rank (lower is worse)
* wimd\_overall\_decile
* wimd\_overall\_quartile
* wimd\_overall\_quintile
* year - the year.

We can also look at the data via the head and tail.

## # A tibble: 6 x 21  
## ageband count county femalecount flats healthboard houses indeterminateco~  
## <dbl> <dbl> <chr> <dbl> <dbl> <chr> <dbl> <dbl>  
## 1 0 68 Caerphilly 35 4 Aneurin Bevan 15 0  
## 2 1 89 Caerphilly 47 4 Aneurin Bevan 15 0  
## 3 2 83 Caerphilly 42 4 Aneurin Bevan 15 0  
## 4 3 99 Caerphilly 56 4 Aneurin Bevan 15 0  
## 5 4 92 Caerphilly 56 4 Aneurin Bevan 15 0  
## 6 5 99 Caerphilly 48 4 Aneurin Bevan 15 0  
## # ... with 13 more variables: lsoa\_code <chr>, lsoa\_name <chr>,  
## # lsoa\_name\_(cymraeg) <chr>, malecount <dbl>, month <chr>, postcode <chr>,  
## # practicecode <chr>, total <dbl>, wimd\_lsoa\_rank <dbl>,  
## # wimd\_overall\_decile <dbl>, wimd\_overall\_quartile <dbl>,  
## # wimd\_overall\_quintile <dbl>, year <dbl>

## # A tibble: 6 x 21  
## ageband count county femalecount flats healthboard houses indeterminateco~  
## <dbl> <dbl> <chr> <dbl> <dbl> <chr> <dbl> <dbl>  
## 1 NA 25 Swansea 20 9 Swansea Ba~ 52 0  
## 2 NA 18 Swansea 15 9 Swansea Ba~ 52 0  
## 3 NA 10 Swansea 7 9 Swansea Ba~ 52 0  
## 4 NA 2 Swansea 1 9 Swansea Ba~ 52 0  
## 5 NA 3 Neath Port Talbot 3 0 Swansea Ba~ 34 0  
## 6 NA 5 Neath Port Talbot 5 0 Swansea Ba~ 34 0  
## # ... with 13 more variables: lsoa\_code <chr>, lsoa\_name <chr>,  
## # lsoa\_name\_(cymraeg) <chr>, malecount <dbl>, month <chr>, postcode <chr>,  
## # practicecode <chr>, total <dbl>, wimd\_lsoa\_rank <dbl>,  
## # wimd\_overall\_decile <dbl>, wimd\_overall\_quartile <dbl>,  
## # wimd\_overall\_quintile <dbl>, year <dbl>

Along with the summary.

## ageband count county femalecount   
## Min. : 0.00 Min. : 0.00 Length:224804 Min. : 0.00   
## 1st Qu.:23.00 1st Qu.: 41.00 Class :character 1st Qu.: 20.00   
## Median :47.00 Median : 75.00 Mode :character Median : 37.00   
## Mean :46.77 Mean : 83.33 Mean : 41.78   
## 3rd Qu.:70.00 3rd Qu.: 112.00 3rd Qu.: 57.00   
## Max. :94.00 Max. :1473.00 Max. :720.00   
## NA's :2287   
## flats healthboard houses indeterminatecount   
## Min. : 0.00 Length:224804 Min. : 15.00 Min. :0.0000000   
## 1st Qu.: 0.00 Class :character 1st Qu.: 33.00 1st Qu.:0.0000000   
## Median : 8.00 Mode :character Median : 53.00 Median :0.0000000   
## Mean :14.98 Mean : 71.73 Mean :0.0004003   
## 3rd Qu.:19.00 3rd Qu.:104.00 3rd Qu.:0.0000000   
## Max. :73.00 Max. :183.00 Max. :1.0000000   
##   
## lsoa\_code lsoa\_name lsoa\_name\_(cymraeg) malecount   
## Length:224804 Length:224804 Length:224804 Min. : 0.00   
## Class :character Class :character Class :character 1st Qu.: 20.00   
## Mode :character Mode :character Mode :character Median : 38.00   
## Mean : 41.55   
## 3rd Qu.: 57.00   
## Max. :753.00   
##   
## month postcode practicecode total   
## Length:224804 Length:224804 Length:224804 Min. : 19.00   
## Class :character Class :character Class :character 1st Qu.: 38.00   
## Mode :character Mode :character Mode :character Median : 61.00   
## Mean : 86.71   
## 3rd Qu.:118.00   
## Max. :223.00   
##   
## wimd\_lsoa\_rank wimd\_overall\_decile wimd\_overall\_quartile  
## Min. : 1.0 Min. : 1.000 Min. :1.000   
## 1st Qu.: 458.0 1st Qu.: 3.000 1st Qu.:1.000   
## Median : 820.0 Median : 5.000 Median :2.000   
## Mean : 856.9 Mean : 4.988 Mean :2.316   
## 3rd Qu.:1257.0 3rd Qu.: 7.000 3rd Qu.:3.000   
## Max. :1891.0 Max. :10.000 Max. :4.000   
##   
## wimd\_overall\_quintile year   
## Min. :1.00 Min. :2020   
## 1st Qu.:2.00 1st Qu.:2020   
## Median :3.00 Median :2020   
## Mean :2.75 Mean :2020   
## 3rd Qu.:4.00 3rd Qu.:2021   
## Max. :5.00 Max. :2021   
##

Summary is a very useful function as we can easily see the *min, median, mean, max* along with some quartiles - and most importantly we can see which columns have NA’s.. I’m looking at you **ageband**. 2365 NA’s is quite a lot, so this would need to be dealt with as best as possible (this could be dropping all the values, even if it is quite a lot - or simply putting the age band as an outlier so we can easily spot them.)

## [1] "There are 2287 missing values within ageband"   
## [2] "There are 0 missing values within count"   
## [3] "There are 0 missing values within county"   
## [4] "There are 0 missing values within femalecount"   
## [5] "There are 0 missing values within flats"   
## [6] "There are 0 missing values within healthboard"   
## [7] "There are 0 missing values within houses"   
## [8] "There are 0 missing values within indeterminatecount"   
## [9] "There are 0 missing values within lsoa\_code"   
## [10] "There are 0 missing values within lsoa\_name"   
## [11] "There are 0 missing values within lsoa\_name\_(cymraeg)"   
## [12] "There are 0 missing values within malecount"   
## [13] "There are 0 missing values within month"   
## [14] "There are 0 missing values within postcode"   
## [15] "There are 0 missing values within practicecode"   
## [16] "There are 0 missing values within total"   
## [17] "There are 0 missing values within wimd\_lsoa\_rank"   
## [18] "There are 0 missing values within wimd\_overall\_decile"   
## [19] "There are 0 missing values within wimd\_overall\_quartile"  
## [20] "There are 0 missing values within wimd\_overall\_quintile"  
## [21] "There are 0 missing values within year"

Even when looking at the unique values of the age, we can see that NA is in there. This could be because of a number of reasons, but there are 2 assumptions which stand out to me:

* Someone refused to give their age – which is fine .
* They were over 94 which was stated in meta data to be grouped.

Lets now look at the unique values within each column.

## [1] "There are 96 unique values in ageband"   
## [2] "There are 578 unique values in count"   
## [3] "There are 22 unique values in county"   
## [4] "There are 350 unique values in femalecount"   
## [5] "There are 12 unique values in flats"   
## [6] "There are 7 unique values in healthboard"   
## [7] "There are 21 unique values in houses"   
## [8] "There are 2 unique values in indeterminatecount"   
## [9] "There are 337 unique values in lsoa\_code"   
## [10] "There are 337 unique values in lsoa\_name"   
## [11] "There are 337 unique values in lsoa\_name\_(cymraeg)"  
## [12] "There are 339 unique values in malecount"   
## [13] "There are 4 unique values in month"   
## [14] "There are 377 unique values in postcode"   
## [15] "There are 401 unique values in practicecode"   
## [16] "There are 21 unique values in total"   
## [17] "There are 337 unique values in wimd\_lsoa\_rank"   
## [18] "There are 10 unique values in wimd\_overall\_decile"   
## [19] "There are 4 unique values in wimd\_overall\_quartile"  
## [20] "There are 5 unique values in wimd\_overall\_quintile"  
## [21] "There are 2 unique values in year"

Before moving on, it’s important to do something with the missing values within the ageband - this can be done by replacing the values with the mean value or just changing them to 0’s. Here, lets change them to the mean value.

Whilst some of the code above didn’t really show anything which stood out (mainly the unique counts) - there are many packages which I found when researching EDA in R with this one below being *skimr* which is great for a Data Summary.

Data summary

|  |  |
| --- | --- |
| Name | Piped data |
| Number of rows | 222517 |
| Number of columns | 21 |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |
| Column type frequency: |  |
| character | 8 |
| numeric | 13 |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |
| Group variables | None |

**Variable type: character**

| skim\_variable | n\_missing | complete\_rate | min | max | empty | n\_unique | whitespace |
| --- | --- | --- | --- | --- | --- | --- | --- |
| county | 0 | 1 | 5 | 17 | 0 | 22 | 0 |
| healthboard | 0 | 1 | 9 | 21 | 0 | 7 | 0 |
| lsoa\_code | 0 | 1 | 9 | 9 | 0 | 337 | 0 |
| lsoa\_name | 0 | 1 | 4 | 29 | 0 | 337 | 0 |
| lsoa\_name\_(cymraeg) | 0 | 1 | 4 | 33 | 0 | 337 | 0 |
| month | 0 | 1 | 4 | 7 | 0 | 4 | 0 |
| postcode | 0 | 1 | 6 | 7 | 0 | 377 | 0 |
| practicecode | 0 | 1 | 6 | 6 | 0 | 401 | 0 |

**Variable type: numeric**

| skim\_variable | n\_missing | complete\_rate | mean | sd | p0 | p25 | p50 | p75 | p100 | hist |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ageband | 0 | 1 | 46.77 | 27.37 | 0 | 23 | 47 | 70 | 94 | ▇▇▇▇▇ |
| count | 0 | 1 | 84.00 | 58.88 | 0 | 42 | 76 | 113 | 1473 | ▇▁▁▁▁ |
| femalecount | 0 | 1 | 42.07 | 29.93 | 0 | 21 | 38 | 57 | 720 | ▇▁▁▁▁ |
| flats | 0 | 1 | 14.98 | 21.86 | 0 | 0 | 8 | 19 | 73 | ▇▁▁▁▂ |
| houses | 0 | 1 | 71.73 | 49.32 | 15 | 33 | 53 | 104 | 183 | ▇▇▁▂▃ |
| indeterminatecount | 0 | 1 | 0.00 | 0.02 | 0 | 0 | 0 | 0 | 1 | ▇▁▁▁▁ |
| malecount | 0 | 1 | 41.93 | 29.99 | 0 | 20 | 38 | 57 | 753 | ▇▁▁▁▁ |
| total | 0 | 1 | 86.71 | 63.57 | 19 | 38 | 61 | 118 | 223 | ▇▅▂▁▃ |
| wimd\_lsoa\_rank | 0 | 1 | 856.91 | 499.93 | 1 | 458 | 820 | 1257 | 1891 | ▆▇▆▆▃ |
| wimd\_overall\_decile | 0 | 1 | 4.99 | 2.61 | 1 | 3 | 5 | 7 | 10 | ▆▇▆▆▃ |
| wimd\_overall\_quartile | 0 | 1 | 2.32 | 1.02 | 1 | 1 | 2 | 3 | 4 | ▆▇▁▇▃ |
| wimd\_overall\_quintile | 0 | 1 | 2.75 | 1.29 | 1 | 2 | 3 | 4 | 5 | ▆▇▆▆▃ |
| year | 0 | 1 | 2020.50 | 0.50 | 2020 | 2020 | 2020 | 2021 | 2021 | ▇▁▁▁▇ |

The skim package is great for explaining a quick overview of the data, with 4 character variables and 6 numeric variables, the mean, sd, quantiles and a small histogram of each numerical dataset.

We can also try to uncover some descriptive statistics using the package funModeling - this adds a few fun functions which show off the data in a different way again (similar to the above package.)

## variable mean std\_dev variation\_coef p\_01 p\_05  
## 1 ageband 4.676752e+01 27.37129875 5.852630e-01 0 4  
## 2 count 8.399736e+01 58.88013425 7.009760e-01 0 9  
## 3 femalecount 4.206888e+01 29.93063980 7.114675e-01 0 5  
## 4 flats 1.498492e+01 21.85552117 1.458501e+00 0 0  
## 5 houses 7.172509e+01 49.31977274 6.876223e-01 15 15  
## 6 indeterminatecount 4.044635e-04 0.02010726 4.971340e+01 0 0  
## 7 malecount 4.192808e+01 29.98655997 7.151904e-01 0 3  
## 8 total 8.671001e+01 63.57485416 7.331893e-01 19 19  
## 9 wimd\_lsoa\_rank 8.569121e+02 499.93267466 5.834119e-01 11 128  
## 10 wimd\_overall\_decile 4.988149e+00 2.61071147 5.233828e-01 1 1  
## 11 wimd\_overall\_quartile 2.315688e+00 1.02016415 4.405447e-01 1 1  
## 12 wimd\_overall\_quintile 2.750554e+00 1.29017308 4.690594e-01 1 1  
## 13 year 2.020495e+03 0.49997741 2.474529e-04 2020 2020  
## p\_25 p\_50 p\_75 p\_95 p\_99 skewness kurtosis iqr range\_98  
## 1 23 47 70 90 94 0.01118138 1.804253 47 [0, 94]  
## 2 42 76 113 189 265 2.00334934 19.063505 71 [0, 265]  
## 3 21 38 57 95 134 2.28340552 23.052557 36 [0, 134]  
## 4 0 8 19 62 73 1.63092990 4.175944 19 [0, 73]  
## 5 33 53 104 161 183 0.89451998 2.508261 71 [15, 183]  
## 6 0 0 0 0 0 49.69317373 2470.411516 0 [0, 0]  
## 7 20 38 57 96 135 1.84139051 17.166253 37 [0, 135]  
## 8 38 61 118 223 223 1.10586608 2.996774 80 [19, 223]  
## 9 458 820 1257 1704 1863 0.19781717 1.988728 799 [11, 1863]  
## 10 3 5 7 9 10 0.18573428 1.931233 4 [1, 10]  
## 11 1 2 3 4 4 0.20046602 1.909195 2 [1, 4]  
## 12 2 3 4 5 5 0.19231312 1.875807 2 [1, 5]  
## 13 2020 2020 2021 2021 2021 0.01947809 1.000379 1 [2020, 2021]  
## range\_80  
## 1 [9, 85]  
## 2 [19, 157]  
## 3 [10, 79]  
## 4 [0, 62]  
## 5 [26, 161]  
## 6 [0, 0]  
## 7 [8, 79]  
## 8 [26, 223]  
## 9 [202, 1535]  
## 10 [2, 9]  
## 11 [1, 4]  
## 12 [1, 5]  
## 13 [2020, 2021]

## variable q\_zeros p\_zeros q\_na p\_na q\_inf  
## ageband ageband 2308 0.01037224 0 0 0  
## count count 2841 0.01276756 0 0 0  
## county county 0 0.00000000 0 0 0  
## femalecount femalecount 3658 0.01643919 0 0 0  
## flats flats 70708 0.31776449 0 0 0  
## healthboard healthboard 0 0.00000000 0 0 0  
## houses houses 0 0.00000000 0 0 0  
## indeterminatecount indeterminatecount 222427 0.99959554 0 0 0  
## lsoa\_code lsoa\_code 0 0.00000000 0 0 0  
## lsoa\_name lsoa\_name 0 0.00000000 0 0 0  
## lsoa\_name\_(cymraeg) lsoa\_name\_(cymraeg) 0 0.00000000 0 0 0  
## malecount malecount 4112 0.01847949 0 0 0  
## month month 0 0.00000000 0 0 0  
## postcode postcode 0 0.00000000 0 0 0  
## practicecode practicecode 0 0.00000000 0 0 0  
## total total 0 0.00000000 0 0 0  
## wimd\_lsoa\_rank wimd\_lsoa\_rank 0 0.00000000 0 0 0  
## wimd\_overall\_decile wimd\_overall\_decile 0 0.00000000 0 0 0  
## wimd\_overall\_quartile wimd\_overall\_quartile 0 0.00000000 0 0 0  
## wimd\_overall\_quintile wimd\_overall\_quintile 0 0.00000000 0 0 0  
## year year 0 0.00000000 0 0 0  
## p\_inf type unique  
## ageband 0 numeric 95  
## count 0 numeric 578  
## county 0 character 22  
## femalecount 0 numeric 350  
## flats 0 numeric 12  
## healthboard 0 character 7  
## houses 0 numeric 21  
## indeterminatecount 0 numeric 2  
## lsoa\_code 0 character 337  
## lsoa\_name 0 character 337  
## lsoa\_name\_(cymraeg) 0 character 337  
## malecount 0 numeric 339  
## month 0 character 4  
## postcode 0 character 377  
## practicecode 0 character 401  
## total 0 numeric 21  
## wimd\_lsoa\_rank 0 numeric 337  
## wimd\_overall\_decile 0 numeric 10  
## wimd\_overall\_quartile 0 numeric 4  
## wimd\_overall\_quintile 0 numeric 5  
## year 0 numeric 2

As we saw with the 2 functions (profiling and status) the dataset can be seen as a whole which sometimes can be overwhelming, especially within data science but will make going through the data a lot easier in the long run.

So the next part demonstrates how to get some descriptive statistics from the base r packages.

## [1] "The mean ageband is 46.77"

## [1] "The mean count is 84"

## [1] "The mean femalecount is 42.07"

## [1] "The mean flats is 14.98"

## [1] "The mean houses is 71.73"

## [1] "The mean malecount is 41.93"

## [1] "The mean total is 86.71"

## [1] "The mean wimd\_lsoa\_rank is 856.91"

## [1] "The mean wimd\_overall\_decile is 4.99"

## [1] "The mean wimd\_overall\_quartile is 2.32"

## [1] "The mean wimd\_overall\_quintile is 2.75"

Next lets take a quick look at the average number of visits per health board.

## healthboard count  
## 2 Betsi Cadwaladr Uni 72.70938  
## 7 Swansea Bay UHB 83.70657  
## 5 Hywel Dda 85.57849  
## 1 Aneurin Bevan 85.91831  
## 6 Powys Teaching 88.30607  
## 3 Cardiff And Vale Uni 88.86924  
## 4 Cwm Taf Morgannwg UHB 94.96118

## healthboard count  
## 2 Betsi Cadwaladr Uni 65  
## 7 Swansea Bay UHB 74  
## 5 Hywel Dda 81  
## 1 Aneurin Bevan 81  
## 6 Powys Teaching 78  
## 3 Cardiff And Vale Uni 81  
## 4 Cwm Taf Morgannwg UHB 82

From the above we can see that Cwm Taf had the highest mean count compared to the other LHBs - which is interesting as from looking at the *Population Estimates* per LHB, Cwm Taf has the 4th largest *Population estimate* which would suggest a different characteristic is affect their visits, for example:

## New names:  
## \* `` -> ...1

## Rows: 7 Columns: 14

## -- Column specification -----------------------------------------------------------------------------------------------------------------------------------------------  
## Delimiter: ","  
## chr (1): Health Board  
## dbl (13): ...1, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, ...

##   
## i Use `spec()` to retrieve the full column specification for this data.  
## i Specify the column types or set `show\_col\_types = FALSE` to quiet this message.

## Health Board Total  
## 6 Powys Teaching Health Board 1460081  
## 7 Swansea Bay University Health Board 4208245  
## 5 Hywel Dda University Health Board 4216195  
## 4 Cwm Taf Morgannwg University Health Board 4819333  
## 3 Cardiff and Vale University Health Board 5307802  
## 1 Aneurin Bevan University Health Board 6402899  
## 2 Betsi Cadwaladr University Health Board 7615472

* Is there a lot of industry in Cwm Taf areas?
* [Is there a higher rate of deprivation?](https://statswales.gov.wales/Catalogue/Community-Safety-and-Social-Inclusion/Welsh-Index-of-Multiple-Deprivation/WIMD-2019/localhealthboardanalysis)
* How is the Population Health of Cwm Taf?
* [Level of education](https://statswales.gov.wales/Catalogue/Education-and-Skills/Post-16-Education-and-Training/Data-For-Regions-of-Wales/highestqualificationlevelofworkingageadults-by-region-localauthority) - Highest gained qualification

## wimd\_lsoa\_rank count  
## 156 766 259.72456140  
## 21 148 237.25438596  
## 61 352 212.68947368  
## 312 1590 205.54385965  
## 299 1525 204.05614035  
## 195 965 198.86666667  
## 58 326 197.93508772  
## 20 139 191.90526316  
## 264 1302 191.80526316  
## 5 21 183.07368421  
## 92 501 180.25614035  
## 327 1754 170.05644403  
## 68 390 168.06315789  
## 311 1584 167.65964912  
## 325 1734 167.54210526  
## 82 455 163.46491228  
## 224 1137 162.97017544  
## 285 1433 162.36315789  
## 293 1478 161.26315789  
## 335 1883 160.80000000  
## 41 241 160.53157895  
## 201 994 160.01491228  
## 112 572 150.77105263  
## 148 733 149.00877193  
## 192 956 143.57017544  
## 91 498 143.24035088  
## 73 424 143.22982456  
## 133 659 142.52456140  
## 66 379 141.13157895  
## 194 962 141.06315789  
## 169 844 140.68596491  
## 321 1693 140.03859649  
## 153 761 137.19473684  
## 145 717 136.85263158  
## 187 926 135.53157895  
## 221 1127 131.97192982  
## 17 128 131.67543860  
## 271 1359 130.81578947  
## 233 1171 127.99473684  
## 76 438 127.91578947  
## 292 1466 125.83859649  
## 139 690 125.52280702  
## 272 1360 125.45614035  
## 146 726 124.35263158  
## 171 856 123.45877193  
## 1 1 122.86228070  
## 107 555 119.35438596  
## 173 860 119.20701754  
## 115 582 117.50175439  
## 30 182 116.90175439  
## 109 563 116.59649123  
## 154 762 115.65087719  
## 226 1144 115.56578947  
## 51 295 115.39298246  
## 204 1007 114.91578947  
## 114 581 114.50350877  
## 309 1566 113.67543860  
## 313 1592 113.53684211  
## 27 172 113.50877193  
## 179 888 112.63859649  
## 317 1655 112.62280702  
## 50 293 111.35614035  
## 67 381 111.13333333  
## 97 511 110.87192982  
## 219 1091 110.85964912  
## 331 1843 110.55701754  
## 90 494 110.31754386  
## 110 565 110.29122807  
## 60 345 110.25438596  
## 231 1169 109.75438596  
## 142 701 109.55964912  
## 98 518 109.55263158  
## 302 1529 109.01052632  
## 282 1426 108.90789474  
## 65 377 108.06666667  
## 151 755 108.05614035  
## 258 1274 106.92456140  
## 278 1416 106.84035088  
## 315 1616 106.59122807  
## 105 550 105.91052632  
## 117 586 104.92631579  
## 178 874 104.74912281  
## 16 125 104.71754386  
## 32 202 104.36666667  
## 54 317 104.24035088  
## 34 206 103.08070175  
## 191 944 102.48947368  
## 319 1675 102.37368421  
## 157 784 102.28947368  
## 284 1430 101.96315789  
## 168 840 100.07368421  
## 300 1526 100.04210526  
## 164 820 99.88771930  
## 198 978 99.73333333  
## 287 1446 99.67543860  
## 188 929 99.46666667  
## 180 891 99.24385965  
## 47 273 99.14912281  
## 328 1768 98.84298246  
## 43 255 98.67719298  
## 189 936 98.62807018  
## 283 1427 98.39035088  
## 75 434 98.25614035  
## 22 150 98.18771930  
## 37 228 98.05350877  
## 306 1541 98.02982456  
## 122 611 97.58070175  
## 248 1236 97.48596491  
## 266 1318 97.34035088  
## 190 938 97.33684211  
## 295 1492 96.46315789  
## 121 603 95.72982456  
## 128 637 94.62807018  
## 62 359 94.52631579  
## 63 364 94.46666667  
## 237 1186 93.37543860  
## 172 859 93.23508772  
## 186 922 92.96666667  
## 123 621 92.87719298  
## 305 1536 92.82982456  
## 126 633 92.50000000  
## 85 478 91.67368421  
## 211 1061 91.47368421  
## 170 851 91.27192982  
## 86 479 91.24912281  
## 150 749 91.12456140  
## 329 1834 91.04444444  
## 273 1379 90.90964912  
## 26 168 90.71428571  
## 94 505 90.45497076  
## 209 1035 90.40000000  
## 13 92 89.96315789  
## 149 734 89.66754386  
## 119 597 89.66491228  
## 71 418 88.75964912  
## 83 458 88.27894737  
## 289 1454 88.20000000  
## 14 102 87.81578947  
## 267 1322 87.71754386  
## 200 990 87.61578947  
## 57 325 86.97192982  
## 323 1704 86.33684211  
## 165 822 86.20877193  
## 193 958 86.05614035  
## 207 1030 85.82807018  
## 78 441 85.65789474  
## 265 1310 85.54736842  
## 116 584 85.27017544  
## 7 23 84.00701754  
## 103 539 83.89039666  
## 10 50 83.52280702  
## 281 1421 82.68596491  
## 124 622 82.62982456  
## 301 1528 81.66140351  
## 46 265 80.84736842  
## 220 1121 80.56315789  
## 270 1351 80.10000000  
## 176 868 79.99824561  
## 227 1150 79.88947368  
## 326 1750 79.80526316  
## 208 1032 79.63684211  
## 137 680 79.62280702  
## 337 1891 79.59824561  
## 310 1577 79.34210526  
## 316 1626 79.04736842  
## 134 662 78.95087719  
## 182 902 78.91754386  
## 333 1863 78.53157895  
## 268 1338 78.29122807  
## 256 1268 78.19298246  
## 102 526 78.10000000  
## 25 162 77.87017544  
## 197 972 77.84912281  
## 217 1078 77.69649123  
## 260 1284 76.44210526  
## 254 1257 76.28421053  
## 162 814 75.98070175  
## 261 1294 75.94210526  
## 79 443 75.71228070  
## 276 1407 75.40307018  
## 241 1200 74.93333333  
## 77 440 74.76315789  
## 239 1194 74.22631579  
## 247 1233 74.21754386  
## 35 207 73.77017544  
## 106 552 73.58771930  
## 143 704 73.35350877  
## 253 1250 73.34561404  
## 177 870 73.18157895  
## 303 1531 72.82105263  
## 87 481 72.76842105  
## 167 838 72.74035088  
## 64 365 72.58245614  
## 89 484 72.57543860  
## 158 786 72.47894737  
## 111 567 72.43464912  
## 222 1129 72.41228070  
## 249 1239 71.70526316  
## 138 681 71.37192982  
## 131 651 71.14561404  
## 181 901 70.95263158  
## 250 1240 70.63157895  
## 3 5 70.31929825  
## 33 203 70.27017544  
## 296 1495 69.88421053  
## 288 1447 69.30789474  
## 95 506 68.74736842  
## 144 712 68.41578947  
## 125 626 68.20175439  
## 275 1389 67.96842105  
## 308 1564 67.47017544  
## 52 303 67.33684211  
## 297 1513 66.58947368  
## 15 114 66.38315789  
## 314 1615 65.67368421  
## 174 865 65.65964912  
## 130 643 65.17807018  
## 127 634 64.71905180  
## 74 426 64.69035088  
## 81 454 64.21052632  
## 166 823 64.06315789  
## 29 176 63.81228070  
## 330 1840 63.53333333  
## 101 522 63.47368421  
## 332 1859 63.30701754  
## 28 173 63.27017544  
## 44 256 63.22807018  
## 225 1142 63.05789474  
## 31 198 62.91228070  
## 23 152 62.74561404  
## 255 1260 61.79649123  
## 72 420 61.55614035  
## 240 1199 61.34561404  
## 280 1420 61.30526316  
## 203 1006 61.08421053  
## 45 263 61.03947368  
## 8 32 61.00350877  
## 100 520 59.97631579  
## 175 867 59.77543860  
## 236 1184 59.34736842  
## 55 320 58.99649123  
## 304 1535 58.56315789  
## 213 1067 57.57719298  
## 277 1410 57.41403509  
## 202 1000 57.25263158  
## 104 544 56.69473684  
## 9 49 56.66491228  
## 218 1090 56.51447368  
## 49 288 56.45789474  
## 252 1246 56.45614035  
## 216 1076 56.40000000  
## 135 666 56.34210526  
## 36 223 55.25087719  
## 99 519 54.89298246  
## 18 134 54.15438596  
## 140 692 53.66315789  
## 320 1688 53.14365325  
## 245 1223 52.95204678  
## 269 1342 52.92807018  
## 70 417 52.87719298  
## 113 579 52.55614035  
## 19 135 52.09298246  
## 294 1481 51.52631579  
## 120 602 50.95029240  
## 196 967 50.81754386  
## 210 1036 50.65964912  
## 184 913 50.48596491  
## 279 1417 50.33508772  
## 136 679 50.15964912  
## 159 788 50.05087719  
## 206 1020 49.87017544  
## 246 1224 49.43157895  
## 229 1167 48.94035088  
## 39 239 48.79122807  
## 147 730 48.56666667  
## 212 1065 48.34385965  
## 259 1282 47.97719298  
## 234 1174 47.36315789  
## 238 1188 47.34035088  
## 205 1015 46.96315789  
## 84 467 46.62500000  
## 243 1209 46.52982456  
## 38 234 45.94459103  
## 183 907 45.88245614  
## 215 1071 45.67719298  
## 298 1517 45.14421053  
## 69 401 44.91228070  
## 48 275 44.32982456  
## 93 503 43.89473684  
## 56 321 43.28245614  
## 12 66 42.84152047  
## 141 700 42.39298246  
## 42 244 42.24649123  
## 185 918 41.76140351  
## 244 1215 41.58070175  
## 24 156 41.42982456  
## 96 509 40.59298246  
## 318 1661 40.27368421  
## 129 639 39.94912281  
## 334 1868 39.66842105  
## 324 1719 39.08771930  
## 2 3 38.13684211  
## 155 765 37.75789474  
## 53 312 37.61929825  
## 286 1438 37.24736842  
## 257 1270 35.75614035  
## 40 240 34.98421053  
## 223 1132 34.85614035  
## 214 1068 34.30350877  
## 199 987 32.99824561  
## 132 655 32.80175439  
## 160 807 31.60350877  
## 59 338 28.91578947  
## 228 1165 28.00526316  
## 232 1170 26.45614035  
## 242 1207 25.83157895  
## 235 1181 24.62456140  
## 118 590 24.53684211  
## 163 819 24.14912281  
## 230 1168 23.96842105  
## 152 759 23.45087719  
## 108 562 23.34912281  
## 6 22 21.71403509  
## 251 1244 21.68245614  
## 4 11 21.21578947  
## 88 483 21.03157895  
## 291 1465 20.17368421  
## 274 1382 20.09473684  
## 262 1300 13.96842105  
## 11 64 7.98325359  
## 161 808 0.46132597  
## 322 1697 0.30808081  
## 290 1464 0.20484581  
## 80 445 0.14545455  
## 263 1301 0.07692308  
## 307 1556 0.02747253  
## 336 1888 0.02163462

## wimd\_lsoa\_rank count  
## 156 766 286.0  
## 21 148 251.0  
## 61 352 223.0  
## 299 1525 223.0  
## 195 965 221.0  
## 312 1590 218.0  
## 20 139 217.0  
## 58 326 215.0  
## 5 21 212.0  
## 264 1302 203.0  
## 92 501 201.0  
## 68 390 188.0  
## 325 1734 182.5  
## 82 455 182.0  
## 327 1754 180.0  
## 335 1883 175.0  
## 293 1478 172.0  
## 41 241 169.0  
## 148 733 168.0  
## 224 1137 165.0  
## 192 956 161.0  
## 311 1584 159.0  
## 201 994 158.0  
## 133 659 157.0  
## 66 379 153.0  
## 153 761 152.0  
## 73 424 151.0  
## 194 962 151.0  
## 17 128 150.0  
## 285 1433 148.0  
## 145 717 147.0  
## 169 844 146.0  
## 187 926 146.0  
## 221 1127 145.0  
## 76 438 144.0  
## 321 1693 141.0  
## 91 498 138.0  
## 139 690 137.0  
## 233 1171 136.0  
## 271 1359 134.0  
## 107 555 133.0  
## 292 1466 133.0  
## 115 582 131.0  
## 272 1360 129.0  
## 30 182 125.0  
## 109 563 124.0  
## 231 1169 123.5  
## 114 581 123.0  
## 154 762 123.0  
## 219 1091 123.0  
## 27 172 122.0  
## 67 381 122.0  
## 112 572 122.0  
## 146 726 122.0  
## 50 293 121.0  
## 173 860 121.0  
## 313 1592 120.0  
## 289 1454 119.5  
## 97 511 118.0  
## 98 518 117.5  
## 60 345 117.0  
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## 110 565 116.0  
## 90 494 115.5  
## 258 1274 115.0  
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## 317 1655 115.0  
## 278 1416 113.0  
## 34 206 112.0  
## 54 317 112.0  
## 51 295 111.5  
## 178 874 111.5  
## 319 1675 111.0  
## 32 202 110.0  
## 122 611 109.0  
## 179 888 109.0  
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## 65 377 108.0  
## 188 929 108.0  
## 47 273 107.5  
## 142 701 107.0  
## 168 840 107.0  
## 1 1 106.0  
## 121 603 106.0  
## 198 978 106.0  
## 306 1541 106.0  
## 43 255 105.0  
## 171 856 105.0  
## 172 859 105.0  
## 186 922 105.0  
## 190 938 105.0  
## 204 1007 105.0  
## 331 1843 105.0  
## 248 1236 104.5  
## 75 434 104.0  
## 191 944 104.0  
## 300 1526 104.0  
## 126 633 102.0  
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## 123 621 101.0  
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## 62 359 99.5  
## 86 479 99.0  
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## 13 92 98.0  
## 85 478 98.0  
## 157 784 98.0  
## 189 936 98.0  
## 211 1061 98.0  
## 266 1318 98.0  
## 63 364 97.0  
## 149 734 97.0  
## 282 1426 97.0  
## 287 1446 97.0  
## 14 102 96.0  
## 78 441 96.0  
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## 329 1834 95.5  
## 46 265 95.0  
## 57 325 94.0  
## 83 458 94.0  
## 119 597 94.0  
## 10 50 93.5  
## 165 822 93.0  
## 207 1030 93.0  
## 284 1430 93.0  
## 267 1322 92.0  
## 281 1421 92.0  
## 7 23 91.0  
## 180 891 91.0  
## 200 990 90.5  
## 94 505 88.0  
## 116 584 88.0  
## 237 1186 88.0  
## 170 851 87.5  
## 102 526 87.0  
## 137 680 87.0  
## 208 1032 87.0  
## 265 1310 87.0  
## 301 1528 87.0  
## 323 1704 87.0  
## 25 162 86.0  
## 305 1536 86.0  
## 309 1566 85.5  
## 333 1863 85.0  
## 176 868 84.0  
## 227 1150 84.0  
## 220 1121 83.5  
## 37 228 83.0  
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## 162 814 82.0  
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## 217 1078 82.0  
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## 77 440 81.0  
## 197 972 80.0  
## 239 1194 80.0  
## 256 1268 80.0  
## 35 207 79.5  
## 64 365 79.0  
## 253 1250 79.0  
## 270 1351 79.0  
## 103 539 78.5  
## 3 5 78.0  
## 87 481 78.0  
## 181 901 78.0  
## 249 1239 78.0  
## 260 1284 78.0  
## 337 1891 77.5  
## 106 552 77.0  
## 131 651 77.0  
## 158 786 77.0  
## 124 622 76.0  
## 167 838 76.0  
## 193 958 76.0  
## 276 1407 76.0  
## 79 443 75.0  
## 95 506 75.0  
## 303 1531 75.0  
## 310 1577 75.0  
## 33 203 74.0  
## 71 418 74.0  
## 125 626 74.0  
## 222 1129 74.0  
## 268 1338 74.0  
## 275 1389 74.0  
## 326 1750 74.0  
## 283 1427 73.5  
## 177 870 73.0  
## 296 1495 73.0  
## 308 1564 73.0  
## 52 303 72.0  
## 241 1200 72.0  
## 29 176 71.0  
## 316 1626 71.0  
## 144 712 70.5  
## 81 454 70.0  
## 138 681 70.0  
## 15 114 69.0  
## 166 823 69.0  
## 247 1233 69.0  
## 254 1257 69.0  
## 8 32 68.5  
## 174 865 68.0  
## 250 1240 68.0  
## 330 1840 67.5  
## 89 484 67.0  
## 101 522 67.0  
## 130 643 67.0  
## 203 1006 67.0  
## 72 420 66.5  
## 74 426 66.5  
## 31 198 66.0  
## 45 263 65.0  
## 225 1142 65.0  
## 273 1379 65.0  
## 314 1615 65.0  
## 22 150 64.0  
## 55 320 64.0  
## 175 867 64.0  
## 255 1260 64.0  
## 280 1420 64.0  
## 117 586 62.5  
## 28 173 62.0  
## 269 1342 62.0  
## 297 1513 62.0  
## 49 288 61.0  
## 100 520 61.0  
## 304 1535 61.0  
## 240 1199 59.0  
## 44 256 58.0  
## 104 544 58.0  
## 140 692 58.0  
## 202 1000 58.0  
## 332 1859 58.0  
## 99 519 57.5  
## 70 417 57.0  
## 113 579 56.0  
## 184 913 56.0  
## 18 134 55.5  
## 213 1067 55.5  
## 36 223 55.0  
## 196 967 55.0  
## 19 135 54.0  
## 218 1090 54.0  
## 294 1481 54.0  
## 136 679 53.0  
## 159 788 52.5  
## 147 730 52.0  
## 229 1167 52.0  
## 39 239 51.0  
## 84 467 51.0  
## 111 567 51.0  
## 216 1076 51.0  
## 234 1174 51.0  
## 277 1410 51.0  
## 48 275 50.0  
## 205 1015 50.0  
## 279 1417 50.0  
## 320 1688 50.0  
## 210 1036 49.0  
## 238 1188 49.0  
## 245 1223 49.0  
## 24 156 48.0  
## 69 401 48.0  
## 206 1020 48.0  
## 215 1071 48.0  
## 243 1209 48.0  
## 252 1246 48.0  
## 259 1282 48.0  
## 23 152 47.0  
## 288 1447 47.0  
## 93 503 46.0  
## 246 1224 46.0  
## 212 1065 44.0  
## 2 3 43.0  
## 56 321 43.0  
## 96 509 43.0  
## 135 666 43.0  
## 141 700 43.0  
## 143 704 43.0  
## 183 907 43.0  
## 12 66 42.0  
## 38 234 42.0  
## 129 639 42.0  
## 185 918 42.0  
## 298 1517 42.0  
## 334 1868 41.0  
## 9 49 40.0  
## 244 1215 40.0  
## 318 1661 40.0  
## 53 312 39.0  
## 324 1719 38.0  
## 40 240 37.0  
## 120 602 37.0  
## 199 987 37.0  
## 155 765 35.0  
## 223 1132 35.0  
## 257 1270 35.0  
## 132 655 34.0  
## 42 244 33.0  
## 214 1068 33.0  
## 286 1438 33.0  
## 127 634 32.0  
## 160 807 32.0  
## 59 338 30.0  
## 228 1165 28.0  
## 236 1184 26.0  
## 235 1181 25.5  
## 118 590 25.0  
## 163 819 25.0  
## 232 1170 25.0  
## 6 22 24.0  
## 108 562 24.0  
## 152 759 24.0  
## 230 1168 24.0  
## 242 1207 24.0  
## 4 11 22.0  
## 88 483 22.0  
## 251 1244 22.0  
## 274 1382 18.5  
## 291 1465 18.0  
## 262 1300 14.0  
## 11 64 4.0  
## 80 445 0.0  
## 161 808 0.0  
## 263 1301 0.0  
## 290 1464 0.0  
## 307 1556 0.0  
## 322 1697 0.0  
## 336 1888 0.0

Above we can see a bit of a difference in the avg wimd index - with a lot of people being around the 160 rank of deprived. Lets have a look at the median WIMD now.

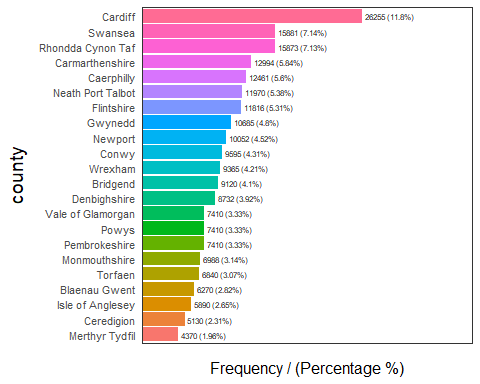
## county count  
## 4 Cardiff 86.87762  
## 3 Caerphilly 89.92994  
## 6 Ceredigion 82.88460  
## 1 Blaenau Gwent 68.27703  
## 5 Carmarthenshire 80.07280  
## 7 Conwy 72.69005  
## 2 Bridgend 104.60055

## healthboard count  
## 4 Cwm Taf Morgannwg UHB 82  
## 3 Cardiff And Vale Uni 81  
## 6 Powys Teaching 78  
## 1 Aneurin Bevan 81  
## 5 Hywel Dda 81  
## 7 Swansea Bay UHB 74  
## 2 Betsi Cadwaladr Uni 65

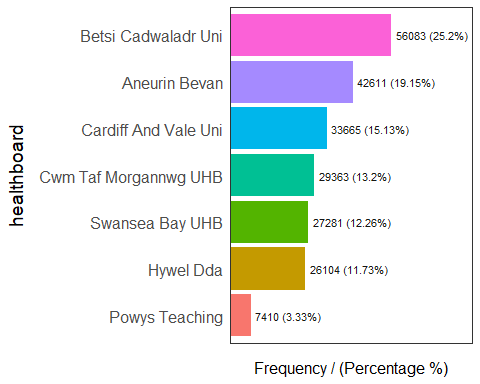
This was a very quick look at the data - next we want to try and pull out some more insights from this dataset. This can be done by looking at the percentages of the data and trying to plot it for a better picture.

## 4 - Plots

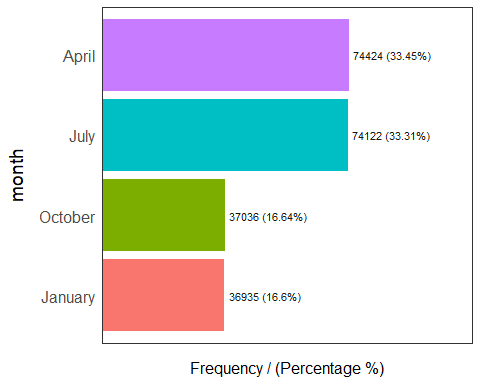
This section will look to explore the dataset and produce some plots - this will use a range of packages from base r packages (plot, barplot etc), ggplot, funModeling and more.



## county frequency percentage cumulative\_perc  
## 1 Cardiff 26255 11.80 11.80  
## 2 Swansea 15881 7.14 18.94  
## 3 Rhondda Cynon Taf 15873 7.13 26.07  
## 4 Carmarthenshire 12994 5.84 31.91  
## 5 Caerphilly 12461 5.60 37.51  
## 6 Neath Port Talbot 11970 5.38 42.89  
## 7 Flintshire 11816 5.31 48.20  
## 8 Gwynedd 10685 4.80 53.00  
## 9 Newport 10052 4.52 57.52  
## 10 Conwy 9595 4.31 61.83  
## 11 Wrexham 9365 4.21 66.04  
## 12 Bridgend 9120 4.10 70.14  
## 13 Denbighshire 8732 3.92 74.06  
## 14 Pembrokeshire 7410 3.33 77.39  
## 15 Powys 7410 3.33 80.72  
## 16 Vale of Glamorgan 7410 3.33 84.05  
## 17 Monmouthshire 6988 3.14 87.19  
## 18 Torfaen 6840 3.07 90.26  
## 19 Blaenau Gwent 6270 2.82 93.08  
## 20 Isle of Anglesey 5890 2.65 95.73  
## 21 Ceredigion 5130 2.31 98.04  
## 22 Merthyr Tydfil 4370 1.96 100.00



## healthboard frequency percentage cumulative\_perc  
## 1 Betsi Cadwaladr Uni 56083 25.20 25.20  
## 2 Aneurin Bevan 42611 19.15 44.35  
## 3 Cardiff And Vale Uni 33665 15.13 59.48  
## 4 Cwm Taf Morgannwg UHB 29363 13.20 72.68  
## 5 Swansea Bay UHB 27281 12.26 84.94  
## 6 Hywel Dda 26104 11.73 96.67  
## 7 Powys Teaching 7410 3.33 100.00  
##   
## lsoa\_code frequency percentage cumulative\_perc  
## 1 W01000304 2280 1.02 1.02  
## 2 W01000883 2280 1.02 2.04  
## 3 W01001293 2280 1.02 3.06  
## 4 W01000194 1710 0.77 3.83  
## 5 W01000364 1710 0.77 4.60  
## 6 W01000641 1710 0.77 5.37  
## 7 W01001524 1710 0.77 6.14  
## 8 W01001586 1710 0.77 6.91  
## 9 W01001857 1710 0.77 7.68  
## 10 W01000130 1615 0.73 8.41  
## 11 W01000016 1330 0.60 9.01  
## 12 W01000216 1140 0.51 9.52  
## 13 W01000240 1140 0.51 10.03  
## 14 W01000243 1140 0.51 10.54  
## 15 W01000264 1140 0.51 11.05  
## 16 W01000283 1140 0.51 11.56  
## 17 W01000290 1140 0.51 12.07  
## 18 W01000334 1140 0.51 12.58  
## 19 W01000568 1140 0.51 13.09  
## 20 W01000587 1140 0.51 13.60  
## 21 W01000653 1140 0.51 14.11  
## 22 W01000654 1140 0.51 14.62  
## 23 W01000747 1140 0.51 15.13  
## 24 W01000762 1140 0.51 15.64  
## 25 W01000850 1140 0.51 16.15  
## 26 W01000897 1140 0.51 16.66  
## 27 W01000900 1140 0.51 17.17  
## 28 W01000938 1140 0.51 17.68  
## 29 W01000939 1140 0.51 18.19  
## 30 W01001017 1140 0.51 18.70  
## 31 W01001082 1140 0.51 19.21  
## 32 W01001130 1140 0.51 19.72  
## 33 W01001148 1140 0.51 20.23  
## 34 W01001228 1140 0.51 20.74  
## 35 W01001337 1140 0.51 21.25  
## 36 W01001375 1140 0.51 21.76  
## 37 W01001403 1140 0.51 22.27  
## 38 W01001455 1140 0.51 22.78  
## 39 W01001554 1140 0.51 23.29  
## 40 W01001608 1140 0.51 23.80  
## 41 W01001755 1140 0.51 24.31  
## 42 W01001760 1140 0.51 24.82  
## 43 W01001767 1140 0.51 25.33  
## 44 W01001824 1140 0.51 25.84  
## 45 W01001829 1139 0.51 26.35  
## 46 W01000861 1063 0.48 26.83  
## 47 W01001232 958 0.43 27.26  
## 48 W01001596 950 0.43 27.69  
## 49 W01000093 900 0.40 28.09  
## 50 W01000104 760 0.34 28.43  
## 51 W01001705 758 0.34 28.77  
## 52 W01000003 570 0.26 29.03  
## 53 W01000005 570 0.26 29.29  
## 54 W01000007 570 0.26 29.55  
## 55 W01000009 570 0.26 29.81  
## 56 W01000014 570 0.26 30.07  
## 57 W01000015 570 0.26 30.33  
## 58 W01000019 570 0.26 30.59  
## 59 W01000025 570 0.26 30.85  
## 60 W01000048 570 0.26 31.11  
## 61 W01000051 570 0.26 31.37  
## 62 W01000061 570 0.26 31.63  
## 63 W01000065 570 0.26 31.89  
## 64 W01000068 570 0.26 32.15  
## 65 W01000077 570 0.26 32.41  
## 66 W01000081 570 0.26 32.67  
## 67 W01000092 570 0.26 32.93  
## 68 W01000095 570 0.26 33.19  
## 69 W01000097 570 0.26 33.45  
## 70 W01000101 570 0.26 33.71  
## 71 W01000108 570 0.26 33.97  
## 72 W01000116 570 0.26 34.23  
## 73 W01000118 570 0.26 34.49  
## 74 W01000119 570 0.26 34.75  
## 75 W01000121 570 0.26 35.01  
## 76 W01000123 570 0.26 35.27  
## 77 W01000126 570 0.26 35.53  
## 78 W01000132 570 0.26 35.79  
## 79 W01000134 570 0.26 36.05  
## 80 W01000152 570 0.26 36.31  
## 81 W01000168 570 0.26 36.57  
## 82 W01000174 570 0.26 36.83  
## 83 W01000176 570 0.26 37.09  
## 84 W01000179 570 0.26 37.35  
## 85 W01000182 570 0.26 37.61  
## 86 W01000183 570 0.26 37.87  
## 87 W01000186 570 0.26 38.13  
## 88 W01000190 570 0.26 38.39  
## 89 W01000193 570 0.26 38.65  
## 90 W01000199 570 0.26 38.91  
## 91 W01000210 570 0.26 39.17  
## 92 W01000238 570 0.26 39.43  
## 93 W01000241 570 0.26 39.69  
## 94 W01000246 570 0.26 39.95  
## 95 W01000255 570 0.26 40.21  
## 96 W01000269 570 0.26 40.47  
## 97 W01000288 570 0.26 40.73  
## 98 W01000308 570 0.26 40.99  
## 99 W01000309 570 0.26 41.25  
## 100 W01000311 570 0.26 41.51  
## 101 W01000318 570 0.26 41.77  
## 102 W01000328 570 0.26 42.03  
## 103 W01000353 570 0.26 42.29  
## 104 W01000355 570 0.26 42.55  
## 105 W01000361 570 0.26 42.81  
## 106 W01000377 570 0.26 43.07  
## 107 W01000381 570 0.26 43.33  
## 108 W01000390 570 0.26 43.59  
## 109 W01000393 570 0.26 43.85  
## 110 W01000402 570 0.26 44.11  
## 111 W01000403 570 0.26 44.37  
## 112 W01000404 570 0.26 44.63  
## 113 W01000405 570 0.26 44.89  
## 114 W01000411 570 0.26 45.15  
## 115 W01000420 570 0.26 45.41  
## 116 W01000432 570 0.26 45.67  
## 117 W01000449 570 0.26 45.93  
## 118 W01000456 570 0.26 46.19  
## 119 W01000460 570 0.26 46.45  
## 120 W01000461 570 0.26 46.71  
## 121 W01000467 570 0.26 46.97  
## 122 W01000473 570 0.26 47.23  
## 123 W01000476 570 0.26 47.49  
## 124 W01000480 570 0.26 47.75  
## 125 W01000486 570 0.26 48.01  
## 126 W01000487 570 0.26 48.27  
## 127 W01000489 570 0.26 48.53  
## 128 W01000499 570 0.26 48.79  
## 129 W01000506 570 0.26 49.05  
## 130 W01000511 570 0.26 49.31  
## 131 W01000513 570 0.26 49.57  
## 132 W01000527 570 0.26 49.83  
## 133 W01000531 570 0.26 50.09  
## 134 W01000533 570 0.26 50.35  
## 135 W01000544 570 0.26 50.61  
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## 141 W01000598 570 0.26 52.17  
## 142 W01000600 570 0.26 52.43  
## 143 W01000612 570 0.26 52.69  
## 144 W01000616 570 0.26 52.95  
## 145 W01000618 570 0.26 53.21  
## 146 W01000619 570 0.26 53.47  
## 147 W01000626 570 0.26 53.73  
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## 152 W01000682 570 0.26 55.03  
## 153 W01000692 570 0.26 55.29  
## 154 W01000695 570 0.26 55.55  
## 155 W01000698 570 0.26 55.81  
## 156 W01000708 570 0.26 56.07  
## 157 W01000713 570 0.26 56.33  
## 158 W01000714 570 0.26 56.59  
## 159 W01000716 570 0.26 56.85  
## 160 W01000720 570 0.26 57.11  
## 161 W01000735 570 0.26 57.37  
## 162 W01000742 570 0.26 57.63  
## 163 W01000745 570 0.26 57.89  
## 164 W01000754 570 0.26 58.15  
## 165 W01000767 570 0.26 58.41  
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## 184 W01000924 570 0.26 63.35  
## 185 W01000926 570 0.26 63.61  
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## 187 W01000948 570 0.26 64.13  
## 188 W01000965 570 0.26 64.39  
## 189 W01000967 570 0.26 64.65  
## 190 W01000974 570 0.26 64.91  
## 191 W01000982 570 0.26 65.17  
## 192 W01000987 570 0.26 65.43  
## 193 W01000991 570 0.26 65.69  
## 194 W01001004 570 0.26 65.95  
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## 197 W01001030 570 0.26 66.73  
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## 201 W01001042 570 0.26 67.77  
## 202 W01001050 570 0.26 68.03  
## 203 W01001063 570 0.26 68.29  
## 204 W01001065 570 0.26 68.55  
## 205 W01001066 570 0.26 68.81  
## 206 W01001069 570 0.26 69.07  
## 207 W01001088 570 0.26 69.33  
## 208 W01001103 570 0.26 69.59  
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## 210 W01001124 570 0.26 70.11  
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## 212 W01001141 570 0.26 70.63  
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## 235 W01001322 570 0.26 76.61  
## 236 W01001327 570 0.26 76.87  
## 237 W01001331 570 0.26 77.13  
## 238 W01001341 570 0.26 77.39  
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## 249 W01001418 570 0.26 80.25  
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## 254 W01001451 570 0.26 81.55  
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## 323 W01001696 418 0.19 99.31  
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## 326 W01000999 380 0.17 99.85  
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## 328 W01001686 362 0.16 100.18  
## 329 W01001556 338 0.15 100.33  
## 330 W01000076 285 0.13 100.46  
## 331 W01000106 190 0.09 100.55  
## 332 W01000415 190 0.09 100.64  
## 333 W01001048 190 0.09 100.73  
## 334 W01001204 190 0.09 100.82  
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## 337 W01000350 55 0.02 100.00  
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## 2 Cyfarthfa 3 2280 1.02 2.04  
## 3 Holywell Central 2280 1.02 3.06  
## 4 Carmarthen Town South 1 1710 0.77 3.83  
## 5 Coedpoeth 3 1710 0.77 4.60  
## 6 Denbigh Central 1710 0.77 5.37  
## 7 Pontypool 1710 0.77 6.14  
## 8 Riverside 3 1710 0.77 6.91  
## 9 St. Kingsmark 2 1710 0.77 7.68  
## 10 Conwy 2 1615 0.73 8.41  
## 11 Holyhead Town 1330 0.60 9.01  
## 12 Aberdare East 2 1140 0.51 9.52  
## 13 Alway 3 1140 0.51 10.03  
## 14 Bargoed 2 1140 0.51 10.54  
## 15 Briton Ferry West 2 1140 0.51 11.05  
## 16 Bryn and Cwmavon 3 1140 0.51 11.56  
## 17 Buckley Mountain 1 1140 0.51 12.07  
## 18 Castle 6 1140 0.51 12.58  
## 19 Cockett 8 1140 0.51 13.09  
## 20 Connah's Quay Wepre 1140 0.51 13.60  
## 21 Cowbridge 1 1140 0.51 14.11  
## 22 Cwmtillery 3 1140 0.51 14.62  
## 23 Drybridge 2 1140 0.51 15.13  
## 24 Elli 1 1140 0.51 15.64  
## 25 Elli 2 1140 0.51 16.15  
## 26 Flint Coleshill 2 1140 0.51 16.66  
## 27 Gabalfa 1 1140 0.51 17.17  
## 28 Grangetown 2 1140 0.51 17.68  
## 29 Grangetown 8 1140 0.51 18.19  
## 30 Haverfordwest: Castle 1140 0.51 18.70  
## 31 Maesteg West 1 1140 0.51 19.21  
## 32 Milford: Central 1140 0.51 19.72  
## 33 Moriah 2 1140 0.51 20.23  
## 34 Neath North 1 1140 0.51 20.74  
## 35 Neath North 2 1140 0.51 21.25  
## 36 Penylan 4 1140 0.51 21.76  
## 37 Pontllanfraith 3 1140 0.51 22.27  
## 38 Pontypridd Town 2 1140 0.51 22.78  
## 39 Prestatyn East 3 1140 0.51 23.29  
## 40 Rhyl West 2 1140 0.51 23.80  
## 41 Ruthin 2 1140 0.51 24.31  
## 42 Shotton East 1140 0.51 24.82  
## 43 St. Thomas 2 1140 0.51 25.33  
## 44 Stanwell 2 1140 0.51 25.84  
## 45 Plasnewydd 1 1139 0.51 26.35  
## 46 Sketty 9 1063 0.48 26.83  
## 47 Porth 4 958 0.43 27.26  
## 48 Usk 1 950 0.43 27.69  
## 49 Menai (Caernarfon) 900 0.40 28.09  
## 50 Penygroes (Gwynedd) 760 0.34 28.43  
## 51 Caerau (Cardiff) 4 758 0.34 28.77  
## 52 Aber Valley 2 570 0.26 29.03  
## 53 Aberaeron 570 0.26 29.29  
## 54 Aberaman South 2 570 0.26 29.55  
## 55 Abercarn 1 570 0.26 29.81  
## 56 Abercynon 3 570 0.26 30.07  
## 57 Aberdare East 4 570 0.26 30.33  
## 58 Aberkenfig 570 0.26 30.59  
## 59 Abermaw 1 570 0.26 30.85  
## 60 Aberteifi/Cardigan - Teifi 570 0.26 31.11  
## 61 Aberystwyth Canol/Central 570 0.26 31.37  
## 62 Adamsdown 5 570 0.26 31.63  
## 63 Allt-yr-yn 4 570 0.26 31.89  
## 64 Amlwch Port 570 0.26 32.15  
## 65 Ammanford 2 570 0.26 32.41  
## 66 Badminton 1 570 0.26 32.67  
## 67 Bala 570 0.26 32.93  
## 68 Beaumaris 570 0.26 33.19  
## 69 Bedwas Trethomas and Machen 2 570 0.26 33.45  
## 70 Betws-y-Coed 570 0.26 33.71  
## 71 Blaenavon 1 570 0.26 33.97  
## 72 Blaina 1 570 0.26 34.23  
## 73 Bodorgan 570 0.26 34.49  
## 74 Brackla 4 570 0.26 34.75  
## 75 Broughton North East 570 0.26 35.01  
## 76 Bryn 570 0.26 35.27  
## 77 Bryncoch 570 0.26 35.53  
## 78 Bryngwran 570 0.26 35.79  
## 79 Brynmawr 3 570 0.26 36.05  
## 80 Builth 2 570 0.26 36.31  
## 81 Burry Port 2 570 0.26 36.57  
## 82 Butetown 1 570 0.26 36.83  
## 83 Buttrills 1 570 0.26 37.09  
## 84 Buttrills 3 570 0.26 37.35  
## 85 Buttrills 4 570 0.26 37.61  
## 86 Cadoc 3 570 0.26 37.87  
## 87 Caerau (Bridgend) 1 570 0.26 38.13  
## 88 Caergwrle 570 0.26 38.39  
## 89 Caerleon 1 570 0.26 38.65  
## 90 Canton 1 570 0.26 38.91  
## 91 Cantref 2 570 0.26 39.17  
## 92 Cartrefle 2 570 0.26 39.43  
## 93 Castle 1 570 0.26 39.69  
## 94 Castle 4 570 0.26 39.95  
## 95 Cathays 5 570 0.26 40.21  
## 96 Cathays 8 570 0.26 40.47  
## 97 Cefn 2 570 0.26 40.73  
## 98 Cefn Fforest 2 570 0.26 40.99  
## 99 Chirk South 570 0.26 41.25  
## 100 Church Village 1 570 0.26 41.51  
## 101 Clydach 5 570 0.26 41.77  
## 102 Coedffranc Central 1 570 0.26 42.03  
## 103 Coedffranc Central 2 570 0.26 42.29  
## 104 Colwyn 1 570 0.26 42.55  
## 105 Corwen 2 570 0.26 42.81  
## 106 Craig-y-Don 1 570 0.26 43.07  
## 107 Criccieth 570 0.26 43.33  
## 108 Crumlin 4 570 0.26 43.59  
## 109 Crwst 570 0.26 43.85  
## 110 Cwm 2 570 0.26 44.11  
## 111 Cwmbwrla 5 570 0.26 44.37  
## 112 Cwmllynfell 570 0.26 44.63  
## 113 Cyngar 570 0.26 44.89  
## 114 Denbigh Upper/Henllan 2 570 0.26 45.15  
## 115 Diffwys and Maenofferen 570 0.26 45.41  
## 116 Dinas Powys 3 570 0.26 45.67  
## 117 Dolgellau South 570 0.26 45.93  
## 118 Dowlais 4 570 0.26 46.19  
## 119 Ebbw Vale North 1 570 0.26 46.45  
## 120 Ebbw Vale South 3 570 0.26 46.71  
## 121 Ely 10 570 0.26 46.97  
## 122 Ely 6 570 0.26 47.23  
## 123 Ely 8 570 0.26 47.49  
## 124 Fairwater (Cardiff) 4 570 0.26 47.75  
## 125 Fairwater (Torfaen) 1 570 0.26 48.01  
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## 127 Ferndale 1 570 0.26 48.53  
## 128 Fishguard North West 570 0.26 48.79  
## 129 Flint Castle 570 0.26 49.05  
## 130 Gilfach Goch 1 570 0.26 49.31  
## 131 Glyncorrwg 570 0.26 49.57  
## 132 Glynneath 2 570 0.26 49.83  
## 133 Gorseinon 1 570 0.26 50.09  
## 134 Gorseinon 2 570 0.26 50.35  
## 135 Gower (Swansea) 1 570 0.26 50.61  
## 136 Gowerton 2 570 0.26 50.87  
## 137 Grangetown 7 570 0.26 51.13  
## 138 Grangetown 9 570 0.26 51.39  
## 139 Grofield 570 0.26 51.65  
## 140 Gwaun-Cae-Gurwen 1 570 0.26 51.91  
## 141 Gwersyllt North 1 570 0.26 52.17  
## 142 Gwyngyll 570 0.26 52.43  
## 143 Hawthorn 2 570 0.26 52.69  
## 144 Heath 1 570 0.26 52.95  
## 145 Heath 5 570 0.26 53.21  
## 146 Hendre (Bridgend) 2 570 0.26 53.47  
## 147 Hermitage 1 570 0.26 53.73  
## 148 Hirael & Garth 2 570 0.26 53.99  
## 149 Hirwaun 3 570 0.26 54.25  
## 150 Hope 2 570 0.26 54.51  
## 151 Illtyd 6 570 0.26 54.77  
## 152 Kidwelly 2 570 0.26 55.03  
## 153 Kinmel Bay 4 570 0.26 55.29  
## 154 Knighton 2 570 0.26 55.55  
## 155 Lampeter 1 570 0.26 55.81  
## 156 Leeswood 570 0.26 56.07  
## 157 Liswerry 5 570 0.26 56.33  
## 158 Llanbedrgoch 570 0.26 56.59  
## 159 Llanberis 570 0.26 56.85  
## 160 Llanbradach 2 570 0.26 57.11  
## 161 Llandaff 3 570 0.26 57.37  
## 162 Llandaff 5 570 0.26 57.63  
## 163 Llandaff North 5 570 0.26 57.89  
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## 169 Llanegwad 1 570 0.26 59.45  
## 170 Llanfair Caereinion 570 0.26 59.71  
## 171 Llanfihangel Ysgeifiog 570 0.26 59.97  
## 172 Llanfyllin 570 0.26 60.23  
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## 176 Llanhilleth 2 570 0.26 61.27  
## 177 Llanidloes 2 570 0.26 61.53  
## 178 Llanishen 1 570 0.26 61.79  
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## 180 Llannon 2 570 0.26 62.31  
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## 182 Llantarnam 3 570 0.26 62.83  
## 183 Llantwit Major 2 570 0.26 63.09  
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## 185 Llanyrafon North 570 0.26 63.61  
## 186 Llay 1 570 0.26 63.87  
## 187 Llwynhendy 3 570 0.26 64.13  
## 188 Machynlleth 570 0.26 64.39  
## 189 Maesydre 570 0.26 64.65  
## 190 Malpas 4 570 0.26 64.91  
## 191 Mancot 1 570 0.26 65.17  
## 192 Menai (Bangor) 570 0.26 65.43  
## 193 Merthyr Vale 3 570 0.26 65.69  
## 194 Mold West 1 570 0.26 65.95  
## 195 Montgomery 570 0.26 66.21  
## 196 Morgan Jones 3 570 0.26 66.47  
## 197 Morgan Jones 4 570 0.26 66.73  
## 198 Morriston 8 570 0.26 66.99  
## 199 Mostyn (Conwy) 1 570 0.26 67.25  
## 200 Mountain Ash West 3 570 0.26 67.51  
## 201 Mynyddbach 5 570 0.26 67.77  
## 202 Nant-y-moel 2 570 0.26 68.03  
## 203 Narberth 570 0.26 68.29  
## 204 Nefyn 570 0.26 68.55  
## 205 Nelson 2 570 0.26 68.81  
## 206 New Quay 570 0.26 69.07  
## 207 Newport 570 0.26 69.33  
## 208 Newton (Bridgend) 2 570 0.26 69.59  
## 209 Newtown East 570 0.26 69.85  
## 210 Neyland: East 570 0.26 70.11  
## 211 Offa 570 0.26 70.37  
## 212 Ogmore Vale 2 570 0.26 70.63  
## 213 Ogwen 2 570 0.26 70.89  
## 214 Oldcastle 1 570 0.26 71.15  
## 215 Oldcastle 2 570 0.26 71.41  
## 216 Overton 1 570 0.26 71.67  
## 217 Overton 2 570 0.26 71.93  
## 218 Oystermouth 1 570 0.26 72.19  
## 219 Pant 570 0.26 72.45  
## 220 Panteg 2 570 0.26 72.71  
## 221 Pembroke Dock: Central 570 0.26 72.97  
## 222 Pen-y-graig 4 570 0.26 73.23  
## 223 Penderry 3 570 0.26 73.49  
## 224 Pengam 3 570 0.26 73.75  
## 225 Penrhiwceiber 2 570 0.26 74.01  
## 226 Penrhyn 2 570 0.26 74.27  
## 227 Penrhyndeudraeth 2 570 0.26 74.53  
## 228 Pensarn 1 570 0.26 74.79  
## 229 Pentre 1 570 0.26 75.05  
## 230 Pentre Mawr 2 570 0.26 75.31  
## 231 Pentwyn 5 570 0.26 75.57  
## 232 Pentwyn 8 570 0.26 75.83  
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## 234 Penyrheol (Caerphilly) 6 570 0.26 76.35  
## 235 Pillgwenlly 1 570 0.26 76.61  
## 236 Pillgwenlly 2 570 0.26 76.87  
## 237 Plasnewydd 5 570 0.26 77.13  
## 238 Ponciau 2 570 0.26 77.39  
## 239 Pont-y-clun 4 570 0.26 77.65  
## 240 Pontamman 1 570 0.26 77.91  
## 241 Pontardawe 3 570 0.26 78.17  
## 242 Pontardulais 2 570 0.26 78.43  
## 243 Pontnewydd 3 570 0.26 78.69  
## 244 Pontnewydd 4 570 0.26 78.95  
## 245 Pontprennau/Old St. Mellons 5 570 0.26 79.21  
## 246 Pontyberem 1 570 0.26 79.47  
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## 248 Presteigne 2 570 0.26 79.99  
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## 251 Pyle 3 570 0.26 80.77  
## 252 Queensferry 570 0.26 81.03  
## 253 Rhayader 570 0.26 81.29  
## 254 Rhiw 3 570 0.26 81.55  
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## 260 Risca West 2 570 0.26 83.11  
## 261 Riverside 6 570 0.26 83.37  
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## 264 Ruabon 2 570 0.26 84.15  
## 265 Rumney 6 570 0.26 84.41  
## 266 Saundersfoot 2 570 0.26 84.67  
## 267 Seven Sisters 570 0.26 84.93  
## 268 Severn 1 570 0.26 85.19  
## 269 Shaftesbury 4 570 0.26 85.45  
## 270 Snatchwood 570 0.26 85.71  
## 271 Solva 570 0.26 85.97  
## 272 Splott 5 570 0.26 86.23  
## 273 Splott 7 570 0.26 86.49  
## 274 St. Arvans 570 0.26 86.75  
## 275 St. Asaph West 570 0.26 87.01  
## 276 St. Augustine's 2 570 0.26 87.27  
## 277 St. Cattwg 5 570 0.26 87.53  
## 278 St. Clears 1 570 0.26 87.79  
## 279 St. David's 570 0.26 88.05  
## 280 St. David Within 570 0.26 88.31  
## 281 St. Dials 2 570 0.26 88.57  
## 282 St. Julians 1 570 0.26 88.83  
## 283 St. Julians 6 570 0.26 89.09  
## 284 St. Thomas 4 570 0.26 89.35  
## 285 Stow Hill 3 570 0.26 89.61  
## 286 Sully 2 570 0.26 89.87  
## 287 Taffs Well 2 570 0.26 90.13  
## 288 Tai-bach 2 570 0.26 90.39  
## 289 Talbot Green 2 570 0.26 90.65  
## 290 Tenby: North 570 0.26 90.91  
## 291 Tonypandy 1 570 0.26 91.17  
## 292 Tonypandy 2 570 0.26 91.43  
## 293 Tonyrefail East 1 570 0.26 91.69  
## 294 Townhill 3 570 0.26 91.95  
## 295 Tredegar Central and West 1 570 0.26 92.21  
## 296 Tredegar Central and West 4 570 0.26 92.47  
## 297 Tredegar Park 1 570 0.26 92.73  
## 298 Tregaron 570 0.26 92.99  
## 299 Treharris 4 570 0.26 93.25  
## 300 Treorchy 5 570 0.26 93.51  
## 301 Trowbridge 1 570 0.26 93.77  
## 302 Trowbridge 2 570 0.26 94.03  
## 303 Tudno 1 570 0.26 94.29  
## 304 Tylorstown 2 570 0.26 94.55  
## 305 Tywyn 1 570 0.26 94.81  
## 306 Uplands 2 570 0.26 95.07  
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## 308 Uwchaled 570 0.26 95.59  
## 309 Victoria 1 570 0.26 95.85  
## 310 Waunfawr 570 0.26 96.11  
## 311 Welshpool Gungrog 1 570 0.26 96.37  
## 312 West Cross 2 570 0.26 96.63  
## 313 Whitchurch and Tongwynlais 5 570 0.26 96.89  
## 314 Whitchurch and Tongwynlais 9 570 0.26 97.15  
## 315 Whitland 570 0.26 97.41  
## 316 Y Felinheli 570 0.26 97.67  
## 317 Ystrad 1 570 0.26 97.93  
## 318 Ystrad Mynach 2 570 0.26 98.19  
## 319 Ystwyth 570 0.26 98.45  
## 320 Mynyddbach 2 568 0.26 98.71  
## 321 Treherbert 2 475 0.21 98.92  
## 322 Carmarthen Town West 2 454 0.20 99.12  
## 323 Adamsdown 3 418 0.19 99.31  
## 324 Mold South 1 416 0.19 99.50  
## 325 St. Martins 4 396 0.18 99.68  
## 326 Bedlinog 1 380 0.17 99.85  
## 327 Cornelly 1 380 0.17 100.02  
## 328 Stow Hill 2 362 0.16 100.18  
## 329 Goetre Fawr 2 338 0.15 100.33  
## 330 Hirael & Garth 1 285 0.13 100.46  
## 331 Mountain Ash East 1 190 0.09 100.55  
## 332 Porthmadog West 190 0.09 100.64  
## 333 Pyle 1 190 0.09 100.73  
## 334 Rhosnesni 1 190 0.09 100.82  
## 335 St. Asaph East 182 0.08 100.90  
## 336 St. James 3 95 0.04 100.94  
## 337 Brynyffynnon 2 55 0.02 100.00  
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## 3 Treffynnon Canol 2280 1.02 3.06  
## 4 Coedpoeth 3 1710 0.77 3.83  
## 5 Dinbych Canol 1710 0.77 4.60  
## 6 Glanyrafon 3 1710 0.77 5.37  
## 7 Pont-y-pwl 1710 0.77 6.14  
## 8 St. Kingsmark 2 1710 0.77 6.91  
## 9 Tre Caerfyrddin De 1 1710 0.77 7.68  
## 10 Conwy 2 1615 0.73 8.41  
## 11 Tref Caergybi 1330 0.60 9.01  
## 12 Aberdâr Dwyrain 2 1140 0.51 9.52  
## 13 Aberdaugleddau: Canol 1140 0.51 10.03  
## 14 Alway 3 1140 0.51 10.54  
## 15 Bargod 2 1140 0.51 11.05  
## 16 Bryn a Chwmafan 3 1140 0.51 11.56  
## 17 Castell-Nedd Gogledd 1 1140 0.51 12.07  
## 18 Castell-Nedd Gogledd 2 1140 0.51 12.58  
## 19 Castell 6 1140 0.51 13.09  
## 20 Cei Connah Gwepre 1140 0.51 13.60  
## 21 Cwmtyleri 3 1140 0.51 14.11  
## 22 Drybridge 2 1140 0.51 14.62  
## 23 Elli 1 1140 0.51 15.13  
## 24 Elli 2 1140 0.51 15.64  
## 25 Gabalfa 1 1140 0.51 16.15  
## 26 Grangetown 2 1140 0.51 16.66  
## 27 Grangetown 8 1140 0.51 17.17  
## 28 Hwlffordd: Castell 1140 0.51 17.68  
## 29 Llansawel Gorllewin 2 1140 0.51 18.19  
## 30 Maesteg Gorllewin 1 1140 0.51 18.70  
## 31 Moria 2 1140 0.51 19.21  
## 32 Mynydd Bwcle 1 1140 0.51 19.72  
## 33 Pen-y-lan 4 1140 0.51 20.23  
## 34 Pontllan-fraith 3 1140 0.51 20.74  
## 35 Prestatyn Dwyrain 3 1140 0.51 21.25  
## 36 Rhuthun 2 1140 0.51 21.76  
## 37 Rhyl Gorllewin 2 1140 0.51 22.27  
## 38 Shotton Dwyrain 1140 0.51 22.78  
## 39 St. Thomas 2 1140 0.51 23.29  
## 40 Stanwell 2 1140 0.51 23.80  
## 41 Tref Pontypridd 2 1140 0.51 24.31  
## 42 Y Bont-faen 1 1140 0.51 24.82  
## 43 Y Cocyd 8 1140 0.51 25.33  
## 44 Y Fflint Cwnsyllt 2 1140 0.51 25.84  
## 45 Plasnewydd 1 1139 0.51 26.35  
## 46 Sgeti 9 1063 0.48 26.83  
## 47 Y Porth 4 958 0.43 27.26  
## 48 Brynbuga 1 950 0.43 27.69  
## 49 Menai (Caernarfon) 900 0.40 28.09  
## 50 Pen-y-groes (Gwynedd) 760 0.34 28.43  
## 51 Caerau (Caerdydd) 4 758 0.34 28.77  
## 52 Aberaeron 570 0.26 29.03  
## 53 Aberaman De 2 570 0.26 29.29  
## 54 Abercarn 1 570 0.26 29.55  
## 55 Abercynffig 570 0.26 29.81  
## 56 Abercynon 3 570 0.26 30.07  
## 57 Aberdâr Dwyrain 4 570 0.26 30.33  
## 58 Abergwaun Gogledd Orllewin 570 0.26 30.59  
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## 62 Aberystwyth Canol 570 0.26 31.63  
## 63 Adamsdown 5 570 0.26 31.89  
## 64 Allt-yr-ynn 4 570 0.26 32.15  
## 65 Arberth 570 0.26 32.41  
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## 212 Pen-yr-heol (Caerffili) 6 570 0.26 70.63  
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## 261 Stow Hill 3 570 0.26 83.37  
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## 311 Yr Eglwys Newydd a Thongwynlais 5 570 0.26 96.37  
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## 313 Yr Hôb 2 570 0.26 96.89  
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## 318 Ystumllwynarth 1 570 0.26 98.19  
## 319 Ystwyth 570 0.26 98.45  
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## 321 Treherbert 2 475 0.21 98.92  
## 322 Tre Caerfyrddin Gorllewin 2 454 0.20 99.12  
## 323 Adamsdown 3 418 0.19 99.31  
## 324 Yr Wyddgrug De 1 416 0.19 99.50  
## 325 Sant Martin 4 396 0.18 99.68  
## 326 Bedlinog 1 380 0.17 99.85  
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## 328 Stow Hill 2 362 0.16 100.18  
## 329 Goetre Fawr 2 338 0.15 100.33  
## 330 Hirael a Garth 1 285 0.13 100.46  
## 331 Aberpennar Dwyrain 1 190 0.09 100.55  
## 332 Porthmadog Gorllewin 190 0.09 100.64  
## 333 Rhosnesni 1 190 0.09 100.73  
## 334 Y Pîl 1 190 0.09 100.82  
## 335 Llanelwy Dwyrain 182 0.08 100.90  
## 336 Sant Iago 3 95 0.04 100.94  
## 337 Brynyffynnon 2 55 0.02 100.00

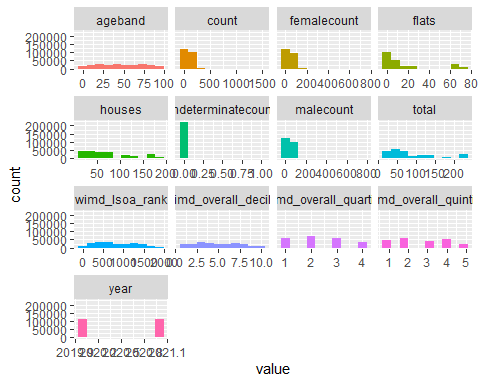


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## 33 CF142FD 570 0.26 14.52  
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## 348 W98019 570 0.26 90.48  
## 349 W98020 570 0.26 90.74  
## 350 W98021 570 0.26 91.00  
## 351 W98022 570 0.26 91.26  
## 352 W98023 570 0.26 91.52  
## 353 W98024 570 0.26 91.78  
## 354 W98028 570 0.26 92.04  
## 355 W98030 570 0.26 92.30  
## 356 W98031 570 0.26 92.56  
## 357 W98032 570 0.26 92.82  
## 358 W98033 570 0.26 93.08  
## 359 W98034 570 0.26 93.34  
## 360 W98035 570 0.26 93.60  
## 361 W98036 570 0.26 93.86  
## 362 W98040 570 0.26 94.12  
## 363 W98041 570 0.26 94.38  
## 364 W98043 570 0.26 94.64  
## 365 W98044 570 0.26 94.90  
## 366 W98045 570 0.26 95.16  
## 367 W98046 570 0.26 95.42  
## 368 W98048 570 0.26 95.68  
## 369 W98049 570 0.26 95.94  
## 370 W98055 570 0.26 96.20  
## 371 W98056 570 0.26 96.46  
## 372 W98057 570 0.26 96.72  
## 373 W98608 570 0.26 96.98  
## 374 W98612 570 0.26 97.24  
## 375 W98627 570 0.26 97.50  
## 376 W98785 570 0.26 97.76  
## 377 W97056 569 0.26 98.02  
## 378 W98039 568 0.26 98.28  
## 379 W98053 493 0.22 98.50  
## 380 W94046 475 0.21 98.71  
## 381 W95071 475 0.21 98.92  
## 382 W00149 454 0.20 99.12  
## 383 W00100 418 0.19 99.31  
## 384 W00071 416 0.19 99.50  
## 385 W00165 396 0.18 99.68  
## 386 W00102 388 0.17 99.85  
## 387 W93038 380 0.17 100.02  
## 388 W95290 380 0.17 100.19  
## 389 W93131 362 0.16 100.35  
## 390 W00166 338 0.15 100.50  
## 391 W00075 330 0.15 100.65  
## 392 W94040 285 0.13 100.78  
## 393 W91054 190 0.09 100.87  
## 394 W94014 190 0.09 100.96  
## 395 W94033 190 0.09 101.05  
## 396 W94612 190 0.09 101.14  
## 397 W95623 190 0.09 101.23  
## 398 W97623 188 0.08 101.31  
## 399 W00072 182 0.08 101.39  
## 400 W95636 95 0.04 101.43  
## 401 W00073 55 0.02 100.00

## [1] "Variables processed: county, healthboard, lsoa\_code, lsoa\_name, lsoa\_name\_.cymraeg., month, postcode, practicecode"

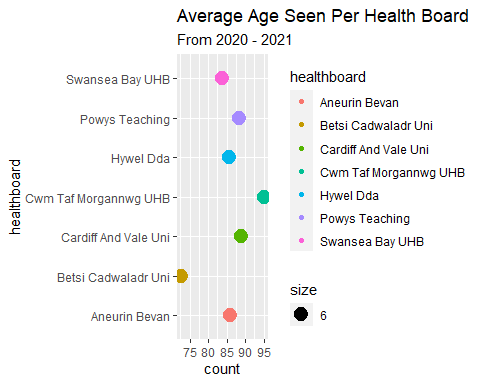
The freq function from the funModeling package is great to quickly look at the frequencies in the dataset and creates some plots for us - with the Health Board Frequency plot looking very interesting.

## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =  
## "none")` instead.

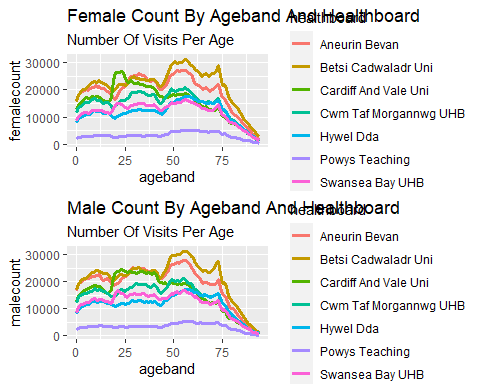
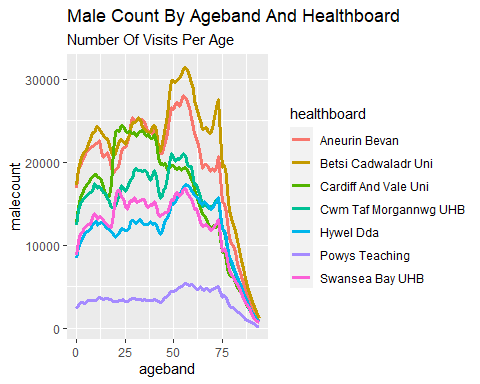
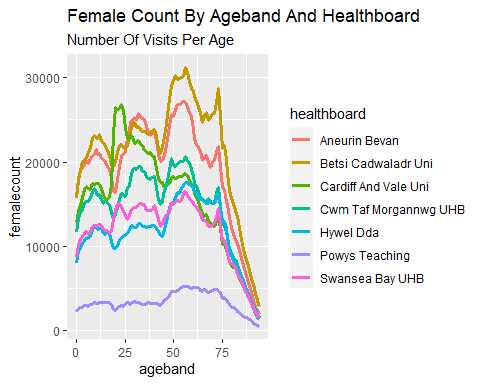


plot\_num plots all of the numerical values within a dataset and plots them nicely, although this plot isn’t too interesting to us in this form.

Lets try to look at the average visits per GP.



Whilst the plot above shoes a basic average age seen per health board, this isn’t the best of plots.



# 5 - Hypothesis Testing

Before carrying out any Hypothesis tests, usually in ML projects the data would need to be normalised or standardised somehow. From a quick search online, there are two ways to do this within R.

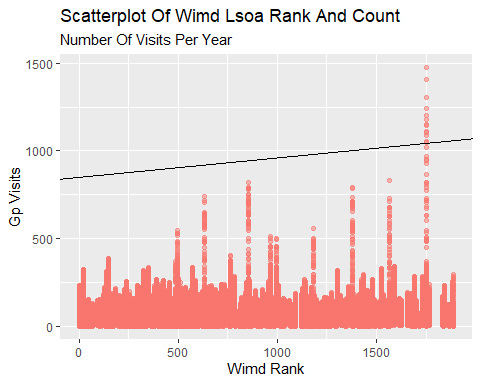
With the data being ‘normalised’ the data ranges from 0-1 which is often useful for ML.

First lets start by covering some t.tests and see if these could be useful.

We would first look at the a boxplot to find our first Null Hypothesis.

## (Intercept)   
## 847.6237

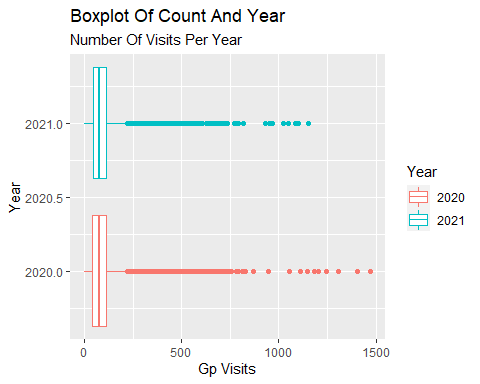
## Warning: geom\_abline(): Ignoring `mapping` because `slope` and/or `intercept`  
## were provided.



## Warning in cor.test.default(df$wimd\_lsoa\_rank, df$count, method = "spearman"):  
## Cannot compute exact p-value with ties

## Length Class Mode   
## statistic 1 -none- numeric   
## parameter 0 -none- NULL   
## p.value 1 -none- numeric   
## estimate 1 -none- numeric   
## null.value 1 -none- numeric   
## alternative 1 -none- character  
## method 1 -none- character  
## data.name 1 -none- character

This section will go over how to carry out a T-test on the *GP Visits modelled by the year*.



## Loading required package: carData

##   
## Attaching package: 'car'

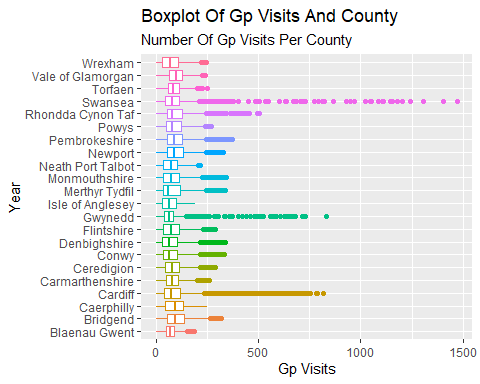
## The following object is masked from 'package:dplyr':  
##   
## recode

## The following object is masked from 'package:purrr':  
##   
## some

## Levene's Test for Homogeneity of Variance (center = median)  
## Df F value Pr(>F)  
## group 1 1.3068 0.253  
## 222515

##   
## Two Sample t-test  
##   
## data: df$count by df$year  
## t = -6.4299, df = 222515, p-value = 1.279e-10  
## alternative hypothesis: true difference in means between group 2020 and group 2021 is not equal to 0  
## 95 percent confidence interval:  
## -2.094381 -1.115840  
## sample estimates:  
## mean in group 2020 mean in group 2021   
## 83.20262 84.80773

This next section will cover how to carry out an ANOVA analysis, of the data *GP Visits modelled by County*.

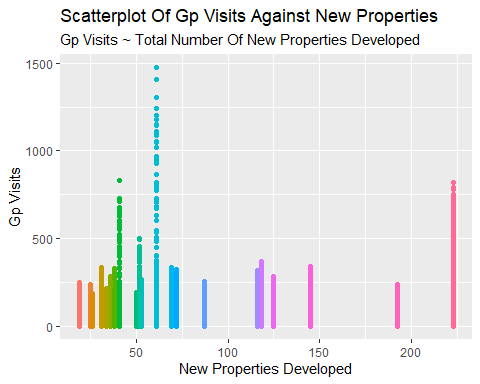


## Df Sum Sq Mean Sq F value Pr(>F)   
## df$county 21 21730310 1034777 307.1 <2e-16 \*\*\*  
## Residuals 222495 749703782 3370   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## Tukey multiple comparisons of means  
## 95% family-wise confidence level  
##   
## Fit: aov(formula = df$count ~ df$county)  
##   
## $`df$county`  
## diff lwr upr  
## Bridgend-Blaenau Gwent 36.32351475 32.9019596 39.74506995  
## Caerphilly-Blaenau Gwent 21.65290792 18.4236280 24.88218785  
## Cardiff-Blaenau Gwent 18.60058982 15.6689926 21.53218703  
## Carmarthenshire-Blaenau Gwent 11.79576934 8.5887361 15.00280259  
## Ceredigion-Blaenau Gwent 14.60756690 10.6811591 18.53397468  
## Conwy-Blaenau Gwent 4.41301341 1.0261381 7.79988871  
## Denbighshire-Blaenau Gwent 8.46277411 5.0103879 11.91516035  
## Flintshire-Blaenau Gwent 9.47821363 6.2195639 12.73686336  
## Gwynedd-Blaenau Gwent -1.97885848 -5.2967585 1.33904152  
## Isle of Anglesey-Blaenau Gwent -1.55326439 -5.3377843 2.23125556  
## Merthyr Tydfil-Blaenau Gwent 15.31266902 11.2027643 19.42257375  
## Monmouthshire-Blaenau Gwent 14.58458643 10.9566120 18.21256086  
## Neath Port Talbot-Blaenau Gwent 4.98528898 1.7339144 8.23666352  
## Newport-Blaenau Gwent 26.68357136 23.3272611 30.03988166  
## Pembrokeshire-Blaenau Gwent 29.33092872 25.7521438 32.90971368  
## Powys-Blaenau Gwent 20.02903938 16.4502544 23.60782434  
## Rhondda Cynon Taf-Blaenau Gwent 24.27642206 21.1654910 27.38735308  
## Swansea-Blaenau Gwent 23.13100127 20.0202921 26.24171040  
## Torfaen-Blaenau Gwent 16.33846358 12.6919742 19.98495297  
## Vale of Glamorgan-Blaenau Gwent 27.64887744 24.0700925 31.22766240  
## Wrexham-Blaenau Gwent 5.40710959 2.0038372 8.81038199  
## Caerphilly-Bridgend -14.67060683 -17.5446769 -11.79653681  
## Cardiff-Bridgend -17.72292494 -20.2579381 -15.18791175  
## Carmarthenshire-Bridgend -24.52774541 -27.3767965 -21.67869436  
## Ceredigion-Bridgend -21.71594786 -25.3558253 -18.07607042  
## Conwy-Bridgend -31.91050135 -34.9605758 -28.86042692  
## Denbighshire-Bridgend -27.86074064 -30.9833998 -24.73808146  
## Flintshire-Bridgend -26.84530112 -29.7523319 -23.93827038  
## Gwynedd-Bridgend -38.30237323 -41.2756694 -35.32907707  
## Isle of Anglesey-Bridgend -37.87677915 -41.3631269 -34.39043136  
## Merthyr Tydfil-Bridgend -21.01084573 -24.8479470 -17.17374441  
## Monmouthshire-Bridgend -21.73892833 -25.0546829 -18.42317379  
## Neath Port Talbot-Bridgend -31.33822577 -34.2370990 -28.43935253  
## Newport-Bridgend -9.63994339 -12.6560416 -6.62384517  
## Pembrokeshire-Bridgend -6.99258603 -10.2544462 -3.73072591  
## Powys-Bridgend -16.29447537 -19.5563355 -13.03261525  
## Rhondda Cynon Taf-Bridgend -12.04709269 -14.7875163 -9.30666910  
## Swansea-Bridgend -13.19251349 -15.9326852 -10.45234178  
## Torfaen-Bridgend -19.98505117 -23.3210539 -16.64904840  
## Vale of Glamorgan-Bridgend -8.67463731 -11.9364974 -5.41277719  
## Wrexham-Bridgend -30.91640516 -33.9846771 -27.84813323  
## Cardiff-Caerphilly -3.05231811 -5.3211285 -0.78350767  
## Carmarthenshire-Caerphilly -9.85713859 -12.4721531 -7.24212409  
## Ceredigion-Caerphilly -7.04534103 -10.5050978 -3.58558429  
## Conwy-Caerphilly -17.23989452 -20.0725899 -14.40719917  
## Denbighshire-Caerphilly -13.19013381 -16.1008398 -10.27942784  
## Flintshire-Caerphilly -12.17469429 -14.8527601 -9.49662846  
## Gwynedd-Caerphilly -23.63176641 -26.3816208 -20.88191205  
## Isle of Anglesey-Caerphilly -23.20617232 -26.5040246 -19.90832001  
## Merthyr Tydfil-Caerphilly -6.34023890 -10.0069207 -2.67355710  
## Monmouthshire-Caerphilly -7.06832150 -10.1852811 -3.95136191  
## Neath Port Talbot-Caerphilly -16.66761894 -19.3368276 -13.99841027  
## Newport-Caerphilly 5.03066344 2.2345845 7.82674237  
## Pembrokeshire-Caerphilly 7.67802080 4.6184554 10.73758618  
## Powys-Caerphilly -1.62386854 -4.6834339 1.43569685  
## Rhondda Cynon Taf-Caerphilly 2.62351414 0.1272909 5.11973735  
## Swansea-Caerphilly 1.47809334 -1.0178534 3.97404003  
## Torfaen-Caerphilly -5.31444434 -8.4529350 -2.17595371  
## Vale of Glamorgan-Caerphilly 5.99596951 2.9364041 9.05553490  
## Wrexham-Caerphilly -16.24579833 -19.0980784 -13.39351827  
## Carmarthenshire-Cardiff -6.80482048 -9.0418529 -4.56778802  
## Ceredigion-Cardiff -3.99302292 -7.1767205 -0.80932538  
## Conwy-Cardiff -14.18757641 -16.6755829 -11.69956992  
## Denbighshire-Cardiff -10.13781571 -12.7142906 -7.56134086  
## Flintshire-Cardiff -9.12237619 -11.4327982 -6.81195414  
## Gwynedd-Cardiff -20.57944830 -22.9727123 -18.18618434  
## Isle of Anglesey-Cardiff -20.15385421 -23.1608200 -17.14688843  
## Merthyr Tydfil-Cardiff -3.28792079 -6.6953493 0.11950768  
## Monmouthshire-Cardiff -4.01600339 -6.8233955 -1.20861128  
## Neath Port Talbot-Cardiff -13.61530084 -15.9154505 -11.31515120  
## Newport-Cardiff 8.08298154 5.6367455 10.52921759  
## Pembrokeshire-Cardiff 10.73033890 7.9868095 13.47386834  
## Powys-Cardiff 1.42844956 -1.3150799 4.17197900  
## Rhondda Cynon Taf-Cardiff 5.67583224 3.5788955 7.77276899  
## Swansea-Cardiff 4.53041145 2.4338039 6.62701901  
## Torfaen-Cardiff -2.26212623 -5.0934045 0.56915206  
## Vale of Glamorgan-Cardiff 9.04828762 6.3047582 11.79181705  
## Wrexham-Cardiff -13.19348022 -15.7037621 -10.68319838  
## Ceredigion-Carmarthenshire 2.81179756 -0.6272038 6.25079888  
## Conwy-Carmarthenshire -7.38275593 -10.1900636 -4.57544827  
## Denbighshire-Carmarthenshire -3.33299523 -6.2189999 -0.44699060  
## Flintshire-Carmarthenshire -2.31755571 -4.9687536 0.33364214  
## Gwynedd-Carmarthenshire -13.77462782 -16.4983224 -11.05093319  
## Isle of Anglesey-Carmarthenshire -13.34903373 -16.6251050 -10.07296242  
## Merthyr Tydfil-Carmarthenshire 3.51689969 -0.1302045 7.16400386  
## Monmouthshire-Carmarthenshire 2.78881709 -0.3050883 5.88272247  
## Neath Port Talbot-Carmarthenshire -6.81048036 -9.4527310 -4.16822973  
## Newport-Carmarthenshire 14.88780202 12.1174463 17.65815774  
## Pembrokeshire-Carmarthenshire 17.53515938 14.4990840 20.57123477  
## Powys-Carmarthenshire 8.23327004 5.1971947 11.26934543  
## Rhondda Cynon Taf-Carmarthenshire 12.48065272 10.0132768 14.94802861  
## Swansea-Carmarthenshire 11.33523193 8.8681358 13.80232806  
## Torfaen-Carmarthenshire 4.54269424 1.4270985 7.65828999  
## Vale of Glamorgan-Carmarthenshire 15.85310810 12.8170327 18.88918349  
## Wrexham-Carmarthenshire -6.38865975 -9.2157280 -3.56159148  
## Conwy-Ceredigion -10.19455349 -13.8018506 -6.58725642  
## Denbighshire-Ceredigion -6.14479279 -9.8136671 -2.47591850  
## Flintshire-Ceredigion -5.12935327 -8.6165392 -1.64216731  
## Gwynedd-Ceredigion -16.58642538 -20.1290414 -13.04380936  
## Isle of Anglesey-Ceredigion -16.16083129 -20.1438275 -12.17783505  
## Merthyr Tydfil-Ceredigion 0.70510213 -3.5882631 4.99846732  
## Monmouthshire-Ceredigion -0.02298047 -3.8575425 3.81158161  
## Neath Port Talbot-Ceredigion -9.62227792 -13.1026664 -6.14188940  
## Newport-Ceredigion 12.07600446 8.4973893 15.65461965  
## Pembrokeshire-Ceredigion 14.72336182 10.9353056 18.51141800  
## Powys-Ceredigion 5.42147248 1.6334163 9.20952866  
## Rhondda Cynon Taf-Ceredigion 9.66885516 6.3192941 13.01841627  
## Swansea-Ceredigion 8.52343437 5.1740793 11.87278940  
## Torfaen-Ceredigion 1.73089669 -2.1211875 5.58298089  
## Vale of Glamorgan-Ceredigion 13.04131054 9.2532544 16.82936672  
## Wrexham-Ceredigion -9.20045730 -12.8231539 -5.57776068  
## Denbighshire-Conwy 4.04976070 0.9651400 7.13438139  
## Flintshire-Conwy 5.06520022 2.1990683 7.93133214  
## Gwynedd-Conwy -6.39187189 -9.3251933 -3.45855048  
## Isle of Anglesey-Conwy -5.96627780 -9.4185966 -2.51395897  
## Merthyr Tydfil-Conwy 10.89965562 7.0934461 14.70586514  
## Monmouthshire-Conwy 10.17157302 6.8916168 13.45152921  
## Neath Port Talbot-Conwy 0.57227557 -2.2855821 3.43013325  
## Newport-Conwy 22.27055796 19.2938596 25.24725628  
## Pembrokeshire-Conwy 24.91791531 21.6924516 28.14337898  
## Powys-Conwy 15.61602598 12.3905623 18.84148964  
## Rhondda Cynon Taf-Conwy 19.86340865 17.1664092 22.56040807  
## Swansea-Conwy 18.71798786 16.0212444 21.41473134  
## Torfaen-Conwy 11.92545018 8.6250261 15.22587423  
## Vale of Glamorgan-Conwy 23.23586403 20.0104004 26.46132770  
## Wrexham-Conwy 0.99409619 -2.0354544 4.02364682  
## Flintshire-Denbighshire 1.01543952 -1.9278169 3.95869596  
## Gwynedd-Denbighshire -10.44163259 -13.4503567 -7.43290847  
## Isle of Anglesey-Denbighshire -10.01603850 -13.5326493 -6.49942768  
## Merthyr Tydfil-Denbighshire 6.84989491 2.9852763 10.71451356  
## Monmouthshire-Denbighshire 6.12181232 2.7742522 9.46937246  
## Neath Port Talbot-Denbighshire -3.47748513 -6.4126848 -0.54228551  
## Newport-Denbighshire 18.22079725 15.1697680 21.27182646  
## Pembrokeshire-Denbighshire 20.86815461 17.5739685 24.16234073  
## Powys-Denbighshire 11.56626527 8.2720791 14.86045139  
## Rhondda Cynon Taf-Denbighshire 15.81364795 13.0348259 18.59247004  
## Swansea-Denbighshire 14.66822715 11.8896535 17.44680084  
## Torfaen-Denbighshire 7.87568947 4.5080723 11.24330662  
## Vale of Glamorgan-Denbighshire 19.18610333 15.8919172 22.48028945  
## Wrexham-Denbighshire -3.05566452 -6.1582801 0.04695106  
## Gwynedd-Flintshire -11.45707211 -14.2413581 -8.67278617  
## Isle of Anglesey-Flintshire -11.03147802 -14.3580948 -7.70486126  
## Merthyr Tydfil-Flintshire 5.83445539 2.1418811 9.52702965  
## Monmouthshire-Flintshire 5.10637280 1.9589951 8.25375048  
## Neath Port Talbot-Flintshire -4.49292465 -7.1975918 -1.78825754  
## Newport-Flintshire 17.20535773 14.3754096 20.03530590  
## Pembrokeshire-Flintshire 19.85271509 16.7621667 22.94326352  
## Powys-Flintshire 10.55082575 7.4602773 13.64137418  
## Rhondda Cynon Taf-Flintshire 14.79820843 12.2641051 17.33231174  
## Swansea-Flintshire 13.65278764 11.1189567 16.18661855  
## Torfaen-Flintshire 6.86024995 3.6915479 10.02895200  
## Vale of Glamorgan-Flintshire 18.17066381 15.0801154 21.26121224  
## Wrexham-Flintshire -4.07110404 -6.9565937 -1.18561434  
## Isle of Anglesey-Gwynedd 0.42559409 -2.9590834 3.81027153  
## Merthyr Tydfil-Gwynedd 17.29152751 13.5465619 21.03649306  
## Monmouthshire-Gwynedd 16.56344491 13.3547616 19.77212823  
## Neath Port Talbot-Gwynedd 6.96414746 4.1883797 9.73991520  
## Newport-Gwynedd 28.66242984 25.7644531 31.56040655  
## Pembrokeshire-Gwynedd 31.30978720 28.1568280 34.46274644  
## Powys-Gwynedd 22.00789786 18.8549386 25.16085710  
## Rhondda Cynon Taf-Gwynedd 26.25528054 23.6454258 28.86513532  
## Swansea-Gwynedd 25.10985975 22.5002695 27.71945004  
## Torfaen-Gwynedd 18.31732206 15.0877191 21.54692498  
## Vale of Glamorgan-Gwynedd 29.62773592 26.4747767 32.78069516  
## Wrexham-Gwynedd 7.38596807 4.4337294 10.33820674  
## Merthyr Tydfil-Isle of Anglesey 16.86593342 12.7019332 21.02993364  
## Monmouthshire-Isle of Anglesey 16.13785082 12.4487074 19.82699428  
## Neath Port Talbot-Isle of Anglesey 6.53855337 3.2190628 9.85804390  
## Newport-Isle of Anglesey 28.23683575 24.8144974 31.65917411  
## Pembrokeshire-Isle of Anglesey 30.88419311 27.2434126 34.52497363  
## Powys-Isle of Anglesey 21.58230377 17.9415233 25.22308429  
## Rhondda Cynon Taf-Isle of Anglesey 25.82968645 22.6476316 29.01174126  
## Swansea-Isle of Anglesey 24.68426566 21.5024278 27.86610354  
## Torfaen-Isle of Anglesey 17.89172798 14.1843750 21.59908092  
## Vale of Glamorgan-Isle of Anglesey 29.20214183 25.5613613 32.84292235  
## Wrexham-Isle of Anglesey 6.96037399 3.4919674 10.42878053  
## Monmouthshire-Merthyr Tydfil -0.72808260 -4.7503338 3.29416865  
## Neath Port Talbot-Merthyr Tydfil -10.32738004 -14.0135356 -6.64122446  
## Newport-Merthyr Tydfil 11.37090234 7.5918647 15.14993997  
## Pembrokeshire-Merthyr Tydfil 14.01825970 10.0403195 17.99619992  
## Powys-Merthyr Tydfil 4.71637036 0.7384301 8.69431058  
## Rhondda Cynon Taf-Merthyr Tydfil 8.96375304 5.4008612 12.52664489  
## Swansea-Merthyr Tydfil 7.81833224 4.2556341 11.38103037  
## Torfaen-Merthyr Tydfil 1.02579456 -3.0131646 5.06475376  
## Vale of Glamorgan-Merthyr Tydfil 12.33620841 8.3582682 16.31414863  
## Wrexham-Merthyr Tydfil -9.90555943 -13.7263669 -6.08475198  
## Neath Port Talbot-Monmouthshire -9.59929745 -12.7391421 -6.45945276  
## Newport-Monmouthshire 12.09898493 8.8505996 15.34737024  
## Pembrokeshire-Monmouthshire 14.74634229 11.2685715 18.22411314  
## Powys-Monmouthshire 5.44445295 1.9666821 8.92222380  
## Rhondda Cynon Taf-Monmouthshire 9.69183563 6.6976613 12.68600998  
## Swansea-Monmouthshire 8.54641484 5.5524710 11.54035865  
## Torfaen-Monmouthshire 1.75387716 -1.7935266 5.30128087  
## Vale of Glamorgan-Monmouthshire 13.06429101 9.5865202 16.54206185  
## Wrexham-Monmouthshire -9.17747683 -12.4743619 -5.88059176  
## Newport-Neath Port Talbot 21.69828238 18.8767146 24.51985020  
## Pembrokeshire-Neath Port Talbot 24.34563974 21.2627632 27.42851631  
## Powys-Neath Port Talbot 15.04375040 11.9608738 18.12662697  
## Rhondda Cynon Taf-Neath Port Talbot 19.29113308 16.7663919 21.81587424  
## Swansea-Neath Port Talbot 18.14571229 15.6212445 20.67018004  
## Torfaen-Neath Port Talbot 11.35317460 8.1919547 14.51439446  
## Vale of Glamorgan-Neath Port Talbot 22.66358846 19.5807119 25.74646503  
## Wrexham-Neath Port Talbot 0.42182061 -2.4554505 3.29909174  
## Pembrokeshire-Newport 2.64735736 -0.5459967 5.84071145  
## Powys-Newport -6.65453198 -9.8478861 -3.46117789  
## Rhondda Cynon Taf-Newport -2.40714930 -5.0656640 0.25136539  
## Swansea-Newport -3.55257010 -6.2108251 -0.89431505  
## Torfaen-Newport -10.34510778 -13.6141586 -7.07605694  
## Vale of Glamorgan-Newport 0.96530608 -2.2280480 4.15866017  
## Wrexham-Newport -21.27646177 -24.2718034 -18.28112013  
## Powys-Pembrokeshire -9.30188934 -12.7283151 -5.87546360  
## Rhondda Cynon Taf-Pembrokeshire -5.05450666 -7.9888862 -2.12012712  
## Swansea-Pembrokeshire -6.19992745 -9.1340718 -3.26578314  
## Torfaen-Pembrokeshire -12.99246514 -16.4895463 -9.49538401  
## Vale of Glamorgan-Pembrokeshire -1.68205128 -5.1084770 1.74437445  
## Wrexham-Pembrokeshire -23.92381913 -27.1664962 -20.68114207  
## Rhondda Cynon Taf-Powys 4.24738268 1.3130031 7.18176222  
## Swansea-Powys 3.10196188 0.1678176 6.03610620  
## Torfaen-Powys -3.69057580 -7.1876569 -0.19349468  
## Vale of Glamorgan-Powys 7.61983806 4.1934123 11.04626379  
## Wrexham-Powys -14.62192979 -17.8646068 -11.37925273  
## Swansea-Rhondda Cynon Taf -1.14542079 -3.4862311 1.19538950  
## Torfaen-Rhondda Cynon Taf -7.93795848 -10.9545404 -4.92137658  
## Vale of Glamorgan-Rhondda Cynon Taf 3.37245538 0.4380758 6.30683492  
## Wrexham-Rhondda Cynon Taf -18.86931247 -21.5868747 -16.15175023  
## Torfaen-Swansea -6.79253768 -9.8088908 -3.77618460  
## Vale of Glamorgan-Swansea 4.51787617 1.5837319 7.45202049  
## Wrexham-Swansea -17.72389167 -20.4411999 -15.00658344  
## Vale of Glamorgan-Torfaen 11.31041386 7.8133327 14.80749498  
## Wrexham-Torfaen -10.93135399 -14.2486025 -7.61410550  
## Wrexham-Vale of Glamorgan -22.24176785 -25.4844449 -18.99909079  
## p adj  
## Bridgend-Blaenau Gwent 0.0000000  
## Caerphilly-Blaenau Gwent 0.0000000  
## Cardiff-Blaenau Gwent 0.0000000  
## Carmarthenshire-Blaenau Gwent 0.0000000  
## Ceredigion-Blaenau Gwent 0.0000000  
## Conwy-Blaenau Gwent 0.0006045  
## Denbighshire-Blaenau Gwent 0.0000000  
## Flintshire-Blaenau Gwent 0.0000000  
## Gwynedd-Blaenau Gwent 0.8693849  
## Isle of Anglesey-Blaenau Gwent 0.9979491  
## Merthyr Tydfil-Blaenau Gwent 0.0000000  
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## Neath Port Talbot-Blaenau Gwent 0.0000082  
## Newport-Blaenau Gwent 0.0000000  
## Pembrokeshire-Blaenau Gwent 0.0000000  
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## Cardiff-Bridgend 0.0000000  
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## Ceredigion-Bridgend 0.0000000  
## Conwy-Bridgend 0.0000000  
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## Flintshire-Bridgend 0.0000000  
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## Isle of Anglesey-Bridgend 0.0000000  
## Merthyr Tydfil-Bridgend 0.0000000  
## Monmouthshire-Bridgend 0.0000000  
## Neath Port Talbot-Bridgend 0.0000000  
## Newport-Bridgend 0.0000000  
## Pembrokeshire-Bridgend 0.0000000  
## Powys-Bridgend 0.0000000  
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## Swansea-Bridgend 0.0000000  
## Torfaen-Bridgend 0.0000000  
## Vale of Glamorgan-Bridgend 0.0000000  
## Wrexham-Bridgend 0.0000000  
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## Carmarthenshire-Caerphilly 0.0000000  
## Ceredigion-Caerphilly 0.0000000  
## Conwy-Caerphilly 0.0000000  
## Denbighshire-Caerphilly 0.0000000  
## Flintshire-Caerphilly 0.0000000  
## Gwynedd-Caerphilly 0.0000000  
## Isle of Anglesey-Caerphilly 0.0000000  
## Merthyr Tydfil-Caerphilly 0.0000001  
## Monmouthshire-Caerphilly 0.0000000  
## Neath Port Talbot-Caerphilly 0.0000000  
## Newport-Caerphilly 0.0000000  
## Pembrokeshire-Caerphilly 0.0000000  
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## Rhondda Cynon Taf-Caerphilly 0.0266351  
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## Torfaen-Caerphilly 0.0000003  
## Vale of Glamorgan-Caerphilly 0.0000000  
## Wrexham-Caerphilly 0.0000000  
## Carmarthenshire-Cardiff 0.0000000  
## Ceredigion-Cardiff 0.0013628  
## Conwy-Cardiff 0.0000000  
## Denbighshire-Cardiff 0.0000000  
## Flintshire-Cardiff 0.0000000  
## Gwynedd-Cardiff 0.0000000  
## Isle of Anglesey-Cardiff 0.0000000  
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## Monmouthshire-Cardiff 0.0000611  
## Neath Port Talbot-Cardiff 0.0000000  
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## Powys-Cardiff 0.9628700  
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## Torfaen-Cardiff 0.3462656  
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## Wrexham-Cardiff 0.0000000  
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## Conwy-Carmarthenshire 0.0000000  
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## Merthyr Tydfil-Carmarthenshire 0.0753339  
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## Newport-Carmarthenshire 0.0000000  
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## Powys-Carmarthenshire 0.0000000  
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## Torfaen-Carmarthenshire 0.0000362  
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## Denbighshire-Ceredigion 0.0000004  
## Flintshire-Ceredigion 0.0000282  
## Gwynedd-Ceredigion 0.0000000  
## Isle of Anglesey-Ceredigion 0.0000000  
## Merthyr Tydfil-Ceredigion 1.0000000  
## Monmouthshire-Ceredigion 1.0000000  
## Neath Port Talbot-Ceredigion 0.0000000  
## Newport-Ceredigion 0.0000000  
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## Powys-Ceredigion 0.0000603  
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## Vale of Glamorgan-Ceredigion 0.0000000  
## Wrexham-Ceredigion 0.0000000  
## Denbighshire-Conwy 0.0005102  
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## Gwynedd-Conwy 0.0000000  
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## Newport-Conwy 0.0000000  
## Pembrokeshire-Conwy 0.0000000  
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## Swansea-Conwy 0.0000000  
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## Flintshire-Denbighshire 0.9998426  
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## Merthyr Tydfil-Denbighshire 0.0000000  
## Monmouthshire-Denbighshire 0.0000000  
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## Newport-Denbighshire 0.0000000  
## Pembrokeshire-Denbighshire 0.0000000  
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## Rhondda Cynon Taf-Denbighshire 0.0000000  
## Swansea-Denbighshire 0.0000000  
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## Vale of Glamorgan-Denbighshire 0.0000000  
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## Gwynedd-Flintshire 0.0000000  
## Isle of Anglesey-Flintshire 0.0000000  
## Merthyr Tydfil-Flintshire 0.0000031  
## Monmouthshire-Flintshire 0.0000013  
## Neath Port Talbot-Flintshire 0.0000005  
## Newport-Flintshire 0.0000000  
## Pembrokeshire-Flintshire 0.0000000  
## Powys-Flintshire 0.0000000  
## Rhondda Cynon Taf-Flintshire 0.0000000  
## Swansea-Flintshire 0.0000000  
## Torfaen-Flintshire 0.0000000  
## Vale of Glamorgan-Flintshire 0.0000000  
## Wrexham-Flintshire 0.0000883  
## Isle of Anglesey-Gwynedd 1.0000000  
## Merthyr Tydfil-Gwynedd 0.0000000  
## Monmouthshire-Gwynedd 0.0000000  
## Neath Port Talbot-Gwynedd 0.0000000  
## Newport-Gwynedd 0.0000000  
## Pembrokeshire-Gwynedd 0.0000000  
## Powys-Gwynedd 0.0000000  
## Rhondda Cynon Taf-Gwynedd 0.0000000  
## Swansea-Gwynedd 0.0000000  
## Torfaen-Gwynedd 0.0000000  
## Vale of Glamorgan-Gwynedd 0.0000000  
## Wrexham-Gwynedd 0.0000000  
## Merthyr Tydfil-Isle of Anglesey 0.0000000  
## Monmouthshire-Isle of Anglesey 0.0000000  
## Neath Port Talbot-Isle of Anglesey 0.0000000  
## Newport-Isle of Anglesey 0.0000000  
## Pembrokeshire-Isle of Anglesey 0.0000000  
## Powys-Isle of Anglesey 0.0000000  
## Rhondda Cynon Taf-Isle of Anglesey 0.0000000  
## Swansea-Isle of Anglesey 0.0000000  
## Torfaen-Isle of Anglesey 0.0000000  
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## Neath Port Talbot-Merthyr Tydfil 0.0000000  
## Newport-Merthyr Tydfil 0.0000000  
## Pembrokeshire-Merthyr Tydfil 0.0000000  
## Powys-Merthyr Tydfil 0.0040155  
## Rhondda Cynon Taf-Merthyr Tydfil 0.0000000  
## Swansea-Merthyr Tydfil 0.0000000  
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## Vale of Glamorgan-Merthyr Tydfil 0.0000000  
## Wrexham-Merthyr Tydfil 0.0000000  
## Neath Port Talbot-Monmouthshire 0.0000000  
## Newport-Monmouthshire 0.0000000  
## Pembrokeshire-Monmouthshire 0.0000000  
## Powys-Monmouthshire 0.0000042  
## Rhondda Cynon Taf-Monmouthshire 0.0000000  
## Swansea-Monmouthshire 0.0000000  
## Torfaen-Monmouthshire 0.9787723  
## Vale of Glamorgan-Monmouthshire 0.0000000  
## Wrexham-Monmouthshire 0.0000000  
## Newport-Neath Port Talbot 0.0000000  
## Pembrokeshire-Neath Port Talbot 0.0000000  
## Powys-Neath Port Talbot 0.0000000  
## Rhondda Cynon Taf-Neath Port Talbot 0.0000000  
## Swansea-Neath Port Talbot 0.0000000  
## Torfaen-Neath Port Talbot 0.0000000  
## Vale of Glamorgan-Neath Port Talbot 0.0000000  
## Wrexham-Neath Port Talbot 1.0000000  
## Pembrokeshire-Newport 0.2756421  
## Powys-Newport 0.0000000  
## Rhondda Cynon Taf-Newport 0.1395134  
## Swansea-Newport 0.0003390  
## Torfaen-Newport 0.0000000  
## Vale of Glamorgan-Newport 0.9999817  
## Wrexham-Newport 0.0000000  
## Powys-Pembrokeshire 0.0000000  
## Rhondda Cynon Taf-Pembrokeshire 0.0000001  
## Swansea-Pembrokeshire 0.0000000  
## Torfaen-Pembrokeshire 0.0000000  
## Vale of Glamorgan-Pembrokeshire 0.9804081  
## Wrexham-Pembrokeshire 0.0000000  
## Rhondda Cynon Taf-Powys 0.0000443  
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## Torfaen-Powys 0.0251877  
## Vale of Glamorgan-Powys 0.0000000  
## Wrexham-Powys 0.0000000  
## Swansea-Rhondda Cynon Taf 0.9811113  
## Torfaen-Rhondda Cynon Taf 0.0000000  
## Vale of Glamorgan-Rhondda Cynon Taf 0.0069022  
## Wrexham-Rhondda Cynon Taf 0.0000000  
## Torfaen-Swansea 0.0000000  
## Vale of Glamorgan-Swansea 0.0000072  
## Wrexham-Swansea 0.0000000  
## Vale of Glamorgan-Torfaen 0.0000000  
## Wrexham-Torfaen 0.0000000  
## Wrexham-Vale of Glamorgan 0.0000000

##   
## Kruskal-Wallis rank sum test  
##   
## data: df$count by df$county  
## Kruskal-Wallis chi-squared = 6398.8, df = 21, p-value < 2.2e-16

Linear Regression to look at the relationship between number of newly built houses vs the number of GP visits.



##   
## Call:  
## lm(formula = count ~ total, data = df)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -91.17 -42.07 -7.64 28.93 1390.36   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 79.43137 0.21076 376.88 <2e-16 \*\*\*  
## total 0.05266 0.00196 26.86 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 58.79 on 222515 degrees of freedom  
## Multiple R-squared: 0.003233, Adjusted R-squared: 0.003228   
## F-statistic: 721.7 on 1 and 222515 DF, p-value: < 2.2e-16