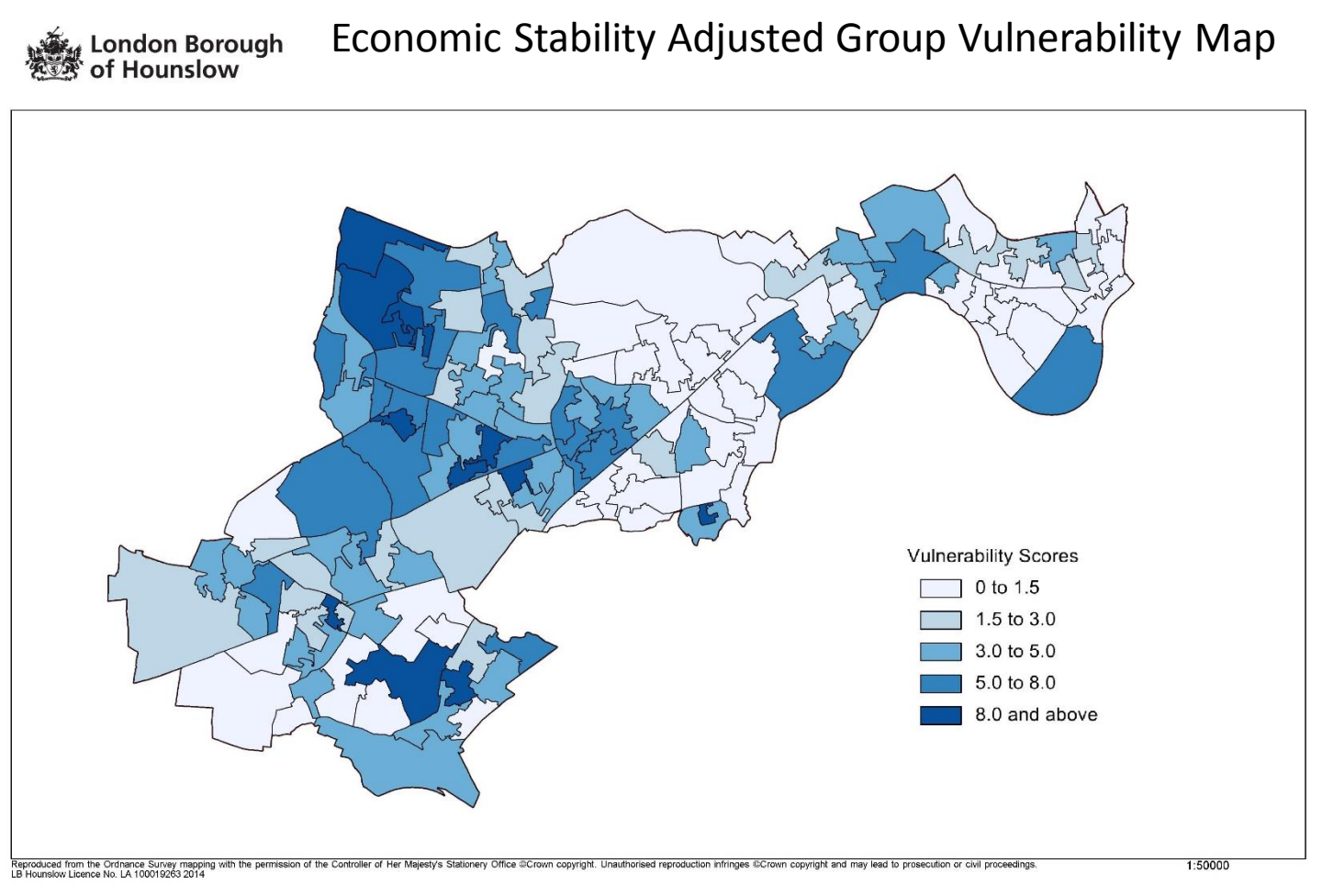
GUIDANCE ON PRODUCTION OF LOCALISED VULNERABILITY MAPS V1.0



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Overview

This guide will provide step-by-step instructions for: obtaining census data; using that data to create Z-Scores and to group vulnerabilities; and plotting that data on a GIS map for emergency planning and policy making decisions.

When working with Excel, it is important to **SAVE OFTEN** to avoid losing work. If you are an advanced user, you can simply use the four steps on the next page (slide 4).

For more detailed instructions, continue through the rest of the guide.

Steps for Advanced Users

1. To obtain the data, use the Nomis table finder and query data for the appropriate vulnerable population.
2. Once that data is downloaded, determine the Z-Scores for each LSOA for each vulnerability.
3. To group vulnerabilities, add the relevant Z-Scores, using the function (IF(X#<0,0,X#)) to ignore negative Z-Scores. X represents the column and # indicates the row.
4. Send the completed table to the GIS team and plot the created maps.

Determine the Vulnerabilities

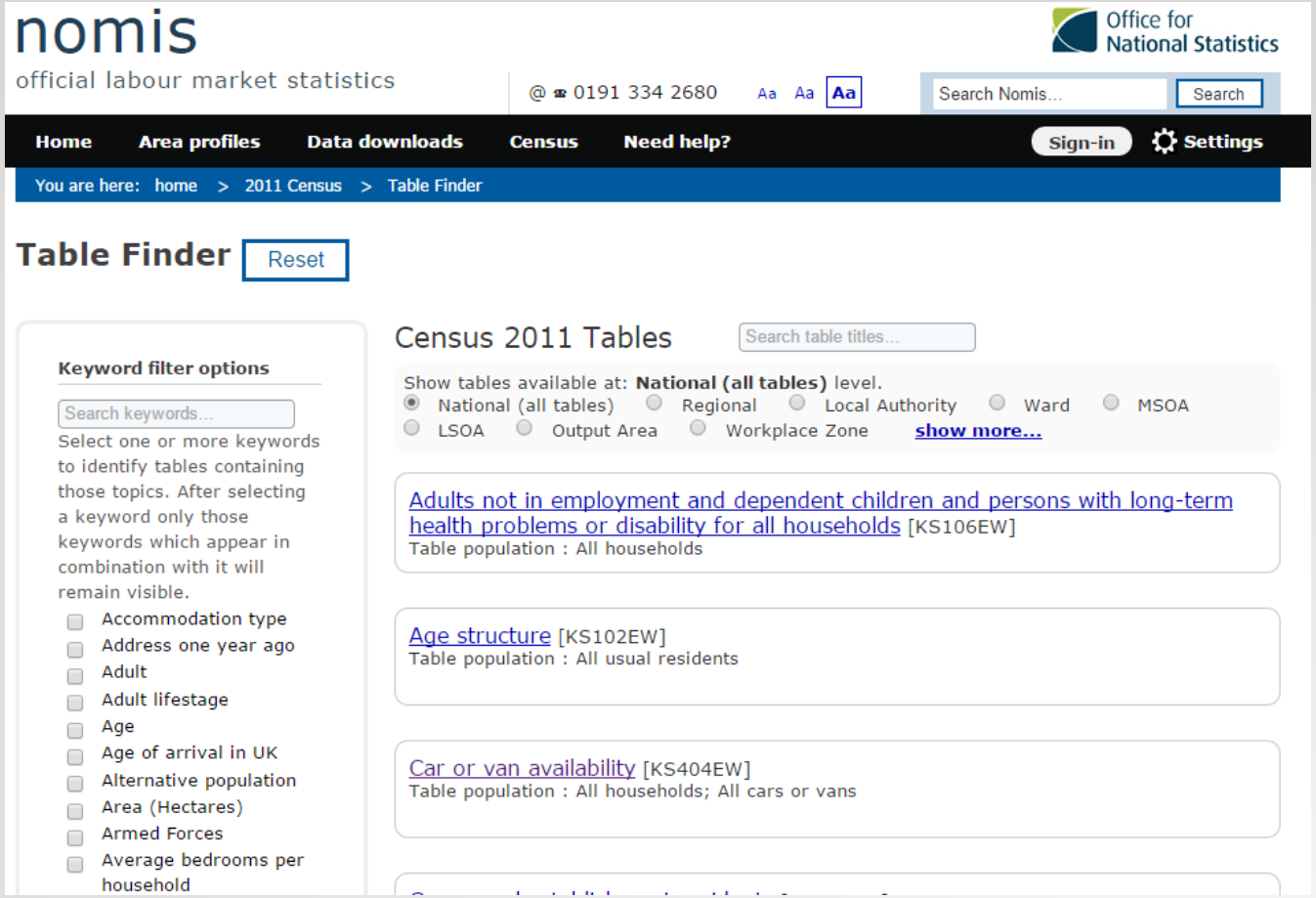
Variables used by the Spring 2015 WPI project group:

- Age
- Population Density
- Disability and Long Term Health Problems
- Education (Highest Level of Qualification)
- Gender
- General Health
- Language (English Proficiency)
- Migration
- Household Occupancy
- Occupation
- Renting
- Unemployment
- Vehicle Ownership

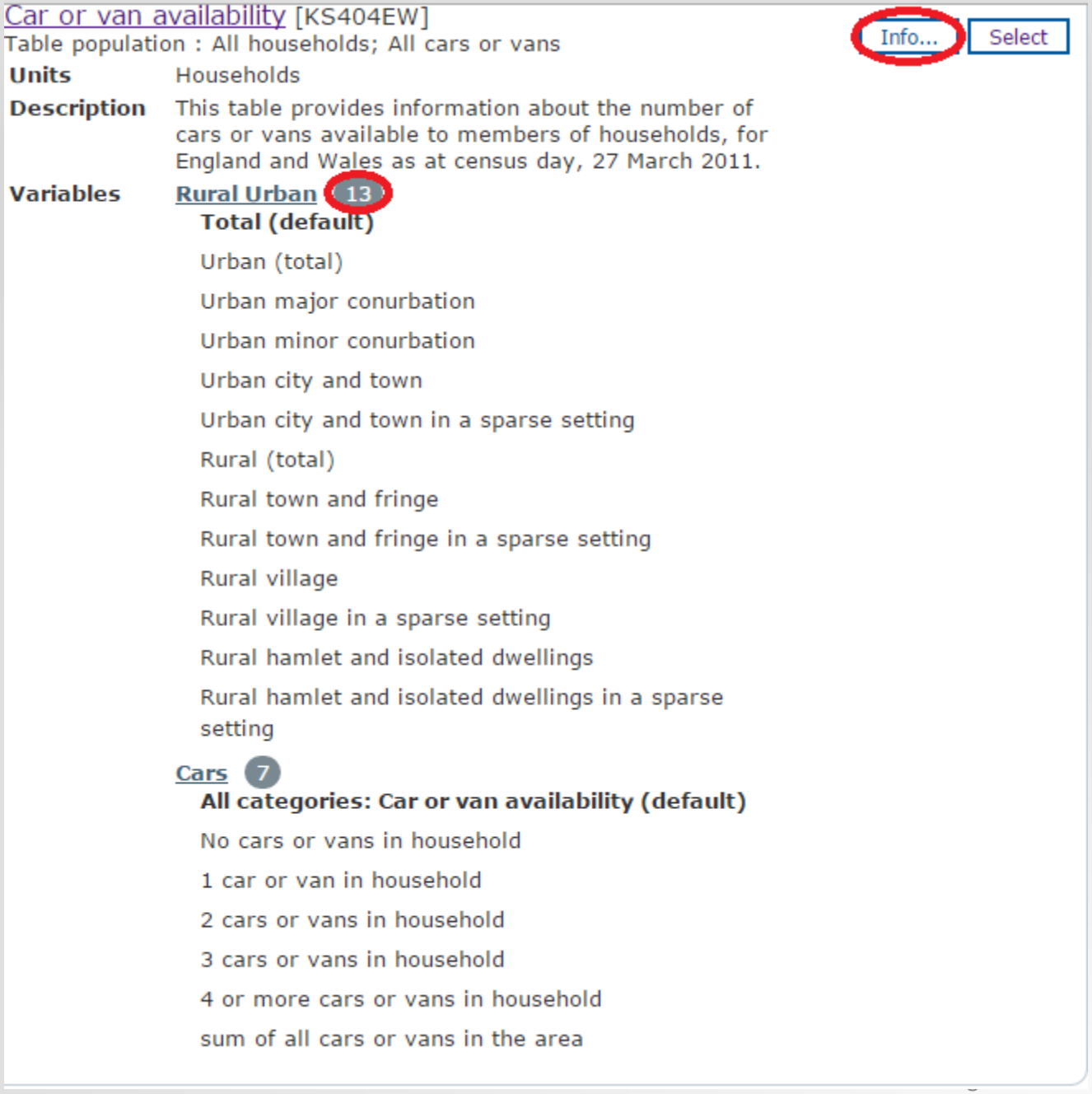
- **Age-** Percentage of population younger than 16 and older than 65 years old
- **Population Density**- Number of residents per hectare
- **Disability-** Percentage of households with long term health problem or disability
- **Education-** Percentage of working age population residents with 1 or less qualifications
- **Gender-** Percentage of population who are women
- **General Health-** Percentage of population identifying themselves with bad or very bad health
- **Language-** Percentage of population who cannot speak and cannot speak English well
- **Migration-** Percentage of population who has lived in the UK for less than 2 years
- **Household Occupancy-** Percentage of households with a -1 rating or less
- **Occupation-** Percentage of workers with level 1 occupation
- **Renting-** Percentage of households socially and privately renting
- **Unemployment**- Percentage of working age unemployed
- **Vehicle Ownership-** Percentage of households without access to a vehicle

Obtaining the Information

- The most comprehensive source of information is the UK Census.
- These data can be obtained from Nomis, specifically the table finder.
- To get to this page, search the internet for ‘Nomis Table Finder,’ and click on the Nomis.gov.uk link.

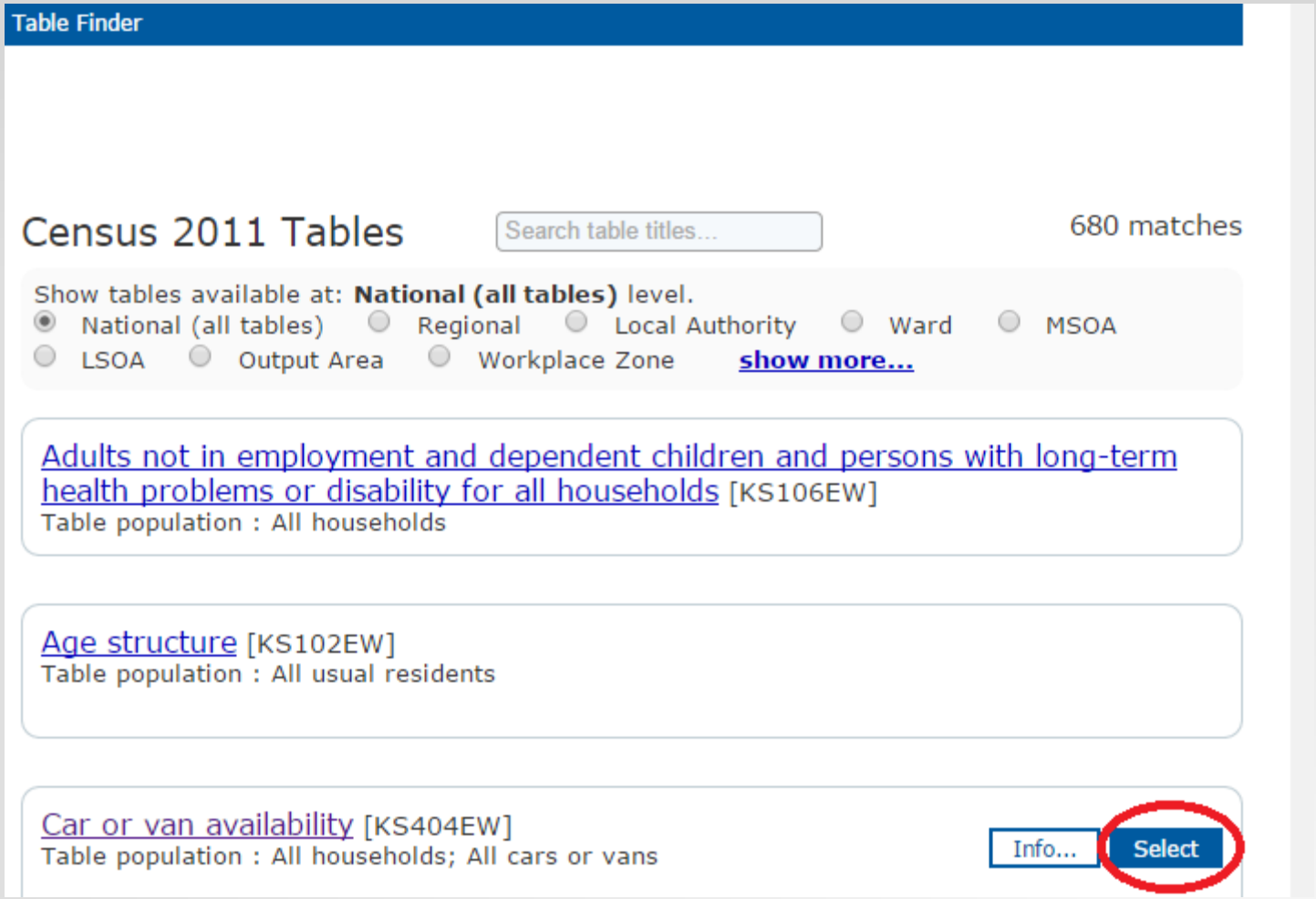


- Additional information can be obtained by clicking the info button.
- This shows a brief description of the census category, as well as variables within the category.
- Clicking on the grey number by each variable breaks them down into additional subcategories.

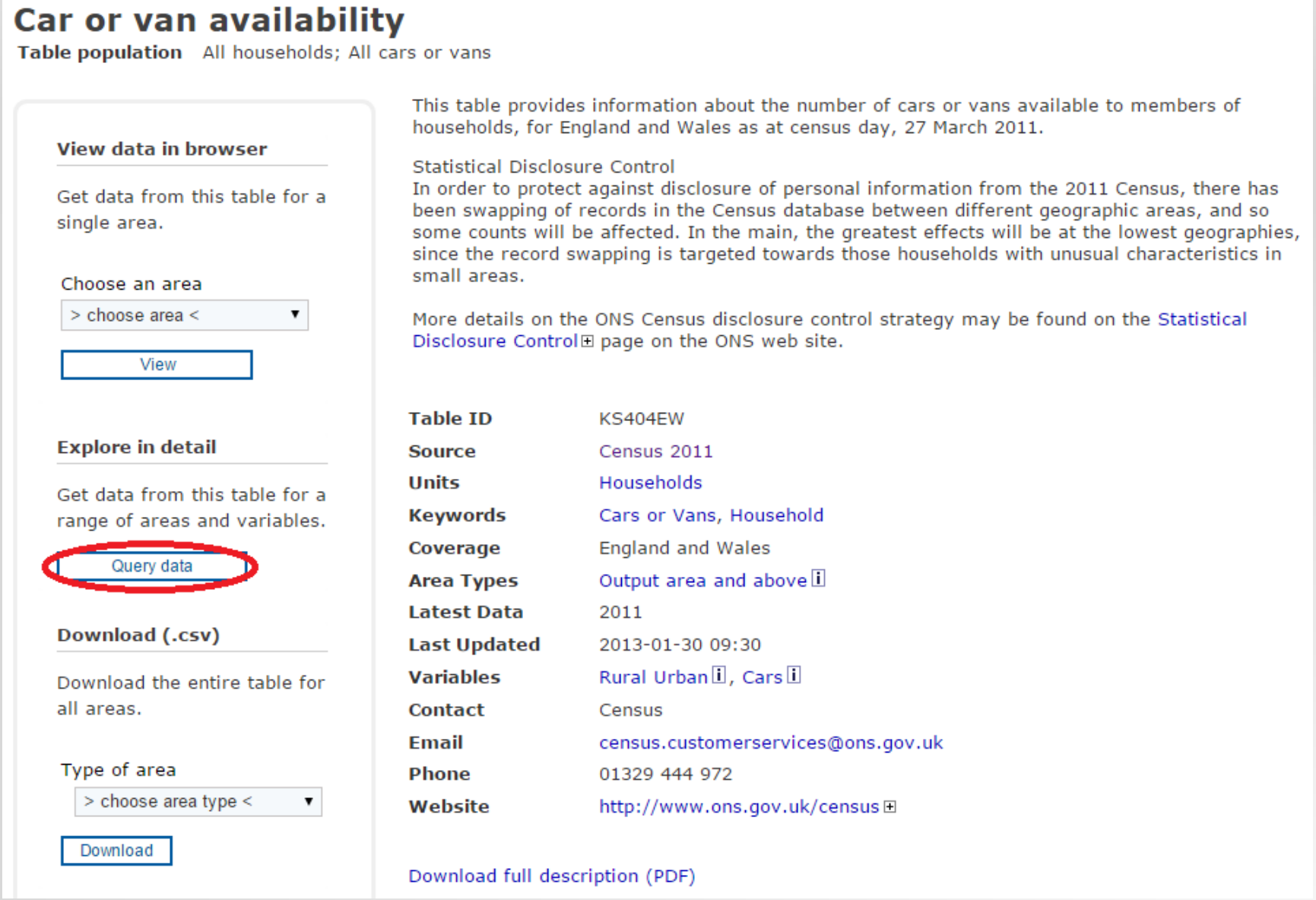


Querying the Data

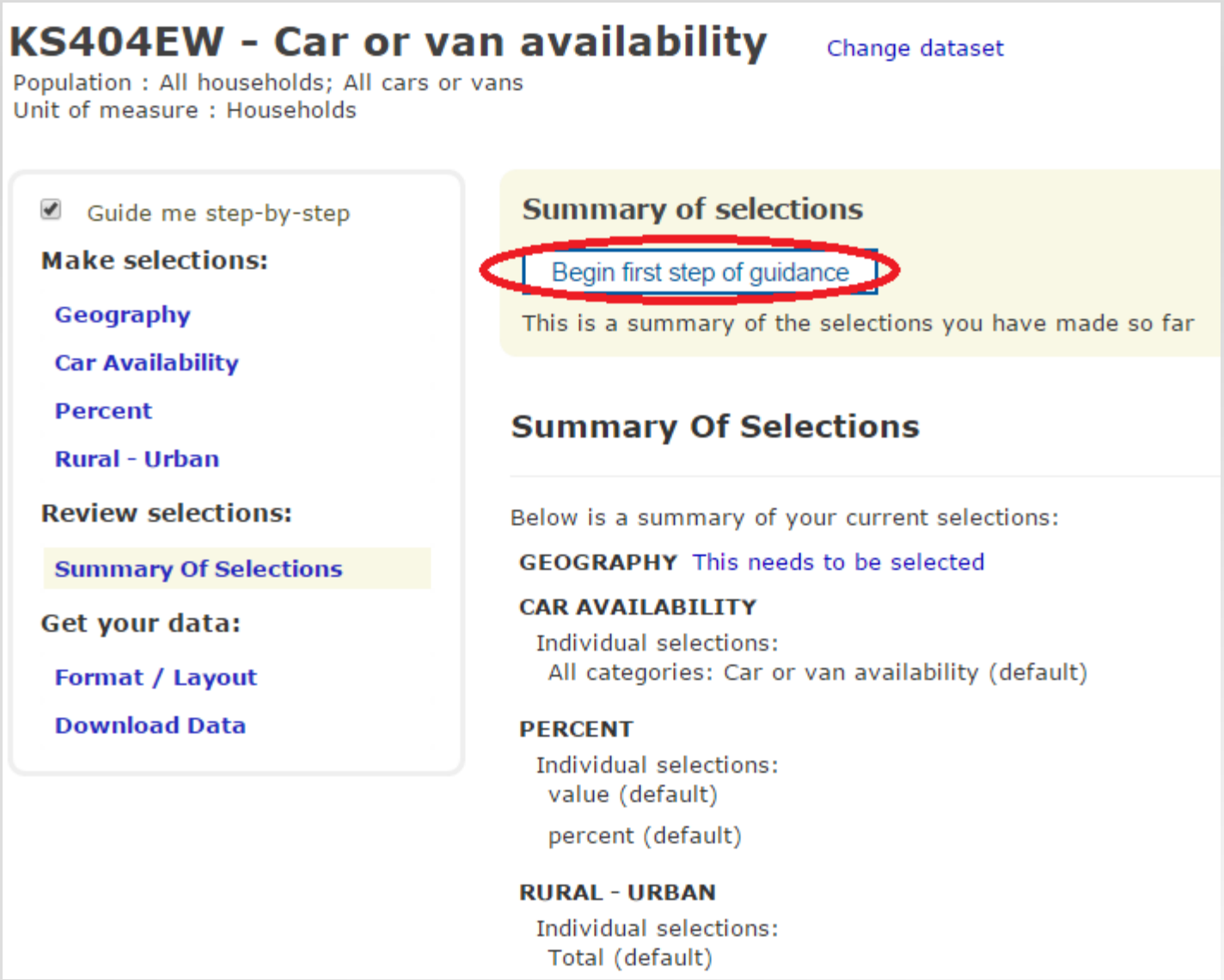
- Once you have selected a variable, you can then query the data to get the information in a useable format.
- To do this, first click on the ‘select’ button that appears next to the ‘info’ button on the Table Finder page.



- This will take you to a page with a more detailed description of the census category.
- To begin the querying process, click the ‘Query data’ button.

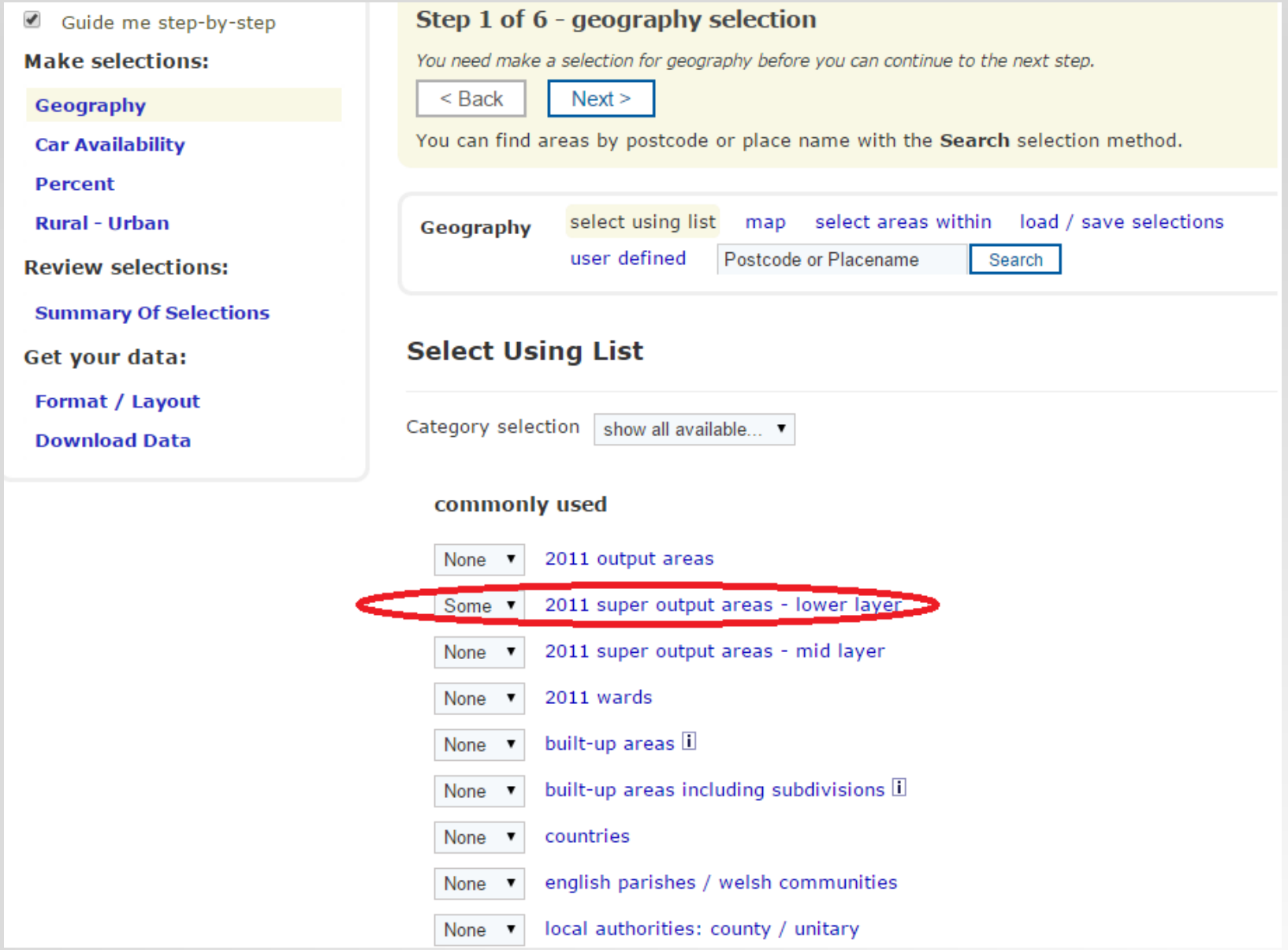


- The querying process can be done manually by choosing the information you want from each selection, or step-by-step by clicking the ‘Begin first step of guidance’ button.
- We will be using the step-by-step procedure for this example

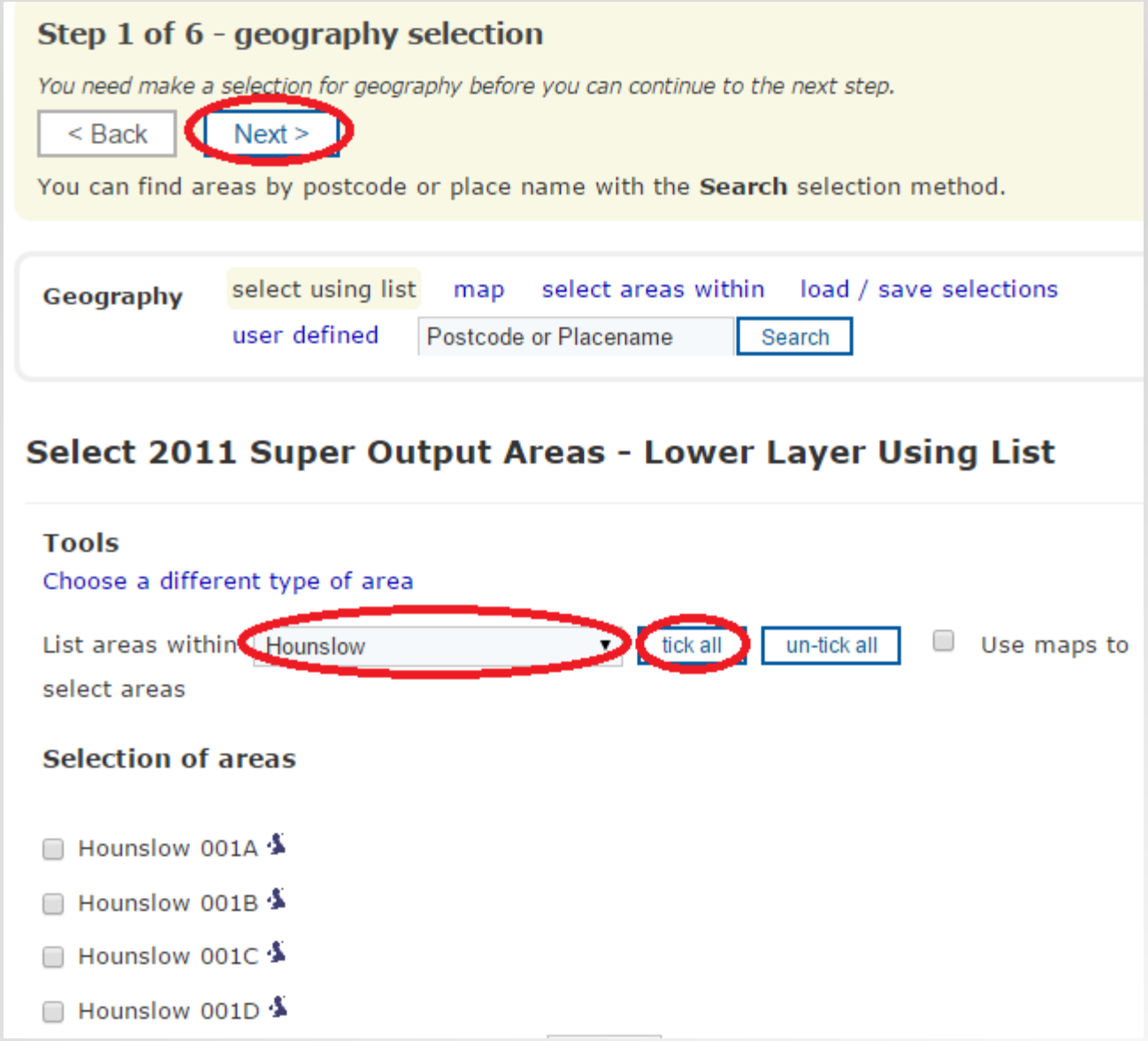


Selecting the Location

- Nomis allows you to select the location a variety of different ways, such as by output area, wards, or countries.
- We will be using Hounslow LSOAs, and therefore will choose ‘some’ from the drop down next to ‘super output areas – lower layer.’ Selecting ‘None’ will not give you any information, and selecting ‘All’ will give you data from every LSOA
- Then, wait for the page to refresh

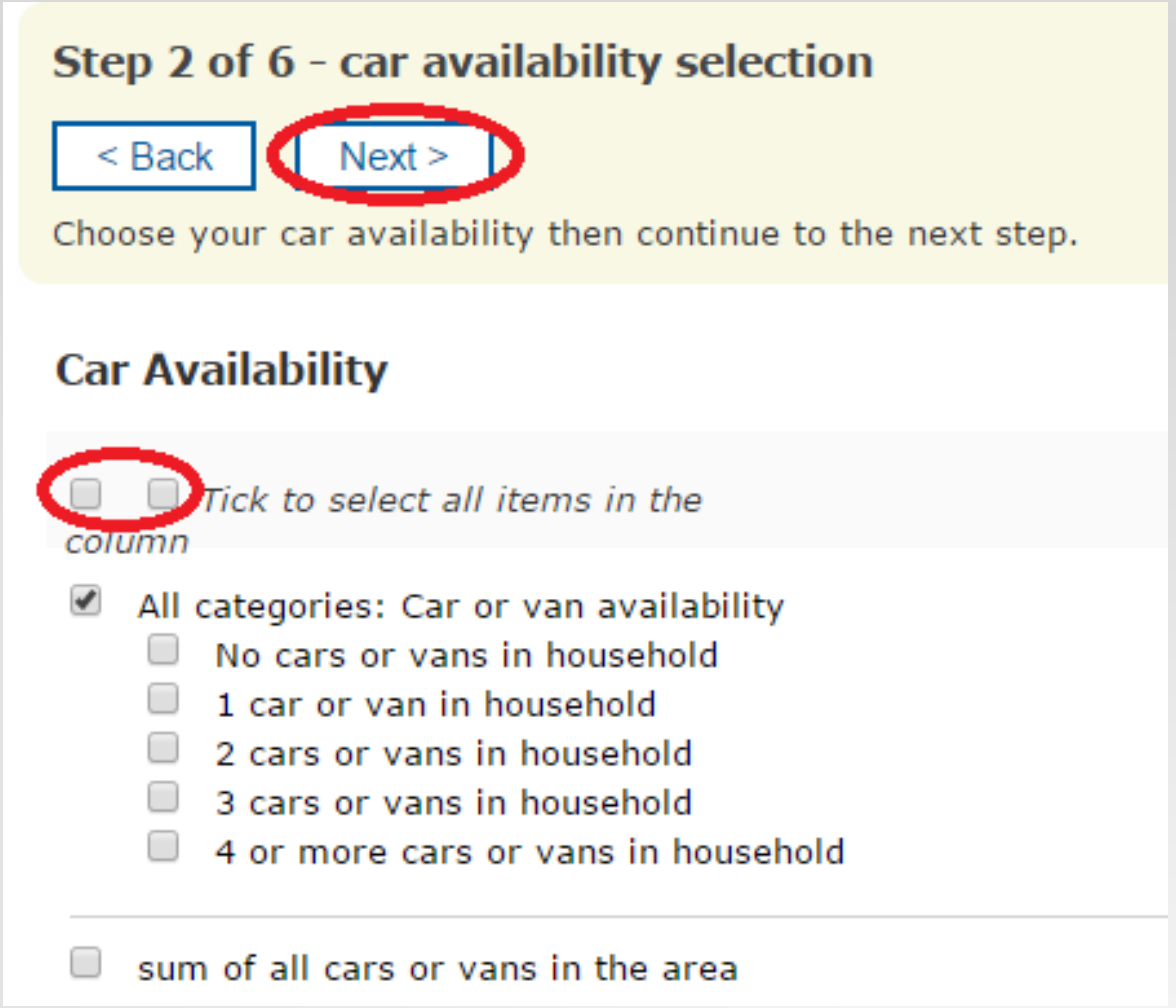


- To get the Hounslow LSOA data specifically, choose Hounslow from the drop down.
- Wait for the information to refresh, and then click ‘tick all.’
- Click ‘Next’ at the top of the page to move on to variable selection

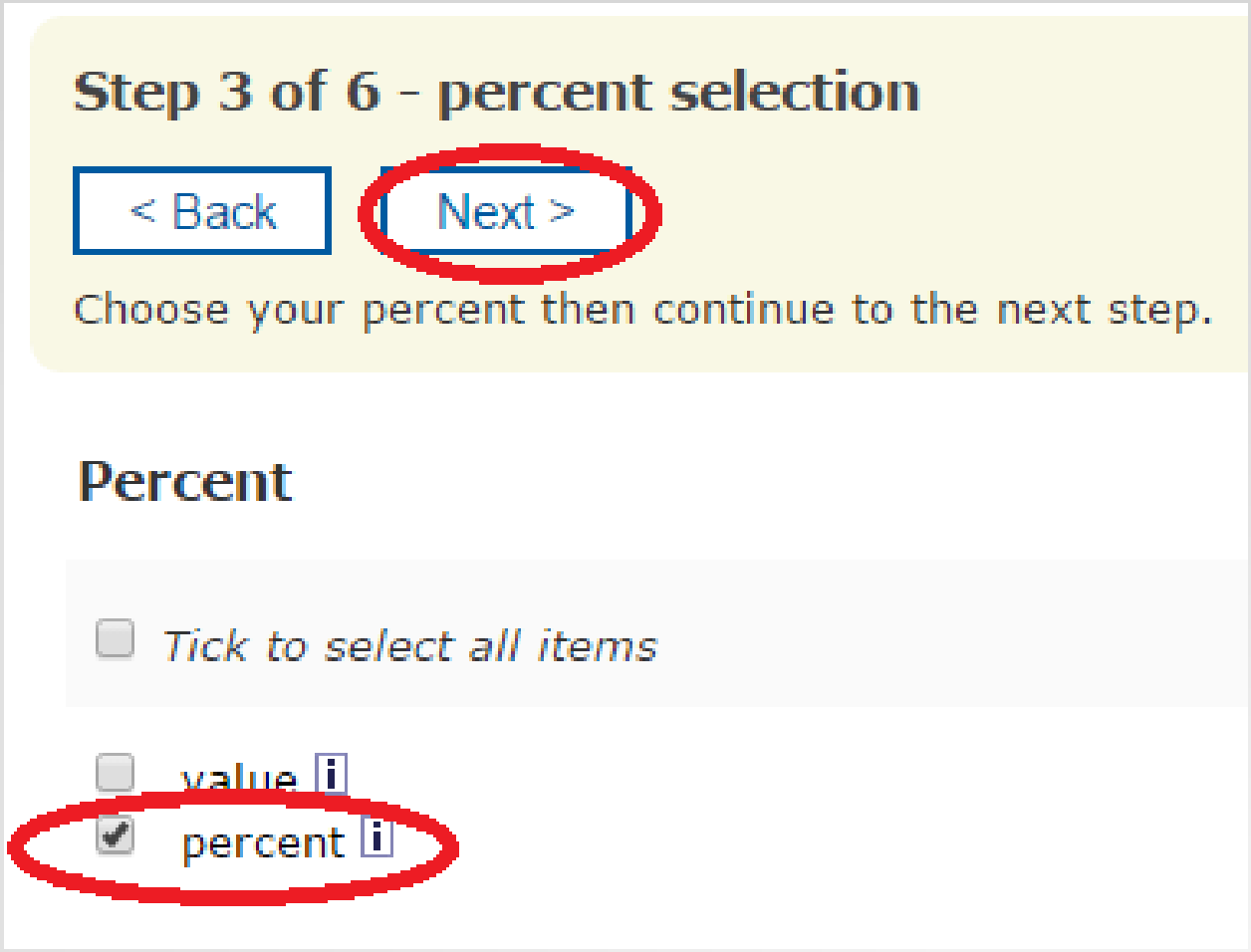


Selecting Variables

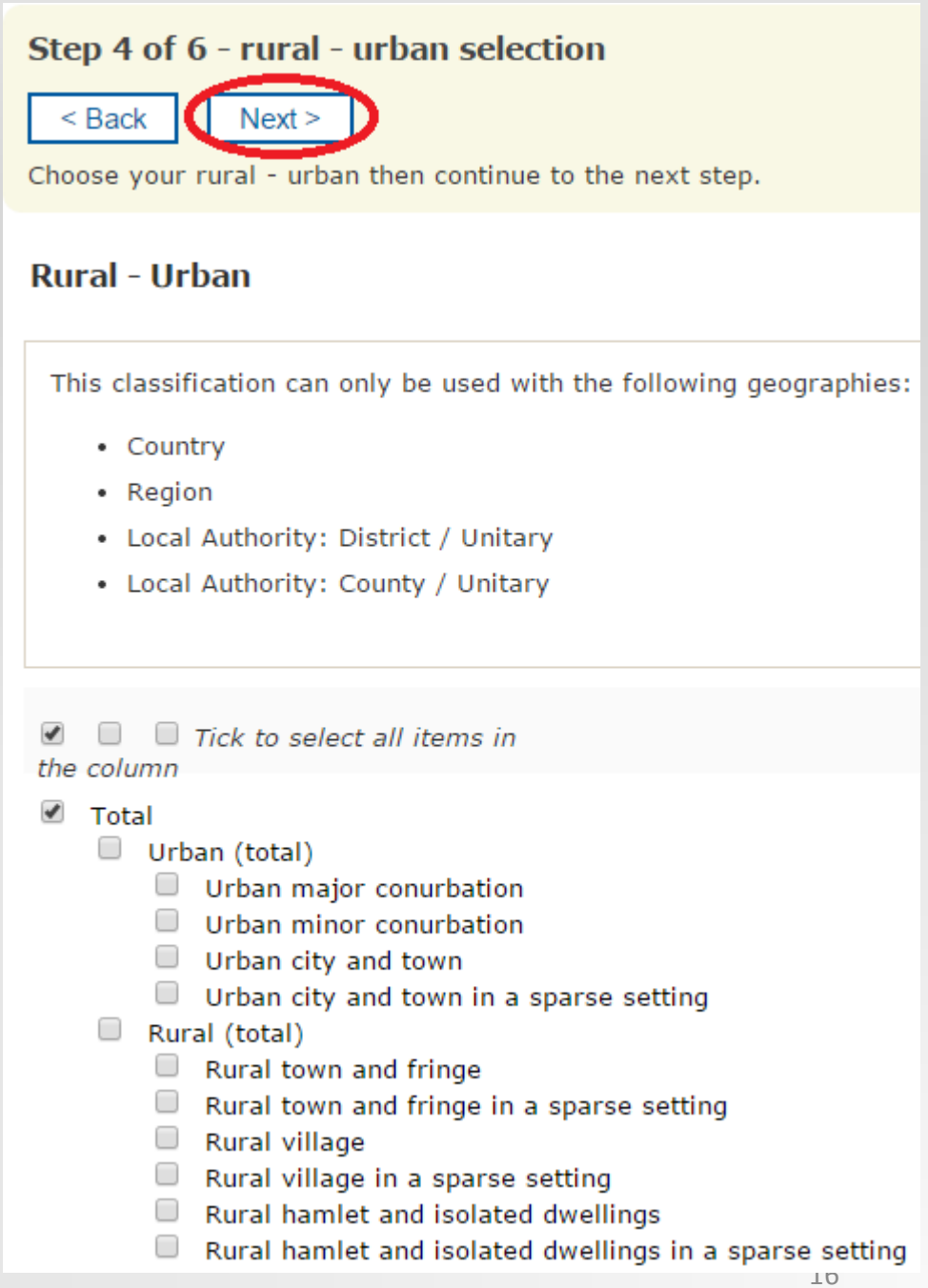
- This step allows for the choosing of variables within each category.
- We will opt to select all of the items, as it provides a greater flexibility when analysing the data.
- When the columns are ticked, click ‘Next.’



- We will be using percentages when analysing the data, so choose the ‘percent’ option if available. It is also possible to use the ‘value’ data and calculate the percentages, which will provide a more accurate number.
- Then, proceed to the next step.

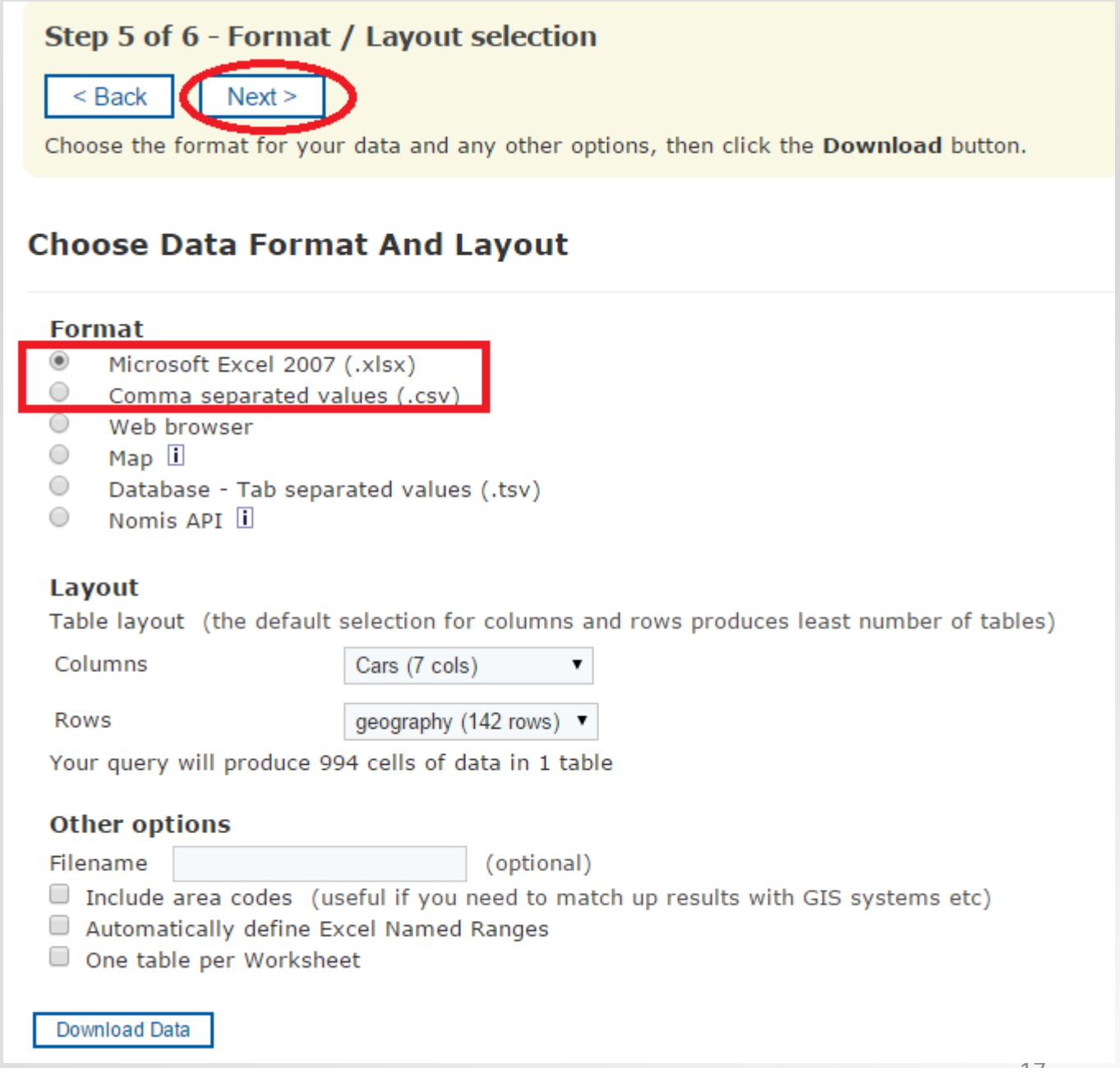


- As we will be using the LSOA data independent from whether the area is rural or urban, we can move on to the next step.
- In a borough more divided between rural and urban areas, however, this would be useful.



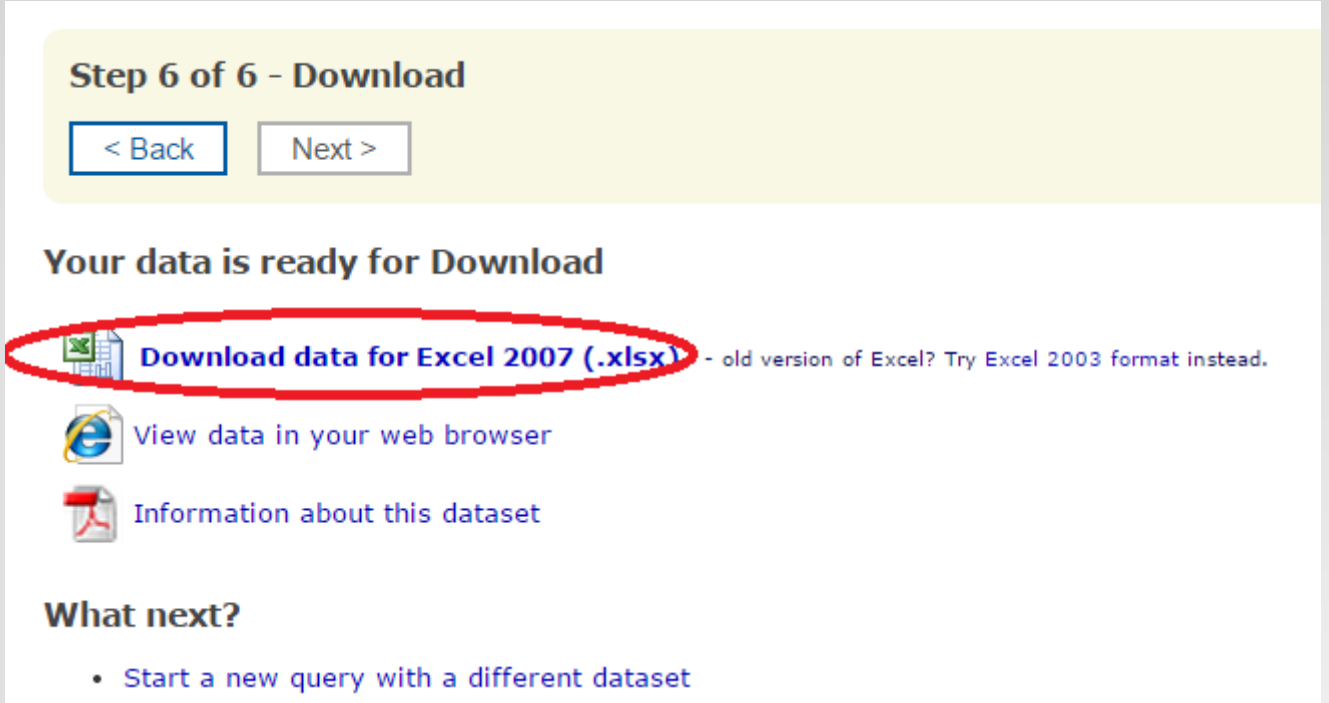
Format selection

- Both CSV and XLSX files will work with Microsoft Excel 2007 and beyond.
- If you are using an older version of Excel, use the CSV option.
- The only difference is that the XLSX file contains auto-spaced columns and rows and the bolding of some text.
- After you have selected the appropriate file type, click ‘Next.’



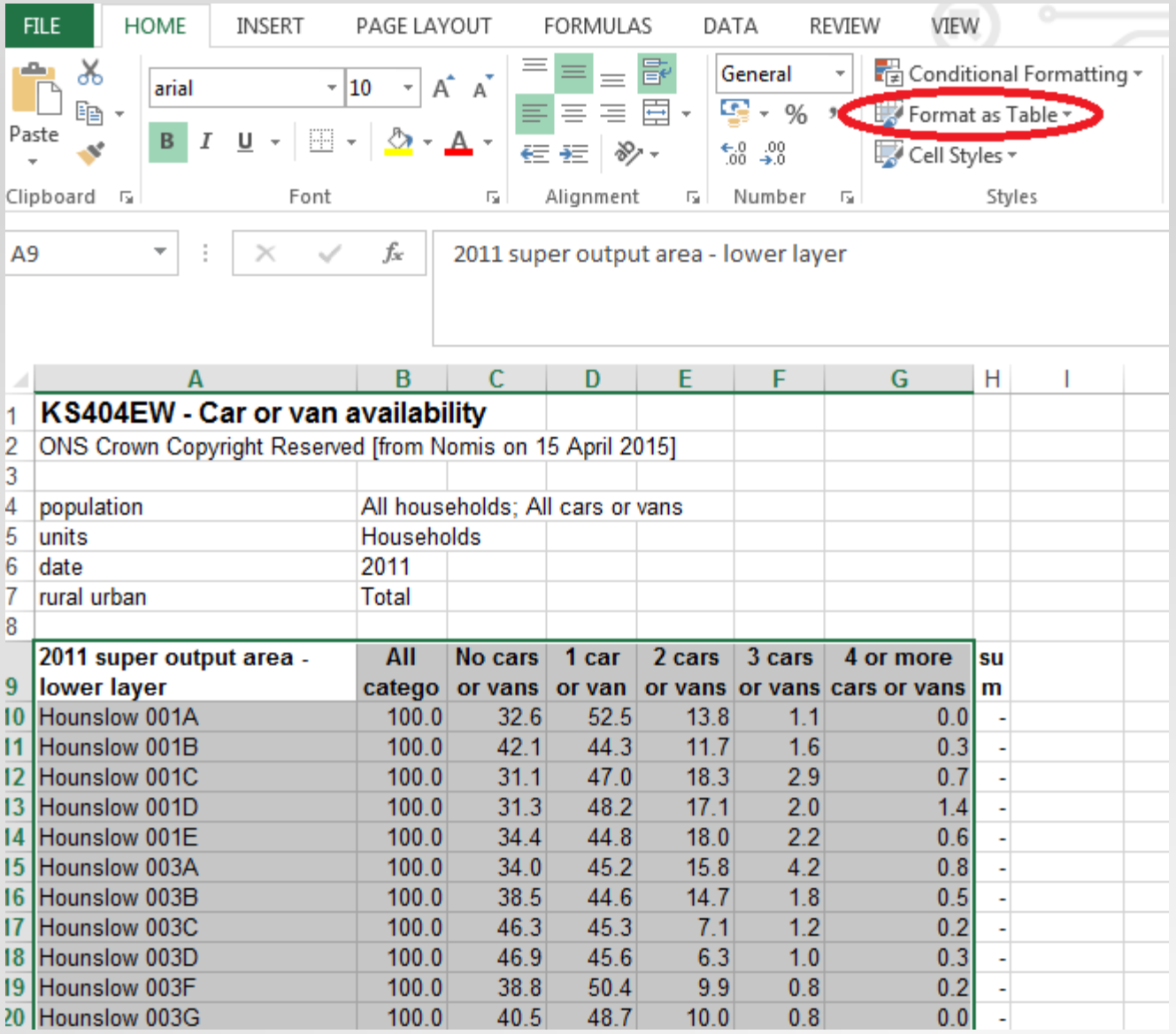
Download the Data

- Wait for the data to load, and click ‘Download data for Excel 2007’ or ‘Download data,’ depending on which file type you selected.



Creating Z-Scores

- Once the census data has been collected, we can create a Z-Score for each LSOA.
- To begin, select the headings and data and click ‘Format as Table.’ Select a style and make sure to tick the box ‘My table has headers.’

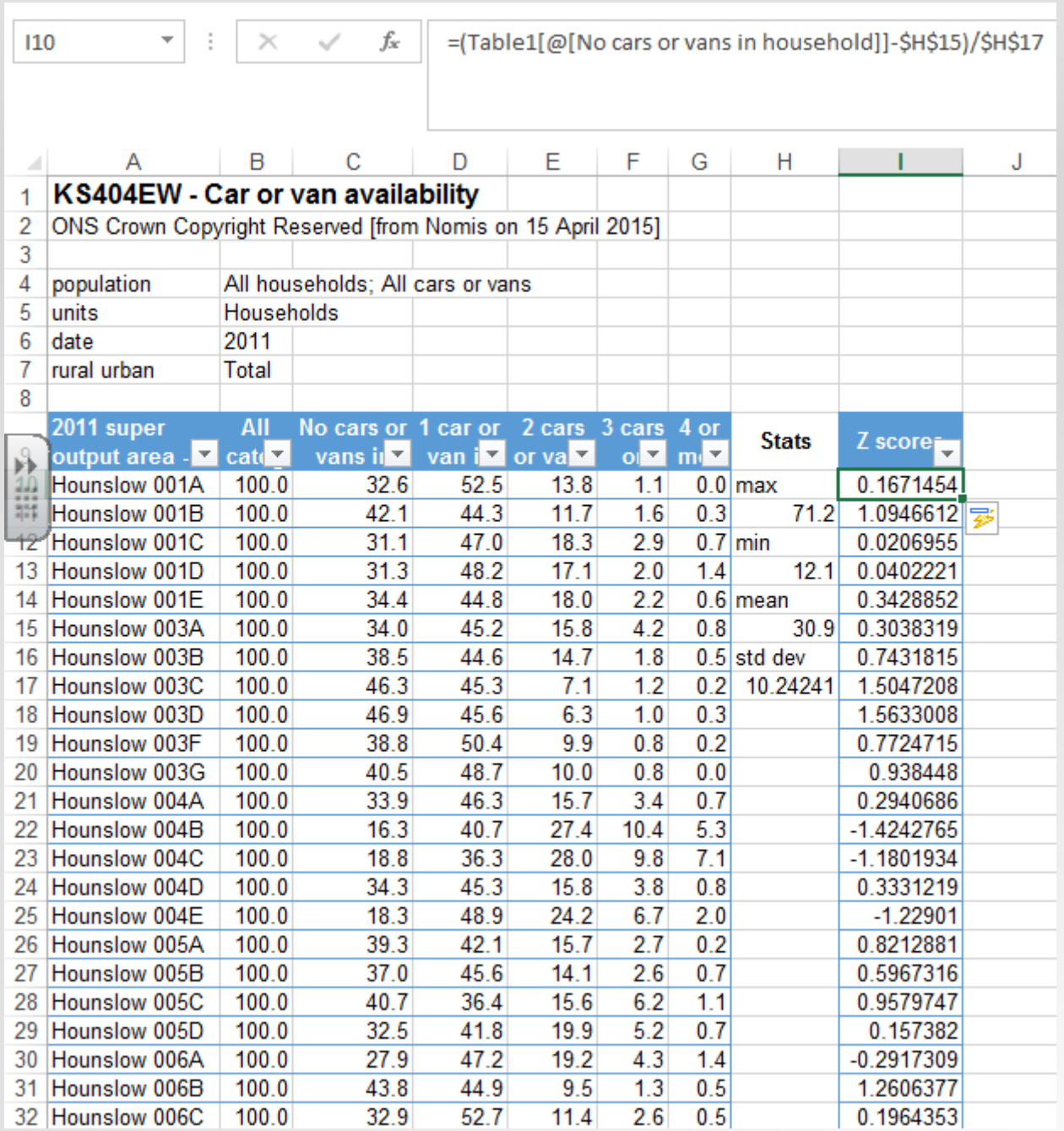


	A	B	C	D	E	F	G	H	I
1	**KS404EW - Car or van availability**								
2	ONS Crown Copyright Reserved [from Nomis on 15 April 2015]								
3									
4	population	All households; All cars or vans							
5	units	Households							
6	date	2011							
7	rural urban	Total							
8									
9	**2011 super output area - lower layer**	**All catego**	**No cars or vans**	**1 car or van**	**2 cars or vans**	**3 cars or vans**	**4 or more cars or vans**	**sum**	
10	Hounslow 001A	100.0	32.6	52.5	13.8	1.1	0.0	-	
11	Hounslow 001B	100.0	42.1	44.3	11.7	1.6	0.3	-	
12	Hounslow 001C	100.0	31.1	47.0	18.3	2.9	0.7	-	
13	Hounslow 001D	100.0	31.3	48.2	17.1	2.0	1.4	-	
14	Hounslow 001E	100.0	34.4	44.8	18.0	2.2	0.6	-	
15	Hounslow 003A	100.0	34.0	45.2	15.8	4.2	0.8	-	
16	Hounslow 003B	100.0	38.5	44.6	14.7	1.8	0.5	-	
17	Hounslow 003C	100.0	46.3	45.3	7.1	1.2	0.2	-	
18	Hounslow 003D	100.0	46.9	45.6	6.3	1.0	0.3	-	
19	Hounslow 003F	100.0	38.8	50.4	9.9	0.8	0.2	-	
20	Hounslow 003G	100.0	40.5	48.7	10.0	0.8	0.0	-	

- Next, determine the maximum, minimum, mean, and standard deviation for the relevant columns (in this case ‘No cars or vans’).
- To find the maximum, type in a new cell ‘MAX(‘ and click the first cell (in this case, this first cell under ‘No vans and cars,’ 32.6). Then, hold down shift and click the last cell in the column, and hit enter.
- Repeat this process, replacing ‘MAX(‘ with ‘MIN(‘ for minimum, ‘AVERAGE’ for mean, and ‘STDDEV’ for standard deviation.

2011 super output area -	All cat	No cars or vans i	1 car or van i	2 cars or va	3 cars o	4 or m	Stats
Hounslow 001A	100.0	32.6	52.5	13.8	1.1	0.0	max
Hounslow 001B	100.0	42.1	44.3	11.7	1.6	0.3	71.2
Hounslow 001C	100.0	31.1	47.0	18.3	2.9	0.7	min
Hounslow 001D	100.0	31.3	48.2	17.1	2.0	1.4	12.1
Hounslow 001E	100.0	34.4	44.8	18.0	2.2	0.6	mean
Hounslow 003A	100.0	34.0	45.2	15.8	4.2	0.8	30.9
Hounslow 003B	100.0	38.5	44.6	14.7	1.8	0.5	std dev
Hounslow 003C	100.0	46.3	45.3	7.1	1.2	0.2	10.24241
Hounslow 003D	100.0	46.9	45.6	6.3	1.0	0.3	
Hounslow 003F	100.0	38.8	50.4	9.9	0.8	0.2	
Hounslow 003G	100.0	40.5	48.7	10.0	0.8	0.0	
Hounslow 004A	100.0	33.9	46.3	15.7	3.4	0.7	
Hounslow 004B	100.0	16.3	40.7	27.4	10.4	5.3	
Hounslow 004C	100.0	18.8	36.3	28.0	9.8	7.1	
Hounslow 004D	100.0	34.3	45.3	15.8	3.8	0.8	
Hounslow 004E	100.0	18.3	48.9	24.2	6.7	2.0	
Hounslow 005A	100.0	39.3	42.1	15.7	2.7	0.2	
Hounslow 005B	100.0	37.0	45.6	14.1	2.6	0.7	

- Create a new empty table to the right of the statistics, labelling the header ‘Z-Scores.’
- In the first cell of the new column, type ‘=(‘ and click the first cell of the relevant column (in this case, ‘No cars or vans’, 32.6). Subtract the mean from this, end the parentheses, and divide by the standard deviation, as shown in the formula bar. Make sure to ‘lock’ mean and standard deviation cells by using the ‘F4’ key after clicking the cell. For a detailed explanation of what ‘locking’ is, go here.[1]



	A	B	C	D	E	F	G	H	I	J
1	**KS404EW - Car or van availability**									
2	ONS Crown Copyright Reserved [from Nomis on 15 April 2015]									
3										
4	population	All households; All cars or vans								
5	units	Households								
6	date	2011								
7	rural urban	Total								
8										
9	2011 super output area -	All cat	No cars or vans i	1 car or van i	2 cars or va	3 cars o	4 or m	Stats	Z score	
10	Hounslow 001A	100.0	32.6	52.5	13.8	1.1	0.0	max	0.1671454	
11	Hounslow 001B	100.0	42.1	44.3	11.7	1.6	0.3	71.2	1.0946612	
12	Hounslow 001C	100.0	31.1	47.0	18.3	2.9	0.7	min	0.0206955	
13	Hounslow 001D	100.0	31.3	48.2	17.1	2.0	1.4	12.1	0.0402221	
14	Hounslow 001E	100.0	34.4	44.8	18.0	2.2	0.6	mean	0.3428852	
15	Hounslow 003A	100.0	34.0	45.2	15.8	4.2	0.8	30.9	0.3038319	
16	Hounslow 003B	100.0	38.5	44.6	14.7	1.8	0.5	std dev	0.7431815	
17	Hounslow 003C	100.0	46.3	45.3	7.1	1.2	0.2	10.24241	1.5047208	
18	Hounslow 003D	100.0	46.9	45.6	6.3	1.0	0.3		1.5633008	
19	Hounslow 003F	100.0	38.8	50.4	9.9	0.8	0.2		0.7724715	
20	Hounslow 003G	100.0	40.5	48.7	10.0	0.8	0.0		0.938448	
21	Hounslow 004A	100.0	33.9	46.3	15.7	3.4	0.7		0.2940686	
22	Hounslow 004B	100.0	16.3	40.7	27.4	10.4	5.3		-1.4242765	
23	Hounslow 004C	100.0	18.8	36.3	28.0	9.8	7.1		-1.1801934	
24	Hounslow 004D	100.0	34.3	45.3	15.8	3.8	0.8		0.3331219	
25	Hounslow 004E	100.0	18.3	48.9	24.2	6.7	2.0		-1.22901	
26	Hounslow 005A	100.0	39.3	42.1	15.7	2.7	0.2		0.8212881	
27	Hounslow 005B	100.0	37.0	45.6	14.1	2.6	0.7		0.5967316	
28	Hounslow 005C	100.0	40.7	36.4	15.6	6.2	1.1		0.9579747	
29	Hounslow 005D	100.0	32.5	41.8	19.9	5.2	0.7		0.157382	
30	Hounslow 006A	100.0	27.9	47.2	19.2	4.3	1.4		-0.2917309	
31	Hounslow 006B	100.0	43.8	44.9	9.5	1.3	0.5		1.2606377	
32	Hounslow 006C	100.0	32.9	52.7	11.4	2.6	0.5		0.1964353	

Grouping Variables

Groups used by the Spring 2015 WPI project group:

Economic Stability:

- Unemployment
- Occupation
- Education
- Language
- Gender
- Vehicle Ownership
- Renting
- Occupancy

Evacuation

- Disability
- Occupancy
- Health
- Language
- Gender
- Vehicle Ownership
- Population Density

Minority Status

- Language
- Gender
- Migration

Public Health

- Disability
- Age
- Health
- Population Density

Grouping Variables Definitions

- **Economic Stability-** The ability to financially recover after an event.
- **Evacuation-** The ability to navigate through and leave a hazardous area.
- **Minority Status-** A population that is unable to effectively communicate with responders due to language or cultural differences.
- **Public Health-** The general state of wellness of a community with regards to requiring assistance.

A more detailed description of these groups and the reasons for how and why they were put together is available Here.[2]

- Once the previous processes have been completed for every desired census group, you can begin to group multiple vulnerabilities to create composites.
- To begin the grouping process, create a new Excel file. Next, add a column for the LSOA names, and blank columns for each of the vulnerable populations.
- Copy the values from each sheet for the Z-Scores into the new columns, as shown in the picture. Make sure to copy the values and not the formulas.

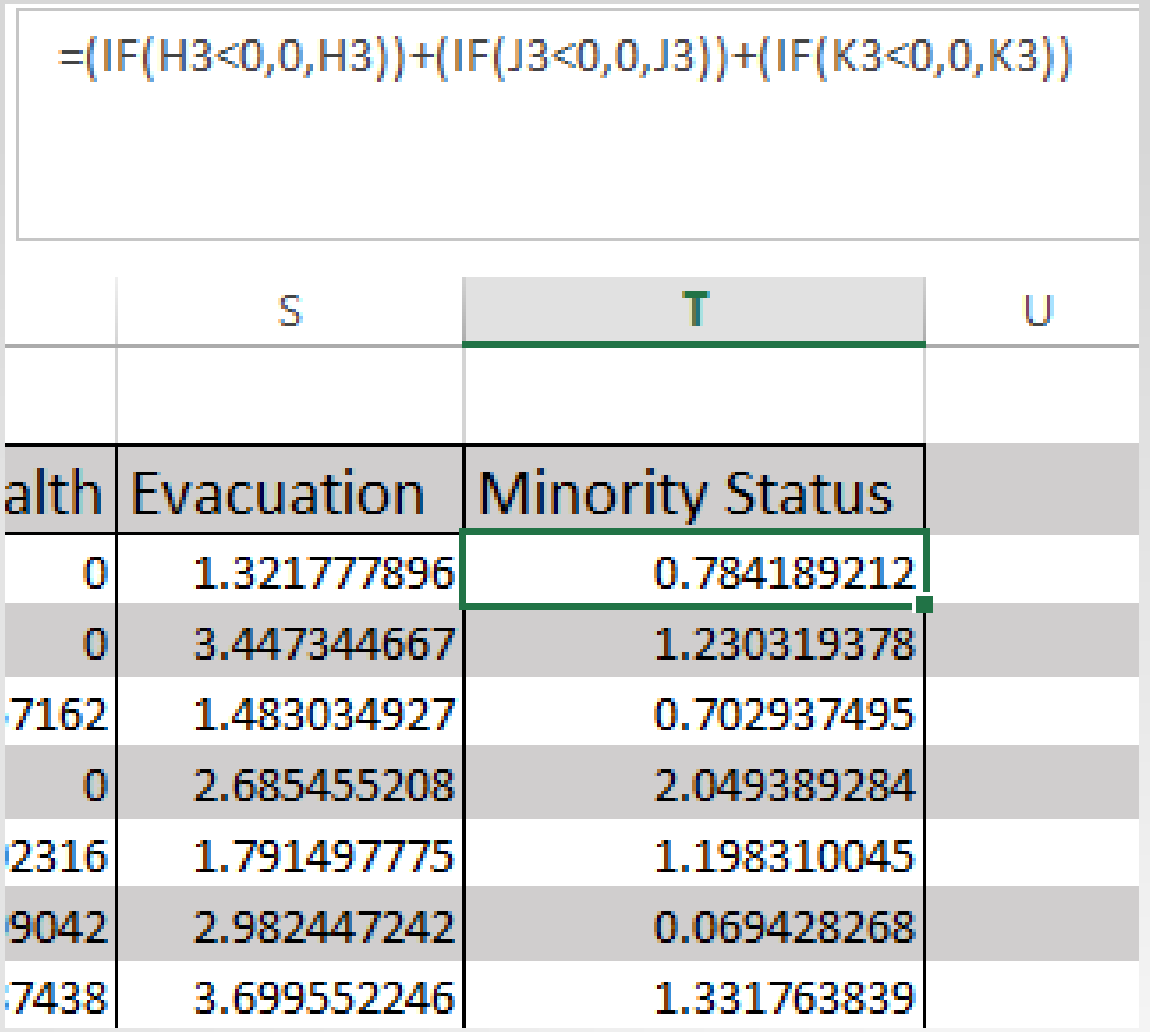
LSOA Name	Age	Density	Disability	Education	Gender	Health
Hounslow 001A	-0.8572	0.3646	-1.6995	-1.3875	0.7842	-1.1902
Hounslow 001B	-1.5342	1.1151	-1.7386	-1.5244	1.2303	-0.7782
Hounslow 001C	0.2810	0.4728	-1.1112	-1.9291	0.7029	-0.9496
Hounslow 001D	-0.9873	0.5860	-1.3618	-1.8337	2.0494	-0.9233
Hounslow 001E	0.0842	0.1529	-1.4734	-1.6866	0.8682	-1.8454
Hounslow 003A	0.0743	-1.3826	1.0632	0.7178	0.0694	1.4655
Hounslow 003B	0.2114	0.1972	0.5388	0.5301	1.3318	0.6729
Hounslow 003C	-0.6751	-0.8511	0.1265	0.2519	0.0762	-0.9888
Hounslow 003D	0.3512	1.6663	0.3090	0.3067	1.5096	0.6356
Hounslow 003F	-2.6307	1.3489	-1.6260	-0.8434	-0.2118	0.2730
Hounslow 003G	-0.2315	-0.5041	0.3481	-0.3932	0.5467	0.0612
Hounslow 004A	1.4367	-0.2408	0.8126	0.3274	-0.2426	0.3767
Hounslow 004B	-0.1996	0.3744	1.1975	0.1035	-0.3396	0.9561
Hounslow 004C	-0.5011	-0.5976	0.8968	0.1048	-0.2065	0.6373
Hounslow 004D	0.2814	1.5433	0.9443	0.1957	-0.2642	1.4761
Hounslow 004E	0.2009	0.1923	-0.1638	0.0606	-0.8941	0.4121
Hounslow 005A	1.2609	-1.3309	1.2673	1.4988	1.0464	-1.3241
Hounslow 005B	1.6756	0.0004	1.6125	1.1809	1.2103	-0.0898
Hounslow 005C	0.1648	-1.1513	0.9686	0.8569	-0.3453	-0.2429
Hounslow 005D	1.2313	-1.1783	0.5844	1.1706	0.3375	0.8736

- After copying over the Z-Scores, it is time to add them together to create groups.
- To begin, add new columns for each group. You may also want to list the vulnerabilities that make up each group above it or to the side.

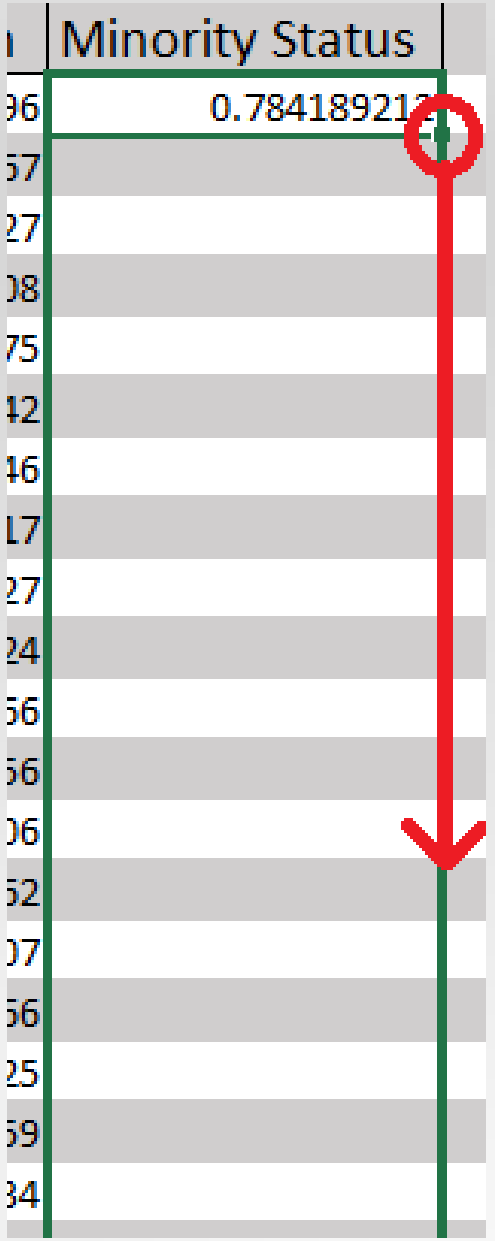
			Economic Stability	Public Health
Evacuation	Minority Status		unemployment	disability
1.321777896	0.784189212		occupation	age
3.447344667	1.230319378		education	health
1.483034927	0.702937495		language	occupancy
2.685455208	2.049389284		gender	
1.791497775	1.198310045		vehicles	
2.982447242	0.069428268		renting	
3.699552246	1.331763839		occupancy	
1.847818117	0.14075929			
6.26170827	1.725082799			
2.606143824	0.199880694			
1.905283666	0.546679083			
5.142319656	1.537964264			
3.927665006	1.166940081			
2.851826162	1.275333522			
7.427913507	1.424126833			
3.507011266	1.809965176			
5.350300225	1.046410306			
7.854514359	1.210315538			
6.35566134	2.813862909			
5.402196903	1.615531213			

- Because Z-Scores indicate a low vulnerability rather than a high resilience, we will void those values when adding. Otherwise a negative Z-Score would lower the overall vulnerability of a particular LSOA. Voiding the negative values makes sure that no vulnerable populations are left out or deemed less vulnerable.
- To accomplish this, each cell added will use this formula:

  =(IF(X#<0,0,X#))+(IF(Y#<0,0,Y#))+…
- X is the column of vulnerability being added, and # is the row.
- The figure to the right shows an example for ‘Minority Status.’

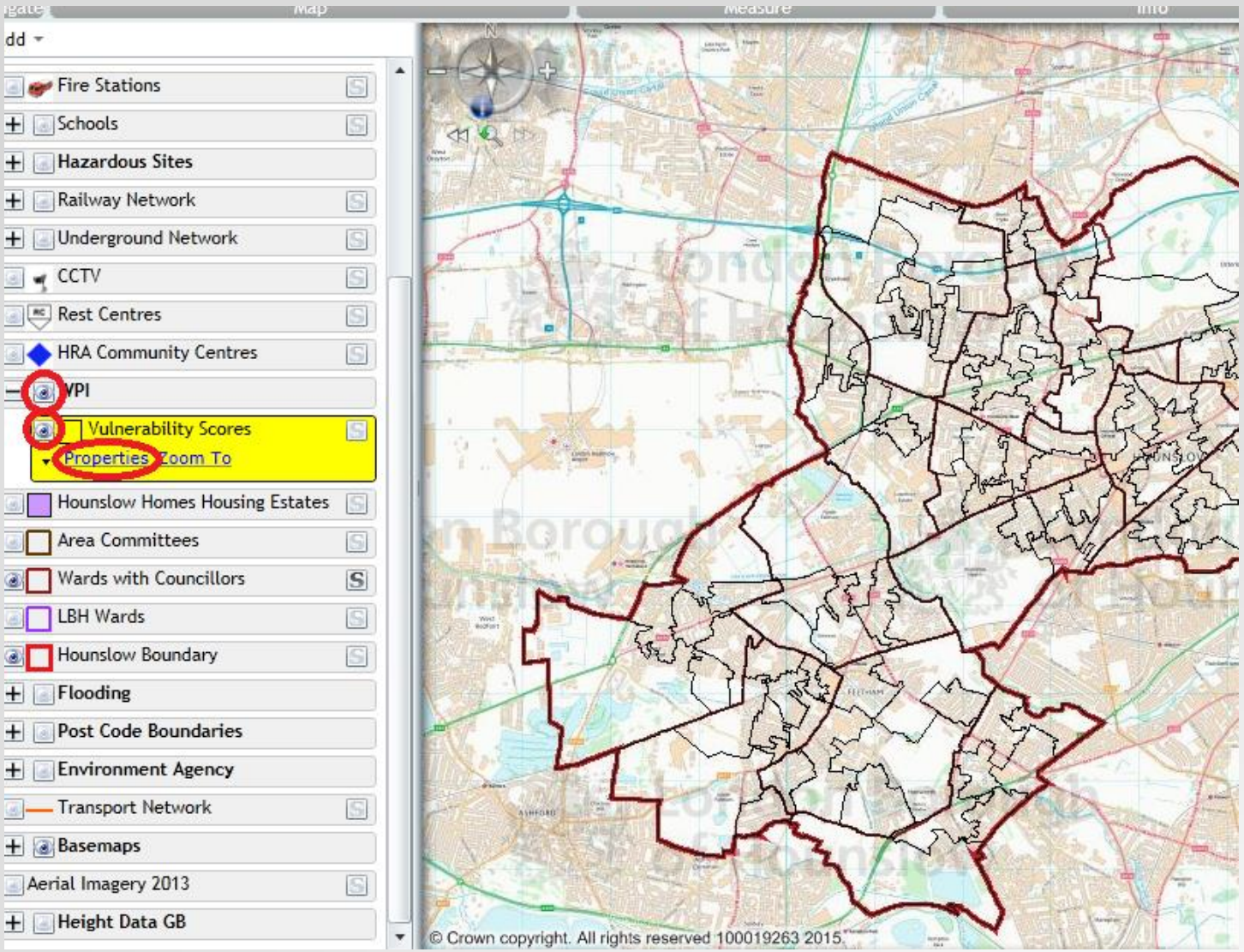


- To populate the rest of the column, click on the small box in the bottom-right hand corner of the cell and drag down to the last cell. When your mouse is in the correct position, the cursor will turn into a black ‘plus’ icon.
- Repeat this process for each vulnerability group.
- It is recommended to populate the columns left to right, as you can more easily align the last row.

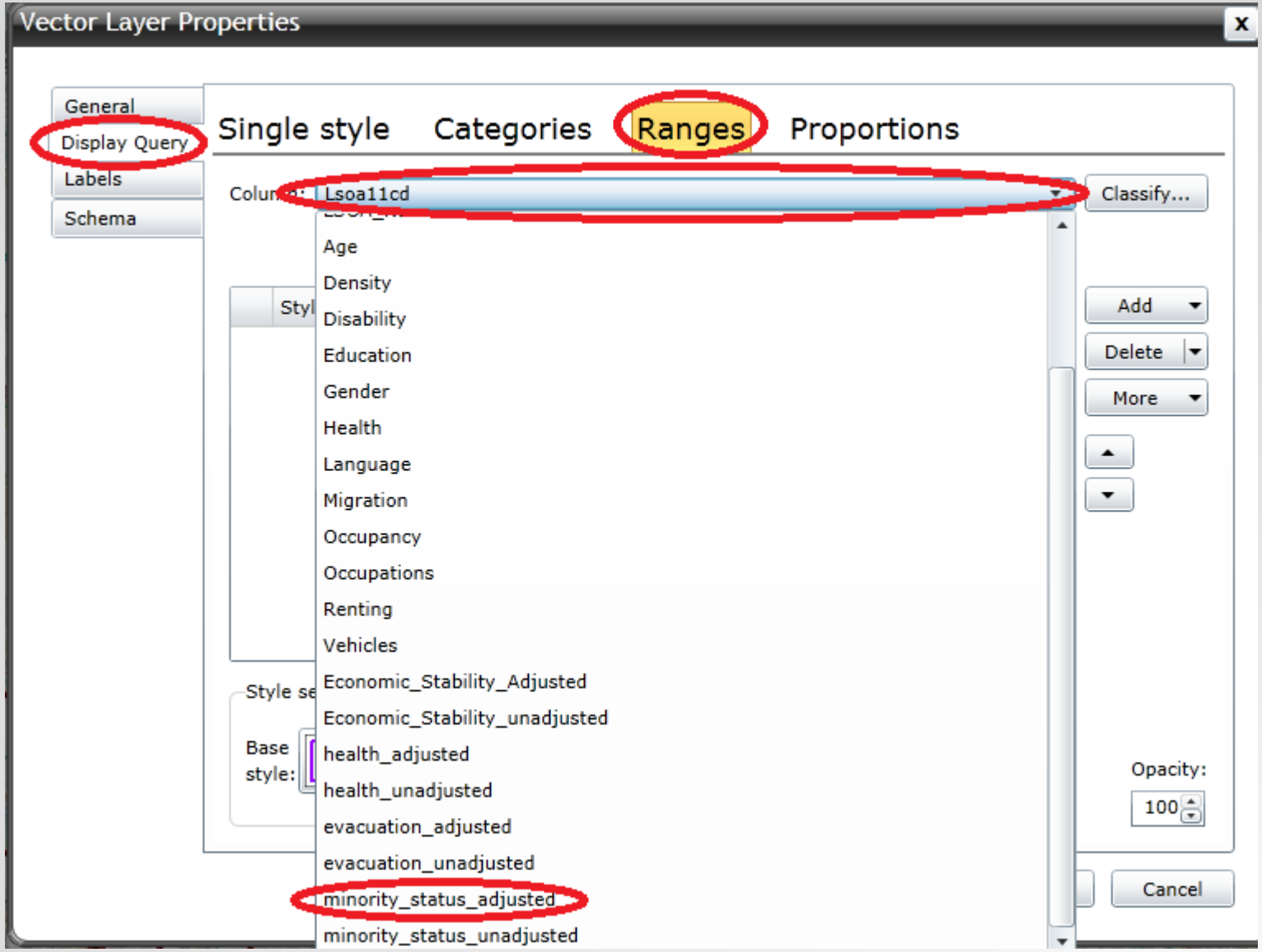


Creating the maps

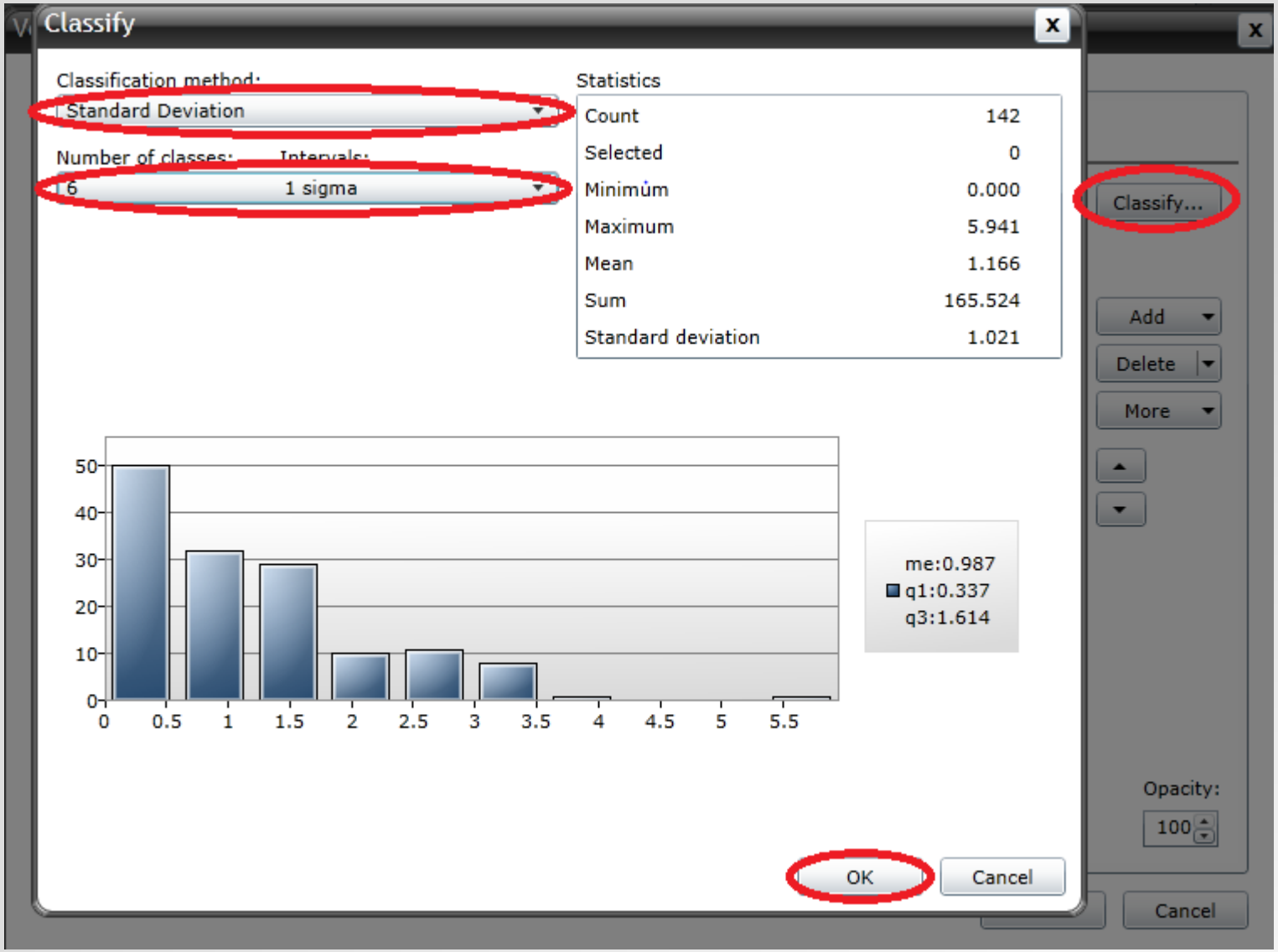
- Once all of the data is compiled into a single Excel sheet, it can be emailed to the GIS team to be inputted into the intranet GIS.
- Once the data has been processed, the maps will be in a ‘blank layer.’ Turn on the layer visibility by clicking the eye for the layer and any ‘folder’ it is under.
- Next, click the layer itself, and then click the ‘Properties’ button.



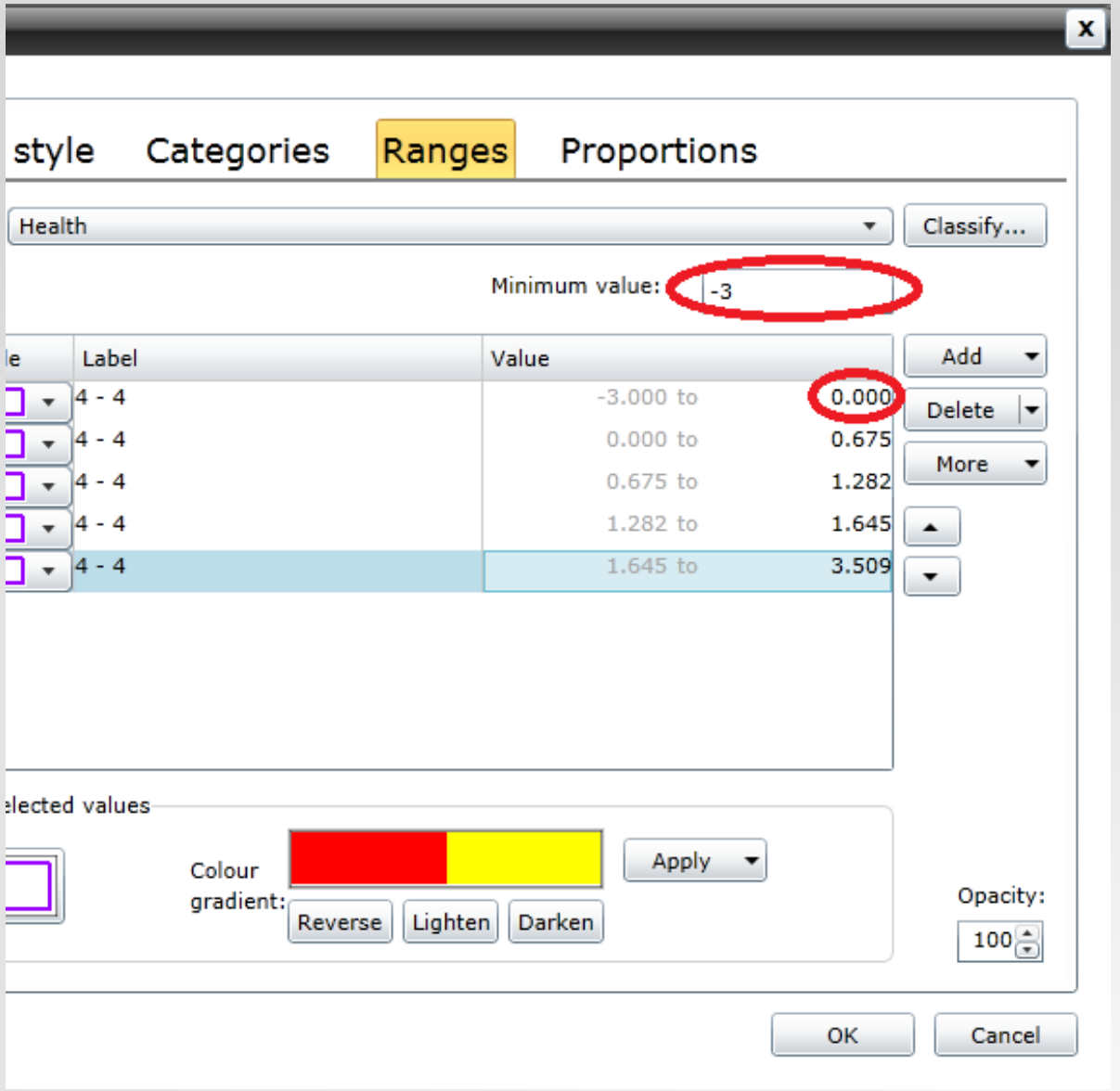
- To fill in the map with the desired data, click ‘Display Query,’ then ‘Ranges.’
- Click on the dropdown menu and select the vulnerability or vulnerability group of your choice.
- Then click the ‘Okay’ button in the bottom-right hand corner of the pop-up. (Hidden by the dropdown in this figure)



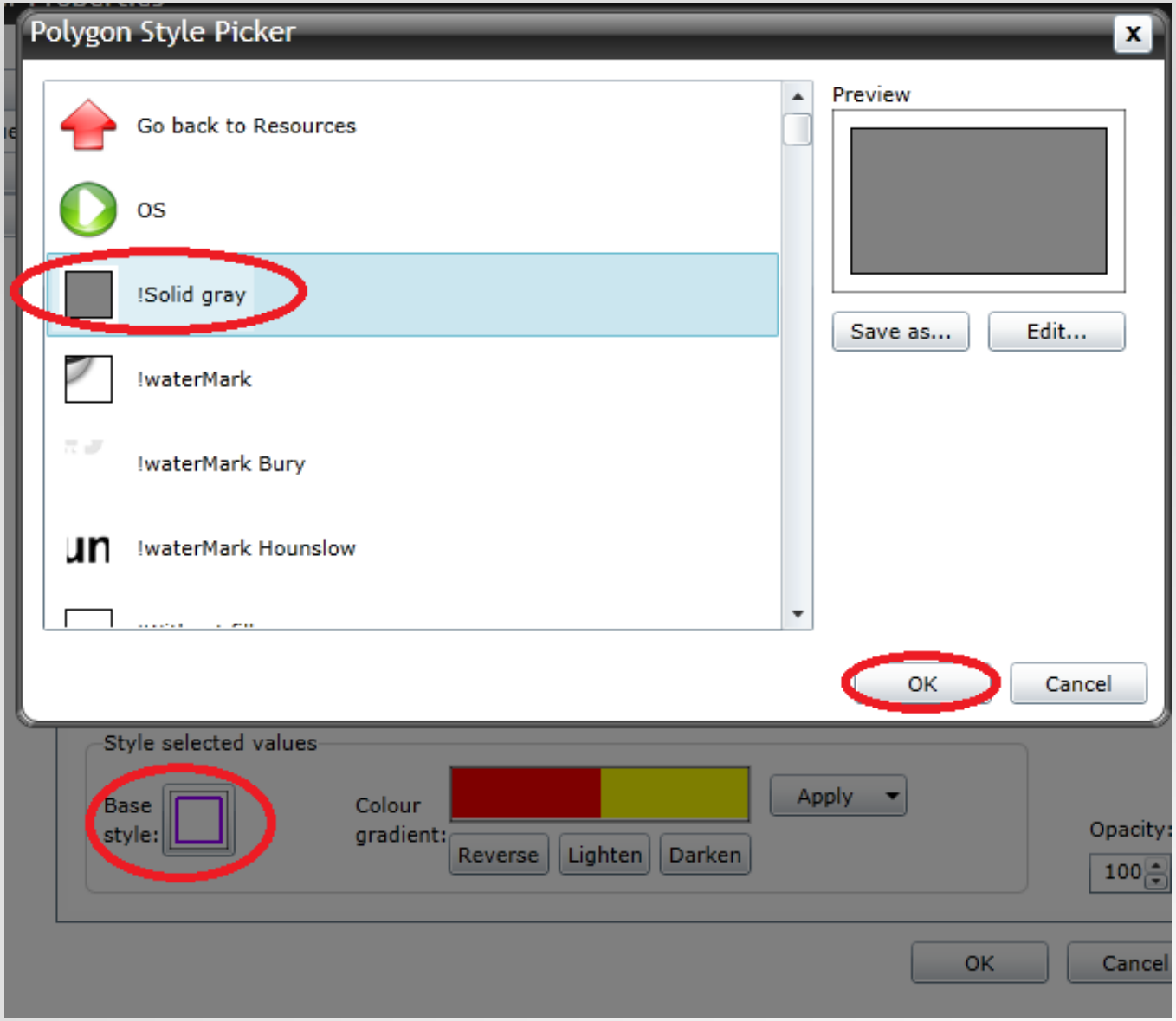
- Next, click ‘Classify…’
- If you are mapping an individual vulnerability, select ‘User-defined Intervals’ from the first dropdown and ‘5’ classes from the second dropdown.
- If you are mapping a grouping of vulnerabilities, select ‘Standard Deviation’ and ‘6 1 sigma’ from the dropdowns.



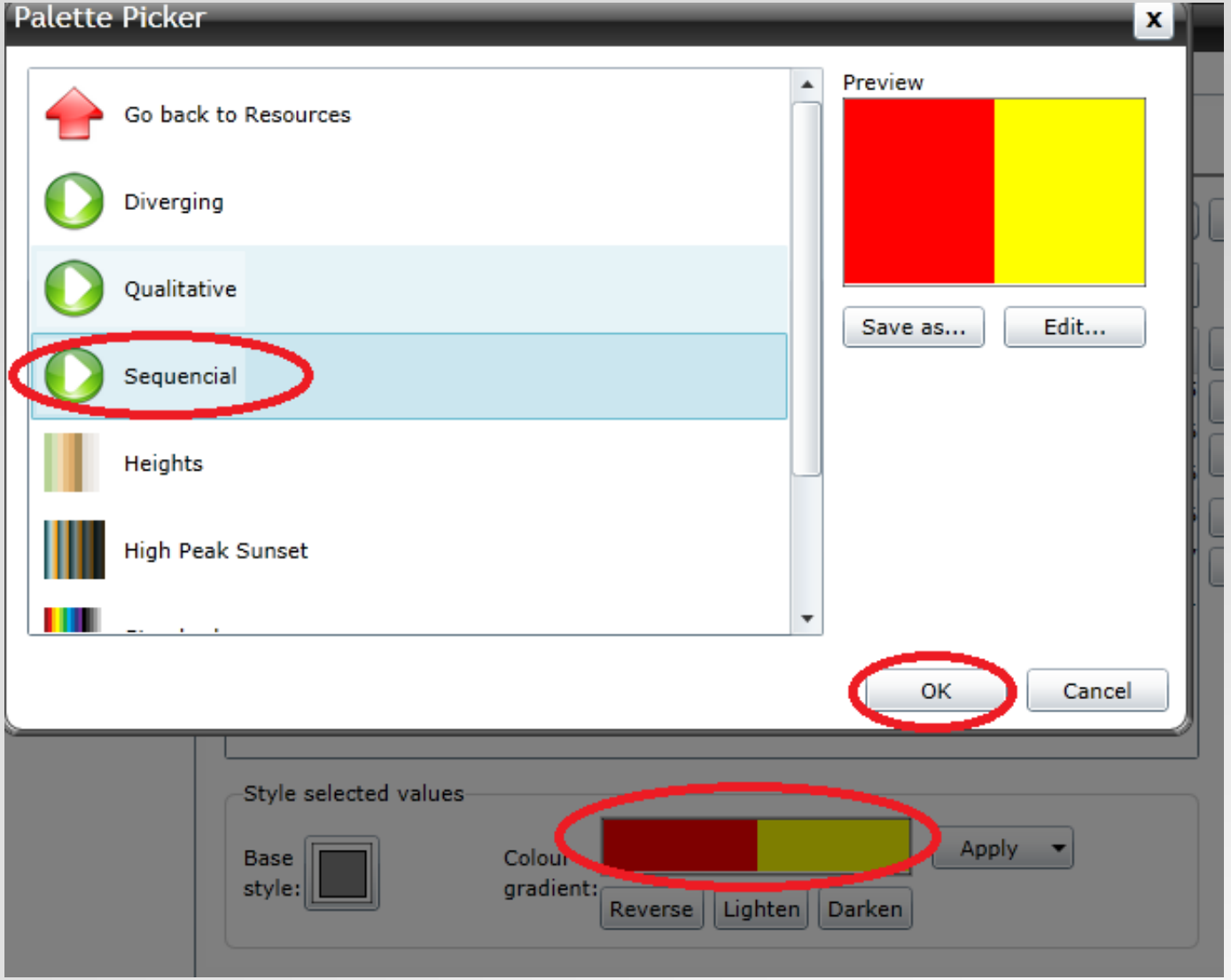
- If the desired selection is a grouping of vulnerabilities, proceed to the next page.
- If the desired selection is a single vulnerability, change the ‘Minimum value’ to ‘-3.’ Next, change the values of each range by double clicking the number. The new values should be ‘0,’ ‘0.675,’ ‘1.282,’ ‘1.645,’ and the maximum value will remain unchanged.
- These values correspond to different percentiles. Anything below and up to 0 is in the 50th percentile. The next range is in the 75th percentile, followed by the 90th, 95th, and greater than 95th percentiles.



- After making sure that each label is selected (highlighted in light blue), click on the icon next to ‘Base style.’
- Next click on ‘!Solid gray’ and click on ‘OK.’
- This will fill the empty LSOAs with colour, rather than highlighting the border.



- To change the colours of the LSOAs, click on the icon next to ‘Colour gradient,’ double-click ‘Sequential,’ and select the appropriate palette and number of colours.
- For example, ‘Blues5seq’ would be appropriate for 5 labels.



- Click ‘Apply’ for the dropdown, followed by ‘Gradient to fill’ to change the LSOA colours from grey to the selected palette.
- Next, click ‘OK’ to return to the map. You are done with your map!