

Exploratory Spatial Analysis of the Crime Data from the Metropolitan Police

Introduction

Exploratory spatial analysis of the Crime Data from the London Metropolitan Police

Police Data

<https://data.police.uk/data/archive/>

2023-12-metropolitan-street.csv

	Crime ID	Month	Reported by	Falls within	Longitude	Latitude	Location	LSOA code	LSOA name	Crime type	Last outcome category	Context	
0	7c946dce2da056f82ed6f379b02b3b7c64e38efcd7d9f0...	2023-12	Metropolitan Police Service	Metropolitan Police Service	0.879583	51.165243	On or near Riding Hill	E01023980	Ashford 015A	Other theft	Under investigation	NaN	
1		Nan	2023-12	Metropolitan Police Service	Metropolitan Police Service	0.134947	51.588063	On or near Mead Grove	E01000027	Barking and Dagenham 001A	Anti-social behaviour	NaN	NaN
2		Nan	2023-12	Metropolitan Police Service	Metropolitan Police Service	0.134947	51.588063	On or near Mead Grove	E01000027	Barking and Dagenham 001A	Anti-social behaviour	NaN	NaN
3		Nan	2023-12	Metropolitan Police Service	Metropolitan Police Service	0.140194	51.582356	On or near Hatch Grove	E01000027	Barking and Dagenham 001A	Anti-social behaviour	Nan ²	NaN

Methodology

Data collection	Data selection	Interpretation and visualisation
<ul style="list-style-type: none">- Police Data csv files for street crime reported- London Datastore- Open Geography Portal (ONS) for the map with LSOAs codes	London Metropolitan area for street crimes reported for December 2023	<ul style="list-style-type: none">- Excel- Python- QGIS- Rstudio

LSOAs

- Lower Layer Output Areas
- Average population of **1500** people or **650** households

MSOAs

- Middle Layer Super Output Areas
- Average population of **7500** people or **4000** households

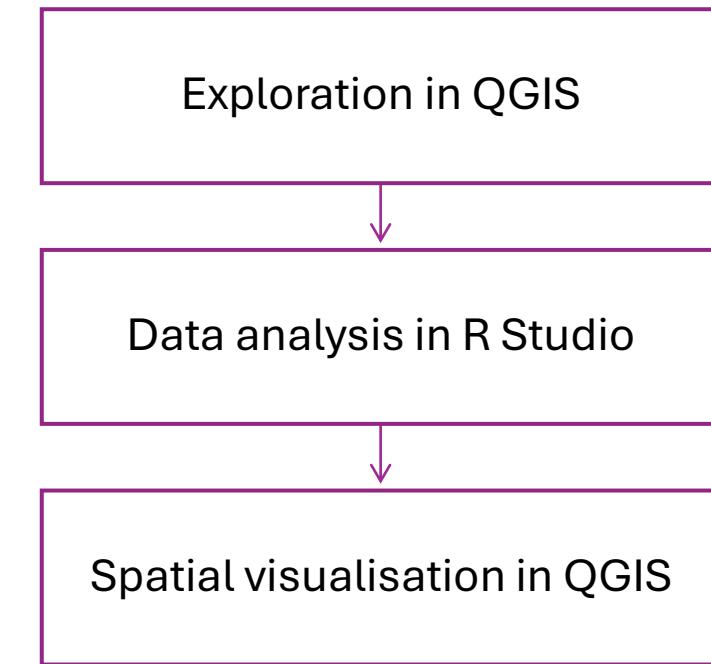
Wards, Constituencies

- More recognizable places
- Vary greatly for historic reasons.
- Local administration and electoral purposes

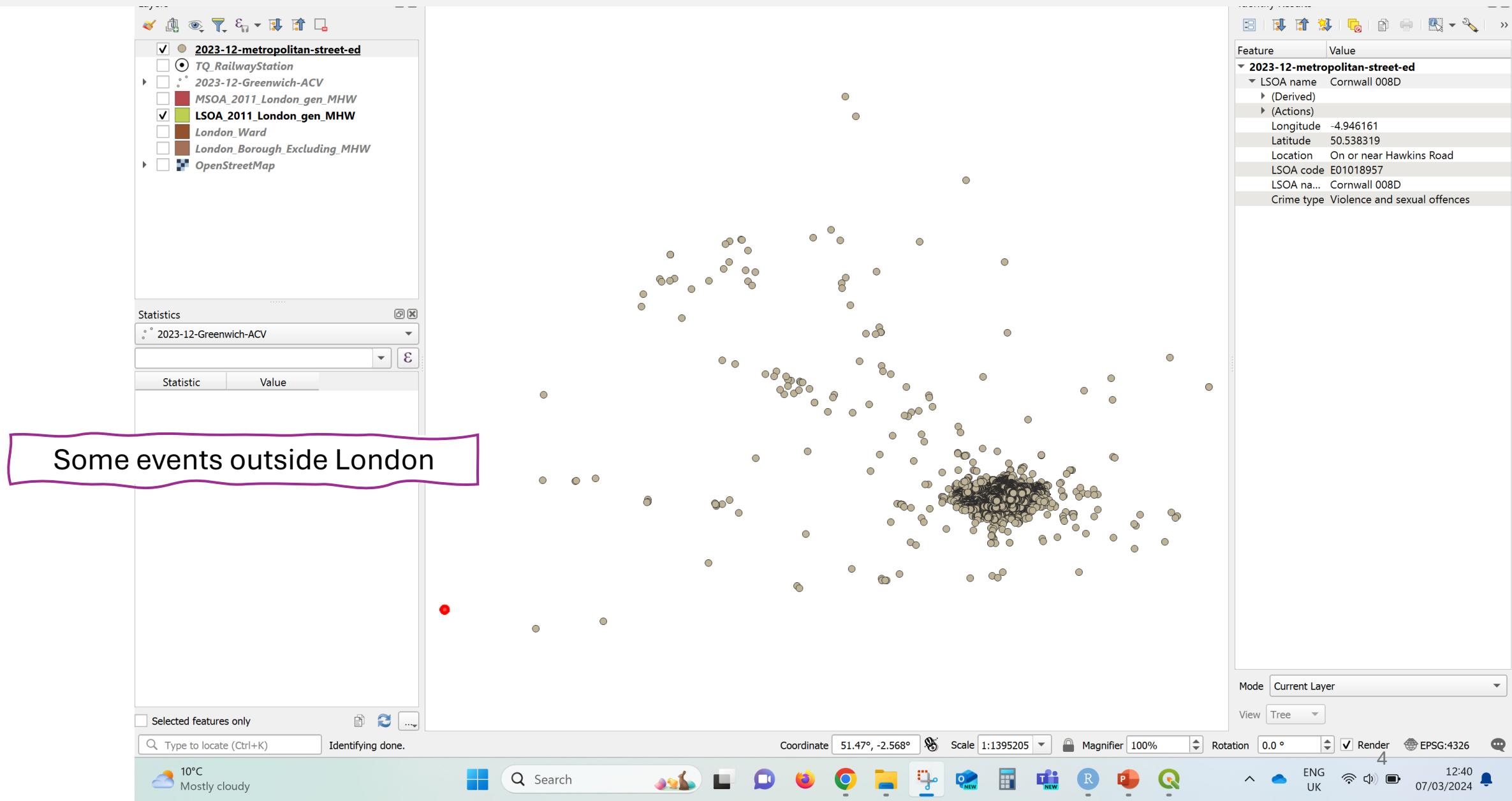
Boroughs

- In London they vary significantly in population and area
- City of London has 8,583 people
- The other boroughs vary between 140,000 and 390,000

Implementation:

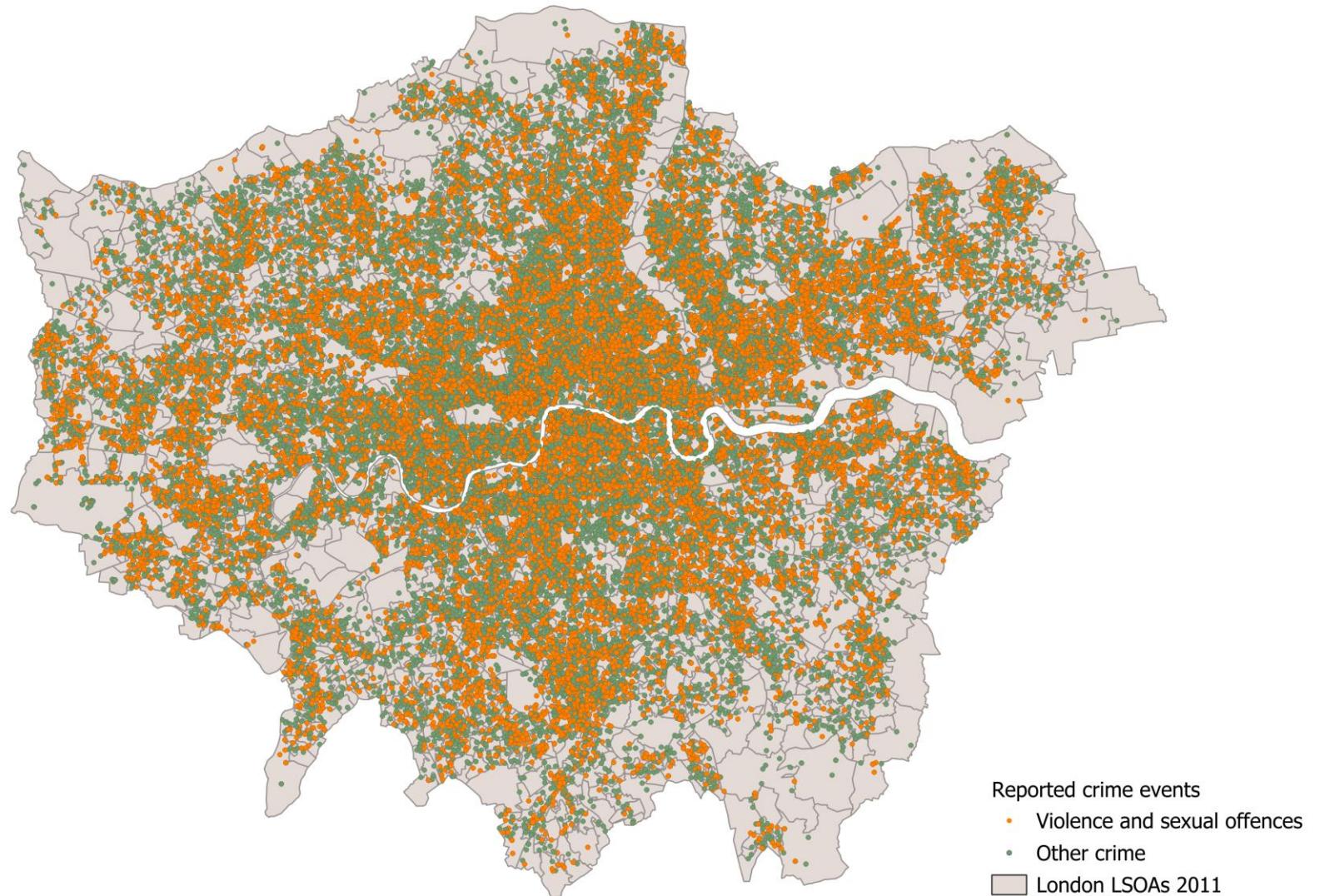


Implementation: Exploration in QGIS



Implementation: Exploration in QGIS

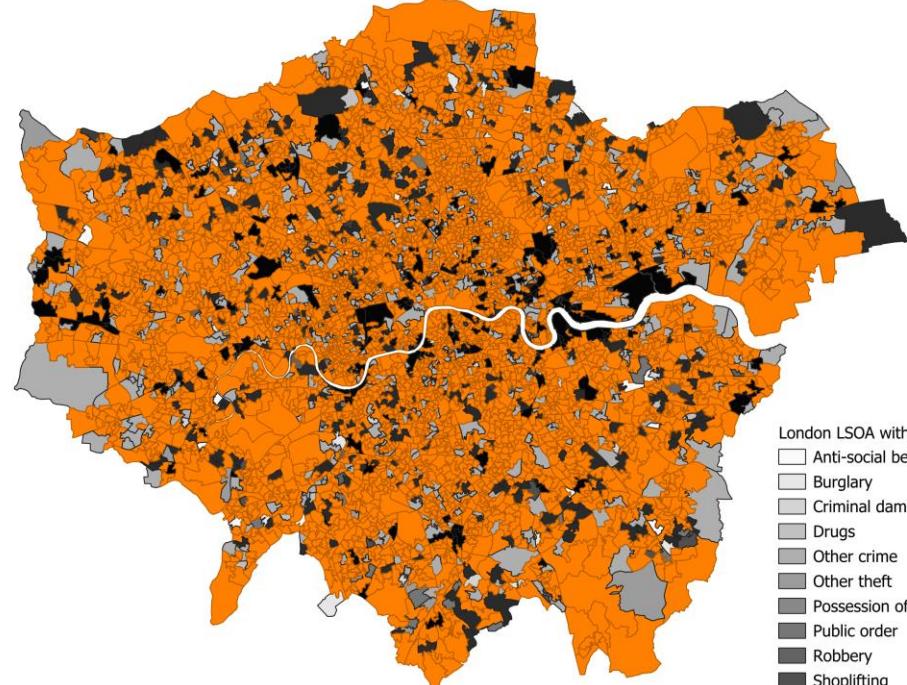
Points map



Reported crime events in London by Metropolitan Police
December 2023

Implementation: Exploration in QGIS

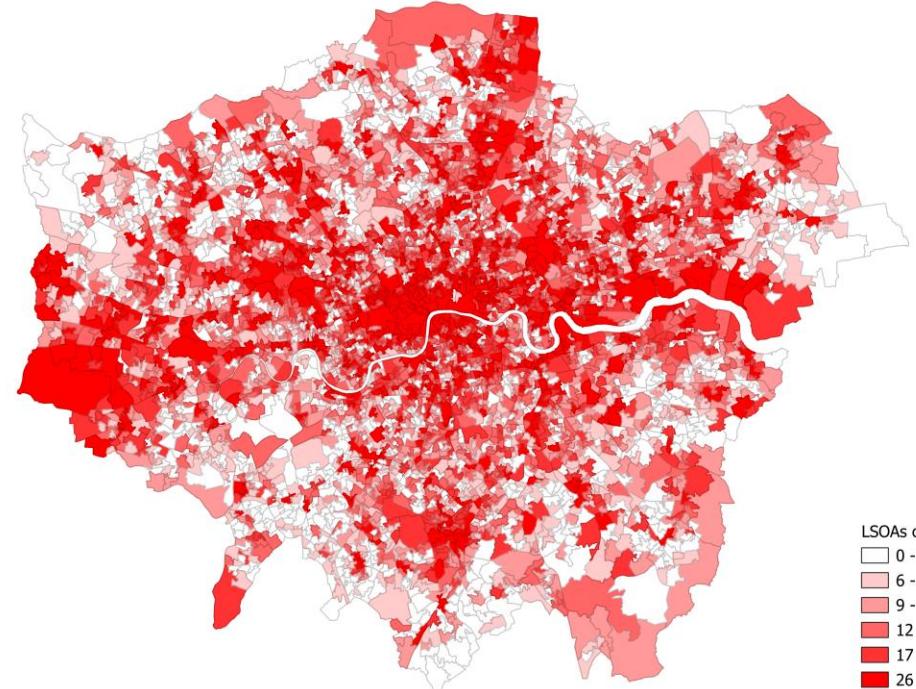
Thematic maps



Reported crime in London LSOAs by Metropolitan Police
December 2023

All areas in orange hide the other crime types or the difference in quantity of events

- London LSOA with crime types
- Anti-social behaviour
- Burglary
- Criminal damage and arson
- Drugs
- Other crime
- Other theft
- Possession of weapons
- Public order
- Robbery
- Shoplifting
- Theft from the person
- Vehicle crime
- Violence and sexual offences



Reported crime in London LSOAs by Metropolitan Police
December 2023

Hard to check the areas, some LSOAs have changed

The last category varies too much

Implementation: Exploration in QGIS

QGIS initial workflow

Load Files

- Shapefile of area of interest
- .csv file of events with location

Check attributes table

- Check location code column is the same in both files

Join shapefile with events

- Check attributes table has the new columns

If area of interest is not the same
Clip data
(Vector Menu → Geoprocessing Tool → Clip)

Error:

No spatial index exists for input layer

- Processing menu → Toolbox → Vector general → **Create spatial index**

Error:

Invalid Geometry

- Processing menu → Vector geometry → Check validity
- Processing menu → Vector geometry → Fix geometries
- New layer created “Fixed geometries” ready to clip

Edit symbology or Layer Style
What to map?

Points Map

- The scale of the map will determine if nearby events are visible as one
- It won't show multiple events occurring at the same point

Thematic Map

- What to show in the areas? By count? By rate?
- LSOA, MSOA, Borough?
- Graduated, categorized? How many classes?
- Centroids? What is visible?

Implementation: Data analysis in RStudio

Preparing data in Excel

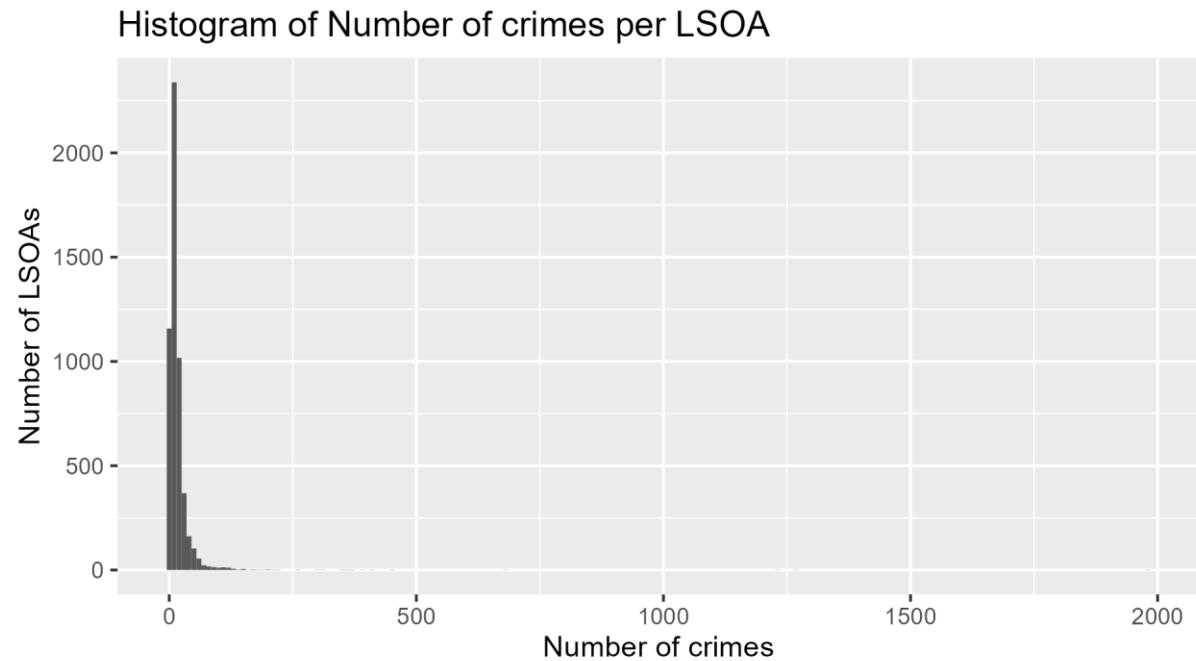
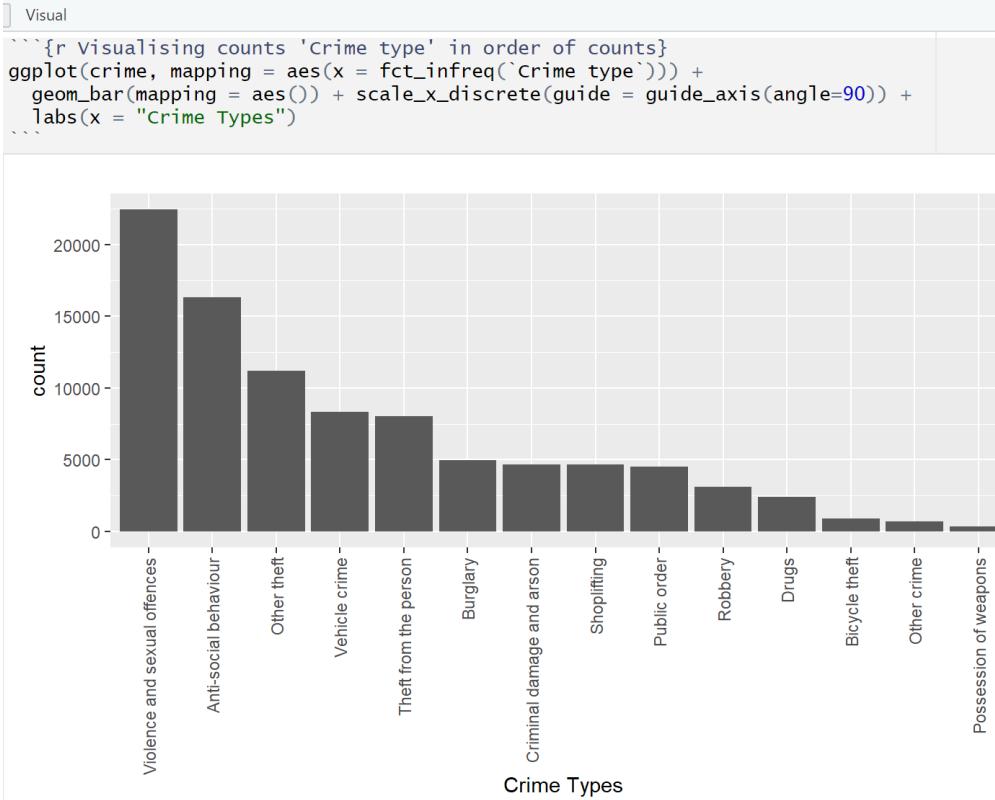
Clipboard Font Alignment Number Styles Cells Filter Select Editing Sensitivity Add-ins Data

C92670 : fx No Location

A	B	C	D	E	F	G	H	I	J	K	L	M
92653	-0.938262	52.251098 On or near Black Cat Drive	E01035424	West Northamptonshire 039	Violence and sexual offences							
92654	0.623074	52.447163 On or near Stores Street	E01029927	West Suffolk 002B	Violence and sexual offences							
92655	0.872886	52.364115 On or near Paddock Farm	E01030095	West Suffolk 005A	Vehicle crime							
92656	-2.515140	52.506474 On or near Orchard Close	E01006337	Wigan 027E	Violence and sexual offences							
		98 On or near Biddulph Road	E01034543	Wiltshire 045H	Violence and sexual offences							
		73 On or near St Alban'S Street	E01016544	Windsor and Maidenhead 01	Possession of weapons							
92659	-0.005845	51.401873 On or near St Alban'S Street	E01016544	Windsor and Maidenhead 01	Theft from the person							
92660	-0.612675	51.469329 On or near Wood Close	E01016596	Windsor and Maidenhead 01	Public order							
92661	-3.07147	53.419248 On or near Sports/Recreation Area	E01007309	Wirral 006D	Vehicle crime							
92662	-3.054742	53.394965 On or near Further/Higer Educational	E01007156	Wirral 015B	Violence and sexual offences							
92663	-0.885221	51.425334 On or near Winnersh Relief Road	E01016703	Wokingham 009D	Robbery							
92664	-0.94309	51.433234 On or near Harcourt Drive	E01016651	Wokingham 012A	Violence and sexual offences							
92665	-2.055768	52.613385 On or near Southall Road	E01010555	W								
92666	-2.151732	52.591007 On or near Tettenhall Road	E01010512	W								
92667	-2.074877	52.569199 On or near Peascroft Lane	E01010422	W								
92668	-0.368607	50.81314 On or near Nightclub	E01034831	W								
92669	-2.879714	53.079716 On or near Vicarage Court	W01000384	W								
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Implementation: Data analysis in RStudio

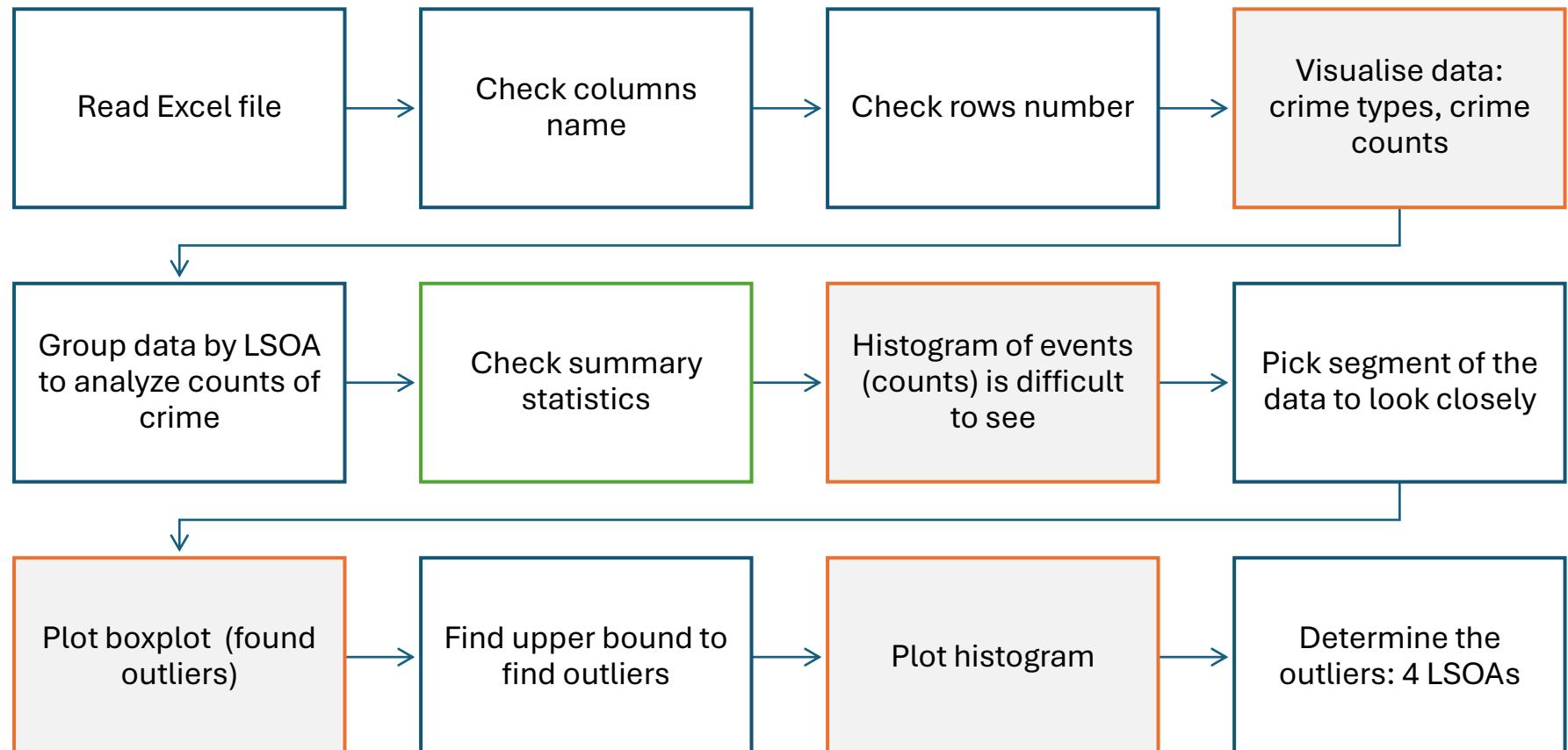
First graphs to visualize distribution



Hard to see, distribution has a long tail

Implementation: Data analysis in RStudio

R Studio workflow

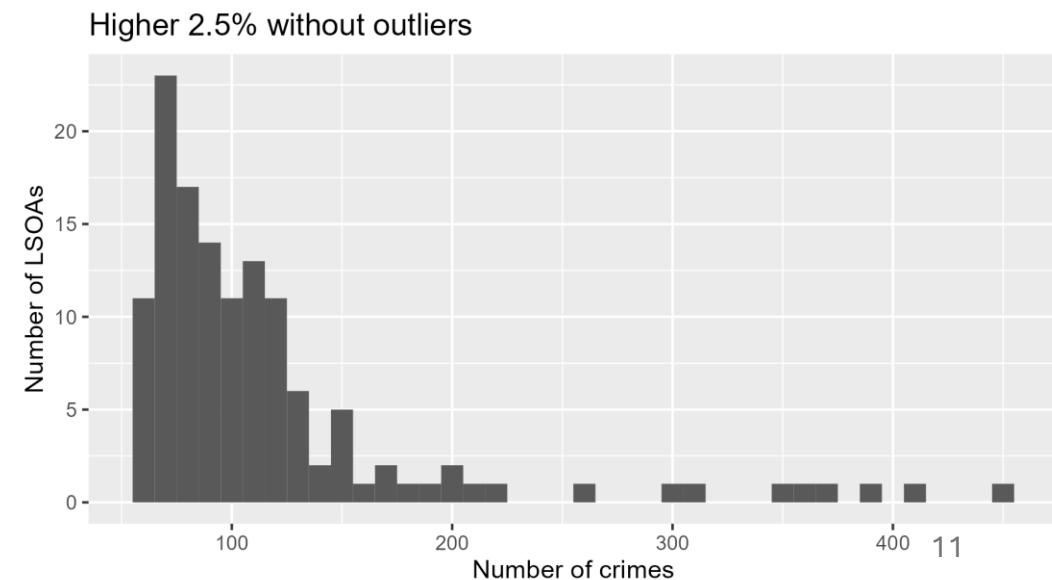
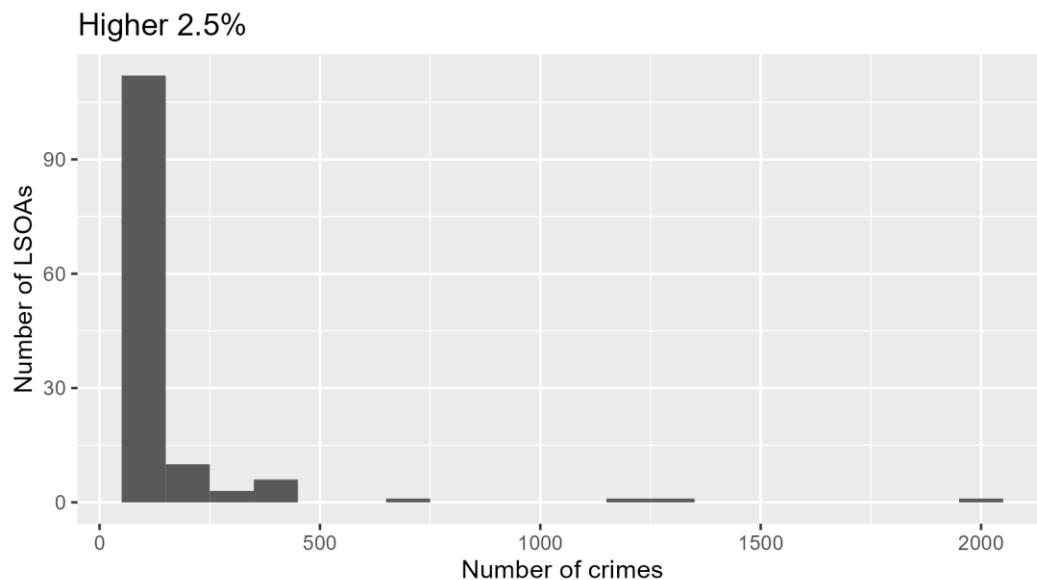
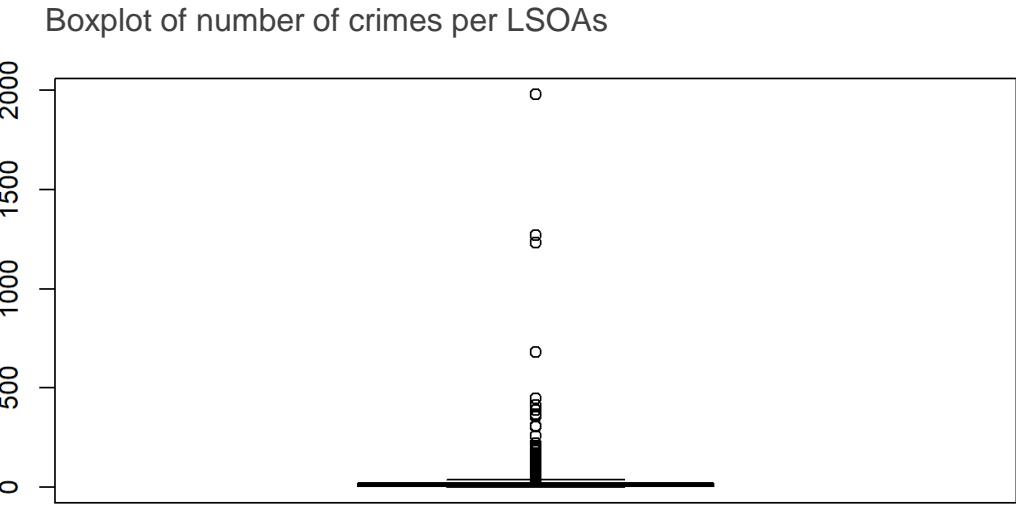
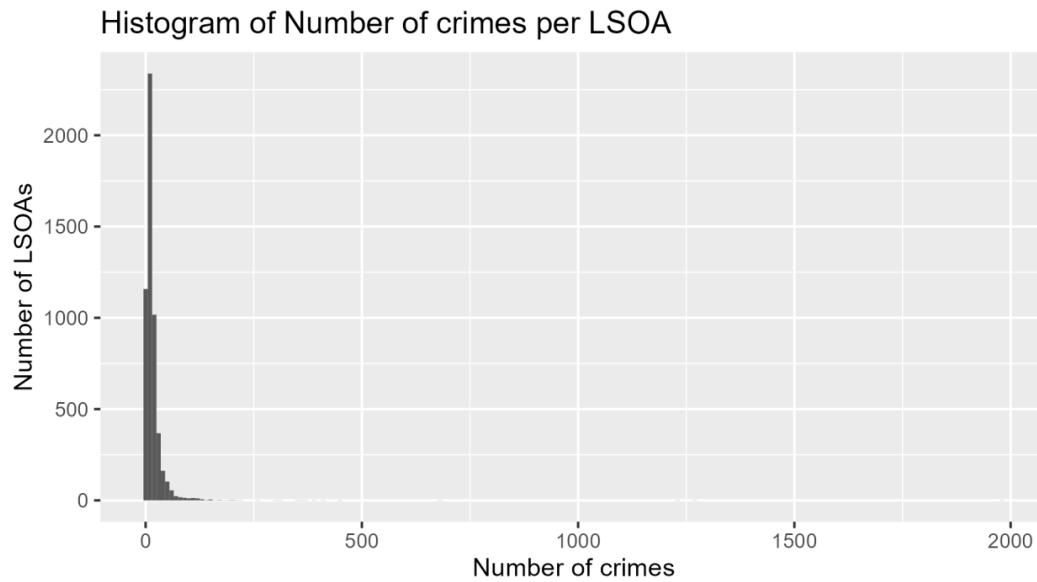


Just code

Visualisation

Statistics

Implementation: Data analysis in RStudio



Implementation: Data analysis in RStudio

Statistics

```
```{r stats}
summary(ncrimes$n)
```
```

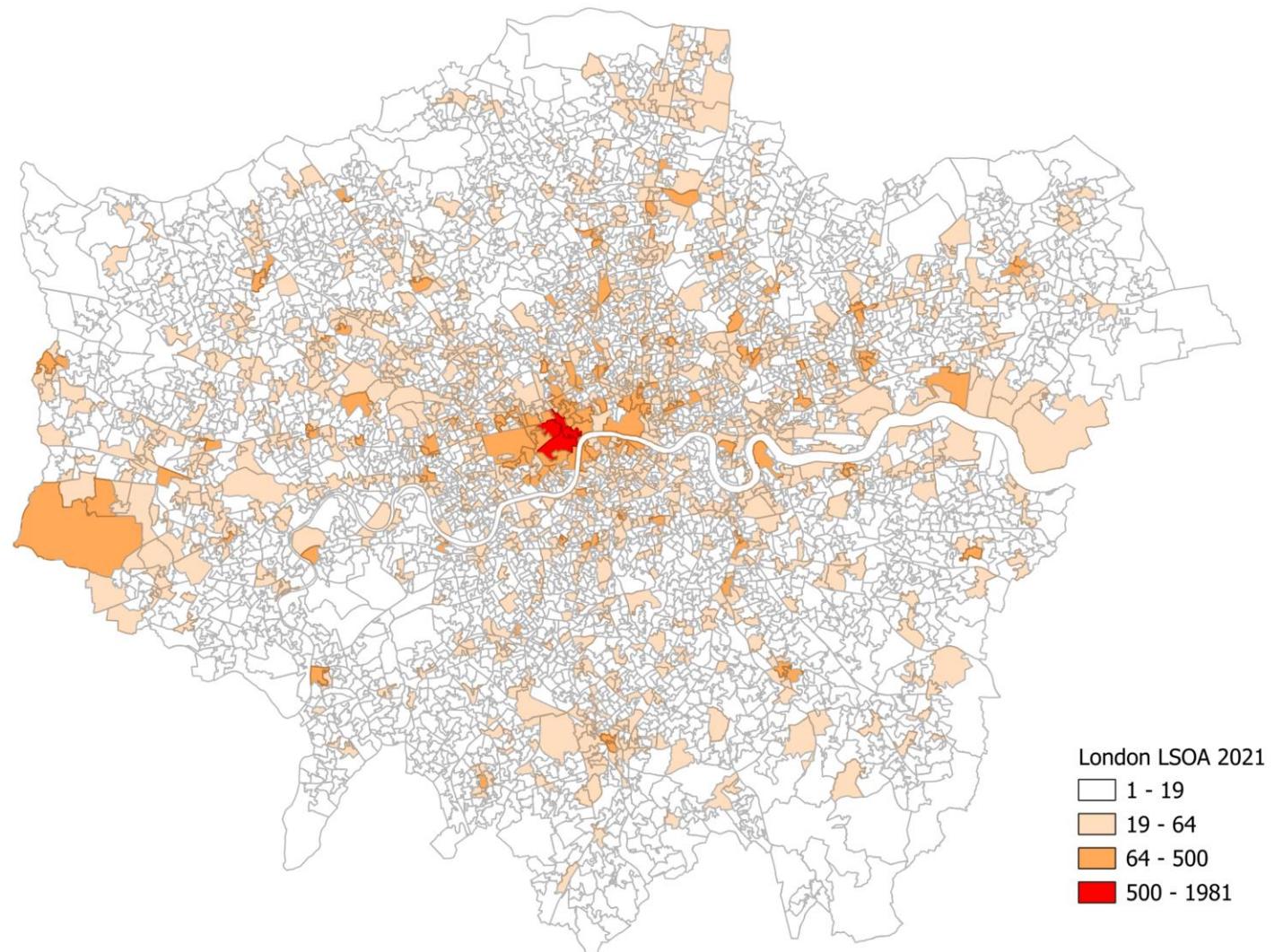
| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|------|---------|--------|------|---------|--------|
| 1.0 | 6.0 | 11.0 | 17.4 | 19.0 | 1981.0 |

| LSOAs | Number of crimes | Statistical significance |
|-------|------------------|-----------------------------|
| 381 | 1 | Minimum value (first 7.15%) |
| 245 | 11 | Median |
| 3660 | 2 - 19 | Between the 2.5% and 75% |
| 1149 | 20 - 63 | Between the 75% and 97.5% |
| 135 | 64-1981 | Above the 97.5% |
| 4 | 679 - 1981 | Outliers (larger than 500) |
| 5325 | 1 - 1981 | Total |

| LSOA code | n |
|-----------|------|
| E01004734 | 1271 |
| E01004736 | 679 |
| E01004763 | 1231 |
| E01035716 | 1981 |

Implementation: Spatial visualisation in QGIS

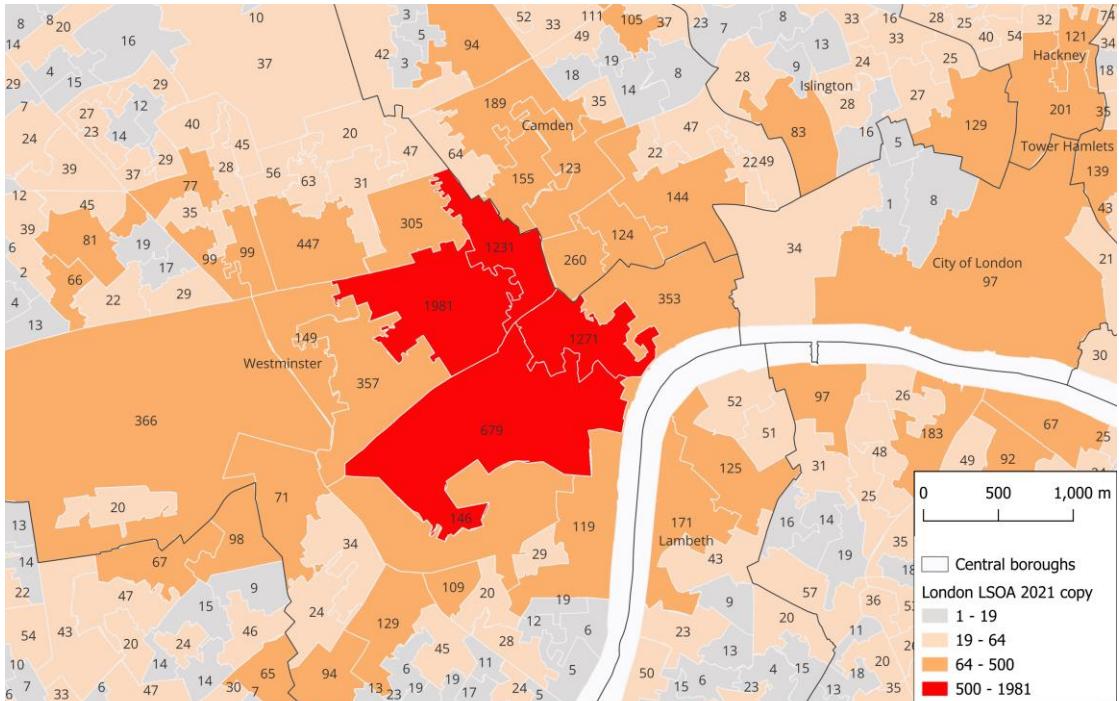
Thematic map



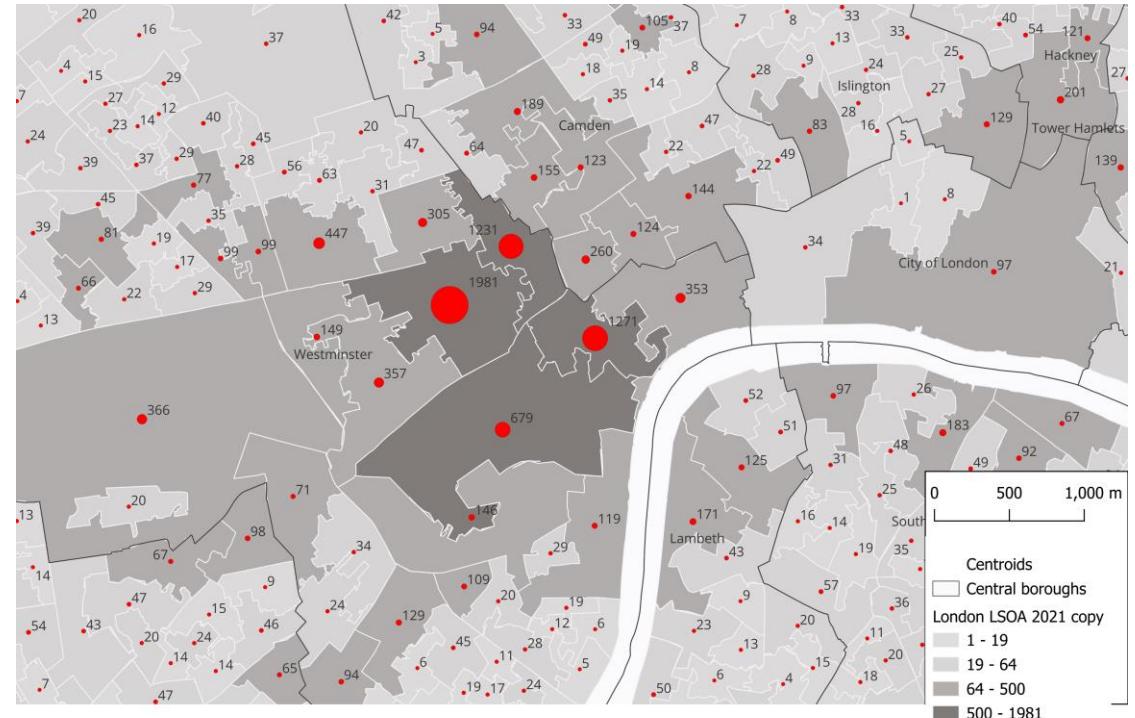
Number of crimes reported by LSOA, manually graduated
Metropolitan Police, December 2023

Implementation: Spatial visualisation in QGIS

Closer look



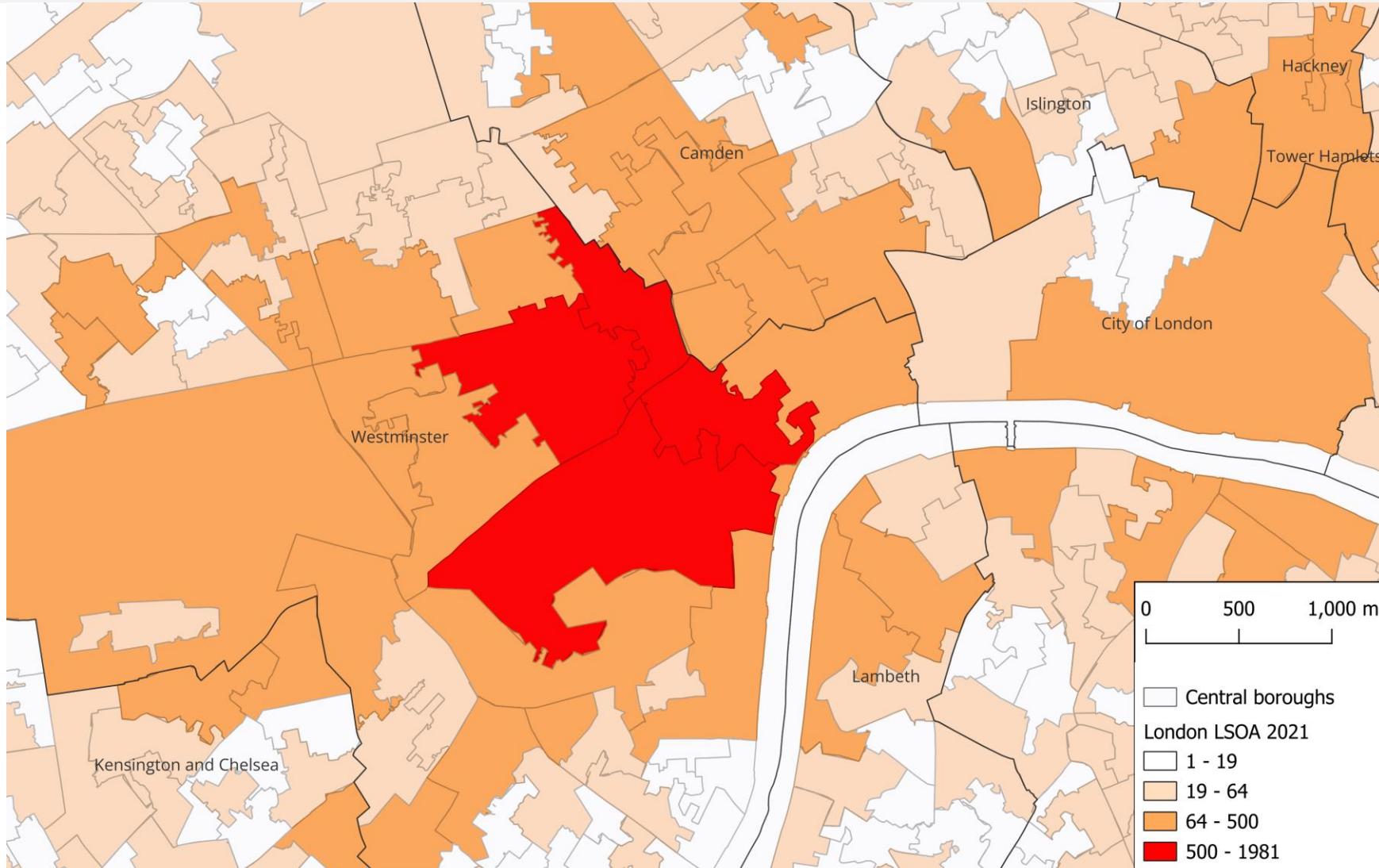
Visualisation of the LSOAs in London with the largest number of reported crimes.
Metropolitan Police, December 2023



Visualisation of the LSOAs in London with the largest number of reported crimes.
Metropolitan Police, December 2023

Irregularity of LSOAs make hard to put labels

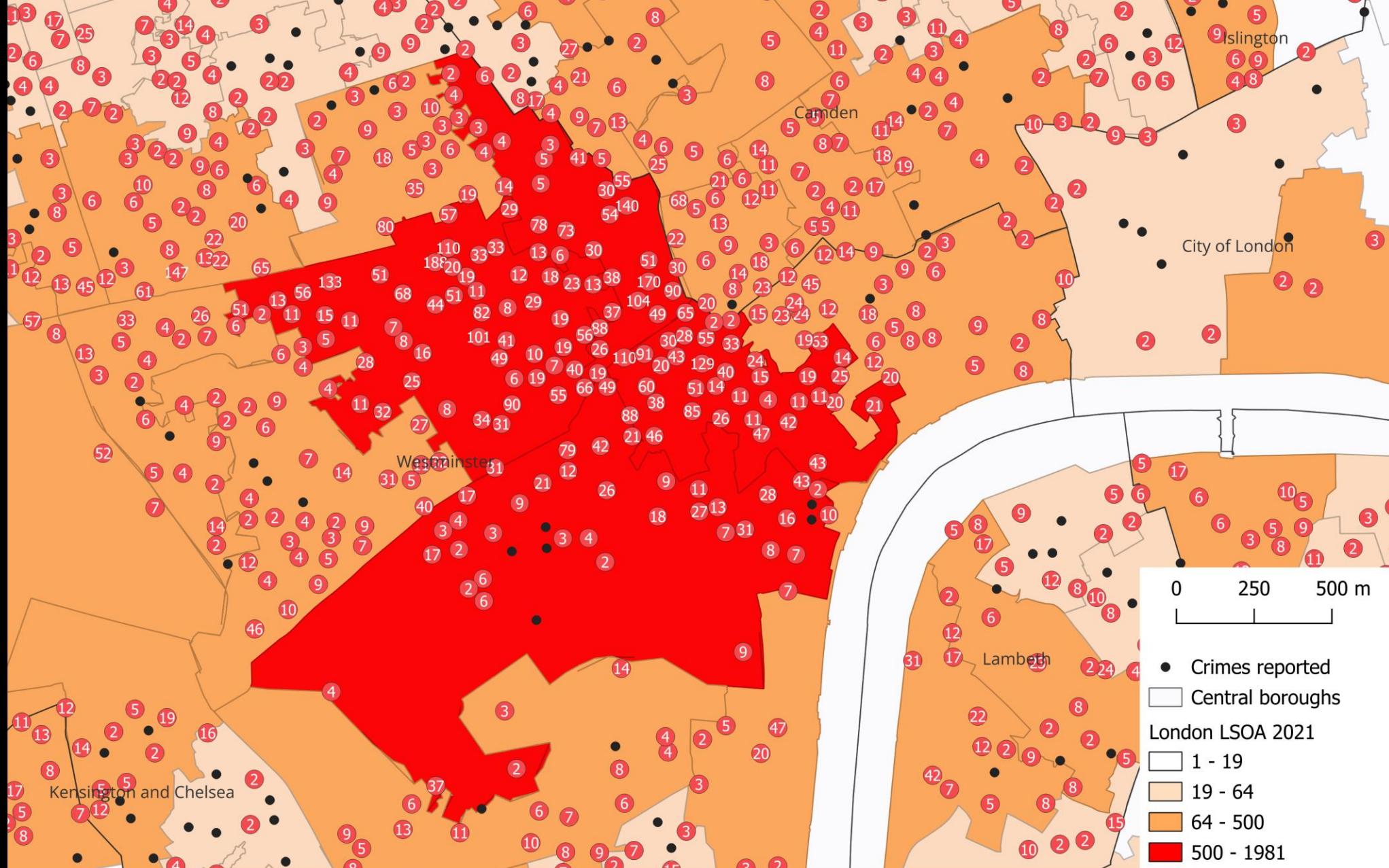
Implementation: Spatial visualisation in QGIS



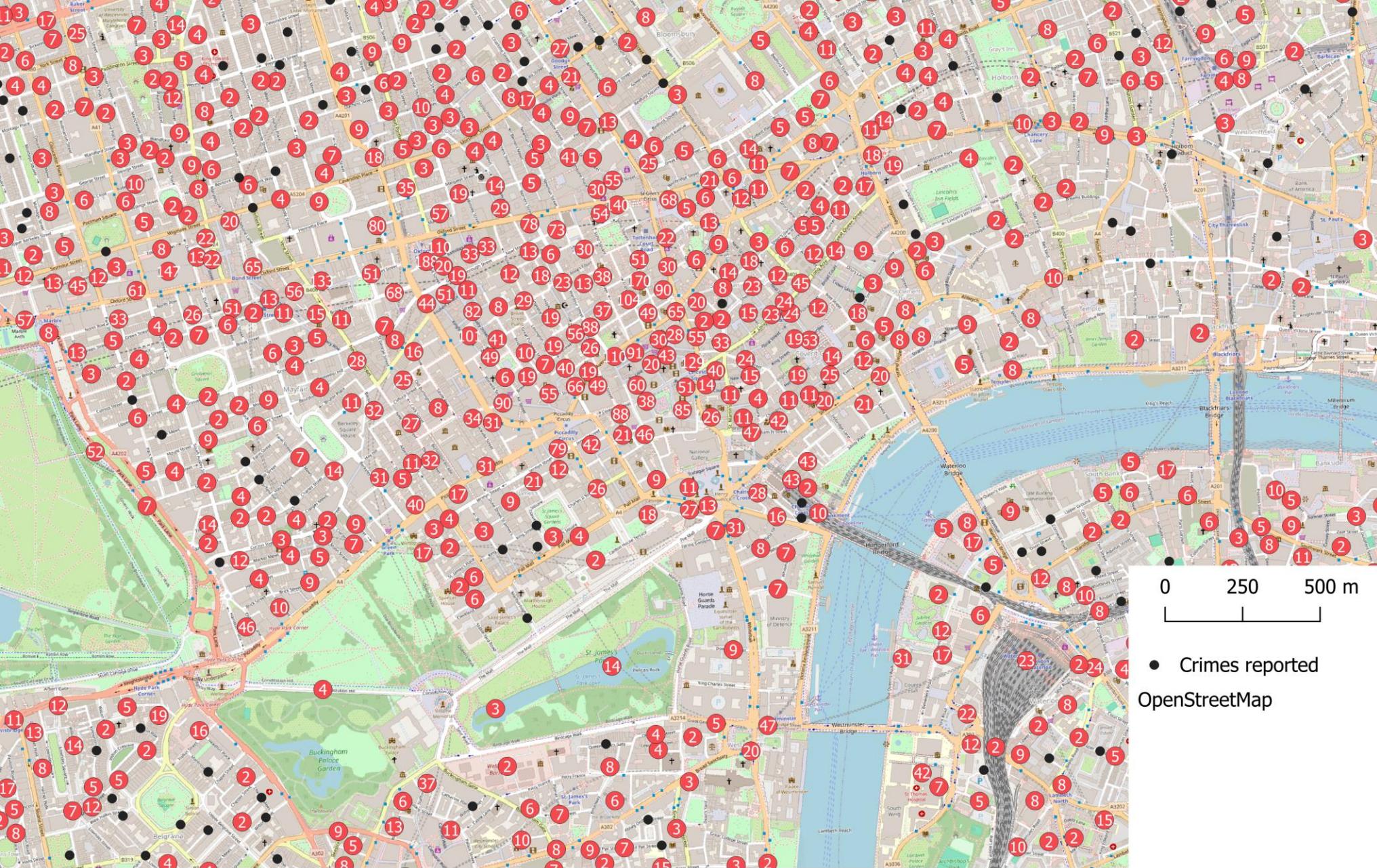
Tobler's Law

Ecological fallacy

Pareto principle



Visualisation of the LSOAs in London with the largest number of reported crimes, and point clusters.
Metropolitan Police, December 2023



Visualisation of reported crimes in central London.
Metropolitan Police, December 2023

Results and Discussion

| Discussion | Future work |
|---------------------------------|---|
| Points map of Thematic map | <ul style="list-style-type: none">- Points: Westminster can be studied at a closer scale, considering neighborhoods or geographic features.- Thematic: If we are studying by boroughs or comparing areas. |
| How to select the areas to show | Depending on the topic, LSOAs helped in a first understanding of the data, separating the data by crime types may need other selection in the areas to show. |
| Count or rate | <ul style="list-style-type: none">- We need to know what crime type is being studied, to choose an adequate target population and compare the rates.- Don't forget the floating populations in city centres. |
| Which symbology | <ul style="list-style-type: none">- Centroids are good at a big scale, like few events per borough.- Clusters are better to show many events in close locations.- Graduated show better the change in quantity instead of categories. |
| Which software | Understanding the data and its magnitude first would help to choose an adequate software |

Conclusions

- Great database → great responsibility
- What are we dealing with → What we want to show?
- Theory backing up hypotheses

References

- Johnson, S. D. (2017). Crime mapping and spatial analysis. In R. Wortley, & M. Townsley, *Environmental Criminology and Crime Analysis* (pp. 199-223). New York: Routledge.
- London Datastore (no date). *Statistical GIS Boundary Files for London*. Available at <https://data.london.gov.uk/dataset/statistical-gis-boundary-files-london> (Accessed: February 2024)
- Metropolitan Police (no date). *Data Downloads*. Available at <https://data.police.uk/data/archive/> (Accessed: February 2024)
- Open Geography Portal (no date). *Lower layer Super Output Areas (December 2021) Boundaries EW BFC V8*. Available at https://geoportal.statistics.gov.uk/datasets/bb427d36197443959de8a1462c8f1c55_0/explore?location=51.473249%2C-0.048998%2C10.00 (Accessed: February 2024)