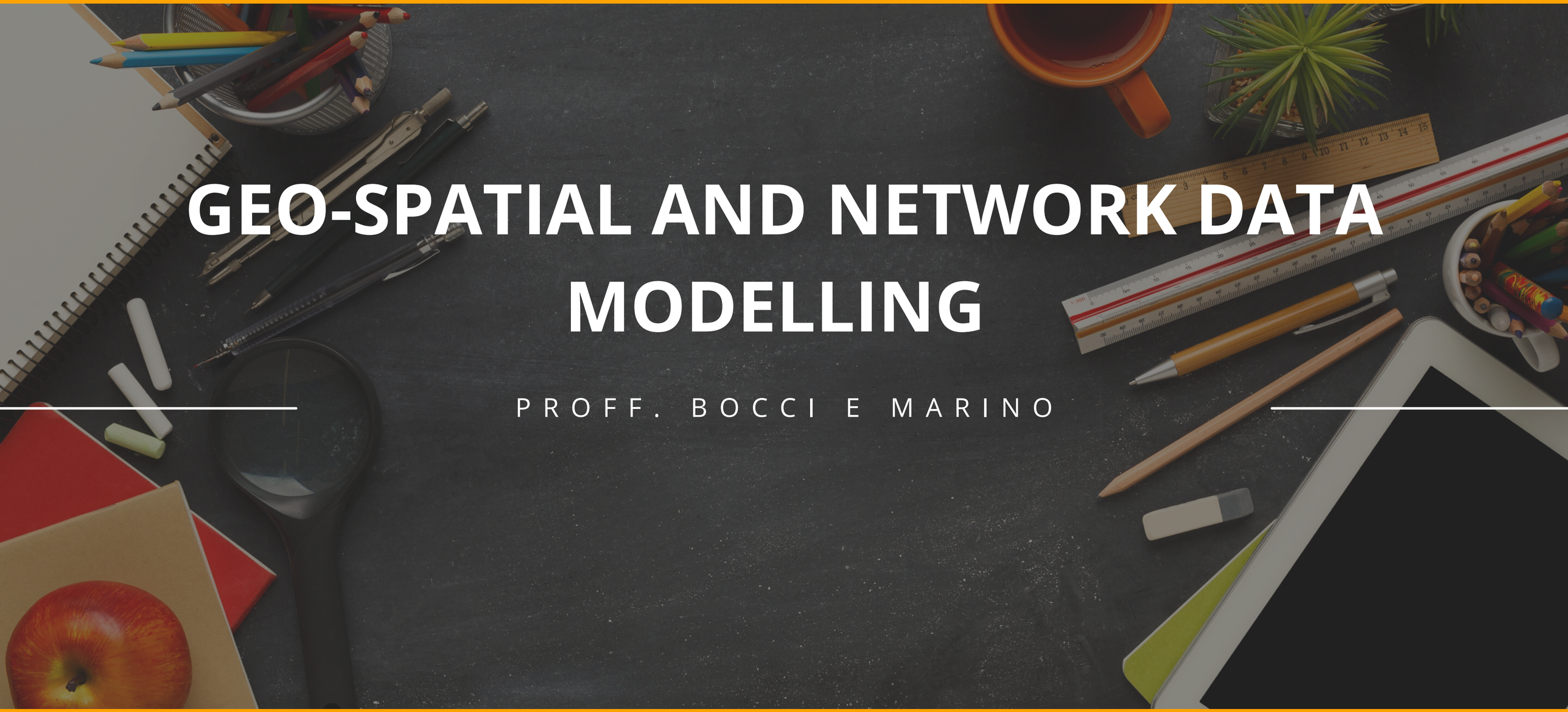


GEO-SPATIAL AND NETWORK DATA MODELLING

PROFF. BOCCI E MARINO

Brexit - EU Referendum Results

In 2016, the United Kingdom ran a referendum to decide whether to remain in the European Union or to leave the club, the so called “Brexit” vote. I used the official data from the Electoral Commission at the local authority level on percentage of votes for the Remain and Leave campaigns. There are two distinct datasets that I combined:

- Electoral Commission data on vote percentages at the local authority level.
- ONS Local Authority Districts (December 2016) Generalized Clipped Boundaries in the UK WGS84.

England

Leave **53.4%**
15,188,406 VOTES

Remain **46.6%**
13,266,996 VOTES

Counting complete

Turnout: 73.0%

Northern Ireland

Leave **44.2%**
349,442 VOTES

Remain **55.8%**
440,707 VOTES

Counting complete

Turnout: 62.7%

Scotland

Leave **38.0%**
1,018,322 VOTES

Remain **62.0%**
1,661,191 VOTES

Counting complete

Turnout: 67.2%

Wales

Leave **52.5%**
854,572 VOTES

Remain **47.5%**
772,347 VOTES

Counting complete

Turnout: 71.7%

UK votes to **LEAVE** the EU

Leave
51.9%
17,410,742 VOTES

Remain
48.1%
16,141,241 VOTES

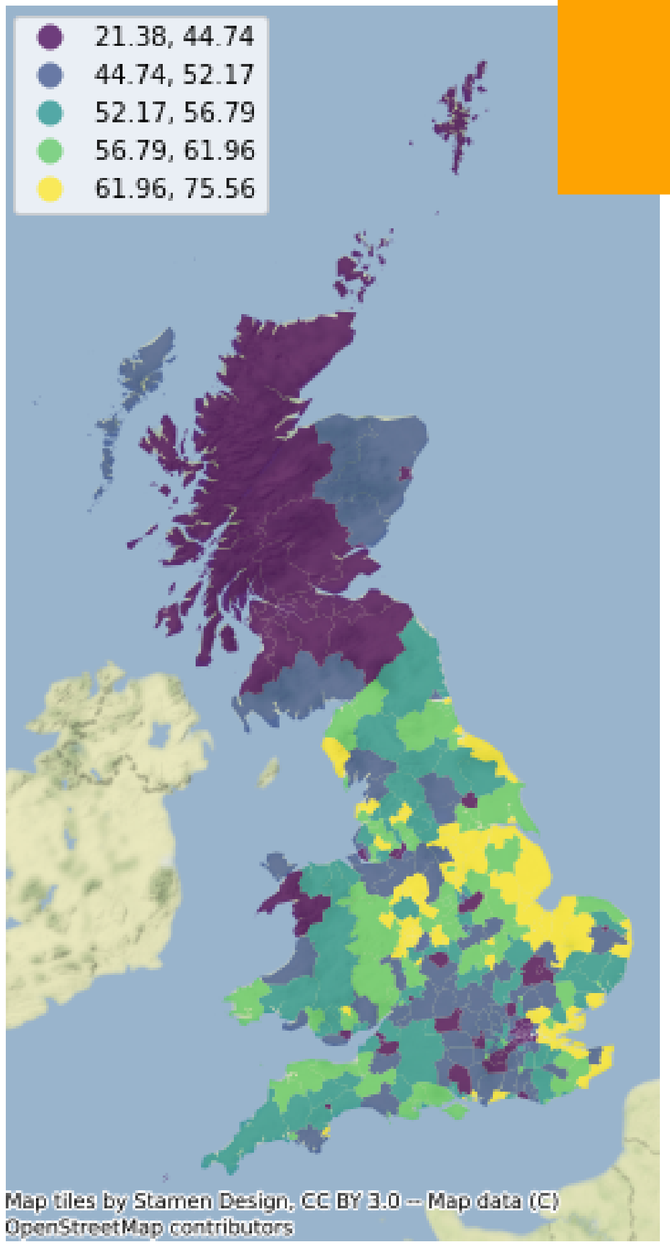
Results

The UK has voted to leave the EU by 52% to 48%. Leave won the majority of votes in England and Wales, while every council in Scotland saw Remain majorities

The proportion of votes for the Leave alternative

The map above is a good way to begin exploring the main spatial patterns in the data.

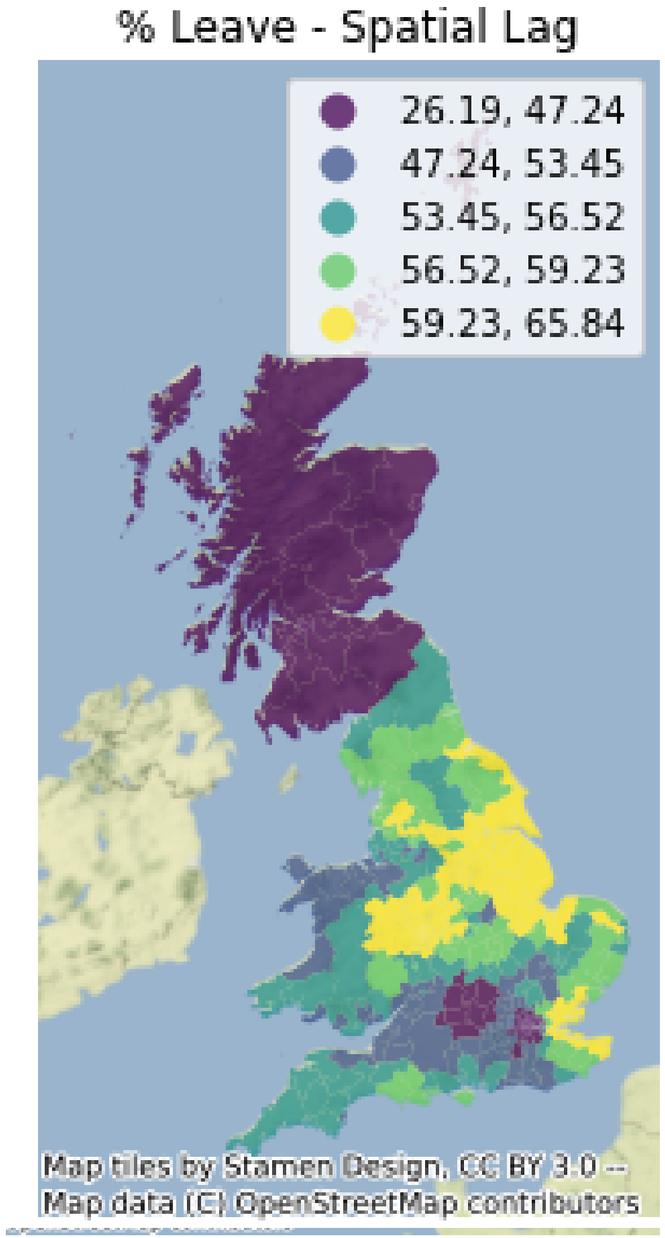
At first sight, it appears to display a fair amount of positive spatial autocorrelation: local authorities with high percentages of votes to leave the EU tend to be next to each other (see, for instance, the eastern region), as are those where a much smaller proportion of their population voted to leave (with Scotland being a good example in the north)



Map with Spatial Lag

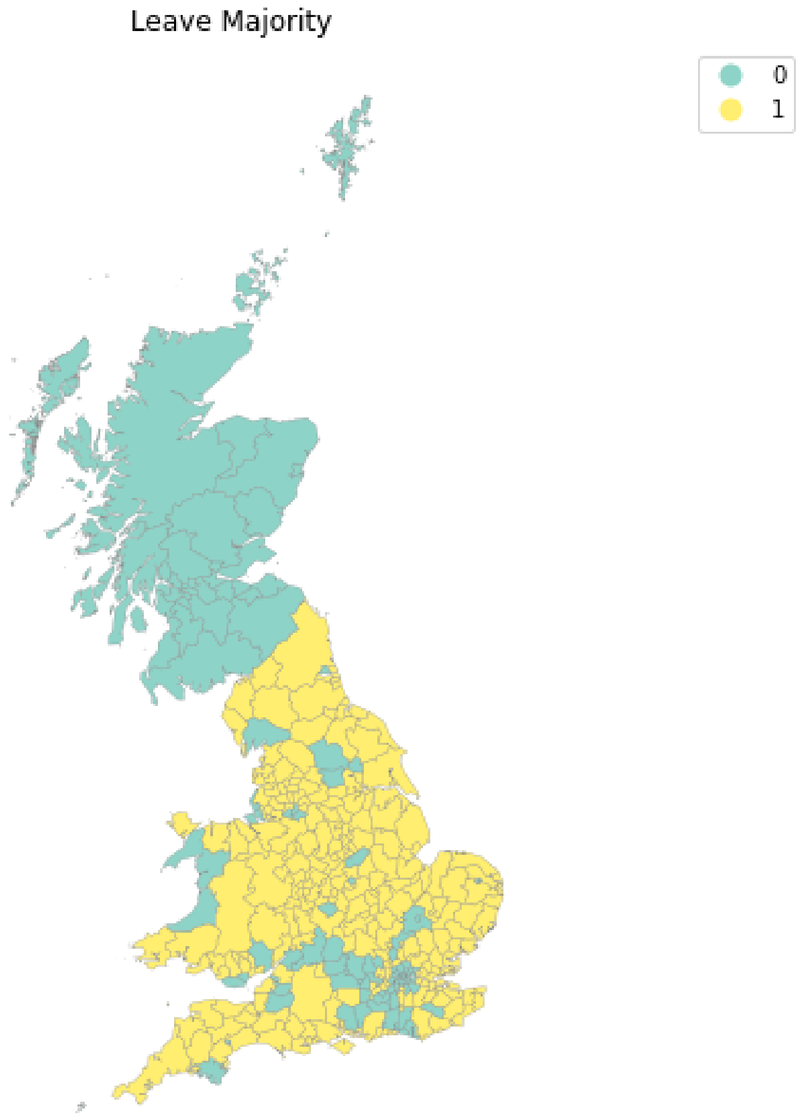
The spatial lag can also smooth out the differences between nearby observations.

The spatial lag can be viewed a “local average,” the average value of Y in the neighborhood of each observation i.



The proportion of votes for the Leave alternative > 50%

Visually, it appears that the map represents a clear case of positive spatial autocorrelation: overall, there are few visible cases where a given observation is surrounded by others in the opposite category.

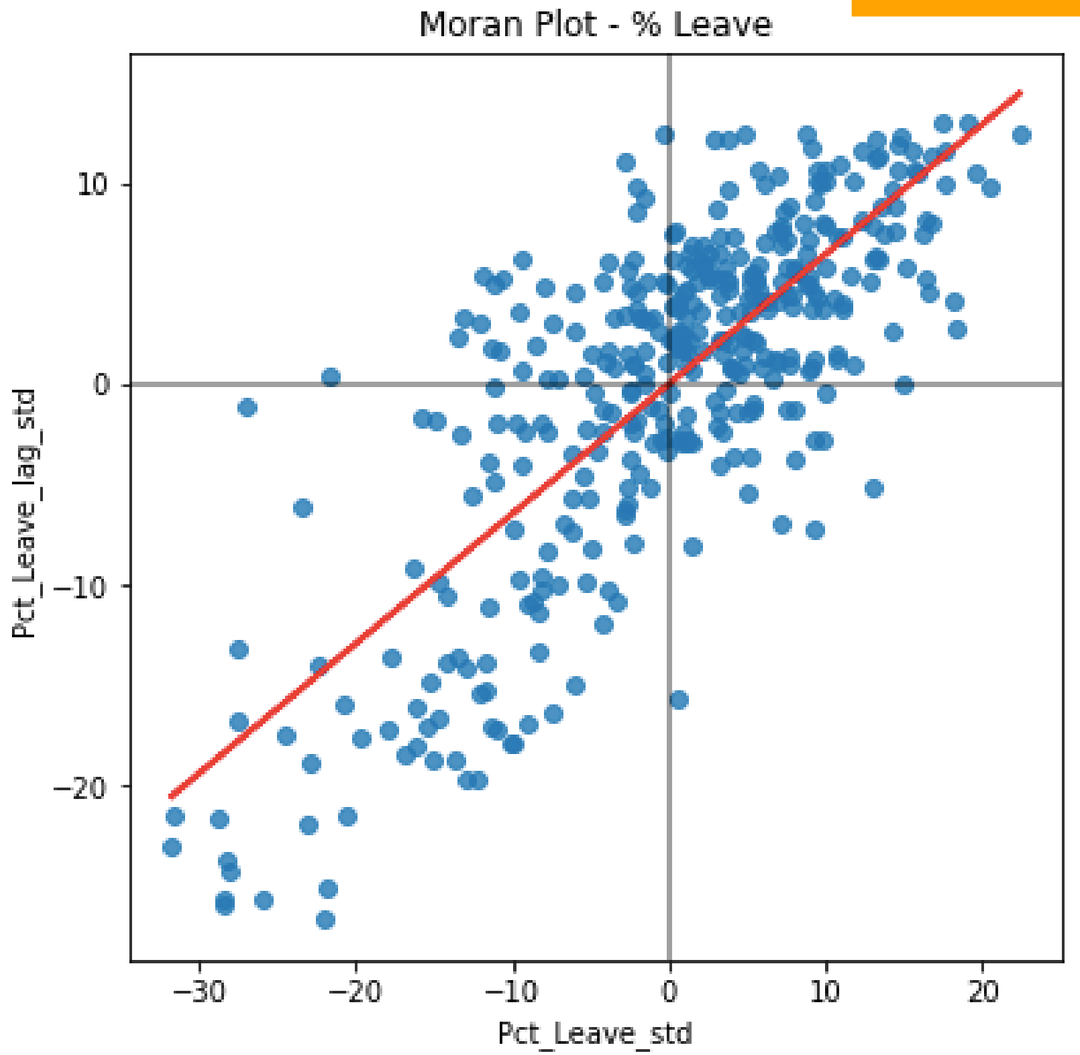


Moran Plot - % Leave

The plot displays a positive relationship between both variables. This is indicates the presence of positive spatial autocorrelation: similar values tend to be located close to each other. This means that the overall trend is for high values to be close to other high values, and for low values to be surrounded by other low values.

Local authorities where people voted in high proportion to leave the EU tend to be located nearby other regions that also registered high proportions of Leave vote. In other words, we can say the percentage of Leave votes is spatially autocorrelated in a positive way.

Moran I = 0.65

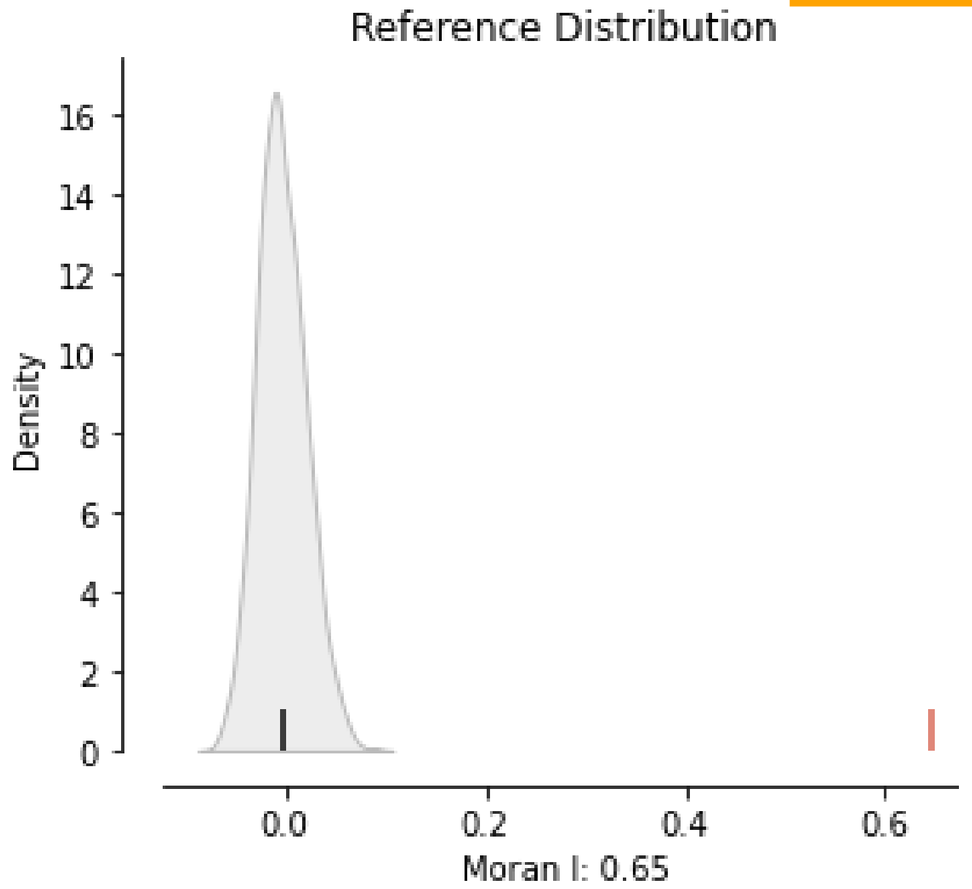


Empirical p-value

The value is calculated as an empirical p-value that represents the proportion of realizations in the simulation under spatial randomness that are more extreme than the observed value

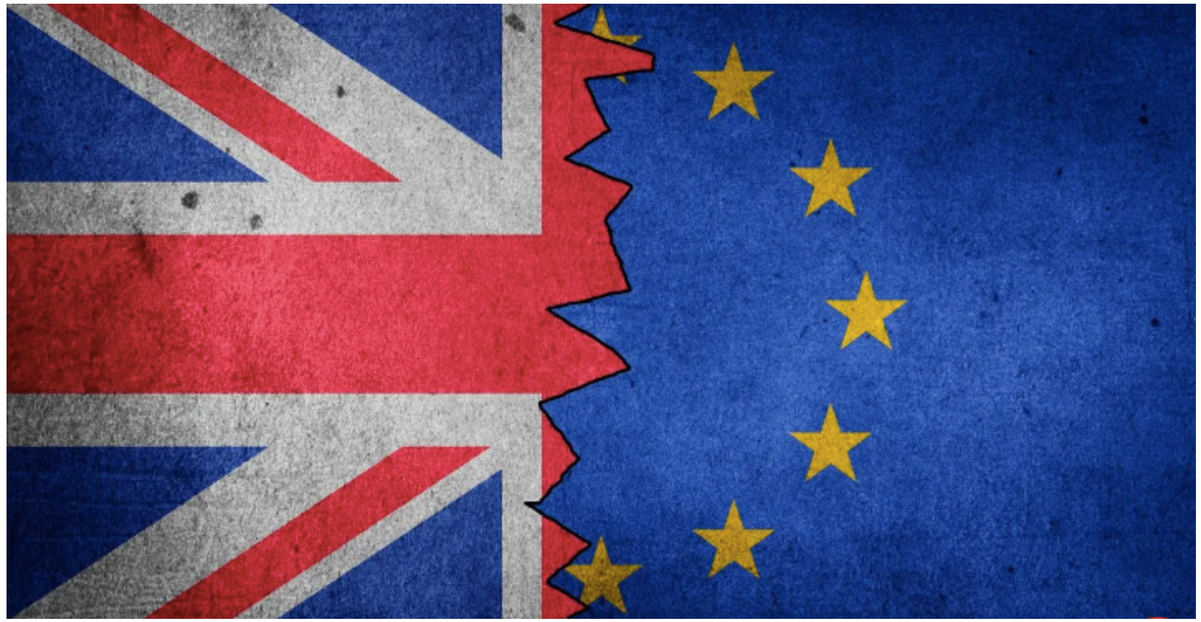
Moran Empirical p-value = 0.001

A small enough p-value associated with the Moran's I of a map allows to reject the hypothesis that the map is random. In other words, we can conclude that the map displays more spatial pattern than we would expect if the values had been randomly allocated to a locations



Global Evaluation

As a first step, the global autocorrelation analysis can teach us that observations do seem to be positively autocorrelated over space. Indeed, the overall spatial pattern in the EU Referendum vote was highly marked: nearby areas tended to vote alike.

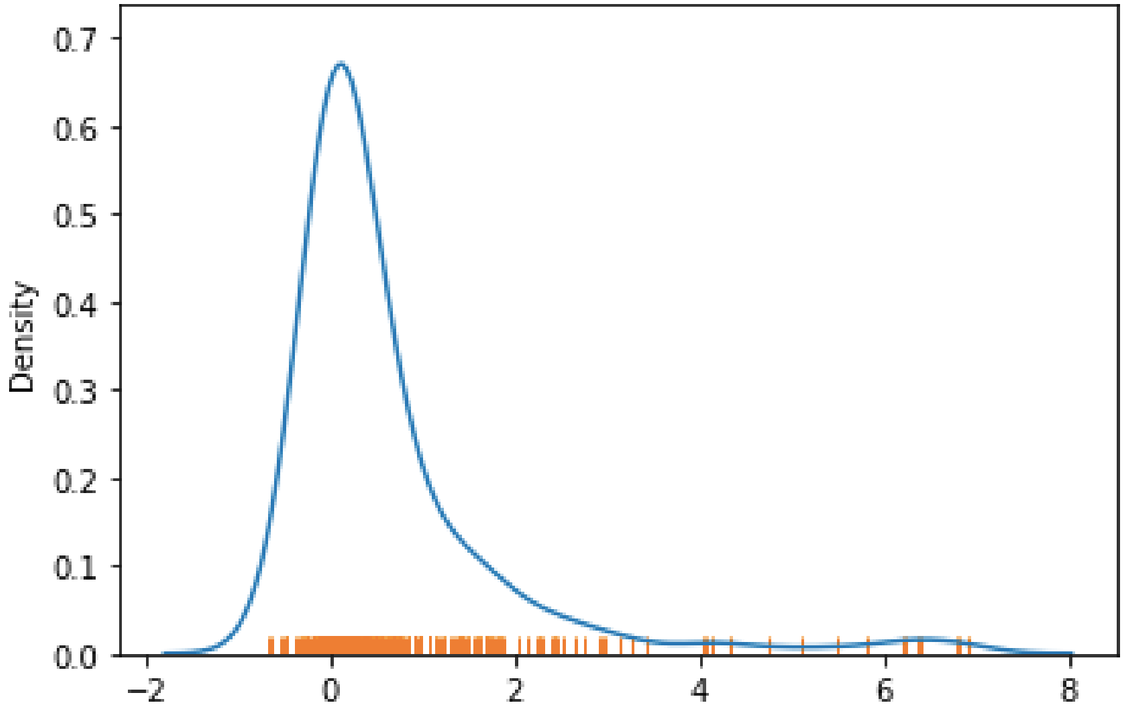


Local Moran

The figure reveals a rather skewed distribution of local Moran's statistics.

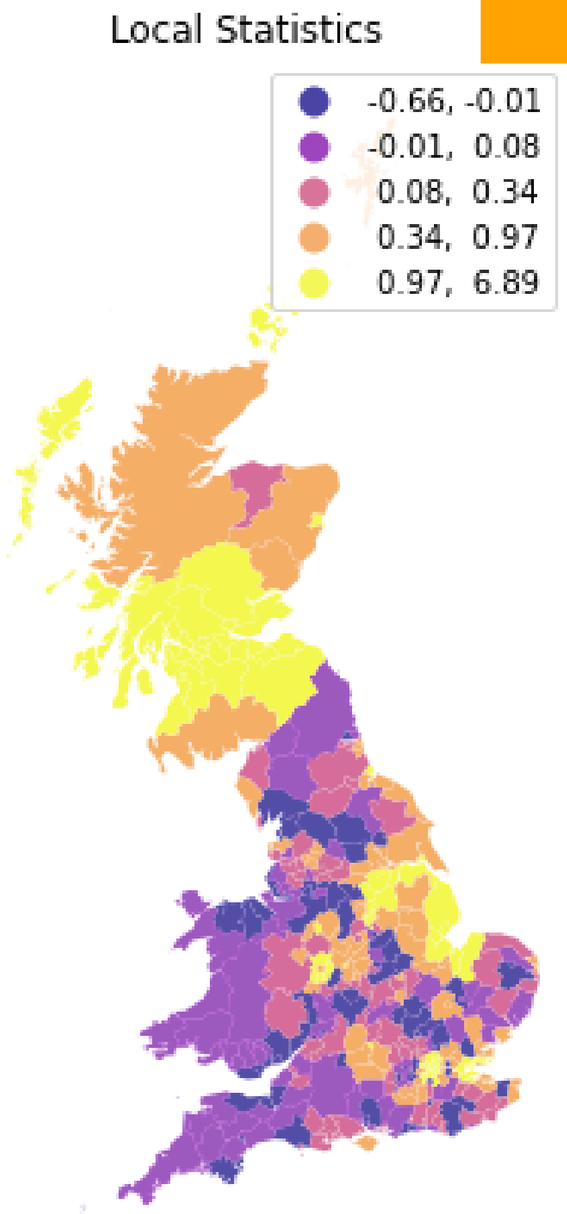
This outcome is due to the dominance of positive forms of spatial association, implying most of the local statistic values will be positive. Here it is important to keep in mind that the high positive values arise from value similarity in space, and this can be due to either high values being next to high values or low values next to low values.

The local Moran values alone cannot distinguish these two cases.



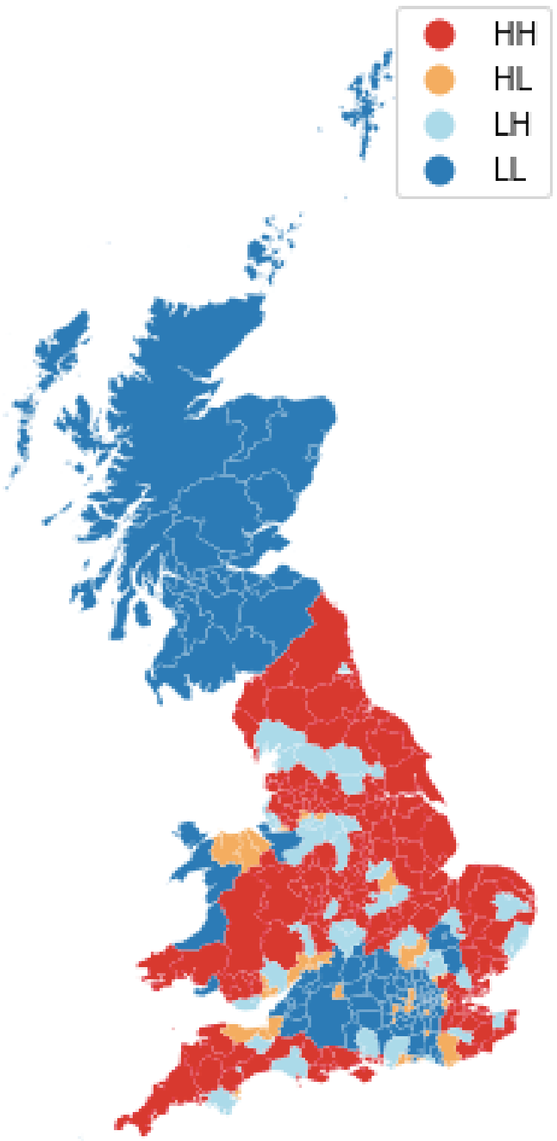
Local Moran

The purple and yellow locations in the map display the largest magnitude (positive and negative values) for the local statistics. This map thus cannot distinguish between areas with low support for the Brexit vote and those highly in favour.



Local Moran

The map shows the location of the LISA statistic in the quadrant of the Moran Scatter plot. This indicates whether the positive (or negative) local association exists within a specific quadrant, such as the High-High quadrant.



Local Moran

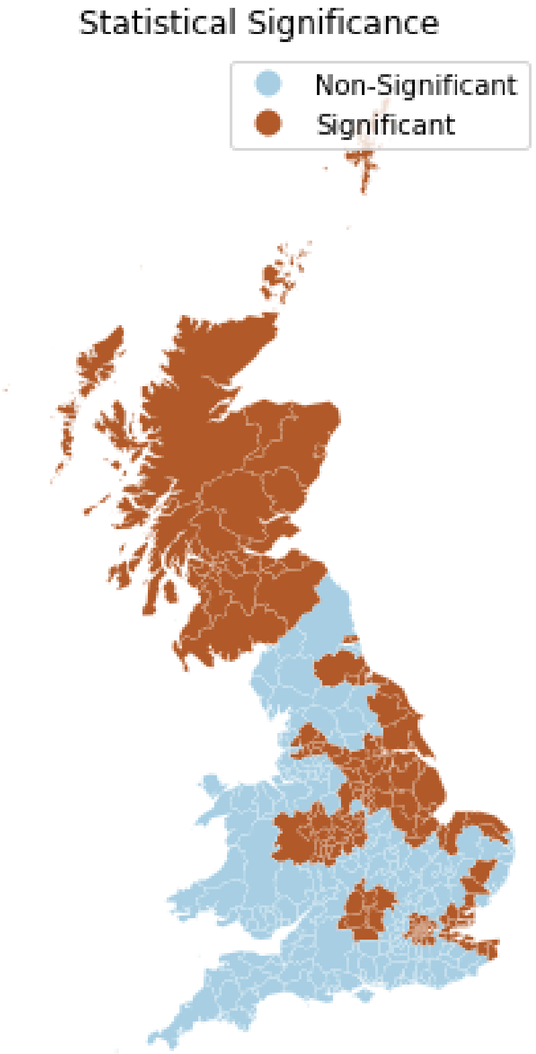
The table and the maps showing that the high-high, and low-low, values are predominant. Care must be taken, however, in the interpretation of these first two maps, as the underlying statistical significance of the local values has not been considered. We have simply mapped the raw LISA value alongside the quadrant in which the local statistic resides.

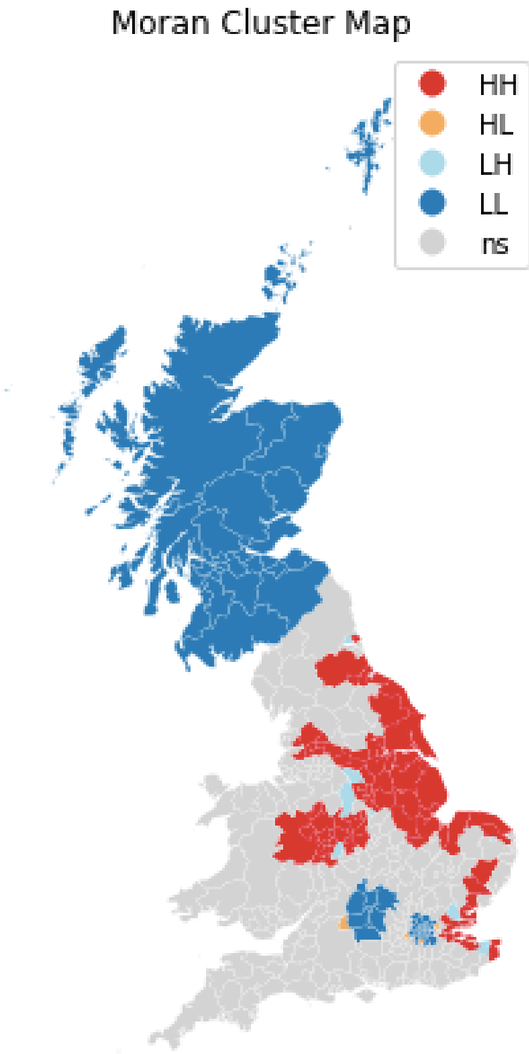
	High	Low
High	**183**	34
Low	50	**113**

Local Moran

To statistical significance, the bottom left map distinguishes those polygons whose pseudo p-value is above (“Non-Significant”) or below (“Significant”) the threshold value of 5% I use in this context.

We could identify three clear areas of low support for leaving the EU: Scotland, London, and the area around Oxford (North-West of London). And third, although there appeared to be many areas with concentrated values indicating high support, it is only the region in the North-East and West of England whose spatial concentration shows enough strength to reasonably rule out pure chance.





Conclusion

- Probable presence of spatial correlation, both globally and locally.
- Three clear areas of low support for leaving the EU: Scotland, London, and the area around Oxford.
- Regions in the North east and West of England indicating high support for Leave.
- Add spatial regressions to the project to add more evaluation dimensions beyond spatial.


THANK YOU!!!