Your Name = [Ankila Kumari] internet_id = [kuma0389]

Time_Spent = [60 mins] (after-class)

GIS 5555 Basic Spatial Analysis

[Windows+Shift+S for screenshot of your analysis]

[Fill the above-listed info and then submit the completed document in Canvas (try to include all analysis results that can help reflect your workflow and thoughts, i.e., images, information about data, your statements, etc.)]

Assignment for Lab 3b

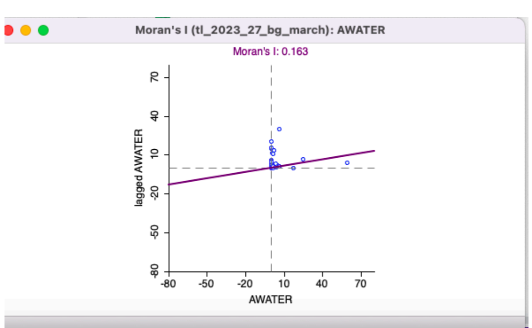
“Global Spatial Autocorrelation”

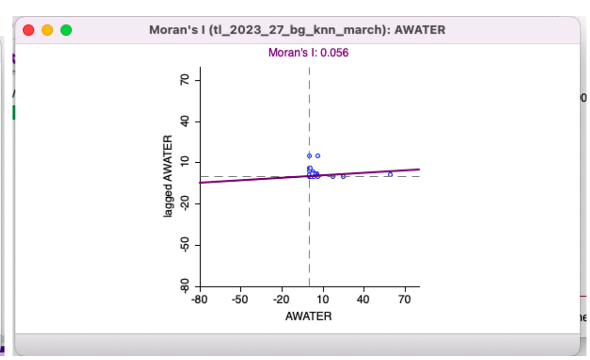
Please choose carefully on your target variable. Conduct EDA mapping if necessary as we hope the selected target variable to exhibit spatial autocorrelation to highlight the purpose of this lab exercice.

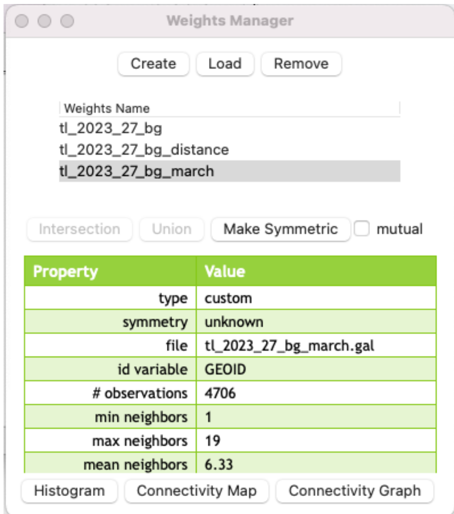
- ***Task 1 Moran’s I from Moran Scatter Plot***
  - *Create a queen spatial weights for your data*
  - *Read the Moran’s I for your target variable from the Moran’s scatterplot*
  - *Use knn spatial weights instead, does the Moran’s I change?*

*In this task, I choose a GEOID variable. I used a **queen contiguity weights matrix**. Then, I created a **Moran scatterplot**, which shows how the AWATER values in one area compared to the average values of its neighbors. The slope of the line in the scatterplot is called **Moran’s I**, which tells us if there’s a pattern (like high values near high values or low values near low values). I also tried using **KNN weights** (a different way to define neighbors) and saw that Moran’s I changed a little, meaning the results can depend on how we define "neighbors."*

Using KNN





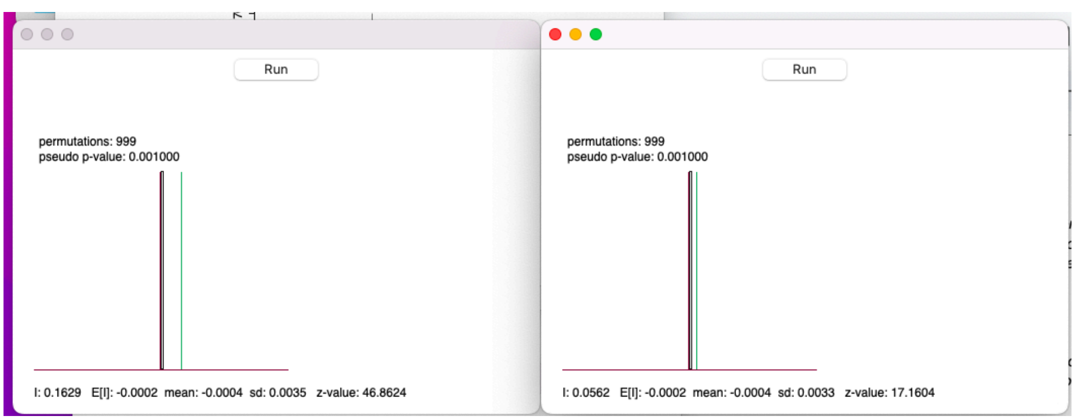


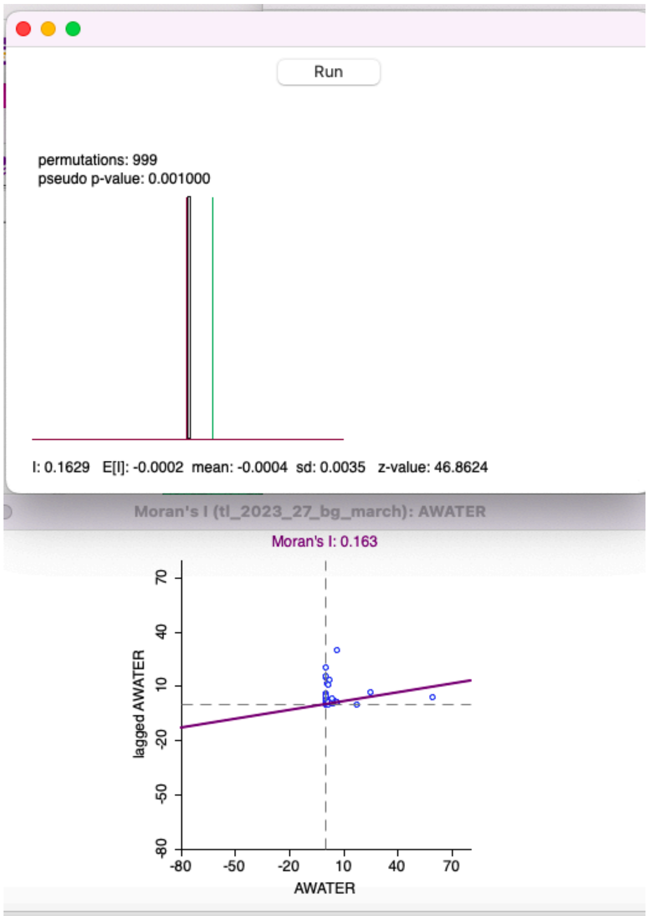
➢ ***Task 2 Significance test under permutation***

- *Under the queen weights, derive the reference distribution of Moran's I with 999 permutations. Explain the stats of the reference distribution.*
- *What's the p-value? How does it imply on the significance level of your spatial autocorrelation?*

  Ans- P-value is 0.001000

- *Under the knn weights, what's the z-scored Moran's I? How do you compare the spatial autocorrelation result using knn weights with the one using the queen weights?*
- *Knn and* *Without Knn -*





Ans- To check if the pattern I found was real or just random, I did a ***permutation test****. This means I shuffled the AWATER values around the map 999 times and calculated Moran's I each time to see what it would look like if there was no pattern. The* ***p-value was 0.001****, which is very small, so the pattern is real and not random. I also tried this with* ***KNN weights****, and the results were similar, showing that the pattern is strong no matter how we define neighbors.*

- ***Task 3 Standardized Spatially lagged variable (Moran scatter plot from scratch)***
  - *Add a new variable which indicates the standardized target variable*
  - *Add a standardized spatially lagged variable based on your standardized target variable using a row-standardized inverse distance spatial weights*
  - *Create a scatterplot with your standardized target variable as the independent var. and the standardized spatially lagged variable as the dependent var.*

Use Linear smoother to read out the Moran's I and LOWESS smoother to identify potential structural breaks.

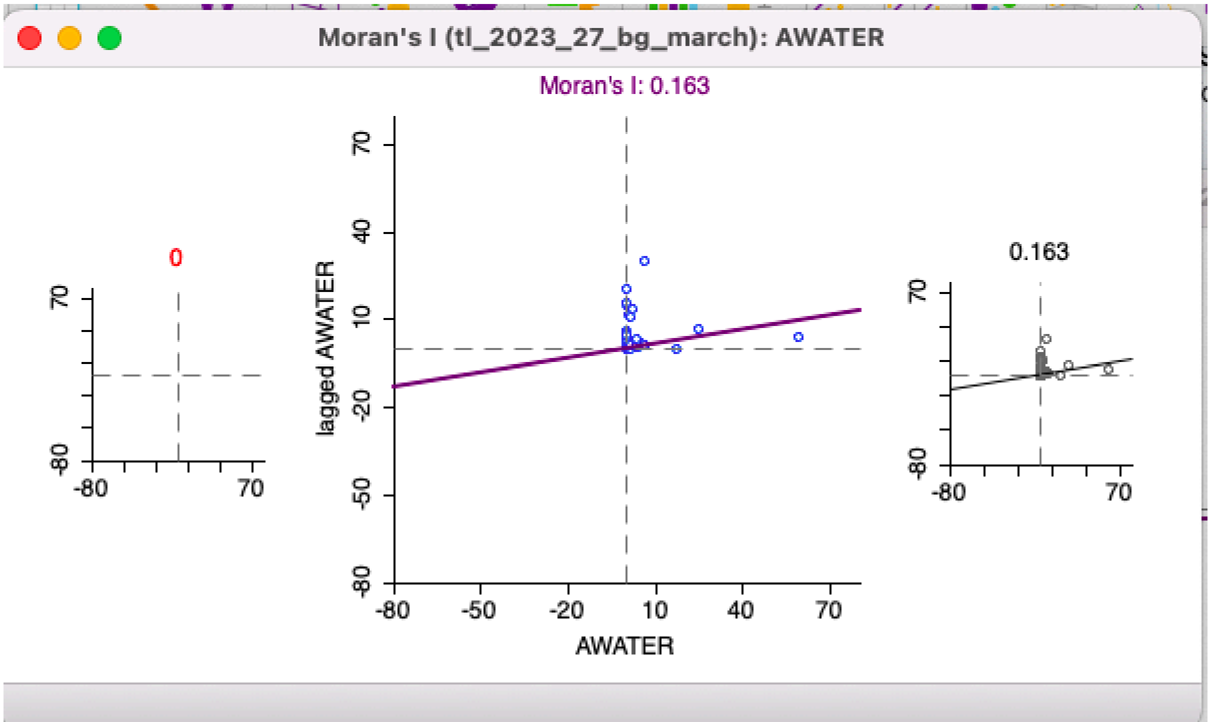


Table - tl_2023_27_bg

	ER	INTPTLAT	INTPTLON	NUM_N_ueen	COORD_X	COORD_Y	Z	Z_LAG
1	0	+44.0521618	-092.4407842	7	-92.440785	44.052162	-0.056991	-3805.303710
2	0	+44.0470838	-092.4980347	3	-92.498035	44.047084	-0.056991	-7268.692077
3	20	+45.5537547	-094.1393030	8	-94.139202	45.554205	-0.055571	-4519.813380
4	41	+46.0789140	-093.1547400	8	-93.146345	46.073511	0.041077	-2.404113
5	19	+45.9390240	-093.1962301	7	-93.204630	45.935257	-0.032180	-39.221158
6	18	+45.0164320	-093.1846115	5	-93.182188	45.015772	-0.056990	-11414.540192
7	0	+44.9468480	-093.0920156	4	-93.092016	44.946848	-0.056991	-57846.516858
8	70	+44.9443374	-093.0904425	9	-93.090893	44.944403	-0.056489	-38058.791033
9	96	+45.1378675	-093.3745295	18	-93.381528	45.139514	-0.056613	-7220.412533
10	46	+45.1120213	-093.3894445	9	-93.384877	45.116458	-0.056897	-9393.672150
11	90	+44.8685741	-093.4424036	8	-93.446153	44.866550	-0.056901	-7881.138803
12	79	+44.8888858	-093.4135066	6	-93.412814	44.888316	-0.056081	-8303.989325
13	96	+44.8817339	-093.4044825	5	-93.403802	44.882755	-0.056697	-8520.117437
14	34	+44.8673421	-093.4022925	5	-93.402236	44.866164	-0.056902	-7266.526701
15	0	+45.1263670	-093.3668735	6	-93.366874	45.126367	-0.056991	-10124.320871
16	0	+45.1454247	-093.2870982	6	-93.287098	45.145425	-0.056991	-10148.901921
17	59	+45.1327340	-093.2233885	10	-93.222900	45.130676	-0.055866	-7356.452893
18	39	+45.1528015	-093.2589245	7	-93.259747	45.153078	-0.056156	-12102.882070
19	11	+45.1466629	-093.0954501	5	-93.095554	45.151842	-0.036634	-3478.430255
20	61	+45.1830634	-093.3602780	5	-93.360407	45.183888	-0.056975	-8935.224270
21	0	+45.1798296	-093.3454438	7	-93.345444	45.179830	-0.056991	-8377.718930

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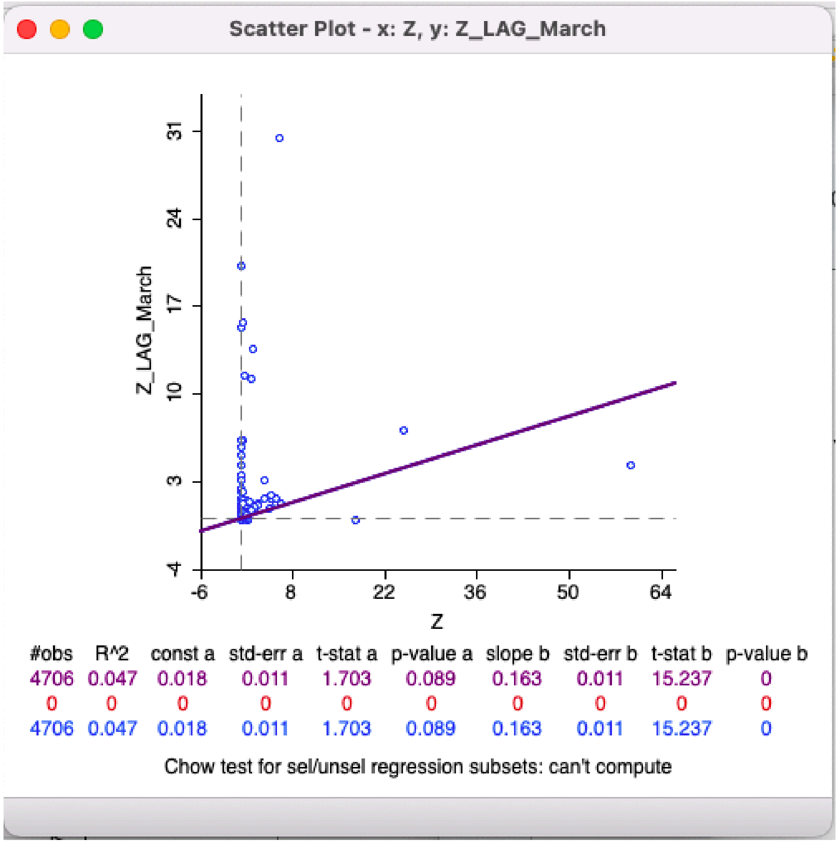
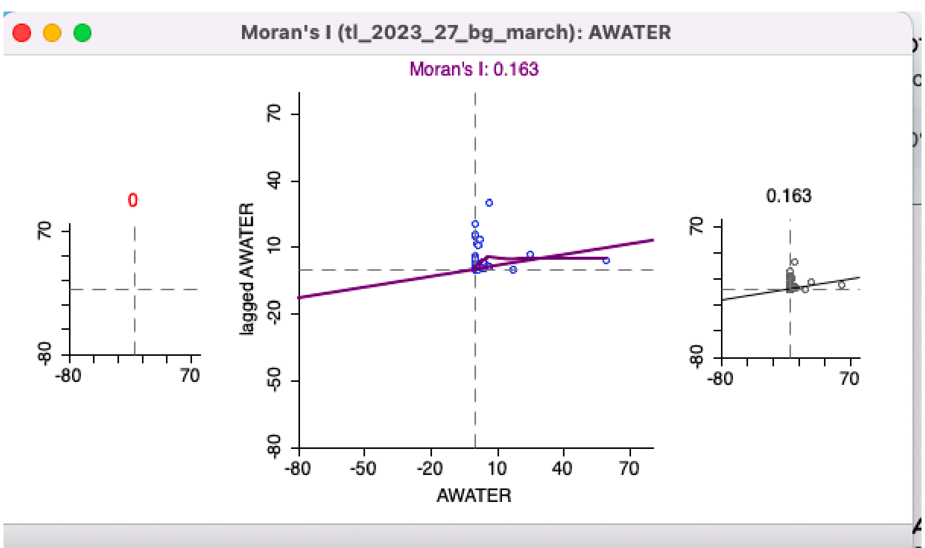
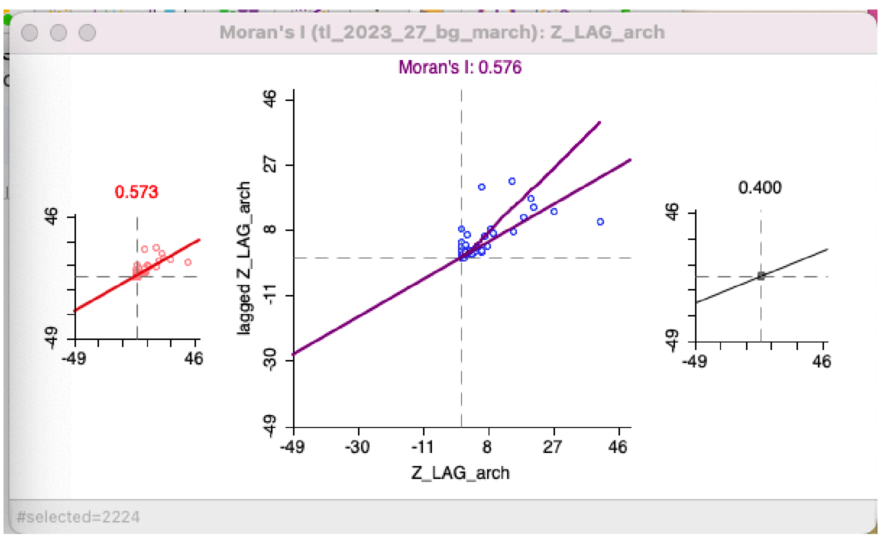


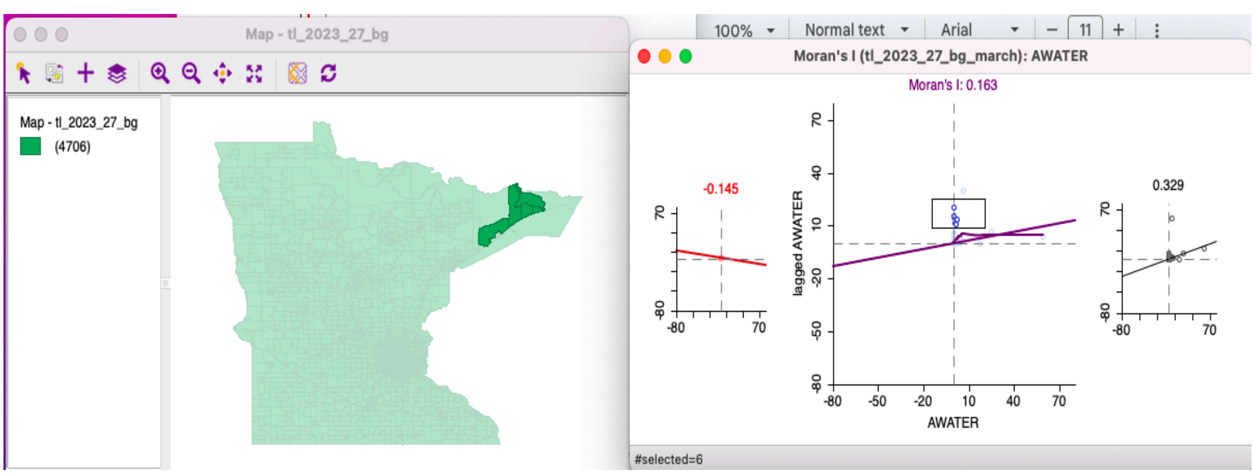


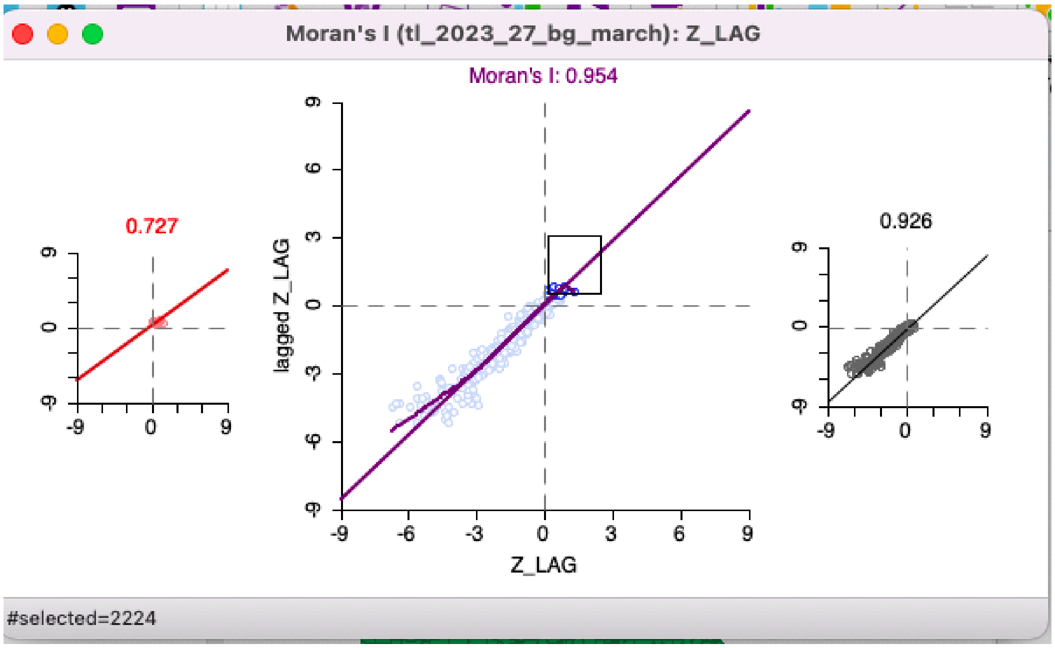
lowless smoother

*Next, I standardized the AWATER variable and calculated its **spatially lagged version** (the average of neighboring values). I made a scatterplot to compare the original AWATER* *values to their lagged values. A straight line through the points gave me Moran's I, and a curved line (called **LOWESS smoother**) helped me see if the pattern changes at different values. This showed that the pattern is mostly consistent, but there might be some unusual areas where it breaks down.*

- ***Task 4 Assess regionalized spatial autocorrelation***
  - *Show the three moran scatter plots when you call the regimes regression in Moran scatter plot options*
  - *Try to select a subset of your observations that suggests very little spatial autocorrelation (Moran's I ~ 0) among your target variable*
  - *Try to select a subset of your observations that suggests similar spatial autocorrelation to your global pattern (Moran's I)*





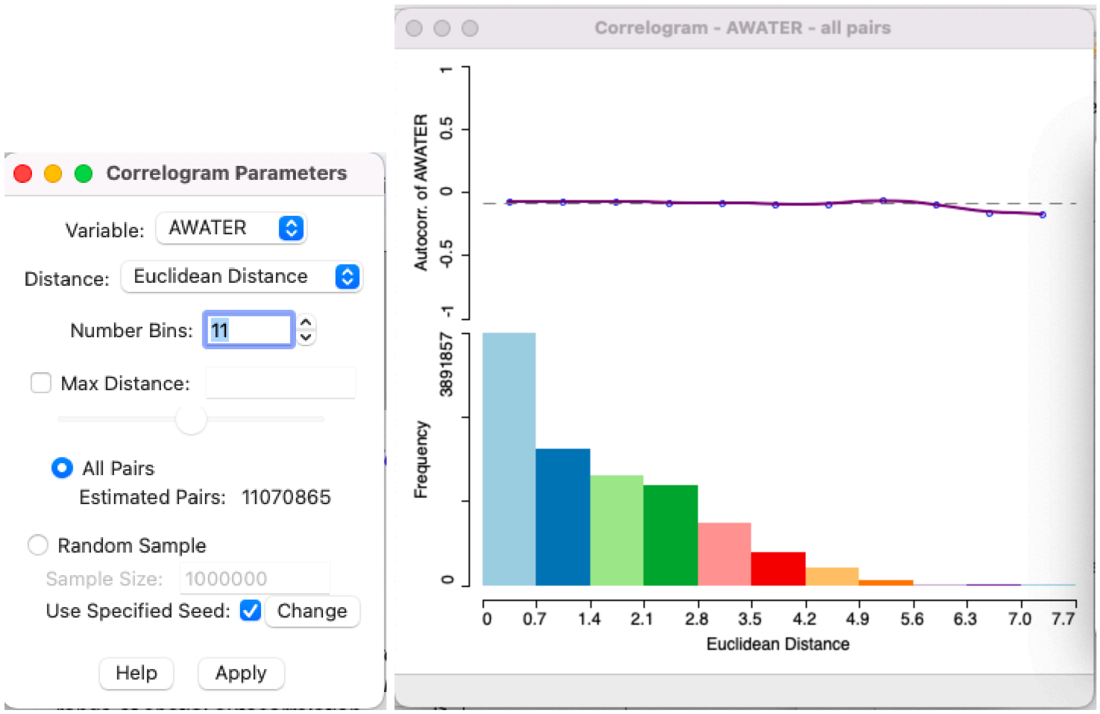


Ans- I wanted to see if the pattern was the same across the whole map or if it changed in different regions. I used a tool called regimes regression to split the data into smaller groups and calculate Moran's I for each group. Some groups had no pattern (Moran's I ≈ 0), while others had a pattern similar to the whole map. This means the strength of the pattern can vary depending on where you look.Created two variables in table "Z_LAG_ARCH" and "Z_LAG" and Choose AWATER.

- ***Task 5 Spatial Correlogram***
  - *Create a spatial correlogram on your target variable*
  - *Change the number of distance bins and identify the distance that suggests the range of spatial autocorrelation.*

*Ans- Finally, I created a **spatial correlogram** to see how the pattern changes with distance. The correlogram shows that areas close to each other tend to have similar AWATER values, but as you move farther apart, the similarity decreases. By adjusting the **number of distance bins**, I found that the pattern fades out. This tells us how far the influence of one area's AWATER value extends.*

I am showing the difference between Distance Number Bins (11) and (16).



Change the number of distance bins