Assignment 2 - GGR376

Interpolation

Dr. Adams

Interpolation

When conducting interpolation the key steps include:

1. Method Selection
2. Initial parameter selection (e.g. k)
3. Fit Variogram (if kriging)
4. Cross-Validate
5. Iterate parameters / variogram models
6. Prediction

Assignment Format:

The assignment submission will be composed of two files.

1. An R script of your code to complete the assignment, with the .R file extension. (5 Marks)
2. Answers to the questions listed below in a PDF file. (29 Marks)

Challenge 1: IDW

Estimate with IDW interpolation a set of points (Prediction Locations) using rainfall observations (Projection: UTM 17 N). You are provided on blackboard:

- Rainfall Observations: 2018_rainfall_observations.csv
- Rainfall Prediction Locations: 2018_rainfall_prediction_locations.csv

You will need to test and cross-validate the following IDW exponent values: 1.5, 1.75, 2, 2.25, 2.5, 2.75, and 3.

Question 1 (3 Marks)

Complete this table using LOOCV for each of the seven IDW exponents.

- Use three decimal places

Exponent Value	RMSE	MAD	MSE
1.5			
1.75			
…			
3			

Question 2 (2 Marks)

Provide the computer code for a *function* to calculate MAD.

Question 3 (3 Marks)

Provide the values estimated for the three prediction locations using the optimal model based on the LOOCV, determined by RMSE.

Question 4 (2 Marks)

Provide a publication quality plot comparing of RMSE and MAD. The viewer should be able to understand the relationship between RMSE and MAD, relative to the exponent value.

Challenge 2: Kriging

Interpolate a set of points with ordinary kriging (Elevation Prediction Locations) using elevation observations (Projection: UTM 17 N). You are provided:

- Elevation Observations: 2018_elevation_observations.csv
- Elevation Prediction Locations: 2018_elevation_prediction_locations.csv

Fit and cross validate five different variogram models. Select models based on those determined appropriate by assessing a sample variogram.

Question 5 (5 Marks)

Complete this table for each of the five variogram models that you tested.

Variogram Model Name	Nugget	Range	Sill
e.g. Spherical			
e.g. Exponential			
...			

Question 6 (2 Marks)

Which variogram model is the best? Explain your choice?

Question 7 (2 Marks)

On one plot, provide both the sample variogram and the best variogram model from Question 6.

- Make sure to include a figure caption explaining the plot components.

Question 8 (5 Marks)

Create a plot with a basemap that shows the LOOCV Residuals. The plot should include:

- A figure caption.
- A classed legend.

Challenge 3

Find an academic journal that uses kriging. The paper must report cross-validation results.

Question 9 (1 Mark)

Provide a full citation for the article, either MLA, APA, Chicago, Harvard or Vancouver.

Question 10 (4 Marks)

Answer the following (1 Mark each):

- Where is the study area?
- What are the lag, range and sill?
    - If more than one model is reported, select the first model reported.
- Which measure(s) of error did they use for cross validation.
- What was their error estimate?

R Script Grading: 5 Marks

The script you submit should be fully reproducible, which means the TA should be able to run your script without modification.

- 5 / 5: The code is properly documented with comments and detailed variable names. No issues are present in the code. A person versed in R should be able to read through the code in one attempt.
- 4.5 / 5: The code is well documented. A single error, inconsistency, poor variable name or documentation is present. A reviewer may need to make a single check of previous code to interpret.
- 4 / 5: The code is documented. A couple errors, inconsistencies, poor variable names or documentation is present. A reviewer may need to make multiple checks of previous code to interpret.
- 3.5 / 5: The code is documented. A few errors, inconsistencies, poor variable names or documentation is present. A reviewer needs to make multiple checks of previous code to interpret, but can understand all sections of the code.
- 3 / 5: The code is partially documented. Errors, inconsistencies, and poor variable names are present. A reviewer needs to make multiple checks of previous code to interpret, and may not completely understand all sections of the code.
- 2.5 / 5: The code is sparsely documented. Many errors, inconsistencies, and poor variable names present. A reviewer needs to make multiple checks of previous code to interpret, and does not completely understand all sections of the code.
- 1 or below: Many inconsistencies in the code. It would not be able to be reproduced by another researcher without many questions directed to the original author.