AHP: Choosing a Leader

LAB 5: Analytic Hierarchy Process (APH)
LSE/ESSE 4600 GIS and Data Integration – W2022

Brief:
- Assigned: March 10, 2022
- Due: 8:30 AM, March 24, 2022
- Project materials are available via 4600 course moodle
- Submission: through the course moodle or email to TA (Afnan Ahmad - aafnan@yorku.ca) by the due time
- Required files: report, result webpages and codes (with descriptions)

Objective:
This lab aims to implement the Analytic Hierarchy Process (APH) for driving optimal weights in multi-criteria decision-making system. Based on the same decision-making problem practiced in Lab 1 ("Optimal school site sensing using Map Builder"), the students are asked to drive new weights using AHP and compare the decision outputs obtained by AHP and Simple Additive Weights (SAW) implemented in Lab 1.

Details:
There are two questions for this assignment. The first question is a follow up to the previous assignment while the second question is an independent question. You will once again be using Model Builder for the first question to find the most suitable location for building a new school. However, unlike the last assignment where you are given pre-determined weights, you will use a pair-wise comparison approach similar to what you learned in lecture 6 with eigenvalue analysis to assist in your decision-making process. In the second question, you will be required to populate a pair-wise comparison matrix based on visually inspecting the length of the four given lines.

Question 1

Referring to the previous lab assignment, you are asked to weight the criteria using the AHP method. First you need to make a pair-wise comparison table using 9-point scale reference to

identify the relative importance of these criteria in comparison with each other. Then you will need to compute the new weights of these criteria. Recall the pre-determined weights from the previous assignment were:

- *Reclassed distance to rec_sites: 50%*
- *Reclassed distance to schools: 25%*
- *Reclassed slope: 13%*
- *landuse: 12%*

After calculating the new weights based on your pair-wise comparison approach, you will need to determine the consistency ratio (lambda and CI) of the matrix. Please note that the consistency index (CI) should be less than 0.1, otherwise the matrix is not acceptable. An example of the pair-wise comparison matrix is given below.

Pair-wise Comparison for the Criteria

	Distance to rec_sites	Distance to schools	Slope	Landuse
Distance to rect_sites	1.00	X	Y	Z
Distance to schools		1.00	A	B
Slope			1.00	C
Landuse				1.00

i)   Generate the final site suitability map like in the previous assignment using the same parameters.
ii) Compare the final result in this assignment to the previous assignment. How are they different?
iii) You may end up having multiple or no site selected at the end using your weights. In that case, please explain in detail how, as a decision maker, you would adjust your weighting factors to produce a more desirable outcome.

Question 2

Figure in the box shows one straight line and three curve lines. Given the dimension and scales of these lines you can apply the pair wise comparison process on the basis of their relative lengths of the lines in a matrix. By eyeballing each pair of lines to produce the comparison table and then use the row-sum method to calculate the relative weights of lines. The measured answers are (A) 0.080, (B) 0.502, (C) 0.270, and (D) 0.148. How are your calculated results close to the actual answers? Show your processes.
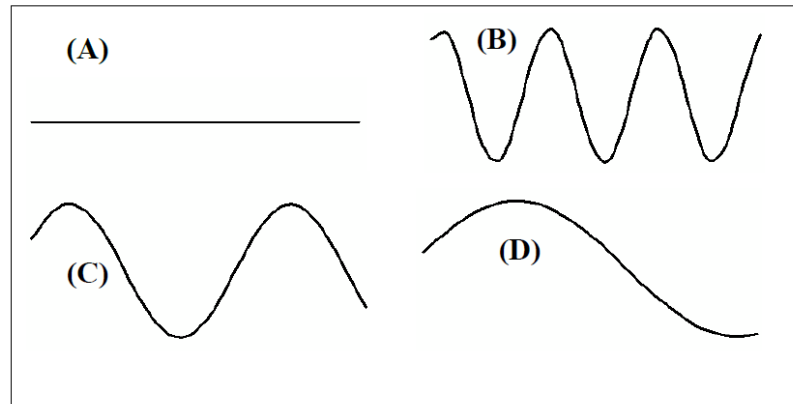
Writeup

For this project, you must do a project report (no min. page length; max. 10 pages with 11 fonts and single space including figures and tables). In the report, you will describe your modeling system and any decisions you made to develop your modeling system in a particular way. Then you will show and discuss the results of your spatial model. In the case of this project, show the results of your site selection system and show some of the intermediate images in the site selection modeling pipeline Also, discuss anything extra you did. Feel free to add any other information you feel is relevant.

Rubric

+40 pts: Answering to Question 1
+40 pts: Answering to Question 2
+20 pts: Write-up with several examples of site selection maps
+10 pts: Extra credit (up to ten points)
-5*n pts: Lose 5 points for every time you do not follow the instructions for the hand in format
-5*n pts: Lose 5 points for every day you delay the submission of your report and codes beyond the due date.

Credits

Assignment developed by Gunho Sohn's Lab (Dr. Brian Kim).