GEOG4340   GIS

Assignment # 4

Two and half weeks from March 22 – April 5, 2013

Hand in your report to TA

NO LATE ASSIGNMENTS WILL BE ACCEPTED!!!

This assignment is about application of GIS for spatial decision support modeling (SDSM). In the first part of the assignment you do not have to use GIS program but in the second part it involves a small project for which you need to use GIS to complete the required tasks. The objective of this assignment is to enhance your knowledge about various SDSM methods including weights of evidence method and AHP methods introduced during the lectures. You are asked to answer all the questions. Hand your report in to TA for evaluation.

Part One
In this part of assignment you will answer some questions.

Question One

One needs to make a decision on purchasing a house on the basis of four criteria Price, Style, Location, and Specifications. You are asked to rank the criteria using the AHP method. First you need to make a consistent pair-wise comparison table using 10 point scale reference to identify the relative importance of these criteria in comparison with each other. Some of the comparisons are already recorded in the table. You need to do two things:

1) Complete the entire table by applying the asymmetric rules
2) Calculate the weights showing the rankings of the criteria

Pair-wise Comparison for the Criteria

	Price	Style	Location	Specifications
Price	1.00	3.00	5.00	7.00
Style		1.00	3.00	4.00
Location			1.00	3.00
Specifications				1.00

Question Two

Figure in the box shows one straight line and three curves. 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.
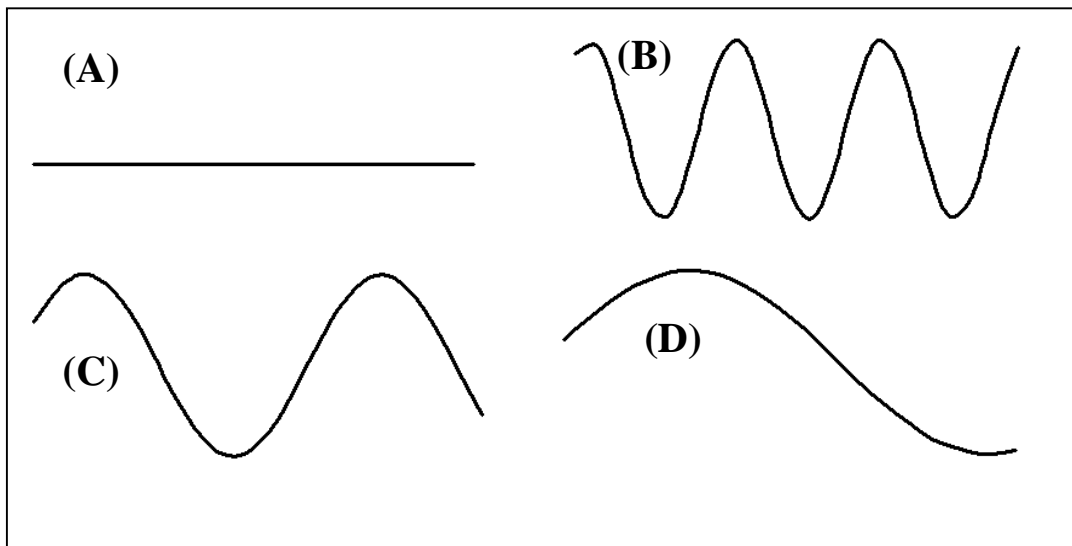
Part Two

To use GIS-based SDSS technology for prediction purpose are sophisticated applications of GIS. In this exercise you are going to develop GIS-based SDSS procedures to preform suitability mapping for predicting gold mineral resource potential in an area in Nova Scotia. Similar approaches can be easily applied for other types of point event prediction such as environmental impact sites, criminal cases and car accidents. The dataset was already used in your second assignment for spatial analysis and hypothesis testing about certain rock formations (polygons) and lineaments are favorable for occurrences of mineral deposits (points). In this project, you will further use these data to create a suitability map showing areas with high possibility to find new gold mineral deposits and mineral occurrences (points). You will use both data-driven and knowledge-driven methods to conduct the project. In use of data-driven method, you can use points (discovered mineral deposits and occurrences) as training set to evaluate the criteria and ranking the relative importance of criteria for data integration (overlay maps).

Step one Get Dataset

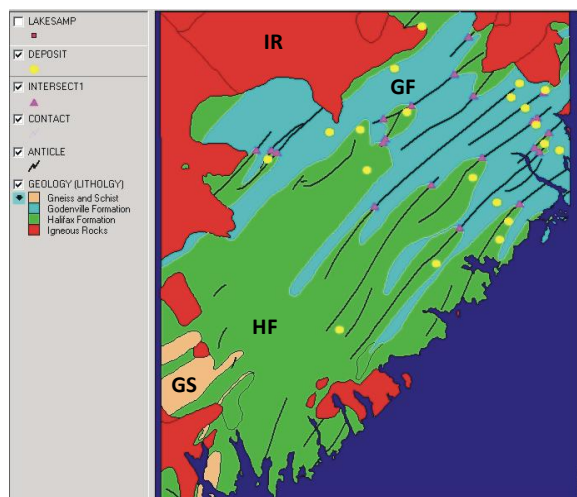You are given three layers of maps covering an area in southern Nova Scotia, Canada, where

some gold mineral deposits and occurrences (points) have been found:

a) Mineral_deposit – a point shape file containing location of mineral deposits;
b) Anticline – a line shape file containing anticline axes (a type of linear geological structures);
c) Geology – a polygon shape file containing lithological units or rock types.
The maps are shown in Figure 1. The polygons are labeled as GS for Gneiss and Schist, GF for Godenville Formation, HF for Halifax Formation and IR- igneous rocks, respectively.

Fig. 1 A simplified geology map of an area in Nova Scotia, Canada.

DOWNLOAD THE DATASETS FROM HERE AND SAVE INTO YOUR LOCAL FOLDER http://www.yorku.ca/gisweb/geog4340/nova_scotia.mdb

Step Two Create Binary Maps

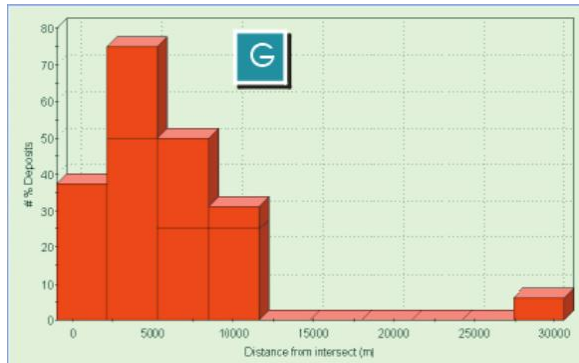**Task 1. Create a binary distance map from the contacts between Godenville Formation (GF) and Halifax Formation (HF)**

Fig. 2 A histogram showing the number of mineral deposits located in areas with distance from the contacts of GF and HF.
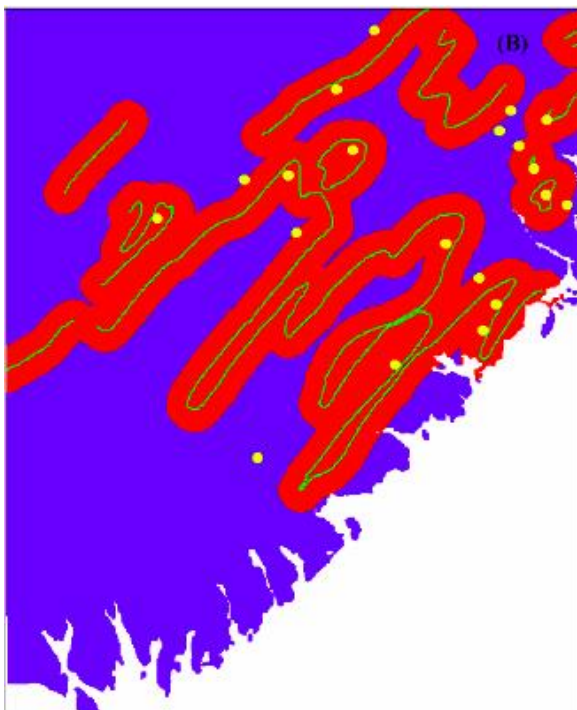
According to the histogram you created in your second assignment (similar to the one shown in Figure 2), based on the frequency distribution of mineral deposits (points) located with distance (unit of 500 meters) from the contacts (common boundaries) between Godenville Formation (GF) and Halifax Formation (HF), you can reclassify the distance into two classes to be labeled as 1 and 0, respectively. The class labeled as 1 is the distance from the contacts (common boundaries) between Godenville Formation (GF) and Halifax Formation (HF) favorable for gold mineral occurrences whereas the class labeled as 0 is the non-favorable distance for gold mineral occurrences. A threshold or cutoff value can be used to separate the classes of distances. Such threshold or cutoff value can be determined in such that the favorable distance is the distance within which it has about 85% of points and beyond the distance it has at most 15% points. Please develop a model of ArcGIS processes that would be followed to generate the binary map. Display the points on the binary map to show the spatial relationship of location of points and the binary distance map. Print out the binary map and include it in your report (similar to the map shown in Fig. 3). Discuss your findings. How many points are located in the favorable class you defined?

Fig. 3 Binary map obtained on the distances from contacts of Goldenville and Halifax Formations

Task 2. Create a binary distance map from anticline axes

Similar to the Task 1, based on the frequency distribution of mineral deposits (points) located with distance (unit of 1000 meters) from the anticline axes, you can reclassify the distance into two classes to be labeled as 1 and 0, respectively. The class labeled as 1 is the favorable distance for gold mineral occurrences and the class labeled as 0 is the non-favorable distance for gold mineral occurrences. A threshold or cutoff value can be determined in such that the favorable distance is the distance within which it has about 85% of points and beyond the distance it has at most 15% points. Please develop a model of ArcGIS processes that would be followed to generate the binary map. Display the points on the binary map to show the spatial relationship of location of points and the binary distance map. Print out the binary and include it in your report. Discuss your findings. How many points are located in the favorable class you defined?

Task 3. Create a binary rock type map

Based the density of mineral deposits (points) located in each rock formations (rock types or lithological units), you can reclassify the rock types into two classes to be labeled as 1 and 0, respectively. The class labeled as 1 is the favorable rock types for gold mineral occurrences and the class labeled as 0 is the non-favorable rock types. The rock type with the highest density of deposits can be defined as the favorable rock type and rest rock types as non-favorable types. Please develop a model of ArcGIS processes that would be followed to generate the binary rock type map. Print out the binary rock type map with points superimposed. Discuss your findings. How many mineral deposits are located in the favorable rock type?

Step Three Calculate the Weights for Each Binary Map

In order to combine the three binary maps to create a suitability map, you need to assign weights for each map. You are asked to use two ways to calculate the weights: AHP as a knowledge-driven method and weights of evidence (WofE) as a data-driven method. Document the processes of analysis and the results of weights in your report.

Step Four Combine Binary Maps to Create Suitability Map

You can create suitability maps by combining the three binary maps by means of AHP and WofE and using the weights calculated in Step Three. The suitability maps should look like the map in Fig 4 although the actual patterns are different because the Fig 4 was created using different binary maps.
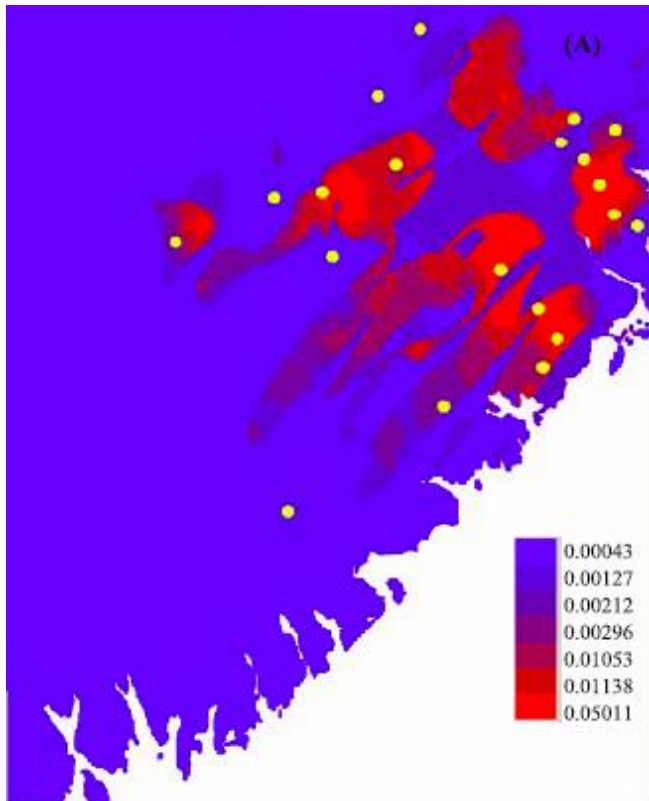
Fig. 4 Suitability map

Step Five Result Interpretation

Compare the results generated by using the two methods AHP and WofE. Explain your results. Are there areas where with high suitability but it has not been found mineral occurrence yet? Highlight a few such areas that can be considered as target areas for further exploration. Write up a report to document the processes and the results of your project.