Decision Analysis - Project 1

1 Introduction

Project 1 is about proposing and solving a selected decision problem using methods from the PROMETHEE and ELECTRE families. Choose a non-trivial decision problem that is important to you, write down all possible options that you can choose. Think about all the criteria that you take into account and that are relevant to you in this issue. Define the scales and directions of preferences for all criteria. Evaluate each alternative on each criterion. Determine the number of decision classes, their order and the boundaries profile separating these classes. Describe the data set according to the guidelines below.

If you are able to give a whole ranking of these alternatives, their class assignment or there is too much dominance in your chosen set, decide on a different decision problem.

Determine the ranking of criteria and their weightings using the SRF method. Adjust the threshold values to your preferences (note, the threshold values should be selected before running the methods, but may be slightly changed in subsequent iterations). Apply the PROMETHEE I and II and ELECTRE TRI-B methods with optimistic and pessimistic assignment procedure for the proposed problem. Present the obtained results. Evaluate the obtained results with your own preference and, in the event of inconsistencies, change the model parameters.Then compare the obtained results between the methods.

- The project requires its own implementation of the PROMETHEE I and II, SRF and ELECTRE TRI-B methods.
- The entire project must be done **individually or in pairs**.
- The report can be made in a jupyter notebook (**.ipynb + HTML**) or as a **python project + report in PDF**.
- The code with the report should be sent by **04/04/2024 23.59**

2 Requirements for the problem

- At least a 12 alternatives at most 50,
- from 4 to 9 criteria,
- at least 4 decision classes,
- at least 4 pairwise comparisons to verify the result, given a priori,
- at least one method should perform at least 2 iterations of problem solving.

3 Information required in report

3.1 Data set

You should put **questions** and **answers** in the report for the following questions:

1. What is the domain of the problem about?
2. What is the source of the data?
3. What is the point of view of the decision maker?
4. What is the number of alternatives considered? Were there more of them in the original data set?
5. Describe one of the alternatives considered (give its name, evaluations, specify preferences for this alternative)
6. What is the number of criteria considered? Were there more of them in the original data set?
7. What is the origin of the various criteria? (catalog parameter / created by the decision maker - how?)
8. What are the domains of the individual criteria (discrete / continuous)? Note: in the case of continuous domains, specify the range of the criterion's variability, in the case of others: list the values. What is the nature (gain / cost) of the individual criteria?
9. Are all criteria of equal importance (should they have the same "weights")? If not, can the relative importance of the criteria under consideration be expressed in terms of weights? In this case, estimate the weights of each criterion on a scale of 1 to 10. Are there any criteria among the criteria that are completely or almost invalid / irrelevant?
10. Are there dominated alternatives among the considered data set? If so, present all of them (dominating and dominated alternative), giving their names and values on the individual criteria.
11. What should the theoretically best alternative look like in your opinion? Is it a small advantage on many criteria, or rather a strong advantage on few (but key) criteria? Which?
12. Which of the considered alternatives (provide name and values on individual criteria) seems to be the best / definitely better than the others? Is it determined by one reason (e.g. definitely the lowest price) or rather the overall value of the criteria? Does this alternative still have any weaknesses?
13. Which of the considered alternatives (provide name and values on individual criteria) seems to be the worst / definitely worse than the others? Is it determined by one reason (e.g. definitely the highest price), or rather the overall value of the criteria? Does this alternative still have any strengths?

3.2 Problem analysis with the use of PROMETHEE I and II

1. Write the preferential information you provided at the input of the method.
2. Enter the final result obtained with the method. Usually, the first result is not the final one, you can slightly adjust the parameter values to your preferences.
3. Compare the complete and partial ranking.
4. Comment on the compliance of the results with your expectations and preferences. Refer, among others, to to the results for the alternatives that you indicated as the best and worst during the data analysis. What operations were required to obtain the final result (e.g. changing the ranking of criteria, adding blank cards, changing the value of threshold)?

3.3 Problem analysis with the use of ELECTRE TRI-B

1. Write the preferential information you provided at the input of the method.
2. Enter the final result obtained with the method. Usually, the first result is not the final one, you can slightly adjust the parameter values to your preferences.
3. Comment on the compliance of the results with your expectations and preferences. Refer, among others, to to the results for the alternatives that you indicated as the best and worst during the data analysis. What operations were required to obtain the final result (e.g. changing the ranking of criteria, adding blank cards, changing the value of threshold)?
4. Compare the optimistic and pessimistic class assignments.
5. Comment on the compliance of the results with your expectations and preferences. Refer, among others, to to the results for the alternatives that you indicated as the best and worst during the data analysis. What operations were required to obtain the final result (e.g. changing the ranking of criteria, adding blank cards, changing the value of threshold, boundaries or the λ parameter)?

3.4 Compare method results

In this section, compare the results obtained from all methods.