

GROUP DECISION MAKING UNDER MULTIPLE CRITERIA
MIDTERM EXAM

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You may use lecture notes and other related printed sources as well as hand-written notes. You are not allowed to use and electronic devices including computers and mobile phones.

Duration: 2 hours

QUESTIONS

1. (10 points) Explain briefly the following criteria that are used to analyze the properties of voting methods and indicate which Arrows condition(s) is related to each criterion:

- Pareto

- Monotonicity

- Consistency

2. (10 pts.) What is rank reversal in multiple attribute decision making (MADM)? Which Arrow's condition is related to the rank-reversal? Which of the following methods are free of rank-reversal: TOPSIS, A-TOPSIS and M-TOPSIS? Explain your answers.
3. (15 pts.) In which part of a Multi Attribute Group Decision Making (MAGDM) process can voting methods be used? Explain based on the conceptual framework for MAGDM in Kabak and Ervural (2017).
4. (10 pts.) Please classify the following papers based on the classification scheme for MAGDM literature defined in Kabak and Ervural (2017).
- Agrebi, M., Abed, M., & Omri, M. N. (2017). ELECTRE I based relevance decision-makers feedback to the location selection of distribution centers. Journal of Advanced Transportation, 2017.
 - Hadas, Y., & Nahum, O. E. (2016). Urban bus network of priority lanes: A combined multi-objective, multi-criteria and group decision-making approach. Transport Policy, 52, 186-196.
5. (10 pts.) In Schulze method (Schulze, 2011) suppose that after finding the binary relations between the candidates (at the end of Stage 3), there is no candidate that is better than all other candidates in pairwise comparisons. How does the method find the winner in this situation? Explain your answer with an example.
6. (25 pts.) Faculty of ITU-IE will select a new committee for the management of graduate programs. There will be 3 professors in the committee who will be selected from the five candidates (a,b,c,d,e). The preferences of 88 faculty are given as follows:

No. of voters	Ranking
19	a > b > c > d > e
9	a > c > e > b > d
10	b > e > c > d > a
9	b > d > a > e > c
8	c > d > b > e > a
12	d > e > b > c > a
6	e > d > c > a > b
13	e > a > b > c > d

- a. Based on the preferences of the faculty, find the committee members using Single Transferable Vote with Gregory Method and Weighted Inclusive Gregory Method (please use Droop quota for setting the quota).
 - b. Suppose that the head of the committee will also be elected based on the same preference structure. Find the head of the committee using Coombs method and Nanson's function. Explain the properties of these two methods briefly.
7. (20 pts.) ELECTRE method is used to solve a MADM problem with five alternatives (A1, A2,..., A5). At the end of the first phase, the following outranking relations are constructed.
- A1 outranks A2
 - A1 outranks A4
 - A2 outranks A4
 - A2 outranks A3
 - A3 outranks A4
 - No outranking relation can be found for A5.
- a. Please exploit these relations and find a set of alternatives that can be suggested to the decision maker using ELECTRE I.
 - b. Suppose the above given relations are "strong outranking" relations. In addition to them the "weak outranking" relations are also constructed as follows. Please rank the alternatives using ELECTRE II.
- A3 weakly outranks A5
 - A5 weakly outranks A1
 - A5 weakly outranks A4

GOOD LUCK!

References

- Tavana, M., & Hatami-Marbini, A. (2011). A group AHP-TOPSIS framework for human spaceflight mission planning at NASA. *Expert Systems with Applications*, 38(11), 13588-13603.
- Kabak, Ö., & Ervural, B. (2017). Multiple attribute group decision making: A generic conceptual framework and a classification scheme. *Knowledge-Based Systems*, 123, 13-30.
- Schulze, M. (2011). A new monotonic, clone-independent, reversal symmetric, and condorcet-consistent single-winner election method. *Social Choice and Welfare*, 36(2), 267-303.