GROUP DECISION MAKING UNDER MULTIPLE CRITERIA

FINAL EXAM – PART 1

Assoc. Prof. Özgür Kabak **May 23, 2018**

Due date: May 30, 2018, 12:00 (final exam date and time)

Please submit your answers and send the excel files to ozgurkabak@gmail.com before the final exam.

All questions related to the questions are welcomed via e-mail (ozgurkabak@gmail.com)

This is an individual exam. Do not cheat! Academic misconduct or cheating will not be tolerated!

Supplier Selection Problem*

A supplier management board of a company is evaluating suppliers in order to decide if a change is appropriate. There are four potential suppliers that need to be evaluated. The board decided to ask each of the three sector managers of the company to provide their evaluations of the suppliers. The managers are very busy and they work in different buildings. It would be complicated to get them together to discuss what the important criteria are to evaluate the suppliers. Under these circumstance, the board will let each manager to evaluate the companies independently, according to a set of criteria that they think it is appropriate and to provide their own weight vector.

The first manager, who is a budget manager, is biased to the financial aspects of the decision and considered the price per batch (in thousands) (C_1^1), warranty (in days) (C_2^1) and payment conditions (C_3^1). The second manager is a production manager and is focused on the overall aspects of the suppliers and considered the price (C_1^2), delivery time (in hours) (C_2^2), production capacity (C_3^2), product quality (C_4^2) and the time to respond to a support request (in hours) (C_5^2). The third manager is the commercial manager and is biased to the capacity to advertise and the final satisfaction of the clients. So, she considered the product lifespan (in years) (C_1^3), social and environment responsibility (C_2^3), quality certifications (C_3^3) and the price (C_4^3). The weight vectors of each one of the decision maker are: w^1 = (0.5, 0.25, 0.25), w^2 = (0.2, 0.2, 0.2, 0.2, 0.2) and w^3 = (0.25, 0.12, 0.23, 0.4). The decision matrices are presented in Tables 1-3. The linguistic evaluations were translated as Triangular Fuzzy Number (TFN) as shown in Table 4. Also, the supplier management board provided the following weight vector for the decision makers w_d = (0.3, 0.4, 0.3).

Based on the above given information, the supplier management board of the company want to rank the suppliers.

Question 1: Write the distinguishing characteristics of the given problem. What kind of multiple attribute group decision making (MAGDM) approach is required to solve such problems? Explain your answers considering The Conceptual Framework for MAGDM introduced in the course.

Question 2: According to the given information in the Supplier Selection Problem, please rank the alternative projects using the cumulative belief degree (CBD) approach. Use the linguistic term set and the related TFNs given in Table 4 and Figure 1 for transformations. Calculate the consensus measures (Hint: You have to define transformation formulas for non-standard interval scales. Please see Kabak and Ruan (2011) for information).

Question 3: Propose a TOPSIS-based MAGDM approach to solve the problem (different from Lourenzutti and Krohling, 2016). Define the step of approach and apply it to the Supplier

* *adapted based on Lourenzutti and Krohling (2016).

Selection Problem. Explain the difficulties of developing an approach for the particular problem. You are free to make any assumption as long as you have an appropriate explanation. Compare your results with the results of CBD approach.

Table 1. Decision matrix for the first manager

Alternatives	C_1^1 (in thousand $)	C_2^1 (in days)	C_3^1 (linguistic term set)
A_1	260	90	Good
A_2	250	90	Poor
A_3	350	180	Good
A_4	550	365	Intermediate

Table 2. Decision matrix for the second manager

Alternatives	C_1^2 (in thousand $)	C_2^2 (in days with interval scale)	C_3^2 (intuitionistic fuzzy sets)	C_4^2 (linguistic term set)	C_5^2 (in hours with interval scale)
A_1	260	[48, 96]	(0.9, 0.1)	Intermediate	[24, 48]
A_2	250	[72, 120]	(0.6, 0.3)	Poor	[24, 48]
A_3	350	[36,72]	(0.55, 0.3)	Good	[12, 36]
A_4	550	[48,96]	(0.55, 0.35)	Excellent	[0, 24]

Table 3. Decision matrix for the third manager

Alternatives	C_1^3 (in years)	C_2^3 (linguistic term set)	C_3^3 (Hesitant)	C_4^3 (in thousand $)
A_1	3.5	Very poor	(0.1, 0.3, 0.4)	260
A_2	3.0	Very poor	(0.1, 0.2)	250
A_3	4.5	Poor	(0.6)	350
A_4	5.0	Intermediate	(0.8, 0.9, 0.1)	550

Table 4. Linguistic variables for the ratings

Linguistic Terms	Label	Triangular fuzzy numbers
Very poor	s_0	(0.0, 0.0, 0.25)
Poor	s_1	(0.0, 0.25, 0.50)
Intermediate	s_2	(0.25, 0.50, 0.75)
Good	s_3	(0.50, 0.75, 1.0)
Excellent	s_4	(0.75, 1.0, 1.0)

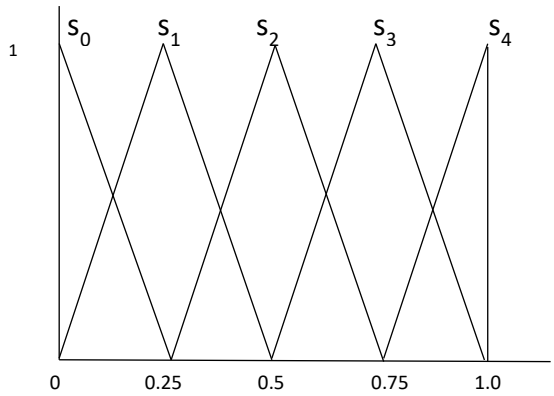

Figure 1. Triangular fuzzy numbers

References

Kabak, O. and Ruan, D. (2011). A Cumulative Belief Degree-Based Approach for Missing Values in Nuclear Safeguards Evaluation. IEEE Transactions on Knowledge and Data Engineering 23:1441–1454.

Lourenzutti, R. and Krohling, R.A. (2016). A generalized TOPSIS method for group decision making with heterogeneous information in a dynamic environment. Information Sciences 330:1–18.