

GROUP DECISION MAKING UNDER MULTIPLE CRITERIA

FINAL EXAM – PART 1

Assoc. Prof. Özgür Kabak

May 26, 2017

Due date: June 3, 2017, 09:00 (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!

Investment Problem

Suppose that three partners of a company are looking for a project to invest for further development of their store. Four different projects were introduced to them: A_1 is to expand the store, A_2 is to introduce new products in the store, A_3 is to invest in a new sector, and A_4 is to open a new store. Firstly, a consultant conducted a growth analysis to measure the growth potential of the company (C_1) for each of the projects in 0-100 scale. Moreover, investment cost (C_2) for each project is predicted. Please see Table 1 for the evaluation of the projects for these objective criteria.

There is no agreement on other criteria for the evaluation of the alternatives. The first partner wanted to consider the financial risk (C_3), social-political risk (C_4) and environmental risk (C_6). The second partner was focused on the technical risk (C_5), environmental risk (C_6) and management risk (C_7). The third partner considered social-political risk (C_4), technical risk (C_5), management risk (C_7) of the projects.

The partners presented their preferences on alternatives with respect to criteria in different formats. The first partner presented her preferences using direct values in [0-100]. The second one expressed his preferences by means of linguistic values in a 7-term linguistic set (see Table 6); and the third partner used Intuitionistic fuzzy sets. The decision matrices of the partners are presented in Tables 3, 4, and 5.

The partners evaluated the importance of the criteria and the weights of criteria for each partner are calculated as given in Table 2. Furthermore, participation of each partner in the final decision depends on their shares in the company. The shares of the partners are 40%, 35%, and 25% respectively.

One of the project will be selected by the company according the given information.

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

Question 2: According to the given information in the investment problem, please rank the alternative projects using the cumulative belief degree (CBD) approach. Use the linguistic term set and the related triangular fuzzy numbers given in Table 6 for transformations.

Question 3: Attach a soft consensus process to the CBD approach. Define necessary formulas and apply this consensus process in the given investment problem.

Table 1. Objective criteria

Alternative	Growth potential [0-100]	Cost (in thousands \$)
A ₁	70	260
A ₂	50	240
A ₃	80	300
A ₄	60	200

Table 2. Importance weights of criteria

Criteria	Partner 1	Partner 2	Partner 3
C ₁ Growth potential	0.20	0.20	0.15
C ₂ Investment cost	0.20	0.15	0.20
C ₃ Financial risk	0.30	-	-
C ₄ Social-political risk	0.20	-	0.15
C ₅ Technical risk	-	0.25	0.30
C ₆ Environmental risk	0.10	0.20	-
C ₇ Management risk	-	0.20	0.20

Table 3. Decision matrix of the first partner – Direct value [0-100]

Alternatives	C ₃	C ₄	C ₆
A ₁	70	50	80
A ₂	60	75	45
A ₃	80	60	90
A ₄	85	65	85

Table 4. Decision matrix of the second partner – linguistic variables

Alternatives	C ₅	C ₆	C ₇
A ₁	F	L	VL
A ₂	H	F	F
A ₃	MH	VH	ML
A ₄	L	VH	F

Table 5. Decision matrix of the third partner – Intuitionistic fuzzy set

Alternatives	C ₄	C ₅	C ₇
A ₁	(0.5 , 0.2)	(0.8 , 0.1)	(0.6 , 0.2)
A ₂	(0.8 , 0.1)	(0.7 , 0.15)	(0.5 , 0.1)
A ₃	(0.6 , 0.3)	(0.7 , 0.2)	(0.8 , 0.1)
A ₄	(0.3 , 0.4)	(0.9 , 0.1)	(0.7 , 0.2)

Table 6. Linguistic variables for the ratings

Linguistic Terms	Triangular fuzzy numbers
Very low (VL)	(0.0, 0.0, 0.167)
Low (L)	(0.0, 0.167, 0.333)
Medium Low (ML)	(0.167, 0.333, 0.5)
Fair (F)	(0.333, 0.5, 0.667)
Medium high (MH)	(0.5, 0.667, 0.833)
High (H)	(0.667, 0.833, 1.0)
Very high (VH)	(0.833, 1.0, 1.0)