IE 443: Multiobjective Decision Analysis

Homework Assignment 2

Spring 2022-2023

Due: April 10th, 2023 - 23:59/11:59 **P.M.**

Question 1. For the restaurant selection problem described in *Question 3* of Homework 1, apply the **ELECTRE** method for the described criteria: cost, review points, and location points. Only consider the **6 Nondominated Alternatives**, namely $(1), (3), (4), (5), (7)$, and (8). Use the weight vector (w_c, w_r, w_l) where :

- $w_c = 0.50$
- $w_r = 0.25$
- $w_l = 0.25$.

Take the discordance (q) and the concordance (p) thresholds as 0.4 and 0.6 repsectively (i outranks j if $c(i,j) \geq p$ and $d(i,j) \leq q$).

Question 2. Read the book exert from *Multiple Attribute Decision Making* by Yoon and Hwang. For the same restaurant selection problem, apply the **TOPSIS** method covered in the reading. Only consider the **6 Nondominated Alternatives**, namely $(1), (3), (4), (5), (7)$, and (8). Provide a full ranking of the preferences. Use the weight vector (w_c, w_r, w_l) where :

- $w_c = 0.50$
- $w_r = 0.25$
- $w_l = 0.25$

. After completing the calculations briefly comment on the differences/similarities between the ELECTRE method covered in class and the TOPSIS method.

Question 3. Consider the following Multi-objective Linear Optimization Problem:

$$\begin{aligned}
&minimize\ [Z_{x_1}, Z_{x_2}] && (1)\\
&s.t. \quad x_2 - \frac{1}{2}x_1 \geqslant 0 && (2)\\
&\qquad x_2 - 2x_1 \leqslant 5 && (3)\\
&\qquad x_2 + \frac{1}{2}x_1 \leqslant 10 && (4)\\
&\qquad x_1 + x_2 \geqslant 4.5 && (5)\\
&\qquad x_1 \geqslant 0 && (6)\\
&\qquad x_2 \quad u.r.s && (7)
\end{aligned}$$

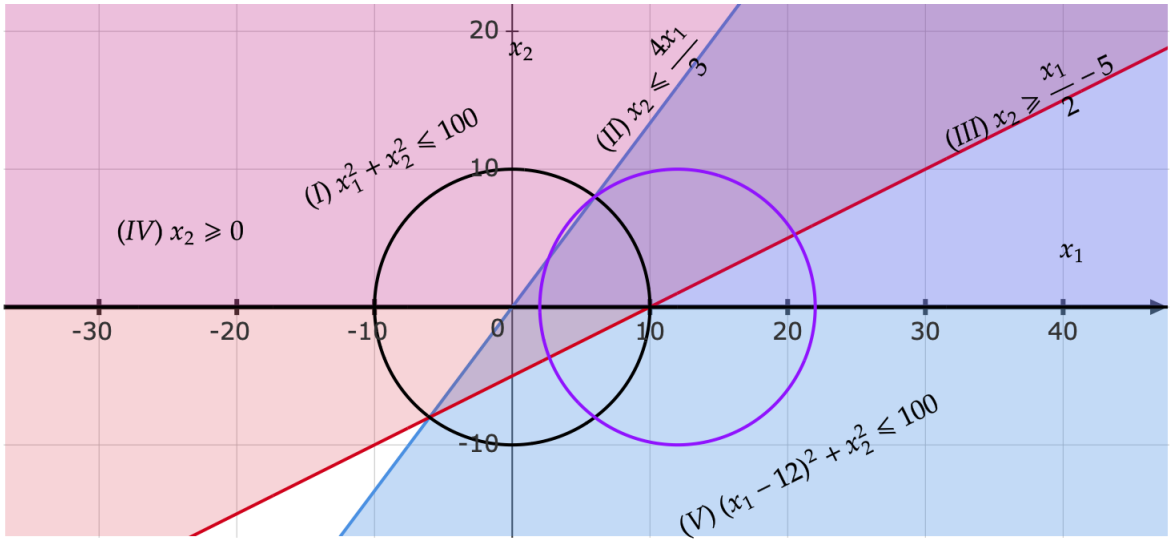
Where Z_{x_1}, Z_{x_2} are functions of the form $\alpha x_1, (1-\alpha)x_2$ respectively for $\alpha \in (0, 1)$.

(a) Draw the feasible region (decision space).

(b) Draw the image of the feasible region for $\alpha = 0.5$. Determine the non-dominated and weakly non-dominated points. Provide the set of efficient and weakly efficient solutions.

(c) Do the set of efficient solutions change for other α?

Question 4. The decision space given by simultaneous satisfaction of all five constraints I, II, III, IV, and V (feasible region) to the Multi-objective Optimization Problem $max\{x_1, x_2\}$, is found below:



(a) Draw the image of the feasible region (objective space).

(b) What are the ideal and nadir points? Indicate them on the figure and provide coordinates.

(c) Sketch the set of nondomimanted images on the graph of the objective space. Classify them as supported and nonsupported.