INTELLIGENT DECISION SUPPORT SYSTEMS – EXERCISES X (PART I) – RANKING METHODS IN DEA

I. Indicate the truth (T) or falsity (F) for the below statements.

a) For an efficient unit, super-efficiency is always greater or equal to its efficiency	
b) For a given unit, cross-efficiency can be greater than its efficiency	
c) When including additional weight constraints, efficiencies for all units always become lesser	
d) To estimate the stochastic acceptability indices with 0.01 accuracy and 95% confidence, one needs to consider 1,000 samples	

II. Write the linear programming model for computing the super-efficiency of A, B, C, or D, while assuming:

a) input- or output-oriented improvements

b) CCR (CRS) or BCC (VRS) (i.e., constant or variable returns to scale)

DMU	A	B	C	D
$input_1$	5	8	7	6
$input_2$	14	15	10	12
$output_1$	9	5	3	6
$output_2$	4	8	7	9

III. Given the matrix of efficiencies attained by different DMUs for the weights vectors being most favorable to other units:

a) What is the cross-efficiency of unit A?

b) What is the super-efficiency of unit B?

c) What can we say about the super-efficiencies of units A and C?

DMU	E_{kA}	E_{kB}	E_{kC}
E_{Ak}	1.0	0.2	0.9
E_{Bk}	0.6	0.7	0.8
E_{Ck}	0.8	0.6	1.0

IV. Using the Monte Carlo simulation, three weight vectors ($w_{1,2,3}$) have been sampled. They implied the efficiency scores given in the below table. Show the respective matrices of efficiency rank acceptability indices (ERAIs) and pairwise efficiency outranking indices (PEOIs) (for w_1: A is the best, C – 2^{nd}, B is the worst)

	A	B	C
w_1	1.0	0.2	0.9
w_2	0.6	0.7	0.8
w_3	0.8	0.6	1.0

INTELLIGENT DECISION SUPPORT SYSTEMS – EXERCISES X (PART II) – CLASSICAL MOO METHODS

I. Indicate the truth (T) or falsity (F) for the below statements.

a) Various solutions in the decision space are always translated to different points in the objective space

b) Weakly Pareto optimal solutions are always Pareto optimal

c) The number of solutions contained in the Pareto frontier may be finite

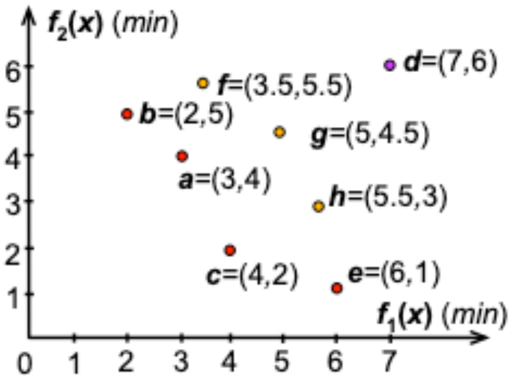
d) The max point attains not better values than the nadir point on all objectives

e) Classical optimization methods require multiple runs with different parameter values to approximate the Pareto frontier

f) The weighted sum method (WSM) parameterized with positive weights for all objectives identifies the Pareto optimal solution

g) The epsilon constrain method (ECM) can find non-supported efficient solutions

II. Consider a set of solutions ***a-h*** in the objective space with two minimized objectives (see figure below).



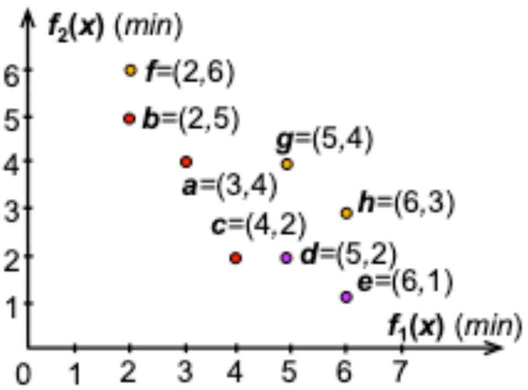
a) Compute the ideal point $\mathbf{z}^{ideal}$.

b) Compute a utopian point $\mathbf{z}^{utop}$ for ε=0.1.

c) Compute the max point $\mathbf{z}^{max}$.

d) Compute the nadir point $\mathbf{z}^{nadir}$.

III. Consider a set of solutions ***a-h*** in the objective space with two minimized objectives (see figure below).



a) Identify Pareto optimal and weakly Pareto optimal solutions.

b) What would be the solution returned by **WSM** with the following objective function: ***Minimize*** $0.5 \cdot f_1(x) + 0.5 \cdot f_2(x)$?

c) What about **WSM** with: ***Minimize*** $2/3 \cdot f_1(x) + 1/3 \cdot f_2(x)$?

d) Solution ***a*** is Pareto optimal. Can it be discovered by **WSM**?

e) What would be the solution returned by **ECM** with the following objective function and constraint:

Minimize $f_1(x)$***,*** *s.t.* $f_2(x) \leq 4.5$?

f) What about **ECM** with: ***Minimize*** $f_2(x)$***,*** *s.t.* $f_1(x) \leq 5.5$?

How to reformulate the objective function using the augmentation factor to be sure that **ECM** always returns a Pareto optimal rather than a weakly Pareto optimal solution?

g) What would be the solution(s) returned by the **ASF** method with the following objective function:

Minimize $max\{0.5 \cdot f_1(x), 0.5 \cdot f_2(x)\}$?

h) What about **ASF** with: ***Minimize*** $max\{2/3 \cdot f_1(x), 1/3 \cdot f_2(x)\}$?

i) Which solution would be selected for the following order of lexicographic optimization $(f_1(x), f_2(x))$?