Multiobjective Exercise in the AMPL

Consider the following resource allocation issue.

A company is organizing a project that involves multiple skills from different areas. It is intended to assign employees from different areas to specific tasks of the project, respecting skills restrictions. An employee can do more than one task.

There are n tasks (T1, T2, … , T_n) to be performed and m available collaborators (C1, C2, … , Cm). The compatibility matrix aij indicates whether the Ci employee has the necessary skills to perform the Tj task. If aij $= 1$, there is compatibility; if aij $= 0$, there is no compatibility. Each Tj task must have a minimum number of dj collaborators. No Ci collaborator can be assigned to more tasks than their maximum hi capacity. It is intended to minimize the total cost of allocation and maximize employee preferences. The cij and pij matrices indicate the unit costs of allocation and the preferences of each employee for each task, respectively.

Decision variables:

x_{ij} = binary variable that indicates whether the employee Ci is assigned to the task Tj. i = 1,…,m,j = 1,…,n

Model:

$$Min\ z1 = \sum_{i=1}^{m}\sum_{j=1}^{n} cij\ x_{ij}$$

$$Max\ z2 = \sum_{i=1}^{m}\sum_{j=1}^{n} pij\ x_{ij}$$

s.a:

$$\sum_{j=1}^{n} xij \leq h_i \qquad i = 1, \dots, m$$

$$\sum_{i=1}^{m} xij \geq d_j \qquad j = 1, \dots, n$$

$$xij \leq a_{ij} \qquad i = 1, \dots, m, j = 1, \dots, n$$

$$xij \in \{0,1\} \qquad i = 1, \dots, m, j = 1, \dots, n$$

Problem data:

Skills (AIJ)

	T1	T2	T3	T4	T5	T6
C1	1	1	0	1	0	1
C2	1	0	1	1	1	0
C3	0	1	1	0	1	1
C4	1	1	0	1	0	1
C5	0	0	1	0	1	1

Costs (CIJ)

	T1	T2	T3	T4	T5	T6
C1	8	6	-	5	-	7
C2	7	-	8	6	9	-
C3	-	5	7	-	6	8
C4	6	7	-	6	-	5
C5	-	-	9	-	7	6

Preferences (pij)

	T1	T2	T3	T4	T5	T6
C1	20	13	-	12	-	13
C2	14	-	17	12	18	-
C3	-	10	15	-	12	19
C4	12	13	-	11	-	9
C5	-	-	20	-	14	11

Maximum availability of each employee (hi) h1 = 3,
h2 = 2, h3 = 2, h4 = 3, h5 = 2

Needs in number of tasks (dj)
d1 = 1 , d2 = 1, d3 = 2 , d4 = 1 , d5 = 1 , d6 = 2

Question: It is intended to determine the efficient solutions that individually optimize each objective function and compose the payoff table. Use hefty sums, ensuring that the solutions obtained are efficient. Resolve issues in AMPL using *cplex*.

Send the AMPL files and a text file with the two solutions obtained and the *payoff*.

Note: For data that does not exist and is marked in the tables with "-" (some costs and preferences when allocation is not possible given the compatibility matrix), you can use any values. Since these allocations are not allowed, the respective values will never enter the objective functions.