MG-UY 4204 Homework 2: Mixed integer Linear Programming Mark Holtje

1. Assume: x_{ij} = number of units shipped from plant i to wholesaler j,
   Parameter c_{ij} = transportation cost of shipping a unit from plant i to wholesaler j,
   $i \in I = \{1,2\}$ and $j \in J = \{1,2,3\}$

minimize $z = 16x_{11} + 14x_{12} + 8x_{13} + 5x_{21} + 9x_{22} + 12x_{23}$ where z is the minimal transportation cost of shipping a unit from a plant i to a wholesaler j. Such that (with these constraints):

$\sum_{i \in I} x_{i1} >= 2700$ (demand of wholesaler 1)

$\sum_{i \in I} x_{i2} >= 4500$ (demand of wholesaler 2)

$\sum_{i \in I} x_{i3} >= 3600$ (demand of wholesaler 3)

$\sum_{i \in I} x_{1j} <= 4500$ (Production capacity of plant 1)

$\sum_{i \in I} x_{2j} <= 9000$ (Production capacity of plant 2)

$\Sigma x_{ij} >= 0$

2. Assume: x_{ij} is the time in hours it takes to set up machine i to complete job j.
   x_{ij} = 1 if machine i is tasked with completing job j or if job j is completed by machine i.
   x_{ij} = 0 if machine i is not tasked with completing job j or if job j is not completed by machine i.

minimize $z = 14x_{11} + 5x_{12} + 8x_{13} + 7x_{14} + 2x_{21} + 12x_{22} + 6x_{23} + 5x_{24} + 7x_{31} + 8x_{32} + 3x_{33} + 9x_{34} + 2x_{41} + 4x_{42} + 6x_{43} + 10x_{44}$ where $i \in I = \{1,2,3,4\}$ and $j \in J = \{1,2,3,4\}$ where z is the minimal setup time required to complete the four jobs. Such that (with these constraints):

$x_{11} + x_{12} + x_{13} + x_{14} = 1$ (machine 1 constraint)

$x_{21} + x_{22} + x_{23} + x_{24} = 1$ (machine 2 constraint)

$x_{31} + x_{32} + x_{33} + x_{34} = 1$ (machine 3 constraint)

$x_{41} + x_{42} + x_{43} + x_{44} = 1$ (machine 4 constraint)

$x_{11} + x_{21} + x_{31} + x_{41} = 1$ (job 1 constraint)

$x_{12} + x_{22} + x_{32} + x_{42} = 1$ (job 2 constraint)

$x_{13} + x_{23} + x_{33} + x_{43} = 1$ (job 3 constraint)

$x_{14} + x_{24} + x_{34} + x_{44} = 1$ (job 4 constraint)

$x_{ij} = 0$ or $x_{ij} = 1$

3. Assume: x_{ij} is the cost of implementing machine i at location j to expand production capacity.

   x_{ij} = 1 if machine i is placed in location j or if location j contains machine i.

   x_{ij} = 0 if machine i is not placed in location j or if location j does not contain machine i .

minimize z= $94x_{11} + 13x_{12} + 62x_{13} + 71x_{14} + 62x_{21} + 19x_{22} + 84x_{23} + 96x_{24} + 75x_{31} + 88x_{32} + 18x_{33} + 80x_{34} + 11x_{41} + 0x_{42} + 81x_{43} + 21x_{44}$ where i $\in$ I = {1,2,3,4} and j $\in$ J={1,2,3,4} where z is the minimal material handling cost of locating each of the machines in one possible location each. Such that (with these constraints):

$x_{11} + x_{12} + x_{13} + x_{14} = 1$ (machine 1 constraint)

$x_{21} + x_{22} + x_{23} + x_{24} = 1$ (machine 2 constraint)

$x_{31} + x_{32} + x_{33} + x_{34} = 1$ (machine 3 constraint)

$x_{41} + x_{42} + x_{43} + x_{44} = 1$ (machine 4 constraint)

$x_{11} + x_{21} + x_{31} + x_{41} = 1$ (Location 1 constraint)

$x_{12} + x_{22} + x_{32} + x_{42} = 1$ (Location 2 constraint)

$x_{13} + x_{23} + x_{33} + x_{43} = 1$ (Location 3 constraint)

$x_{14} + x_{24} + x_{34} + x_{44} = 1$ (Location 4 constraint)

$x_{42} = 0$

$x_{ij} = 0$ or $x_{ij} = 1$

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