Linear Programming: Homework 3

Homework to be submitted on Canvas by the start of class on Monday October 4th, 1pm.

Please include AMPL model and data files for Questions 1 and 2.

Explain all your answers and show your working.

Question 1.

(a) Create a model file in AMPL implementing the "bits and bobs" model from this week's class. Create a separate data file and solve the problem.

(b) Create another data file and resolve the following variation on the model.

Demand	bads	bens	bits	bobs	bugs
June	20	6	40	24	36
July	15	0	20	56	100
Aug	10	0	10	68	90
Sept	0	7	5	80	30

	Available hours	rate ($ per hour)
normal	1300	2
overtime	400	3

	bads	bens	bits	bobs	bugs
manhours	4	8.5	7	16.25	1
storage cost	0	1.5	5	8	3

Question 2.

(a) A certain company has three branch plants with excess production capacity. All three plants have the capability for producing a certain product and so management has decided to use the excess capacity for this purpose. The product can be made in three sizes (large, medium and small) which yield a net unit profit of $12, $10 and $9 respectively. Plants 1, 2 and 3 have excess manpower and equipment capacity which allows them to produce up to 500, 600 and 300 units respectively and this capacity can be used to produce the product in any size or combination of sizes. However, the amount of available in-process storage space also imposes a limitation on the production rates. Plants 1, 2 and 3 have 9000, 8000 and 3500 square metres of in-process storage space available for this product. Each product of the large, medium and small sizes produced per day requires 20, 15 and 12 square meters respectively.

Sales forecast indicate that up to 600, 800 and 500 units of the large, medium and small sizes, respectively can be sold per day.

Management wishes to know how much of each of the sizes should be produced by each of the plants in order to maximise profit. Create an algebraic model of the problem and implement it in AMPL with a separate model and data file to find the solution.

(b) In order to maintain a uniform workload among the plants and to retain some flexibility, management has decided that the additional production assigned to each plant must use the same percentage of their excess manpower and equipment capacity. Extend your model to include this constraint and re-solve.

Question 3. Consider the following problem.

$$\begin{aligned} \max \quad & 2x_1 + x_2 + 6x_3 - 4x_4 \\ \text{s.t.} \quad & x_1 + 2x_2 + 4x_3 - x_4 \leq 6 \\ & 2x_1 + 3x_2 - x_3 + x_4 \leq 12 \\ & x_1 + x_3 + x_4 \leq 2 \\ & x_1, x_2, x_3, x_4 \geq 0 \end{aligned}$$

Find a basic feasible solution with the basic variables x_1, x_2 and x_4. Is this solution optimal? If not, then starting with this solution find an optimal solution using the simplex algorithm. Note that you will have to put the problem into Standard Form 1 (from Class 1). Give your solution in terms of the original variables and objective function.