IE 400 – Study Set 1

Q1) All steel manufactured by Steelco must meet the following requirements: 3.2-3.5% carbon; 1.8-2.5% silicon; 0.9-1.2% nickel; tensile strength of at least 45000 pounds per square inch (psi). Steelco manufactures steel by combining two alloys. The cost and properties of each alloy are given in the table below. Assume that the tensile strength of a mixture of the two alloys can be determined by averaging that of the alloys that are mixed together. For example, a one-ton mixture that is 40% alloy 1 and 60% alloy 2 has a tensile strength of 0.4(42000) + 0.6(50000). Use linear programming to determine how to minimize the cost of producing a ton of steel.

	Alloy 1	**Alloy2**
Cost per ton($)	190	200
Percent silicon	2	2.5
Percent nickel	1	1.5
Percent carbon	3	4
Tensile strength(psi)	42000	50000

Q2) A company wishes to plan its production of two products with seasonal demands over a 12 month period from the beginning of January. The monthly demand of Product 1 is 100,000 kg during the months of October, November and December; 10,000 kg during the months of January, February, March and April; and 30,000 kg during the remaining months. The demand of Product 2 is 50,000 kg during the months of October through February and 15,000 kg during the remaining months. Suppose that cost of producing a kg of Product 1 and 2 is $5.00 and $8.00, respectively, provided that these were produced prior to June. After June, the costs are reduced to $4.50 / kg and $7.00 / kg because of the installation of an improved production system. The total amount of Products 1 and 2 that can be produced during any particular month cannot exceed 120,000 kg for Jan-Sept and 150,000 kg for Oct-Dec. Furthermore, at the end of each month products left at the hand are carried to the inventory space in order to be used in the coming months. Each kg of Product 1 occupies 2 cubic-feet and each kg of Product 2 occupies 4 cubic-feet of inventory. Suppose that the maximum inventory space allocated to these products is 150,000 cubic-feet and that the holding cost per cubic foot during any month is $0.10. Formulate the production scheduling problem so that the total production and inventory costs are minimized.

Q3)

Consider the following model

$$\min \quad x_1 + 3x_2$$

s.t.

$$6x_1 - 4x_2 \leq 24$$
$$x_2 \leq 5$$
$$x_1 - x_2 \geq 2$$
$$x_1, x_2 \geq 0$$

Solve this problem using graphical method.

Q4)

Consider the feasible region determined by the constraints

$$3x_1 - 4x_2 \leq 0$$
$$7x_1 - 4x_2 \geq 0$$
$$x_1 - 4x_2 \leq 16$$
$$x_1, x_2 \geq 0$$

Find the optimal solutions for each of the following objective functions;

a) max $x_1 + x_2$

b) min $-x_1 + 3x_2$

c) max $x_1 - x_2$

d) min $2x_1 + x_2$