

**CSCI 570**  
**Linear Programming**  
**Discussion Problems**

1. A cargo plane can carry a maximum weight of 100 tons and a maximum volume of 60 cubic meters. There are three materials to be transported, and the cargo company may choose to carry any amount of each, up to the maximum available limits given below.

	Density	Volume	Price
Material 1	2 tons/m <sup>3</sup>	40 m <sup>3</sup>	\$1,000 per m <sup>3</sup>
Material 2	1 tons/m <sup>3</sup>	30 m <sup>3</sup>	\$2,000 per m <sup>3</sup>
Material 3	3 tons/m <sup>3</sup>	20 m <sup>3</sup>	\$12,000 per m <sup>3</sup>

Write a linear program that optimizes revenue within the constraints.

2. There are  $n$  people and  $n$  jobs. You are given a cost matrix,  $C$ , where  $c_{ij}$  represents the cost of assigning person  $i$  to do job  $j$ . You need to assign all the jobs to people and also only one job to a person. You also need to minimize the total cost of your assignment. Write a linear program that minimizes the total cost of your assignment.

3. Convert the following LP to standard form

$$\max (5x_1 - 2x_2 + 9x_3)$$

$$3x_1 + x_2 + 4x_3 = 8$$

$$2x_1 + 7x_2 - 6x_3 \leq 4$$

$$x_1 \leq 0, x_3 \geq 1$$

4. Explain why LP cannot contain constraints in the form of *strong* inequalities.
5. Given  $n$  items with weights  $w_1, w_2, \dots, w_n$  and values  $v_1, v_2, \dots, v_n$ . Put these items in a knapsack of capacity  $W$  to get the maximum total value in the knapsack. Write a 0-1 Knapsack Problem as a linear program.
6. Consider the following LP:

$$\max(3x_1 + 8x_2 + x_3)$$

$$x_1 + 4x_2 - 2x_3 \leq 20$$

$$x_1 + x_2 + x_3 \geq 7$$

$$x_2 + x_3 = 3$$

$$x_2 \geq -1$$

$$x_3 \leq 5$$

Write the dual problem.