# Proposal for Problem Set #5

(a) Represent the below problem as a COP in the Standard Simplex Form.

Consider that Komal is the owner of a chocolate factory that makes candies, cakes and biscuits. Her factory runs for 40 hours each week and every hour the single machine she has can make 60 candies or 6 cakes or 20 biscuits. Each hour the machine can produce any one of the items in the specified quantity.

1 Candy needs 45mg sugar and 10ml milk. Cake needs 250mg sugar and 200ml milk. Biscuit needs 100mg sugar and 100ml milk. The factory has 20kg sugar and 7 litres of milk for each week.

The factory makes $1 profit per candy, $7 profit per cake and $3 profit per biscuit. Komal's goal is to maximize her profit.

(b) Use the standard form generated in the above problem to find the number of candies, cakes and biscuits the factory should make to maximize Komal's profit using Simplex Algorithm.

Note: Round off the final solution to nearest integer to find the number of items to produce.

(c) In Simplex Algorithm, to create the standard form we transform the constraints inequalities into less-than-equal-to. Explain what would happen to the slack variables if we did not transform the constraints into less-than-or-equal-to? How will this impact the process of optimization in Simplex Algorithm? Finally, argue why converting the constraints to less than or equal to is important?

(d) Suppose we want to find the maximum value of $z = 5x_1 + 4x_2$ where $x_1, x_2 \geq 0$, subject to the following constraints:
$$x_1 \leq 9$$
$$x_1 - x_2 \leq 11$$
Confirm if there exists any feasible solution for the above maximization problem. If it exists, find the optimal solution else, show why no feasible solution exists using Simplex Method.