ESCUELA SUPERIOR POLITECNICA DEL LITORAL

Gerencia de Operaciones I
Midterm Exam 2016

Directions: Put your full name in the top right corner of your exam. Put your name on every page that you turn in. Number and staple your pages. Answer all questions. Your score is out of 100 points.

1.) Traverso Furniture Company produces sofas and chairs. Each sofa sells for $100 and costs $70 to make. Each chair sells for $90 and cost $75 to make. Both sofas and chairs require labor and fabric in their production. Each sofa requires 10 hours of labor and requires 9 meters of fabric. Each chair requires 3 meters of fabric and 7 hours of labor. Traverso has 110 meters of fabric available and 170 labor hours available and wishes to maximize their profits.

a.) Formulate a linear programming problem for Traverso Furniture Company (primal problem). (7 points)

b.) Formulate the dual problem for Traverso Furniture Company. (4 points)

c.) Using the graphical method for the primal problem (part a), find the optimal decision variable values and objective function values. Be sure to indicate the feasible region in your graph. (7 points)

d.) Now, assume that Traverso was just given a new machine for free that will lower the cost of making chairs to $65. Is the current production of sofas and chairs (found in part b) still optimal? Show this graphically. (7 points)

2.) Bestmans Bank and Loan is trying to determine how to best invest its assets in the coming year. Bestmans has $500,000 dollars to invest in bonds, home loans, car loans, and personal loans. Bonds have a 10% return on investment, home loans have a 16% return on investment, car loans have a 13% return on investment, and personal loans have a 20% return on investment. The manager at Bestmans has given the following three requirements for investments:

   i. The amount invested in personal loans cannot be more than the amount invested in bonds.

   ii. The amount invested in home loans cannot be more than the amount invested in car loans.

   iii. They cannot invest more than 25% of the total quantity invested in personal loans.

The goal of the bank is to maximize the annual returns. Formulate the linear programming problem for Bestmans bank. A complete objective function, defined decision variables, and all correct constraints are needed for full credit. (25 points)

3.) Tennyson Toy Makers make toy trains and sell them in their stores. The trains are made in three stages and each stage requires machinery that is specific to a certain factory location. The first stage of production is where the body of the train is made and it can be made in one of the factory locations in Texas, Iowa, or Oregon. The second stage of production involves making the wheels for the train which can be made in factory locations in Hungary or Hawaii. Finally, painting the completed train can be done in either the Philippines or Fiji. Once the trains are completed and painted, they can be sold in stores in Japan, South Korea, New Zealand, or Australia. The following graphic shows the potential flow of locations of the trains, the costs of sending the trains to each station and the supply at the initial factory locations and the demand at the final toy store. Formulate the linear programming problem for Tennyson Toy Makers. (25 points)
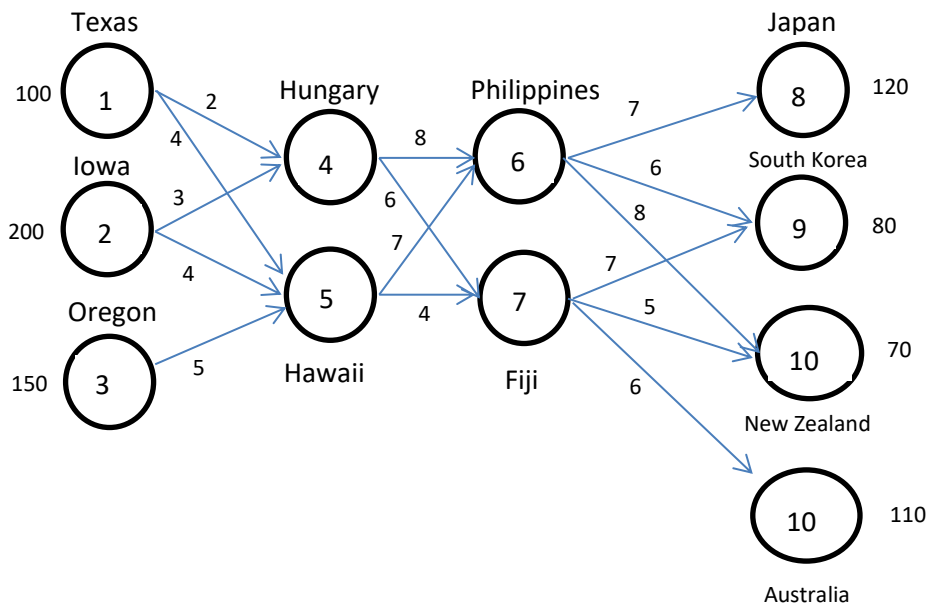
4.) For the following linear programming problem:

$$\max 5X_1 + 3X_2$$

s.t.

$$6X_1 + 9X_2 \leq 30 \quad (1)$$
$$X_1 + X_2 \leq 25 \quad (2)$$
$$X_1, X_2 \geq 0$$

a.) Find the optimal solution (decision variables and objective function value) using the simplex method. (20 points)

b.) By how much can the resource availability (right hand side value) change on the first constraint such that the same variables found in part a would still be basic variables? That is, obtain the right hand side range for the first constraint. (5 points)