Assignment 3: Optimization with Excel

Date Due: February 12, 2017 Instructor: Trani

Show all your work including code and results of your computation in the spreadsheet as screen captures.

Problem 1

A company that makes concrete has to products in the market. Product A is a premium concrete mix that sells for $765 per ton. Product B is a standard concrete mix that is easier to make and sells for $650 per ton.

With the concrete mixing hardware available, the company can produce up to 600 tons of premium concrete per day or up to 720 tons of the standard product. Because the concrete mixes are produced using the same machinery, linear combinations of both products not exceeding their maximum individual productions can be produced in one day. For example, the company may produce 300 tons of premium concrete in the first 12 hours of the day and then produce another 360 tons of standard concrete in the remaining 12 hours of the day (assume 24 hour operation). The company employs special trucks to deliver the concrete to various clients in the region. Because the specific weight of both products is not the same, the delivery trucks can haul up to 675 tons of premium concrete per day or up to 775 tons per day of the standard concrete. Linear combinations of both products not exceeding their maximum individual hauling rates can be delivered in one day.

Task 1:

Formulate the problem as a linear programming problem. The idea is to maximize the revenue to the company.

Task 2:

Solve the problem graphically. Clearly indicate corner points and plot the lines of constant Z value.

Task 3:

Solve the problem using Excel Solver. Comment on the results obtained in Tasks 2 and 3.

Problem 2

Task 1:

Solve the water management pollution control problem stated in the class Notes # 7 (pages 34 through 39) if the total pollution removal is 63,000 kg. In solving the new problem, assume the city invested in new pollution treatment plant and technology ($30,000,000 cost) and generates 9,500 kg/year of pollutant per year. The cost of removing pollutants from the city using the new technology is $1.23 per kilogram. Find out the total cost of pollution removal for this task. In this solution, assume that for political reasons we would like to remove at least 4,000 kg of pollution from all sources.

Task 2:

Using the solution on Task 1, suppose a new (stricter) environmental law takes effect and It is desired to reduce the total pollution discharge to the lake to 93,000 kg/yr instead. Estimate the cost of removal and the amounts to be removed from each pollution source. Contrast the removal cost in tasks 1 and 2. Comment.

Problem 3

A group in your company develops the following Linear Programming problem to minimize the cost of producing two types of steel doublers commonly used in buildings. The objective function is the profit for the company (in dollars per production batch). The company would like to maximize the profit in solving this problem.

Objective Maximize $Z = 110X_1 + 130 X_2$

Subject to

$X_2 - 1.2 X_1 <= 250$

$3X_2 + X_1 <= 1200$

$X_2 + 3X_1 <= 1500$

$X_1, X_2 >= 0$ (non-negativity conditions)

For each task below, use screen captures of your setup using Excel Solver. Show the formulas of the cells to make out task simpler in grading.

Task 1

Solve the problem using Excel Solver. State the exact solution found by Excel for the two decision variables. State the value of the objective function for the optimal solution found.

Task 2

Since number of beams to be produced needs to be an integer solution, solve the problem with Excel to obtain an integer solution. State the value of the objective function for the optimal solution found.

Task 3

Solve the problem by hand using the Simplex method. Show all the tables in each iteration. Also, for each iteration, indicate the Basic Variables (in the table) and the current solution for Z.