Assignment 3: Optimization with Excel

Date Due: February 15, 2021 Instructor: Trani

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

Problem 1

Use the car data file provided in class (see Syllabus Week 1) to answer the following questions. To answer the questions, use the Excel database functions. Please note, that regular filtering will not be accepted. Show your screen captures and formulas to do the queries.

1) Find the average gas tank size for cars produced in the US.
2) Find the average horsepower (in HP) for cars produced in Japan.
3) Find the average horsepower for US cars weighing more than 2900 lbs.
4) Find the number of cars with engine displacements between 118 and 290 cubic inches.
5) Find the standard deviation of the turning circle for cars produced in Japan.
6) Find the maximum horsepower of the cars produced in the US.

Problem 2

Reformulate the Osaka Bay Problem by changing the following conditions:

a) The company is able to purchase an additional 10 ships of the type “Fuji” for the job.
b) The company is able to recruit and train up to 200 crew members for this job.
c) The company invests in automation for the “Fuji” vessels and now they require two crew members to operate instead of the original three.

1) Formulate the new problem as a linear programming problem.
2) Write down the problem in standard form including slack variables.
3) Solve by hand using the Simplex method (tableaus). Clearly show all your tableaus.
4) Find the optimal solution to the allocation problem. State the values of the decision variables in the optimal solution.
5) Check your answer using Excel Solver.

Problem 3

A company that makes concrete has to products in the market. Product A is a premium concrete mix that sells for $1125 per ton. Product B is a standard concrete mix that is easier to make and sells for $1045 per ton.

With the concrete mixing hardware available, the company can produce up to 850 tons of premium concrete per day or up to 910 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 425 tons of premium concrete in the first 12 hours of the day and then produce another 455 tons of standard concrete in the remaining 12 hours of the day (assume 24 hour operation for concrete production). 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 800 tons of premium concrete per day or up to 980 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. For example, in the first 12 hours of the day, the company may deliver 400 tons of premium concrete and in the next 12 hours deliver 490 tons of standard concrete.

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

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

Problem 4

Solve the water management pollution control problem stated in the class Notes # 7 (pages 34 through 39) if the total pollution removal is 65,000 kg. In solving the new problem, assume the city invested in new pollution treatment plant and technology ($26,000,000 cost) and generates 11,500 kg/year of pollutant per year. The cost of removing pollutants from the city using the new technology is $1.65 per kilogram. Find out the total cost of pollution removal for this task. In this solution, assume that for equity reasons we would like to remove at least 5,200 kg of pollution from all sources.