Assignment 3: Excel Functions and Linear Programming

Date Due: February 12, 2015 Instructor: Trani

Problem 1

A formula to estimate the noise generated by rail vehicles is,

Leq = SELref + 10 log(Ncars) + 20 log(S/50) + 10 log (V) – 31.4

where:

Leq = equivalent noise level (decibels - dBA)

SEL ref = reference sound exposure level (decibels - dBA)

Ncars = number of cars in the train

S = train speed (mph)

V = hourly average train volume (trains per hour)

Task 1:

Write an **Excel function** to calculate the value of Leq given values of S (speed), SELref (sound exposure level), Ncars (train cars), and the hourly train volume (V). Assume the value of SELref to be 73 dBA for this train.

Task 2:

Test the Excel function created in Task 1 to calculate the value of Leq for a subway train with 8 cars. The hourly train volume is 28 trains/hr and the train travels at 49 mph on average.

Task 3:

In a separate part of the worksheet create a table with solutions for Leq as a function of train speed (say from 0-65 mph). The idea is to generate solutions for Leq for speeds ranging from 0-65 mph for 8 cars per train and the average speed.

Task 4:

In a separate part of the worksheet create a table with solutions for Leq as a function of train size (say from 2-8 cars per train). Plot the results assuming ab average speed and the baseline train hourly volume.

Problem 2

A construction site requires a minimum of 120,000 cu. meters of sand and gravel mixture. The mixture must contain a minimum of 40% sand of sand and no more than 70% of gravel.

Materials may be obtained from two sites: 35% of sand and 65% gravel from site 1 at a delivery cost of $350.00 per cu. meter and 50% sand and 50% gravel from site 2 at a delivery cost of $420.00 per cu. meter.

a) Formulate the problem as a Linear Programming problem

b) Solve the problem graphically

c) Solve the problem using Excel Solver.

d) Setup the first “Tableau” of the Simplex procedure.

Problem 3

A company makes two Portland Cement Concrete (PCC) mixes for highway construction projects. Product A is a premium product that sells for $120 per cubic meter. Product B is a PCC mix that sells for $97 per cubic meter.

With the mixing hardware available, the company can produce up to 1100 cubic meters of Product A PCC mix per day or up to 1250 cubic meters of the B product. Because the PCC 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 could produce 550 cu. meters of the Product A (mix) and 560 cu. meters of the B mix on the same day if we assume a linear combination of the individual production rates of the two PCC mixes. 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 1150 cu. meters of the Product A per day or up to 1300 cu. meters per day of the PCC mix. Linear combinations of both products do not exceeding their maximum individual hauling rates can be delivered in one day. For example, the company could haul 1160 cu. meters of the product A mix and 1230 cu. meters of the Product B mix on the same day if we assume a linear combination of the individual hauling rates of the two distinct PCC mixes.

Task 1:

Formulate the problem as a linear programming problem. Assume the company wants to maximize the revenue for the company.

Task 2:

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

Task 3:

Solve the PCC mix problem using Excel Solver. Comment on the results obtained in Tasks 3 and 4.

Problem 4

Modify the water management pollution control problem described in the previous problem. New removal costs are presented in Table 1.

Table 1. Removal Costs and Pollution Values for Water Pollution Control Problem.

Source	Removal Cost ($/kg)	Pollution to Lake (kg)
Trinity River	53	15,800
Humbolt River	51	29,200
City	67	15,400
Airport	56	17,400

Assume that under a new water mandate by EPA we would like to control the lake pollution such that 40% of the pollutants discharged in the lake in the baseline year (see Table 1) are to be removed. An initiative to build two processing plants has been circulated. The new pollution law requires that processing plants at all rivers needed to remove at least a quarter of their baseline pollutants as a minimum according to a new environmental law.

a) Formulate the problem as a linear programming problem.

b) Solve the new problem using Excel Solver and state the optimal cost.