

## Assignment 2: Excel Functions

**Date Due: February 5, 2015**

Instructor: Trani

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

### Problem 1

A civil engineer uses the following mathematical relationship to estimate the average delay per vehicle arriving to busy traffic intersection:

$$d = \frac{C(1 - g/C)^2}{2(1 - v/s)} + \frac{(v/c)^2}{2v(1 - v/c)}$$

where:

$d$  is the average vehicle delay (seconds)

$C$  is the cycle length of the traffic signal (seconds)

$g$  is the green time (seconds)

$s$  saturation volume (veh/hr)

$v$  is the volume of vehicles approaching the intersection (veh/hr)

$$v/c = \frac{v/s}{g/C}$$

where:

$v/c$  is the so-called volume over capacity ratio (dimensionless)

- a) Create an **Excel Function** (using Visual Basic For Applications) to calculate the average delay time for vehicles approaching the intersection. The functions should have 4 input parameters ( $C, g, s$  and  $v$ ) and should output the average delay ( $d$ ).
- b) Test the Excel function created in part (a) using the following nominal parameters for the intersection.

$$C = 60 \text{ (seconds)}$$

$$g = 35 \text{ (seconds)}$$

$$s = 1800 \text{ (veh/hr)}$$

$$v = 1000 \text{ (veh/hr)}$$

- c) Use the function created in part (a) to perform a sensitivity analysis by changing the value of green time from 25 to 45 seconds. For this part of the problem, create a table in Excel with values of green time ( $g$ ) and then call your function to estimate the delay. Plot the results in Excel and label the axes accordingly.
- d) Comment on the behavior of the delay with changing green times.
- e) Repeat the process of part (c) but now vary the volume of traffic approaching the intersection from 200 to 1600 vehicles per hour. Other parameters of the delay equation are assumed to be those stated in part (b). For this part of the problem, create a table in Excel with values of volume ( $v$ ) and then call your function to estimate the delay. Plot the results in Excel and comment on the trends observed.

**Note: You will get no credit if you just do regular Excel computations in a spreadsheet and do not show your VBA code.**

## **Problem 2**

Auto data for several vehicles is contained in the file Car data.txt. The data file contains various characteristics for automobiles produced in the year 1998. Use Excel Database functions (Dfunctions) to do this problem. Show all your work and provide screen captures of the your work and include the actual database commands used to make each query.

### **Task 1:**

Calculate the average weight for Japanese cars whose weight  $> 2800$  lb.

### **Task 2:**

Calculate the average weight for Japanese cars whose tank size  $< 15$  gallons

### **Task 3:**

Calculate the average tank size for U.S. cars whose weight  $> 2600$  lbs

### **Task 4:**

Calculate the average horsepower for cars whose weight  $< 2800$  lbs

### **Task 5:**

Calculate the average turning circle for cars whose weight  $< 2700$  lbs and a tank size  $\geq 13$  gallons

### **Task 6:**

Count the number of Small Cars whose gas tank size falls between 11 and 17

### Problem 3

Use the construction company assets file provided in class and use your knowledge of **Excel Pivot tables** when appropriate to answer the following questions. Show your Pivot table.

- Find the average value for the Caterpillar 160H vehicles at the Greensboro construction site.
- Find the average number of miles for Caterpillar Cat 775F vehicles at the Raleigh office.
- Find the total number of miles traveled by all Caterpillar 725 vehicles owned by the company.
- Find the number of Caterpillar 725 that are active at the Greensboro site.
- Make a Pivot Table Plot showing the average miles traveled for each vehicle type for all sites.

### Problem 4

The formula to estimate the wind chill factor is:

$$WC = 35.75 + 0.6215T - 35.75(v^{0.16}) + 0.4275T(v^{0.16})$$

where:

$WC$  = is the wind chill index (on Fahrenheit scale)

$T$  = temperature (deg. F)

$v$  = wind velocity (mph)

#### Task 1:

Create an Excel function to calculate the wind chill factor as a function of  $T$  and  $v$ . Show your function (using a screen capture from the VBA code)

#### Task 2:

Test your function for values of  $T$  ranging from 0 to 100 deg. F and values of speed ranging from 0 to 30 mph.

#### Task 3:

Plot the wind chill when  $T = 32$  deg. F and the wind velocity varies from 0-20 mph.

### Problem 5

The Panama Canal is building a second set set of locks to improve the capacity of ship crossings between the two largest oceans. The additional locks will help reduce ship delays. The company in charge of the project obtains financing for 3.40 billion dollars using international banks with an interest rate of 6.3% per year.

- Estimate the monthly payments to pay the loan over 20 years. Show all your Excel formulas and work.
- If the average container ship pays \$152,000 (this is not a typo - just think about how much fuel and time the canal saves a ship to avoid navigating down to Cape Horn in South America) to transit the canal and the traffic in 2014 was 11,956 ships that executed transits though the canal. Assume the traffic will increase by 2% per year in the next 20 years. Will the company be able to pay back the loan with the tolls received? Comment.