

## Assignment 2: Excel Functions

### Solution

Date Due: February 5, 2015

Instructor: Trani

#### Problem 1

- a) Excel function using VBA to calculate average delay for vehicles approaching the intersection

```
Public Function Delay(cLength, green, vSat, vApp)
' Function to estimate the average delay per vehicle arriving to a busy intersection
'
' Programmer: Moises Bobadilla
' Date : Feb/2/2015
'
' Input Parameters:
' cLength = Traffic signal cycle length (s)
' green = green time (s)
' vSat = Saturation volume (veh/hr)
' vApp = Volume of approaching vehicles (veh/hr)
' Delay = Average delay (s)

vcRatio = (vApp / vSat) / (green / cLength) ' calculates Volume over capacity ratio

Delay = (cLength * (1 - (green / cLength) ^ 2) / (2 * (1 - (vApp / vSat))) + (((vcRatio) ^ 2) / (2 * vApp * (1 - vcRatio))) 'Computes delay

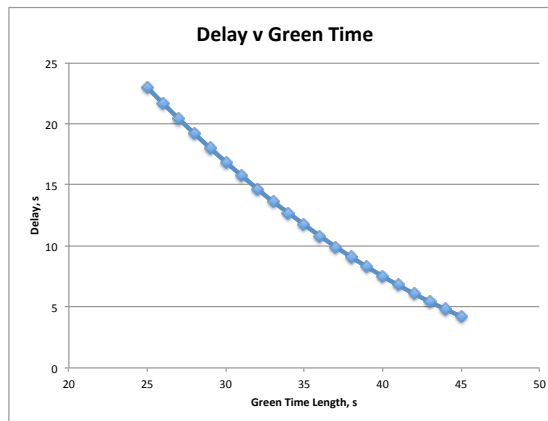
End Function
```

- b) Test with initial parameters of C=60, g=35, s=1800, v=1000

Delay with initial parameters: 11.73 seconds

- c) and d) Perform a sensitivity analysis by changing the green time from 25 to 45 s. Comment on the results.

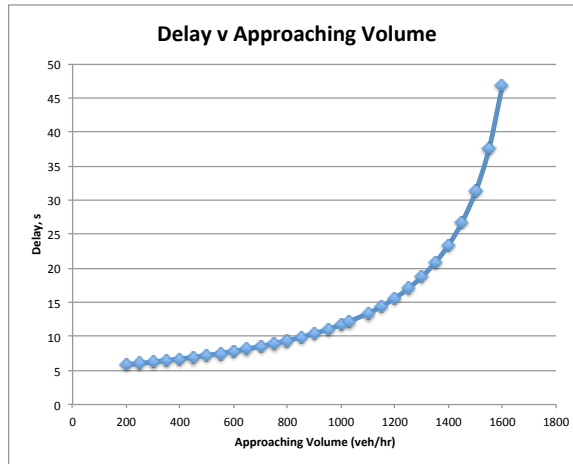
Varying green times		
Green Time	Delay	Unit
25	22.96608	s
26	21.67209	s
27	20.4155	s
28	19.19628	s
29	18.01433	s
30	16.86944	s
31	15.76107	s
32	14.68698	s
33	13.61824	s
34	12.69951	s
35	11.72827	s
36	10.80579	s
37	9.922845	s
38	9.078133	s
39	8.271264	s
40	7.502083	s
41	6.770517	s
42	6.076526	s
43	5.420087	s
44	4.801184	s
45	4.219808	s



Delay decreases as the green time is increased

e) Perform a sensitivity analysis by varying the approaching volume from 200 to 1600 vph. Comment on results.

Varying vApp		
Volume	Delay	Unit
200	5.859487	s
250	6.048536	s
300	6.25019	s
350	6.465755	s
400	6.696722	s
450	6.944802	s
500	7.211971	s
550	7.500524	s
600	7.813135	s
650	8.152948	s
700	8.52368	s
750	8.929762	s
800	9.376524	s
850	9.870445	s
900	10.41952	s
950	11.03394	s
1000	11.72827	s
1030	12.19985	s
1100	13.38238	s
1150	14.4176	s
1200	15.62119	s
1250	17.04248	s
1300	18.74752	s
1350	20.83119	s
1400	23.4356	s
1450	26.78399	s
1500	31.24841	s
1550	37.49852	s
1600	46.87361	s



Delay increases as approach volume increases, as expected

### Problem 2

Using the cardata.txt file and the Excel function DCOUNT, do the following:

a) Calculate the average weight for Japanese cars whose weight > 2800 lb

=DAVERAGE(A1:H117,"Weight",J10:Q11)							
J	K	L	M	N	O	P	Q
<b>Task 1</b>							
Calculate the average weight for Japanese cars whose weight >2800 lb							
Average	3407.66667	lbs					
Model	Country	Type	Weight	Turning Circle	Displacement	Horsepower	Gas Tank Size
	Japan		>2800				

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

=DAVERAGE(A1:H117,"Weight",J19:Q20)							
J	K	L	M	N	O	P	Q
<b>Task 2</b>							
Calculate the average weight for Japanese cars whose tank size <15 gallons							
Average	2338.18182	lbs					
Model	Country	Type	Weight	Turning Circle	Displacement	Horsepower	Gas Tank Size
	Japan						<15

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

=DAVERAGE(\$A\$1:\$H\$117,"Gas Tank Size",J27:Q28)							
J	K	L	M	N	O	P	Q
<b>Task 3</b>							
Calculate the average tank size for U.S. cars whose weight >2600 lbs							
Average	17.3622222	gallons					
Model	Country	Type	Weight	Turning Circle	Displacement	Horsepower	Gas Tank Size
	USA		>2600				

d) Calculate the average horsepower for cars whose weight < 2800 lbs

fx =DAVERAGE(\$A\$1:\$H\$117,"Horsepower",J35:Q36)							
J	K	L	M	N	O	P	Q
30							
31	<b>Task 4</b>						
32	Calculate the average horsepower for cars whose weight <2800 lbs						
33	Average	102.638298					
34							
Model	Country	Type	Weight	Turning Circle	Displacement	Horsepower	Gas Tank Size
			<2800				

e) Calculate the average turning circle for cars whose weight < 2700 lbs and a tank size >= 13 gallons

fx =DAVERAGE(\$A\$1:\$H\$117,"Turning Circle",J43:Q44)							
J	K	L	M	N	O	P	Q
38							
39	<b>Task 5</b>						
40	Calculate the average turning circle for cars whose weight <2700 lbs and a tank size >=13 gallons						
41	Average	36.4					
42							
Model	Country	Type	Weight	Turning Circle	Displacement	Horsepower	Gas Tank Size
			<2700				>=13

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

fx =DCOUNT(A1:H117,"Weight",J51:R52)								
J	K	L	M	N	O	P	Q	R
46	<b>Task 6</b>							
48	Count the number of Small Cars whose gas tank size is between 11 and 17							
49	Count	19						
50								
Model	Country	Type	Weight	Turning Circle	Displacement	Horsepower	Gas Tank Size	Gas Tank Size
		Small					>=11	<=17

### Problem 3

Using the construction company assets file, use Pivot Tables when appropriate to answer the following:

- a) Find the average value for the Caterpillar 160H vehicles at the Greensboro construction site.

The screenshot shows an Excel PivotTable and its corresponding PivotTable Builder. The PivotTable displays the average value for Caterpillar 160H vehicles at the Greensboro construction site. The PivotTable Builder shows the following configuration:

- Field name: Construction Site, Vehicle, Miles, Value (\$), Status
- Report Filter: (empty)
- Column Labels: Construction Site
- Row Labels: Vehicle
- Values: Average of Value (\$)

Average of Value (\$)	Column Labels	Grand Total
	Greensboro	
Cat 160H	151617.4286	151617.4286
Grand Total	151617.4286	151617.4286

- b) Find the average number of miles for Caterpillar Cat 775F vehicles at the Raleigh office.

The screenshot shows an Excel PivotTable and its corresponding PivotTable Builder. The PivotTable displays the average number of miles for Caterpillar Cat 775F vehicles at the Raleigh office. The PivotTable Builder shows the following configuration:

- Field name: Construction Site, Vehicle, Miles, Value (\$), Status
- Report Filter: (empty)
- Column Labels: Construction Site
- Row Labels: Vehicle
- Values: Average of Miles

Average of Miles	Column Labels	Grand Total
	Raleigh	
Cat 775F	133973.3824	133973.3824
Grand Total	133973.3824	133973.3824

c) Find the total number of miles traveled by all Caterpillar 725 vehicles owned by the company.

The screenshot shows an Excel spreadsheet with a PivotTable and its corresponding PivotTable Builder. The PivotTable has 'Sum of Miles' as the value field and 'Cat 725' as the row label. The grand total for 'Cat 725' is 13559812, which is circled in red. The PivotTable Builder shows 'Vehicle' in the Row Labels and 'Sum of Miles' in the Values area.

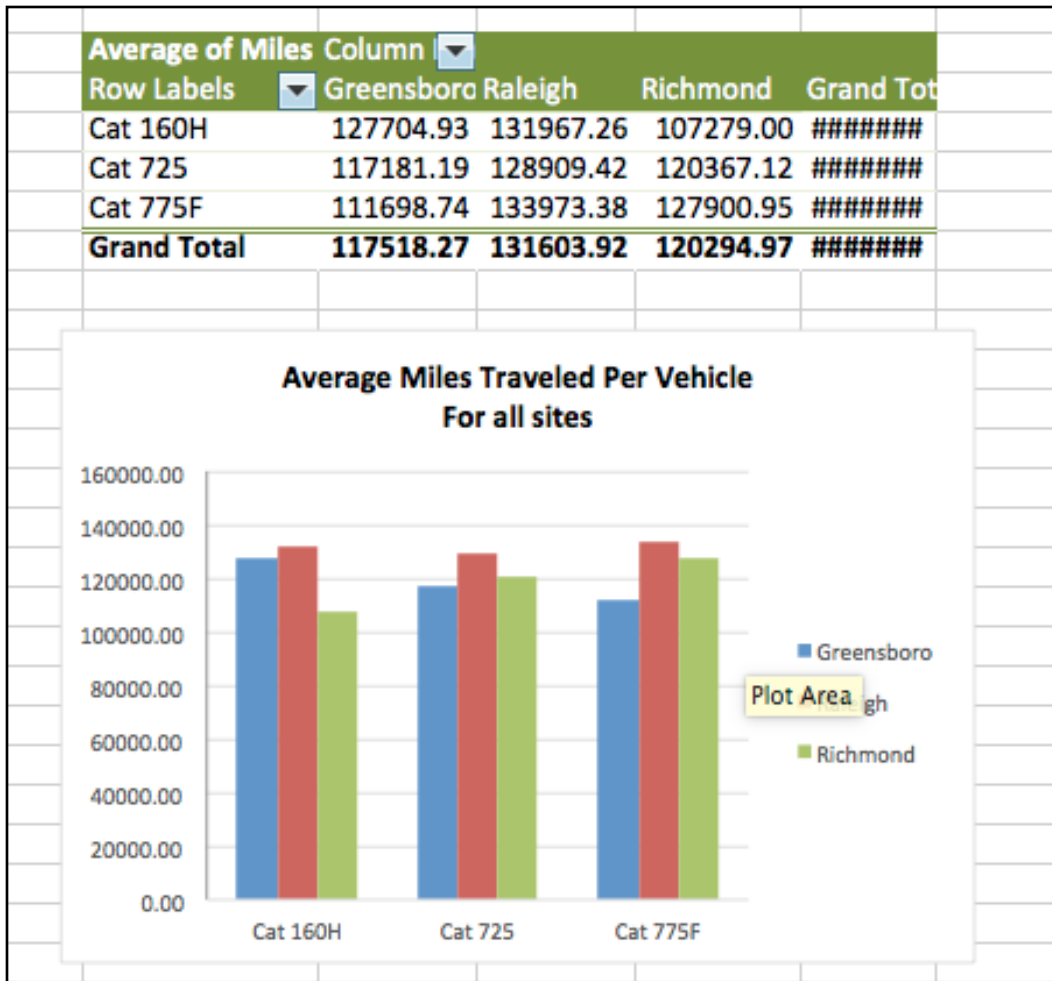
Sum of Miles	Total
Cat 725	13559812
Grand Total	13559812

d) Find the number of Caterpillar 725 that are active at the Greensboro site.

The screenshot shows an Excel spreadsheet with a PivotTable and its corresponding PivotTable Builder. The PivotTable has 'Count of Vehicle' as the value field, 'Active' as the row label, and 'Greensboro' as the column label. The grand total for 'Active' at 'Greensboro' is 25, which is circled in red. The PivotTable Builder shows 'Status' in the Row Labels, 'Vehicle' as a filter, and 'Count of Vehicle' in the Values area. 'Construction Site' is in the Column Labels area.

Count of Vehicle	Greensboro	Grand Total
Active	25	25
Cat 725	25	25
Grand Total	25	25

e) Make a Pivot Table Plot showing the average miles traveled for each vehicle type for all sites.



#### Problem 4

Using this formula:  $WC = 35.75 + 0.6215T - 35.75(v^{0.16}) + 0.4275T(v^{0.16})$ , do the following:

a) Create a VBA function to calculate the wind chill factor as a function of T and v

```

Public Function WindChill(temp, velocity)
' Function that calculates the Wind Chill Factor as a function of T and v (in deg. F)
' Programmer: Moises Bobadilla
' Date: 02/03/2015
'
'
' Inputs:
' temp = Temperature (deg. F)
' velocity = wind velocity (mph)

WindChill = 35.75 + 0.6215 * temp - 35.75 * (velocity ^ 0.16) + (0.4275 * temp * (velocity ^ 0.16))

End Function

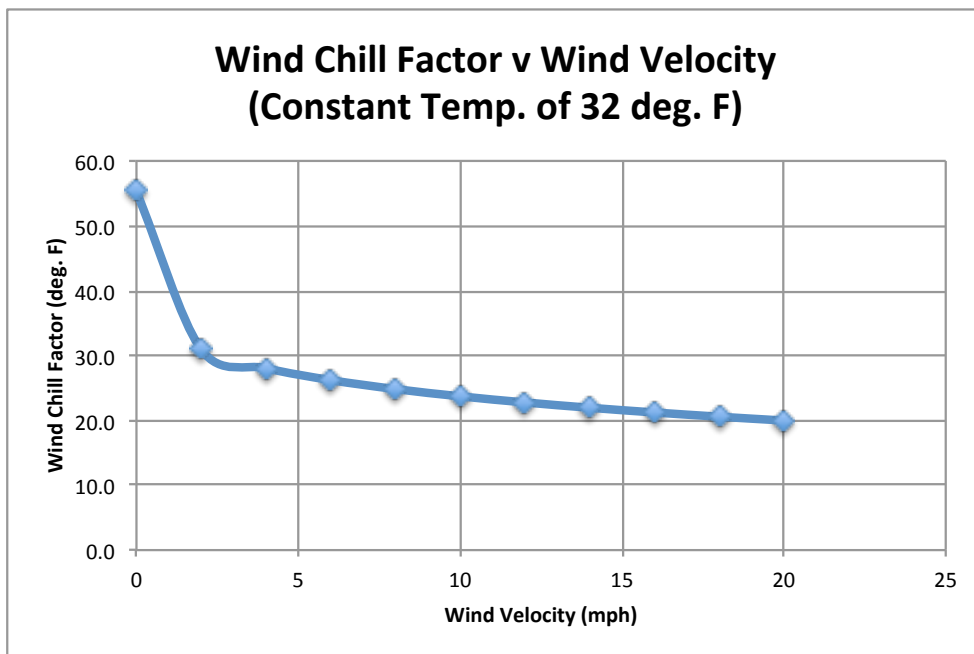
```

b) Test function for values of T ranging from 0 to 100 degrees and values of speed ranging from 0 - 30 mph

Temperature	Speed	Wind Chill Factor
0	0	35.8
10	3	4.4
20	6	11.9
30	9	21.8
40	12	32.9
50	15	44.7
60	18	57.0
70	21	69.8
80	24	82.9
90	27	96.3
100	30	110.0

c) Plot the wind chill when T=32 degrees and wind varies from 0-20 mph

Temperature	Speed	Wind Chill Factor
32	0	55.6
32	2	31.0
32	4	28.1
32	6	26.2
32	8	24.9
32	10	23.7
32	12	22.8
32	14	22.0
32	16	21.2
32	18	20.6
32	20	20.0



### 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.

- a) Estimate the monthly payments to pay the loan over 20 years. Show all your Excel formulas and work

	A	B	C	D	E	F	G	H
4								
5		Rate	=0.063/12	%/month		Rate	0.00525	%/month
6		Periods	=20*12	months		Periods	240	months
7		Present Value	3400000000	\$		Present Value	3400000000	\$
8								
9		Monthly Payments	=PMT(C5,C6,C7)	\$		Monthly Payments	-24950744.42	\$
10								

- b) 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

	H	I	J	K	L	M	N	O
4								
5								
6		Rate	=0.063/12	%/month		Rate	0.00525	%/month
7		Periods	=20*12	months		Periods	240	months
8		Present Value	3400000000	\$		Present Value	3400000000	\$
9								
10		Monthly Payments	=PMT(J6,J7,J8)	\$		Monthly Payments	-24950744.42	\$
11								
12								
13								
14								
15								
16		Accumulated debt after 20 years	=FV(J6,J7,J10)	\$		Accumulated debt after 20 years	11946991178.8897	\$
17								
18								
19		2014 Analysis				2014 Analysis		
20		Payment per ship	152000	\$		Payment per ship	152000	\$
21		2014 Traffic	11956	ships		2014 Traffic	11956	ships
22		2014 Profit	=J21*J20	\$		2014 Profit	1817312000	\$
23								
24		2034 Analysis				2034 Analysis		
25		Period	20	years		Period	20	years
26		Traffic Increase	=2/100	0.02		Traffic Increase	0.02	0.02
27		2034 profit (adjusted for traffic growth)	=FV(J26,J25,J22)			2034 profit (adjusted for traffic growth)	-44155901704.0107	\$
28								
29								

As shown above, the money made through the toll charges at the end of the study period (**\$44.16 billion**) is greater than the accumulated debt incurred by the interest on the loan by 2034 (**\$11.95 billion**). Therefore, by this analysis, it can be determined that the loan will be paid back in 20 years. Furthermore, there will be a profit of approximately **\$33.6 billion**.