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

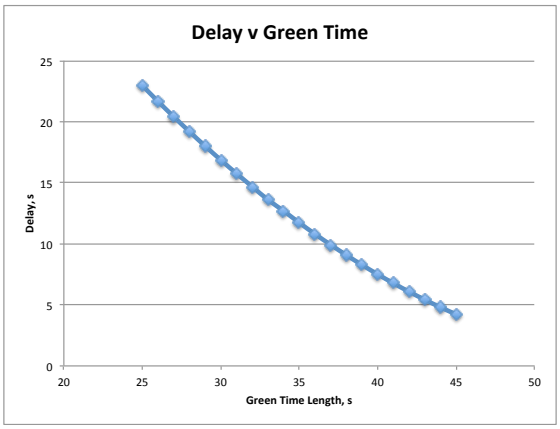
```
Public Function Delay(cLength, green, vSat, vApp)
' Function to estimate the average delay per vehicle arriving to a busy intersection
'
' Programmer: Moises Bobadilla
' Date : Feb/2/2015
'
' Input Parameters:
' cLength = Traffic signal cycle length (s)
' green = green time (s)
' vSat = Saturation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

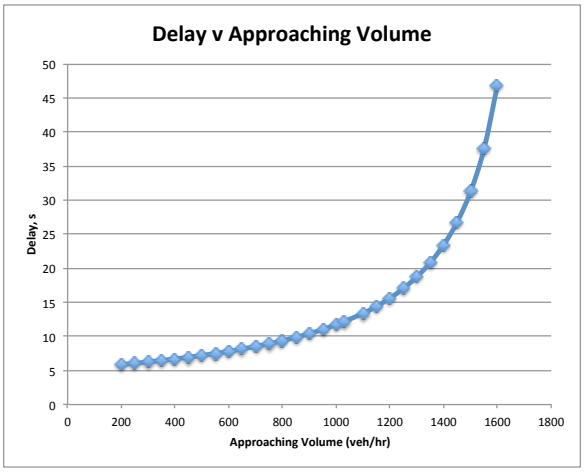
Varying green times		
Green Time	Delay	Unit
25	22.96608	s
26	21.67209	s
27	20.4155	s
28	19.19628	s
29	18.01433	s
30	16.86944	s
31	15.76107	s
32	14.68698	s
33	13.61824	s
34	12.69951	s
35	11.72827	s
36	10.80579	s
37	9.922845	s
38	9.078133	s
39	8.271264	s
40	7.502083	s
41	6.770517	s
42	6.076526	s
43	5.420087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

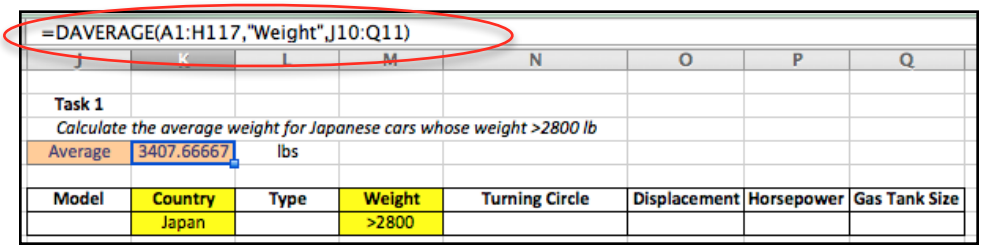


Delay increases as approach volume increases, as expected

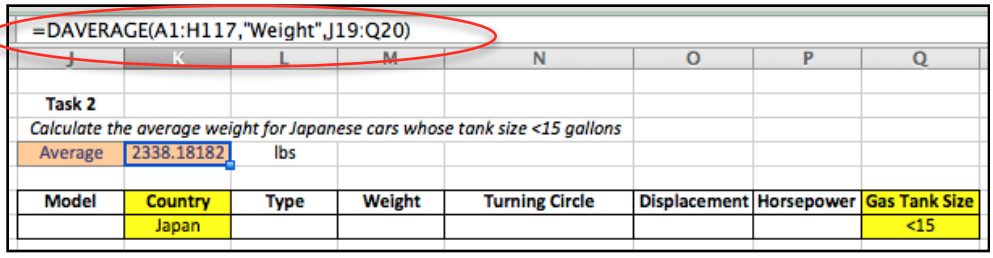
Problem 2

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

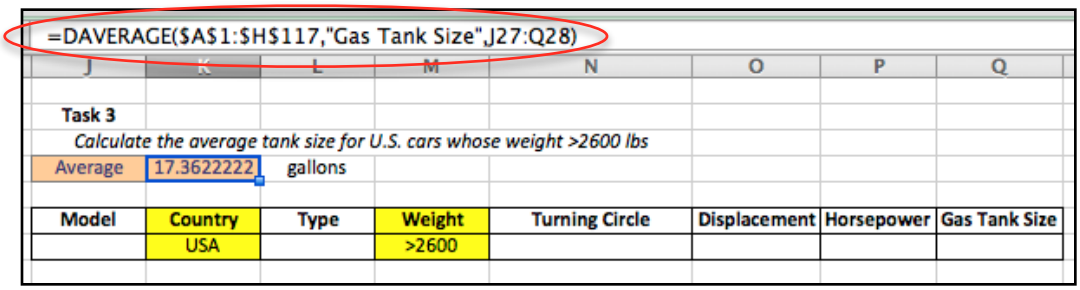
a) Calculate the average weight for Japanese cars whose weight > 2800 lb



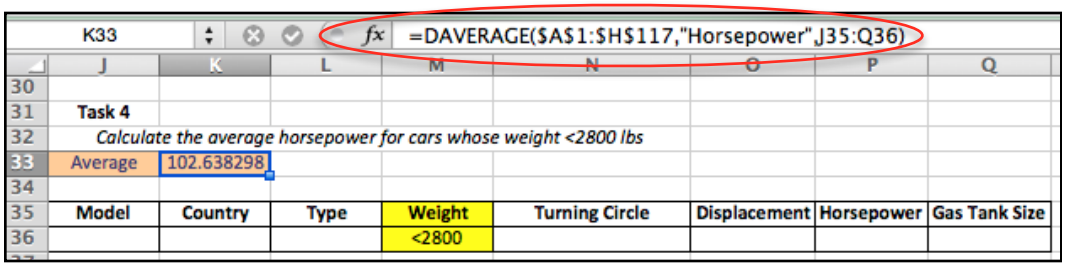
b) Calculate the average weight for Japanese cars whose tank size < 15 gallons



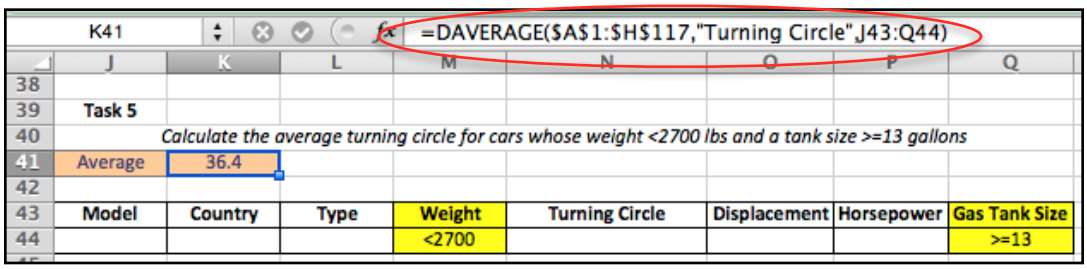
c) Calculate the average tank size for U.S. cars whose weight > 2600 lbs



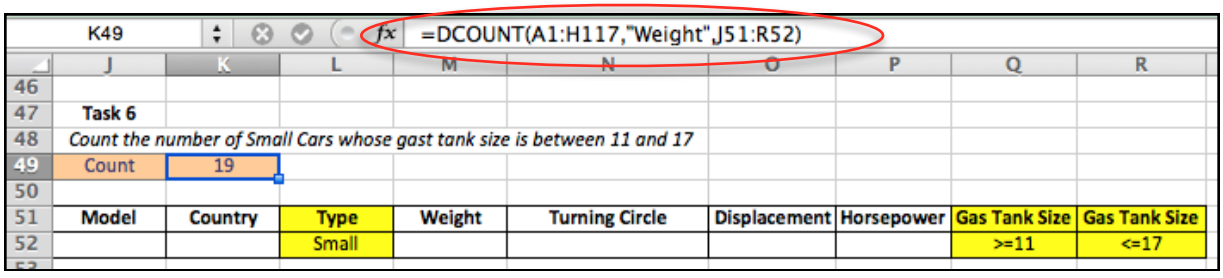
d) Calculate the average horsepower for cars whose weight < 2800 lbs



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



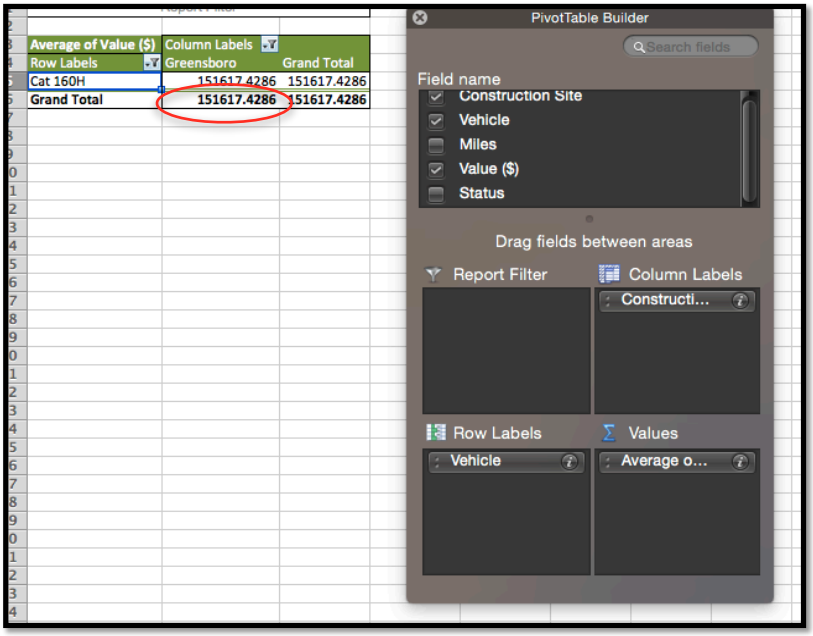
f) Count the number of Small Cars whose gas tank size falls between 11 and 17



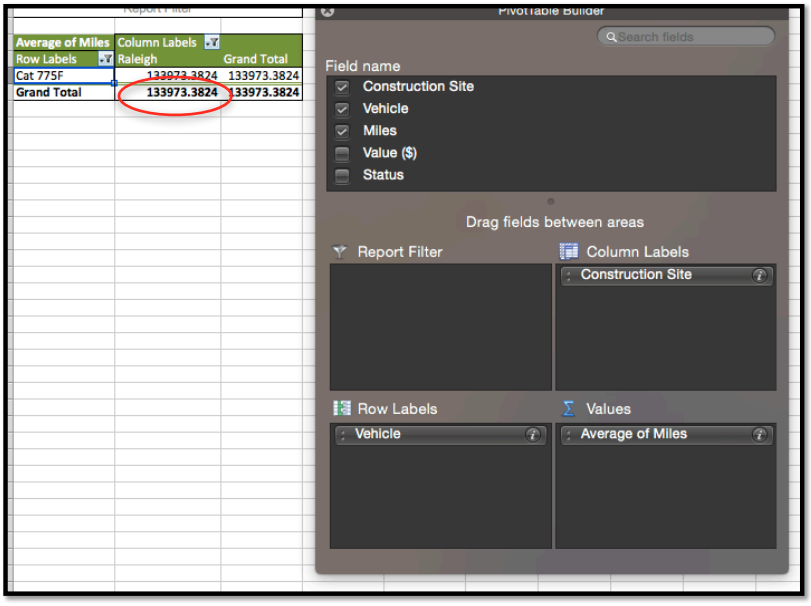
Problem 3

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

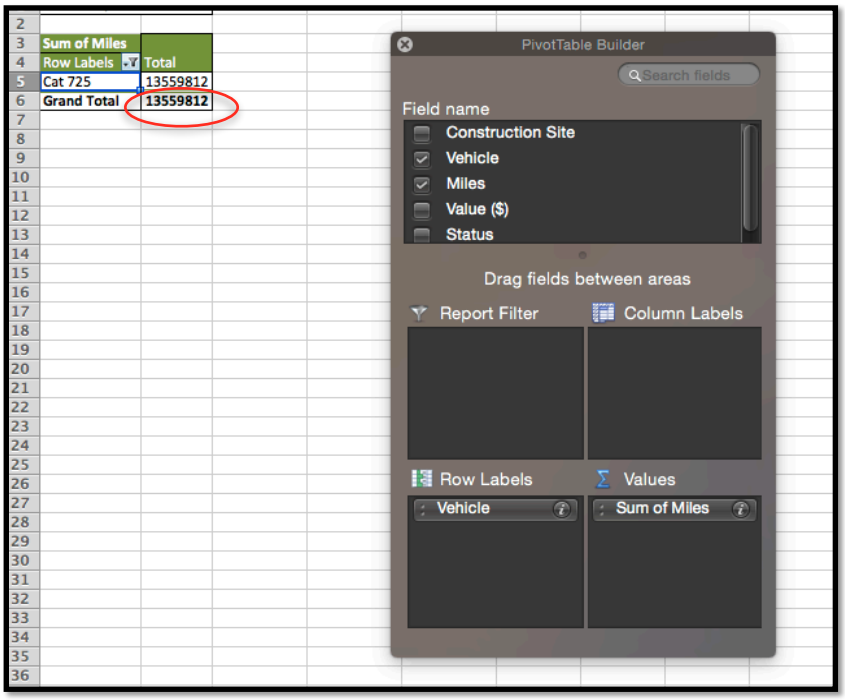
a) Find the average value for the Caterpillar 160H vehicles at the Greensboro construction site.



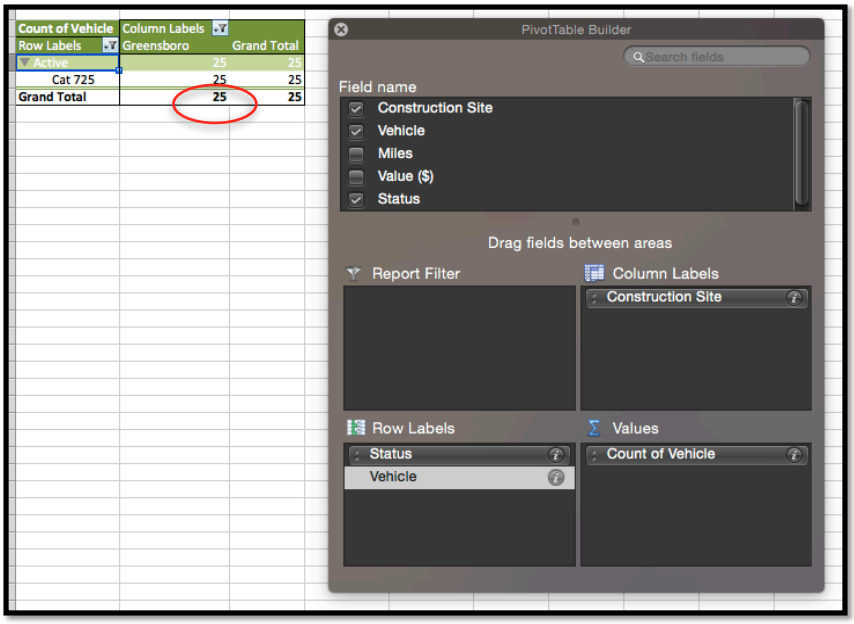
b) Find the average number of miles for Caterpillar Cat 775F vehicles at the Raleigh office.



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

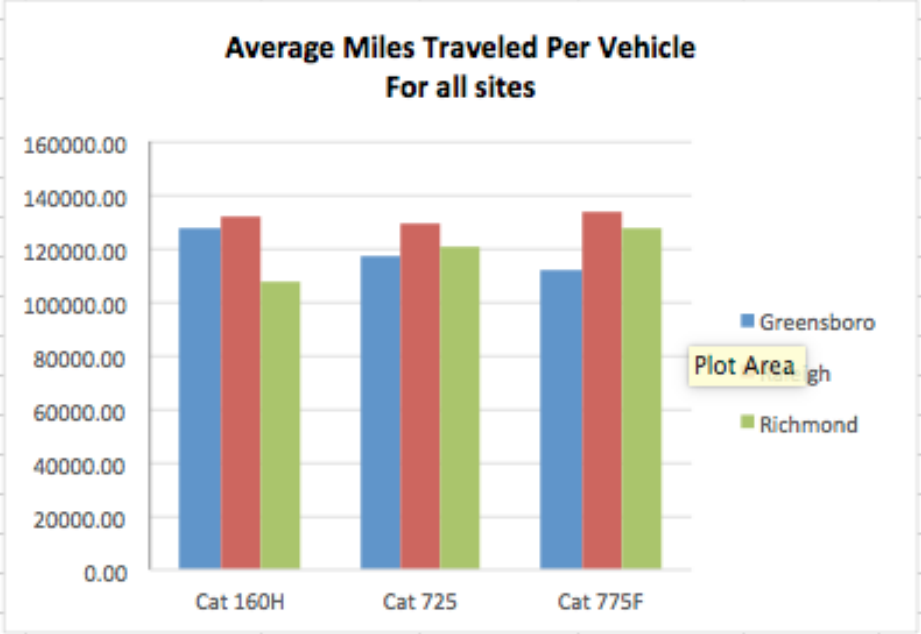


d) Find the number of Caterpillar 725 that are active at the Greensboro site.



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

Average of Miles	Column			
Row Labels	Greensboro	Raleigh	Richmond	Grand Tot
Cat 160H	127704.93	131967.26	107279.00	########
Cat 725	117181.19	128909.42	120367.12	########
Cat 775F	111698.74	133973.38	127900.95	########
Grand Total	**117518.27**	**131603.92**	**120294.97**	########



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

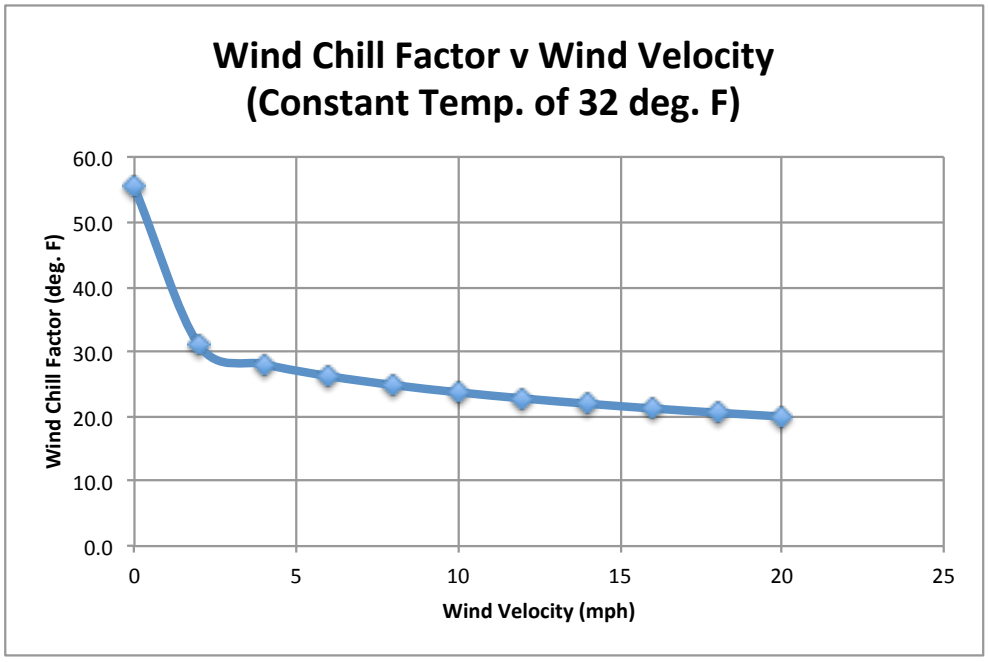
```
Public Function WindChill(temp, velocity)
' Function that calculates the Wind Chill Factor as a function of T and v (in deg. F)
' Programmer: Moises Bobadilla
' Date: 02/03/2015
'
'
'Inputs:
' temp = Temperature (deg. F)
' velocity = wind velociy (mph)

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

	B	C	D	F	G	H
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	$
9	Monthly Payments	=PMT(C5,C6,C7)	$	Monthly Payments	-24950744.42	$

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

	I	J	K	M	N	O
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	$
10	Monthly Payments	=PMT(J6,J7,J8)	$	Monthly Payments	-24950744.42	$
16	Accumulated debt after 20 years	=FV(J6,J7,J10)	$	Accumulated debt after 20 years	11946991178.8897	$
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	$
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	$

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.**