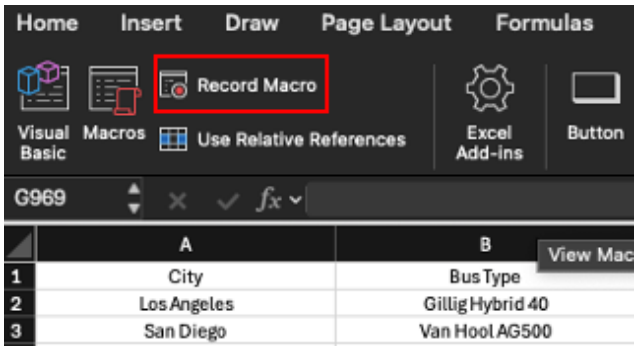
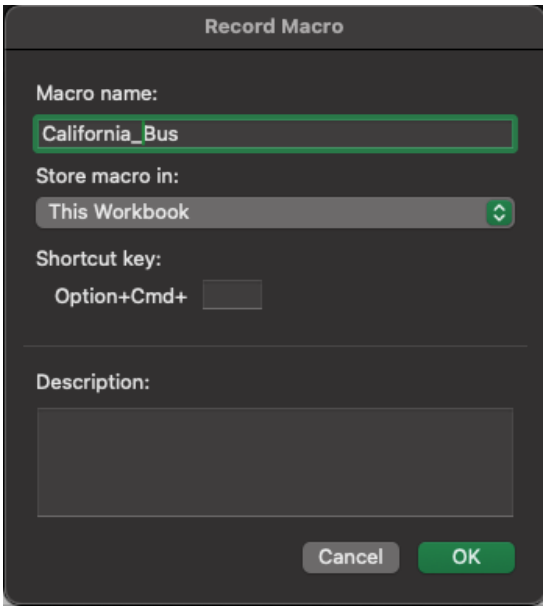
Assignment 4 Solution

Problem 1

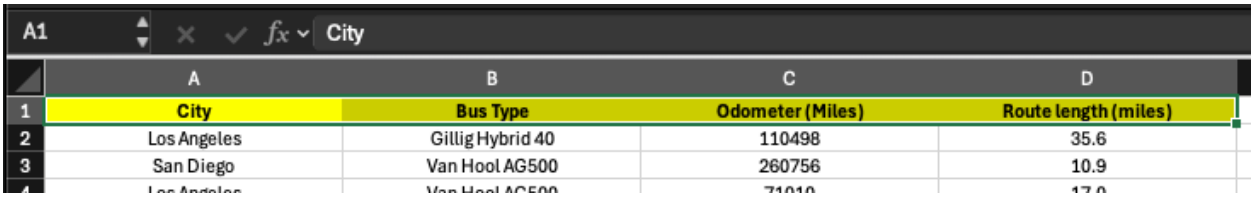
The goal is to create a Macro in the California Bus Company file and then apply it to another Excel file (called Virginia Bus Company). **Record the macro** in the California Bus Company file to do the following tasks:

Must record a Macro. Otherwise, there will be no credit for this problem.





a) Change the header background to yellow and make the text bold.



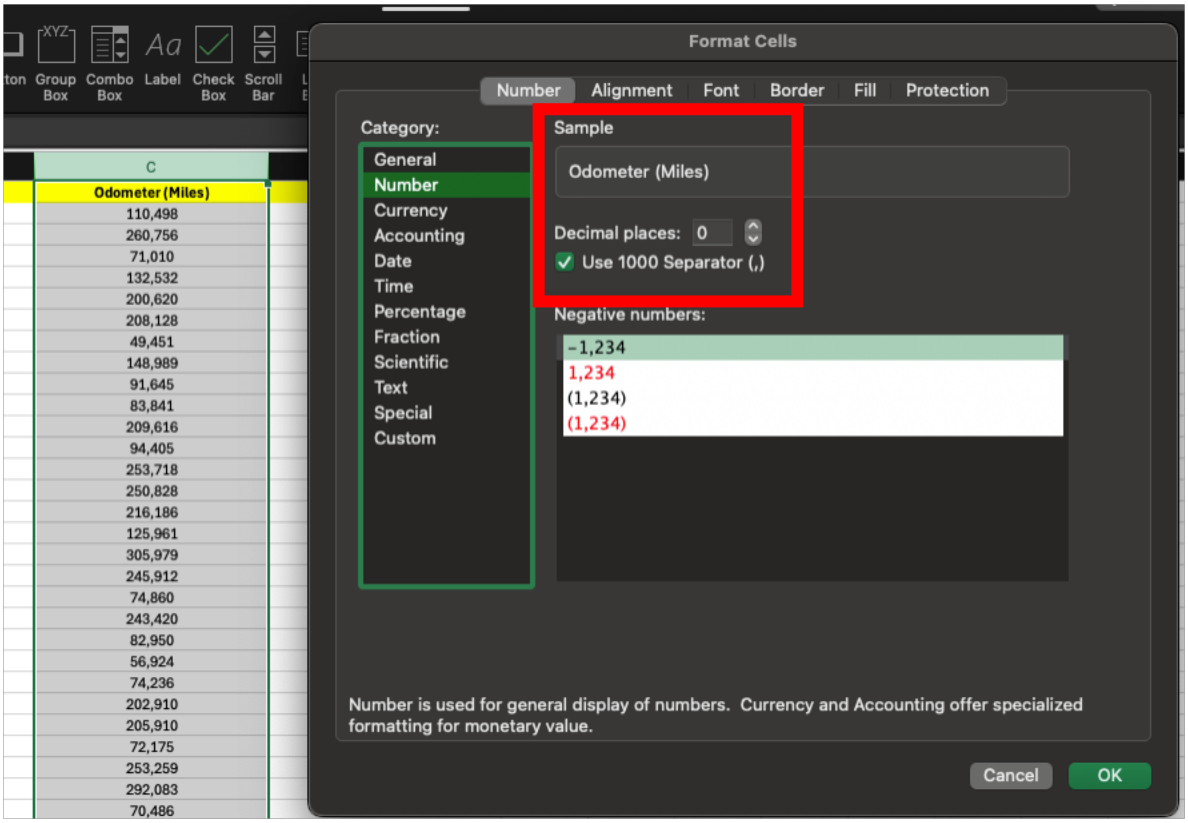
b) Changed the numerical values in the column labeled Odometer (miles) to **include a comma to separate thousands** and **make the odometer readings integers**.

We can change the cell format using a shortcut.

Windows: Ctrl + 1

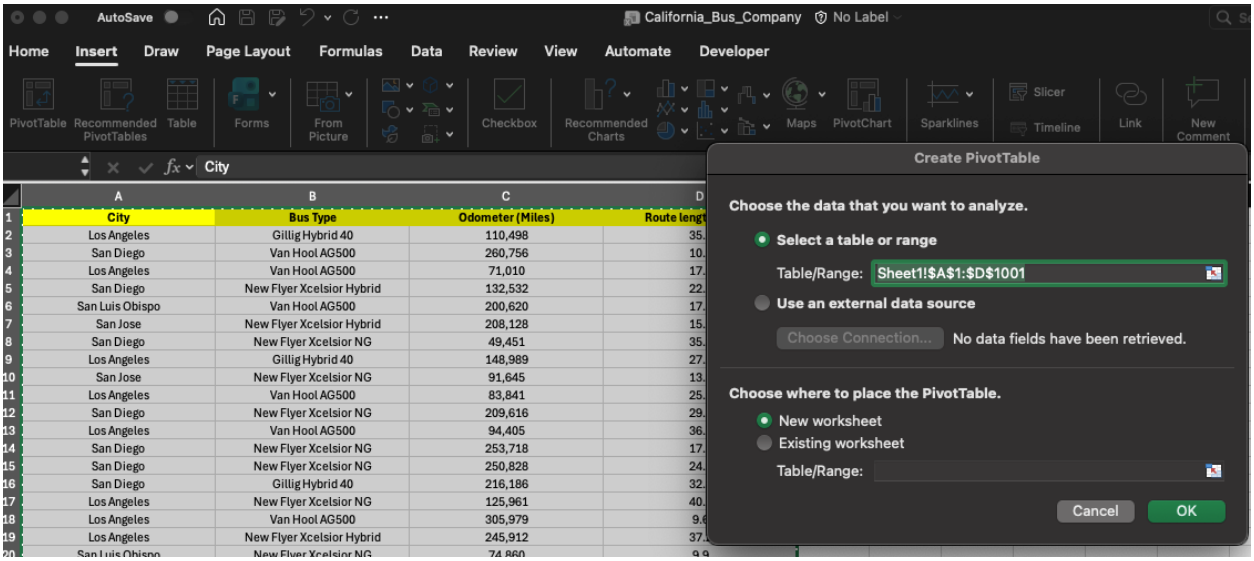
Mac: Cmd + 1

We want to convert the Odometer (miles) to a number with a 1000 separator (,) and an integer type which is 0 decimal places.

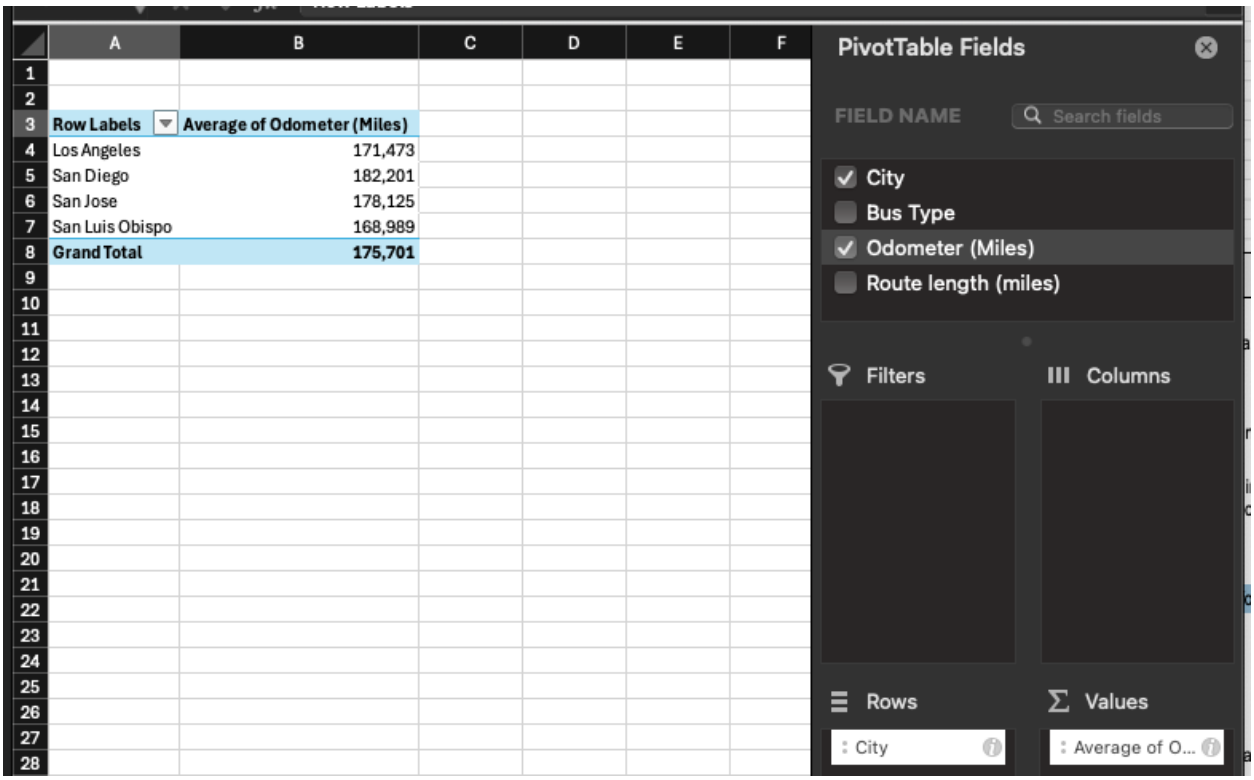


c) **Create a Pivot Table** to find the average number of miles for each type of bus in California. Make the city a filter variable in the Pivot Table. **Show the results for all cities in California**, and also the **results for San Luis Obispo**. **Make a screen capture of the Pivot Table to find the average odometer miles for all four buses in California.**

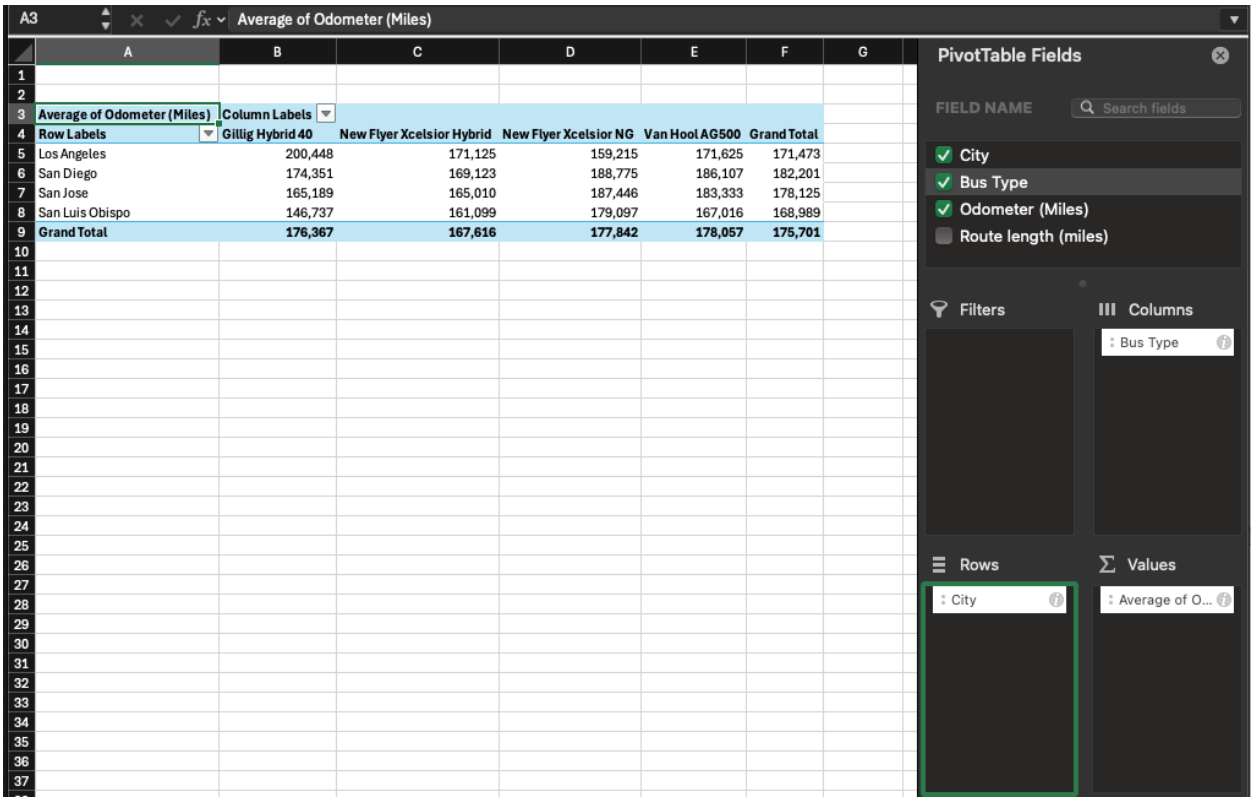
The Pivot Table created is shown below.



	A	B	C	D
1	City	Bus Type	Odometer (Miles)	Route lengt
2	Los Angeles	Gillig Hybrid 40	110,498	35.
3	San Diego	Van Hool AG500	260,756	10.
4	Los Angeles	Van Hool AG500	71,010	17.
5	San Diego	New Flyer Xcelsior Hybrid	132,532	22.
6	San Luis Obispo	Van Hool AG500	200,620	17.
7	San Jose	New Flyer Xcelsior Hybrid	208,128	15.
8	San Diego	New Flyer Xcelsior NG	49,451	35.
9	Los Angeles	Gillig Hybrid 40	148,989	27.
10	San Jose	New Flyer Xcelsior NG	91,645	13.
11	Los Angeles	Van Hool AG500	83,841	25.
12	San Diego	New Flyer Xcelsior NG	209,616	29.
13	Los Angeles	Van Hool AG500	94,405	36.
14	San Diego	New Flyer Xcelsior NG	253,718	17.
15	San Diego	New Flyer Xcelsior NG	250,828	24.
16	San Diego	Gillig Hybrid 40	216,186	32.
17	Los Angeles	New Flyer Xcelsior NG	125,961	40.
18	Los Angeles	Van Hool AG500	305,979	9.6
19	Los Angeles	New Flyer Xcelsior Hybrid	245,912	37.
20	San Luis Obispo	New Flyer Xcelsior NG	74,860	9.9



	A	B	C	D	E	F
1						
2						
3	Row Labels	Average of Odometer (Miles)				
4	Los Angeles	171,473				
5	San Diego	182,201				
6	San Jose	178,125				
7	San Luis Obispo	168,989				
8	Grand Total	175,701				



Average of Odometer (Miles)	Column Labels				
Row Labels	Gillig Hybrid 40	New Flyer Xcelsior Hybrid	New Flyer Xcelsior NG	Van Hool AG500	Grand Total
Los Angeles	200,448	171,125	159,215	171,625	171,473
San Diego	174,351	169,123	188,775	186,107	182,201
San Jose	165,189	165,010	187,446	183,333	178,125
San Luis Obispo	146,737	161,099	179,097	167,016	168,989
Grand Total	**176,367**	**167,616**	**177,842**	**178,057**	**175,701**

Result for San Luis Obispo

Average of Odometer (Miles)	Column Labels				
Row Labels	Gillig Hybrid 40	New Flyer Xcelsior Hybrid	New Flyer Xcelsior NG	Van Hool AG500	Grand Total
San Luis Obispo	146,737	161,099	179,097	167,016	168,989
Grand Total	**146,737**	**161,099**	**179,097**	**167,016**	**168,989**

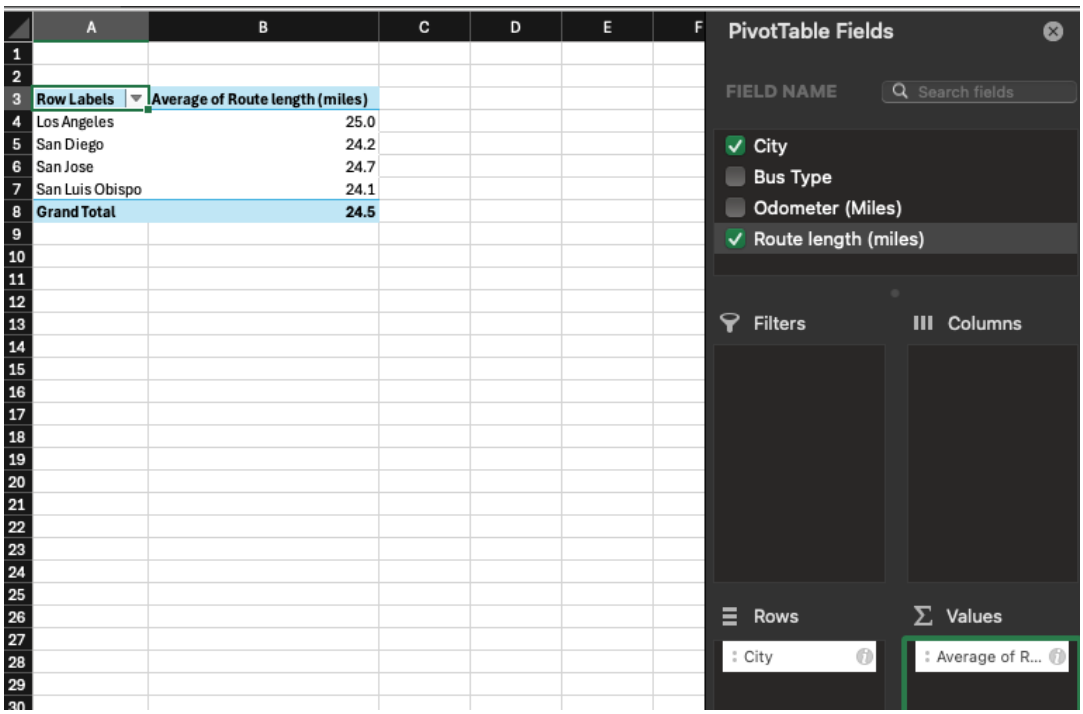
d) **Find the average number of odometer miles for the Gillig Hybrid 40.** Highlight the answer.

The Pivot Table is shown below.

Average of Odometer (Miles)	Column Labels
Row Labels	Gillig Hybrid 40
Los Angeles	200,448
San Diego	174,351
San Jose	165,189
San Luis Obispo	146,737
Grand Total	**176,367**

e) **Create another Pivot Table** to find the **average route length for each city in California**. Show the results for **all cities in California**, and also the **results for San Jose**. Make a screen capture of the Pivot Table to show the results.

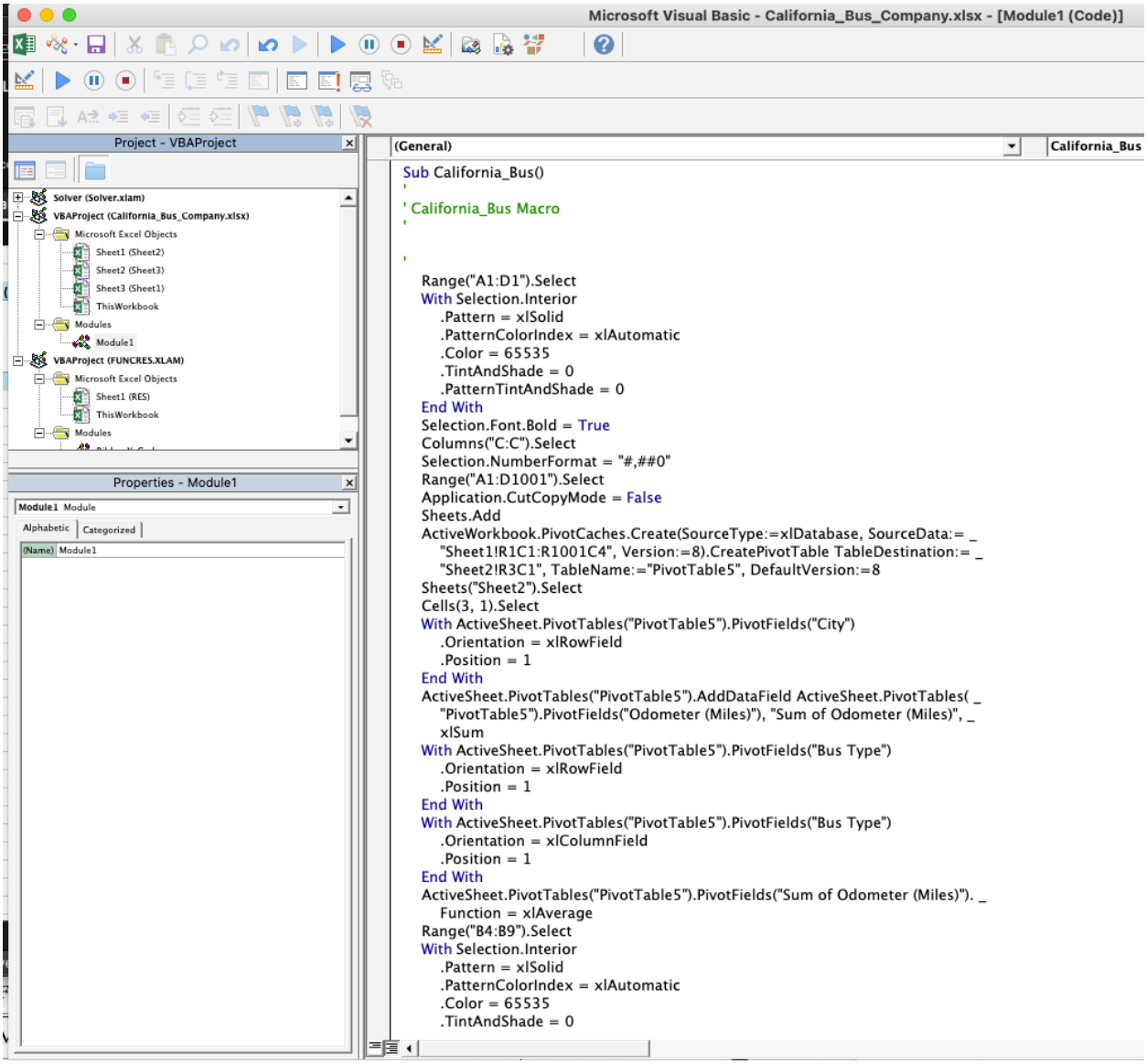
The Pivot Table is shown below.



Row Labels	Average of Route length (miles)
San Jose	24.7
Grand Total	**24.7**

f) **Show the first 20 lines of the macro** created.

The macro created by Excel is shown below.

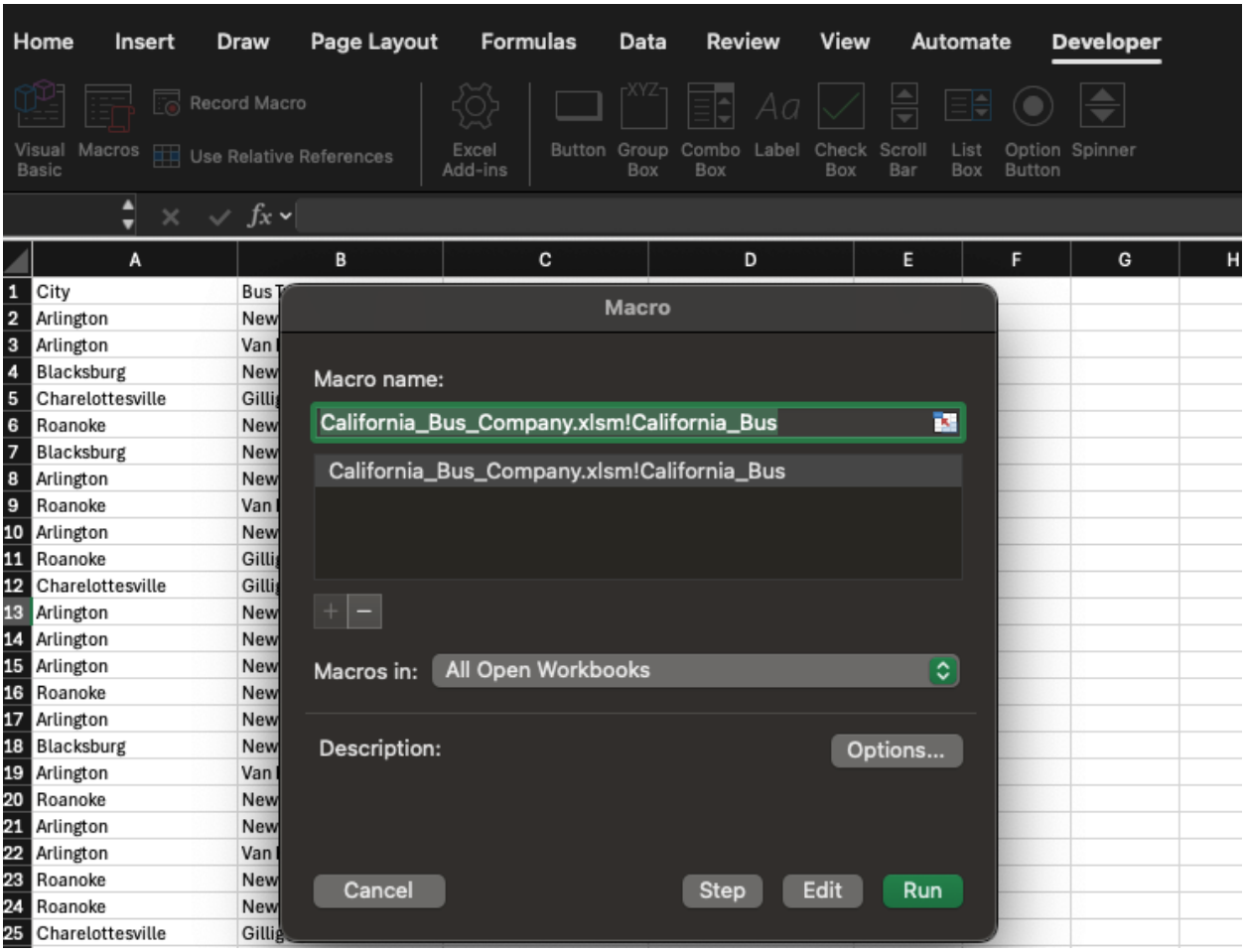


(General) California_Bus

```
Sub California_Bus()
'
' California_Bus Macro
'

'
    Range("A1:D1").Select
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .Color = 65535
        .TintAndShade = 0
        .PatternTintAndShade = 0
    End With
    Selection.Font.Bold = True
    Columns("C:C").Select
    Selection.NumberFormat = "#,##0"
    Range("A1:D1001").Select
    Application.CutCopyMode = False
    Sheets.Add
    ActiveWorkbook.PivotCaches.Create(SourceType:=xlDatabase, SourceData:= _
        "Sheet1!R1C1:R1001C4", Version:=8).CreatePivotTable TableDestination:= _
        "Sheet2!R3C1", TableName:="PivotTable5", DefaultVersion:=8
    Sheets("Sheet2").Select
    Cells(3, 1).Select
    With ActiveSheet.PivotTables("PivotTable5").PivotFields("City")
        .Orientation = xlRowField
        .Position = 1
    End With
    ActiveSheet.PivotTables("PivotTable5").AddDataField ActiveSheet.PivotTables( _
        "PivotTable5").PivotFields("Odometer (Miles)"), "Sum of Odometer (Miles)", _
        xlSum
    With ActiveSheet.PivotTables("PivotTable5").PivotFields("Bus Type")
        .Orientation = xlRowField
        .Position = 1
    End With
    With ActiveSheet.PivotTables("PivotTable5").PivotFields("Bus Type")
        .Orientation = xlColumnField
        .Position = 1
    End With
    ActiveSheet.PivotTables("PivotTable5").PivotFields("Sum of Odometer (Miles)"). _
        Function = xlAverage
    Range("B4:B9").Select
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .Color = 65535
        .TintAndShade = 0
```

g) **Apply the macro** created in the California Bus Company file to the Virginia Bus Company file.

You must have the California_Bus_Company file open to apply the macro created to the Virginia_Bus_Company file.



h) **Verify that all procedures work. Report the average number of miles by bus type in all cities in Virginia.**

The Macro created in the California Bus Company file is applied to the Virginia_Bus_Company file.

	A	B	C	D
1	City	Bus Type	Odometer (Miles)	Route length (miles)
2	Arlington	New Flyer Xcelsior NG	220,727	24.34988196
3	Arlington	Van Hool AG500	43,823	19.10000049
4	Blacksburg	New Flyer Xcelsior NG	208,549	13.26526878
5	Charelottesville	Gillig Hybrid 40	107,574	25.12561854
6	Roanoke	New Flyer Xcelsior NG	291,519	10.22402086
7	Blacksburg	New Flyer Xcelsior NG	155,018	19.39714436
8	Arlington	New Flyer Xcelsior NG	125,801	23.40081688
9	Roanoke	Van Hool AG500	202,804	12.17066461
10	Arlington	New Flyer Xcelsior Hybric	107,947	8.175367015
11	Roanoke	Gillig Hybrid 40	125,790	13.35906712
12	Charelottesville	Gillig Hybrid 40	70,887	15.07933384
13	Arlington	New Flyer Xcelsior NG	52,417	14.91397301
14	Arlington	New Flyer Xcelsior NG	149,709	10.10432815
15	Arlington	New Flyer Xcelsior NG	185,818	25.12608009

3	Average of Odometer (Miles)	Column Labels				
4	Row Labels	Gillig Hybrid 40	New Flyer Xcelsior Hybrid	New Flyer Xcelsior NG	Van Hool AG500	Grand Total
5	Arlington	153,389	170,154	157,182	163,080	160,770
6	Blacksburg	173,494	156,975	144,820	142,828	151,260
7	Charelottesville	142,954	174,566	154,602	175,258	163,281
8	Roanoke	165,566	157,743	154,229	178,784	162,416
9	**Grand Total**	**158,497**	**165,557**	**154,210**	**166,700**	**160,198**

	A	B
1		
2		
3	Row Labels	Average of Route length (miles)
4	Arlington	16.37970517
5	Blacksburg	16.06723786
6	Charelottesville	17.40900498
7	Roanoke	16.55260283
8	**Grand Total**	**16.52707554**
9		
10		
11		

i) **Find the average number of odometer miles for the Gillig Hybrid 40 for all cities in Virginia**. Highlight the answer. **Compare to your answer in part (d)**

The results are shown below.

3	Average of Odometer (Miles)	Column Labels
4	**Row Labels**	**Gillig Hybrid 40**
5	Los Angeles	200,448
6	San Diego	174,351
7	San Jose	165,189
8	San Luis Obispo	146,737
9	**Grand Total**	**176,367**

3	Average of Odometer (Miles)	Column Labels
4	**Row Labels**	**Gillig Hybrid 40**
5	Arlington	153,389
6	Blacksburg	173,494
7	Charelottesville	142,954
8	Roanoke	165,566
9	**Grand Total**	**158,497**

Problem 2

Declare all your variables using Option Explicit. Otherwise, a point will be taken from the problem.

a) **Plot the values of f (in the y-axis) versus design speed (x-axis**) in Excel and estimate the best linear regression model to predict f for a given value of design speed.

b) **Write down the equation to predict f given design speed.** Use the trend function in Excel to do this part

The best linear regression model is shown below:

$$y = -0.0029x + 0.1911$$

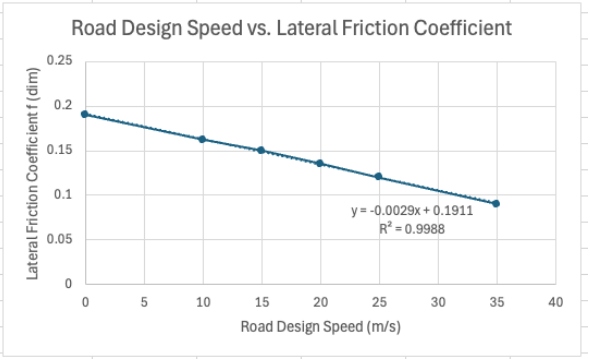
Where:

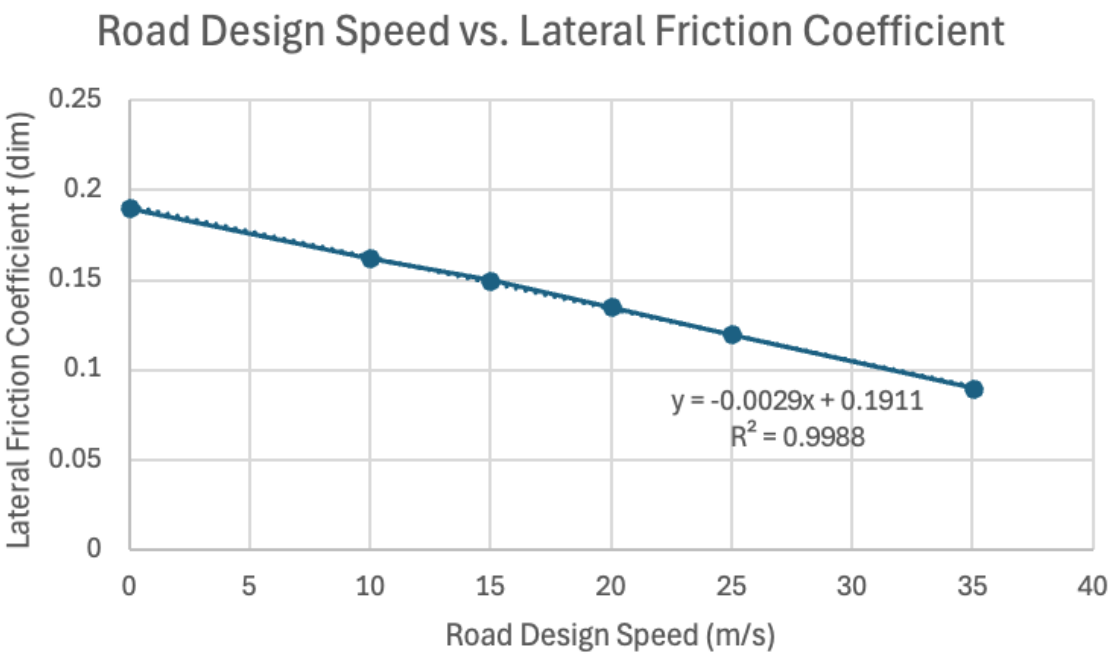
x is the design speed (m/s)

y is the lateral friction coefficient (dimensionless)

Make a sanity check. Check that at at a design speed of zero, the lateral friction coefficient is 0.1911. That checks with the data provided.

	A	B	C	D	E	F	G	H
1	Road Design Speed (m/s)	Lateral Friction Coefficient f (dim)						
2	0	0.19						
3	10	0.162						
4	15	0.15						
5	20	0.135						
6	25	0.12						
7	35	0.09						
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								





c) **Create a VBA Subroutine to estimate the radius of the curve (R)** given the design speed (v) and the superelevation rate (e). **The calculation of f using the equation derived in part (c)** is performed inside the subroutine according to the linear regression model.

d) **Create a simple Excel interface** to calculate the horizontal radius of the highway section given the design speed (v) and the superelevation rate (e). **The speed values (in meters/second) should be included in a validation list, with a low value of 0 and a high value of 40 m/s, in steps of 5.0 m/s.** The values of the **superelevation rate should also be in a data-validated cell, ranging from 0 to 0.10 at steps of 0.01.**

The interface in Excel is shown below.

	A	B	C
1			
2	Calculates the Radius of horizontal curvature of a Highway		
3	Program estimates the lateral friction coefficient given speed		
4	Programmer: A. Trani		
5	Date	3/4/26 20:13	
6	Purpose:	Calcuate R given design speed	
7			
8	Parameter	Value	Units
9	Design Speed	30	m/s
10	Superelevation Rate	0.050	ft/ft
11			
12	Results		
13	Horizontal Radius	600	meters
14	Lateral Friction	0	dim
15			

0
0.01
0.02
0.03
0.04
0.05

Run

0.0 Speed(m/s) 35.0

The subroutine code is shown below.

```
(General)                                   (Declarations)
Option Explicit    ' Define variables explicitly

Dim speed As Single
Dim radius As Single
Dim lateralFriction As Single
Dim superelevation As Single
Const pi As Single = 3.141592      ' pi constant
Const g As Single = 9.81           ' acceleration of gravity (m/s-s)
Dim rowToStartTable As Single


Sub horizontalRadiusCalculation()
' programmer = A. A. Trani
' date = 02/20/2024

' input data
Sheets("Interface").Select

Range("B9").Select
speed = ActiveCell.Value   ' design speed (m/s)
```

```
(General)                                   calculationOfSingleRadii
 Range("B10").Select
superelevation = ActiveCell.Value   ' superelevation rate (dim)

 Range("A17:C1000").Clear

' Call computation subroutine to estimate radius for a single speed

Call calculationOfSingleRadii(speed, superelevation, radius, lateralFriction)

' output results

 Range("B13").Select
 ActiveCell.Value = radius  ' meters

  Range("B14").Select
 ActiveCell.Value = lateralFriction  ' dim

' Call sub to do the calculation for multiple speeds
calculationForMultipleSpeeds
```

```
Sub calculationOfSingleRadii(speed, superelevation, radius, lateralFriction)

' Estimates the horizontal radius of the road in meters

lateralFriction = 0.1911 - 0.0029 * speed
radius = speed * speed / (g * (superelevation + lateralFriction))

End Sub
```

e**) Test your VBA code** and Excel interface to obtain the horizontal radius for the following design conditions. (See Table 2). **Make a screen capture of the horizontal radius for the last value in Table 2.**

To test the code, a speed of 32 m/s and a road superelevation rate of 0.05 are applied. To do so, I expanded the range to 0.5m/s (optional).

However, tested at a speed of 35 m/s and a road super elevation rate of 0.05 is also fine for this problem.

Calculates the Radius of horizontal curvature of a Highway		
Program estimates the lateral friction coefficient given speed		
Programmer: A. Trani		
Date	3/4/26 21:43	
Purpose:	Calcuate R given design speed	
Parameter	Value	Units
Design Speed	35	m/s
Superelevation Rate	0.050	ft/ft
Results		
Horizontal Radius	894.503	meters
Lateral Friction	0.090	dim

e) **Improve the VBA code created in part (a) to make a table of horizontal radius of the curve versus speed for speeds ranging from 0 to 40 m/s at steps of 5 m/s.** Assume a constant **superelevation rate of 0.06**. **Create a plot in Excel with the appropriate labels** for the resulting table (the table should be generated in code). The plot can be done in Excel.

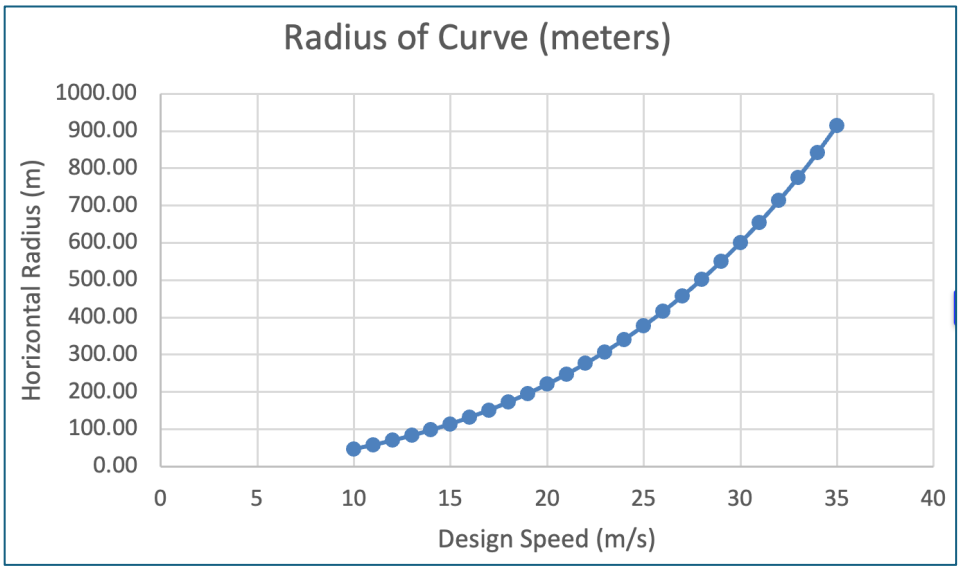
The subroutine code is shown below.

```
Sub calculationForMultipleSpeeds()

' define where do you want to start the table
rowToStartTable = 16

' write down the header or the table (3 columns)
      Range("A" & rowToStartTable).Select
      ActiveCell.Value = "Speed (m/s)"   ' speed in m/s

      ActiveCell.Offset(0, 1).Select
      ActiveCell.Value = "Radius of Curve (meters"   ' radius

      ActiveCell.Offset(0, 1).Select
      ActiveCell.Value = "Lateral Friction (dim)"   ' Friction coefficient

' start a loop to calculate road horizontal radius for various speeds
' Every 5 m/s
  For speed = 10 To 35 Step 1

      lateralFriction = 0.1911 - 0.0029 * speed
      radius = speed * speed / (g * (superelevation + lateralFriction))

      Range("A" & rowToStartTable + 1).Select
      ActiveCell.Value = speed                ' speed (m/s)
      ActiveCell.NumberFormat = 0#            ' format numbers


      ActiveCell.Offset(0, 1).Select
      ActiveCell.Value = radius                ' meters
      ActiveCell.NumberFormat = "0.00"         ' format numbers

      ActiveCell.Offset(0, 1).Select
      ActiveCell.Value = lateralFriction       ' dimensionless
      ActiveCell.NumberFormat = "00.000"

      rowToStartTable = rowToStartTable + 1
  Next speed
```

The FOR loop generates the table below. The table shows a partial answer for radius versus speed for superelevation (e=0.05).

Speed (m/s)	Radius of Curve (meters	Lateral Friction (dim)
10	48.06	00.162
11	58.96	00.159
12	71.15	00.156
13	84.70	00.153
14	99.65	00.150
15	116.07	00.148
16	134.03	00.145
17	153.60	00.142
18	174.84	00.139
19	197.85	00.136
20	222.69	00.133
21	249.47	00.130
22	278.27	00.127
23	309.20	00.124
24	342.36	00.122
25	377.88	00.119
26	415.87	00.116
27	456.46	00.113
28	499.80	00.110

A plot of the road horizontal radius versus speed is shown below. The plot uses a value of superelevation rate e of 0.05.



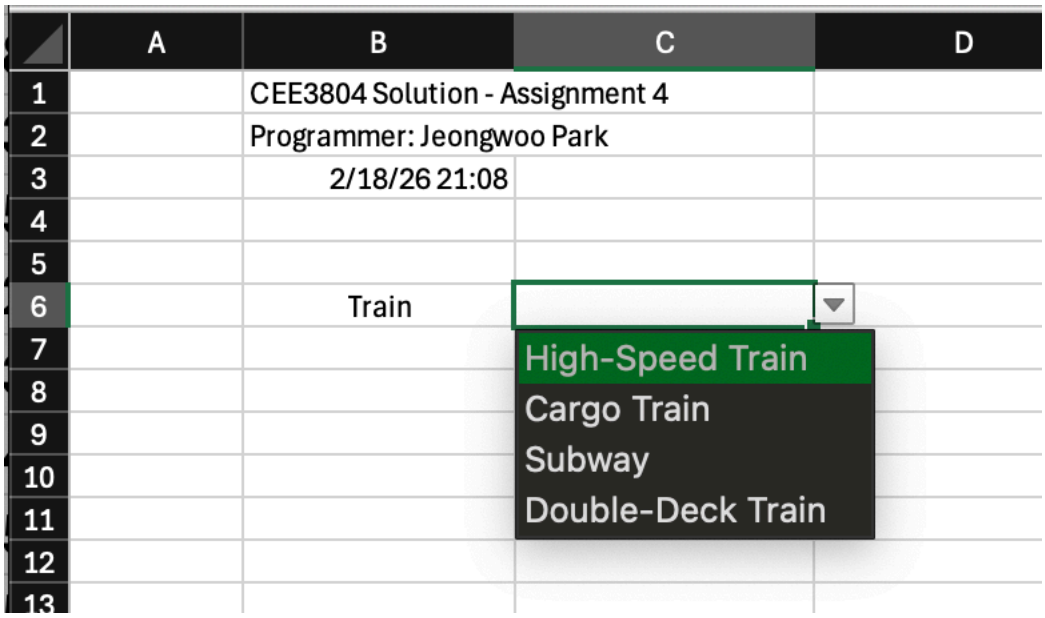
Problem 3

Declare all your variables using Option Explicit. Otherwise, a point deduction will be applied for this problem.

a) **Create a VBA subroutine** to estimate the drag force generated by the train while traveling at a speed (v). In your analysis, **create a simple Excel interface that allows the user to select the train type (a string from a data validation list)** and then **calculate the drag force (Newtons) for a given speed (meters/second).** Display the drag force in the Excel interface

b) **Test the VBA code and the Excel interface showing the drag for a Cargo Train (show a screen capture). Repeat for the High-Speed Train** (show a screen capture).

I created a sheet called "Value" for a clean interface (optional).



	A	B	C	D
1	Train	Drag Coefficient (dim)	Reference Area (m^2)	rho
2	High-Speed Train	0.27	6.7	1.225
3	Cargo Train	0.46	10.4	1.225
4	Subway	0.31	6.2	1.225
5	Double-Deck Train	0.36	11.3	1.225
6				

The subroutine code is shown below.

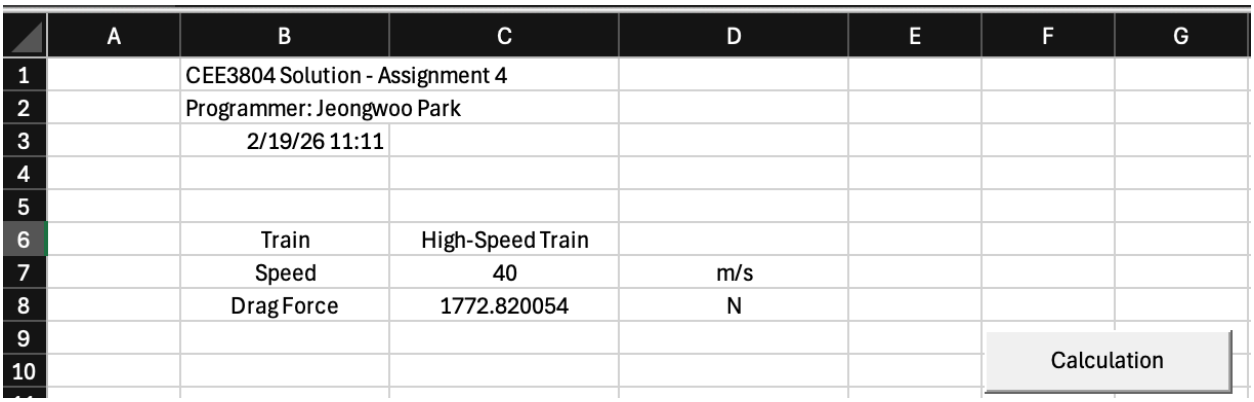
(General) Drag

```
Option Explicit
' CEE 3804 Assignment 4 - Problem 2 Part a and b
' Subroutine that calculates road horizontal radius.

' Input:Speed, Superelevation rate of the road, Gravitational constant
' Output: lateral friction force coefficient, road horizontal radius

Sub Drag()

'Designate Type of Variables
Dim TrainName As String
Dim Drag As Double
Dim Speed As Single, rho As Single, Area As Single, Cd As Single

'Select the sheet
Sheets("DragForce").Select

'Retrieve name of the train
Range("C6").Select
TrainName = ActiveCell.Value

'Select the cd, area, and rho based on name of the train
If TrainName = "High-Speed Train" Then
   'Select the sheet that has values
   Sheets("Value").Select
   Range("B2").Select
   Cd = ActiveCell.Value ' Drag Coefficient, Unit: dim

   ActiveCell.Offset(0, 1).Select
   Area = ActiveCell.Value ' Reference Area, Unit: m^2

   ActiveCell.Offset(0, 1).Select
   rho = ActiveCell.Value 'Density of air, 1.225kg/cu.meter

ElseIf TrainName = "Cargo Train" Then

   Sheets("Value").Select
   Range("B3").Select
   Cd = ActiveCell.Value ' Drag Coefficient, Unit: dim

   ActiveCell.Offset(0, 1).Select
   Area = ActiveCell.Value ' Reference Area, Unit: m^2

   ActiveCell.Offset(0, 1).Select
   rho = ActiveCell.Value 'Density of air, 1.225kg/cu.meter

ElseIf TrainName = "Subway" Then
```

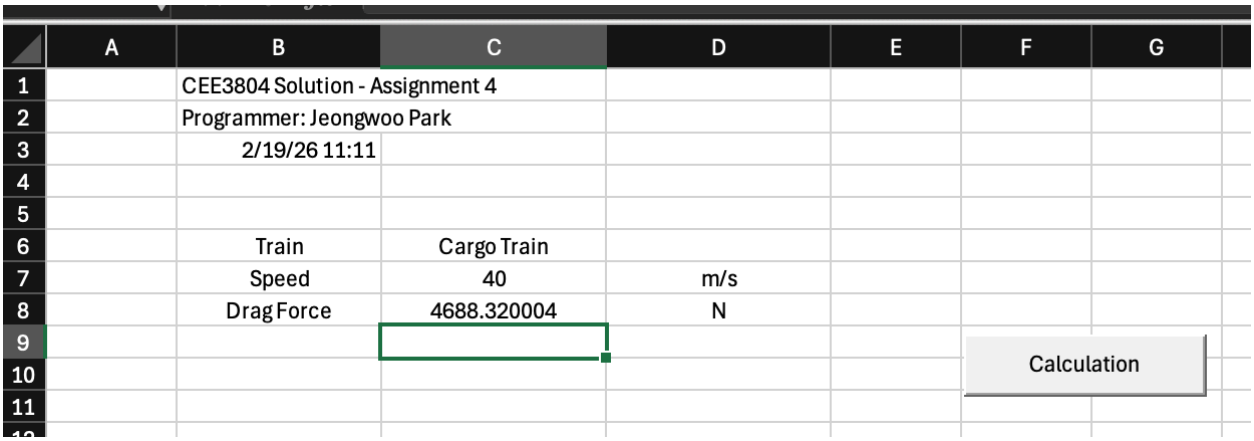
(General) Drag

```
ElseIf TrainName = "Subway" Then

    Sheets("Value").Select
    Range("B4").Select
    Cd = ActiveCell.Value ' Drag Coefficient, Unit: dim

    ActiveCell.Offset(0, 1).Select
    Area = ActiveCell.Value ' Reference Area, Unit: m^2

    ActiveCell.Offset(0, 1).Select
    rho = ActiveCell.Value 'Density of air, 1.225kg/cu.meter

ElseIf TrainName = "Double-Deck Train" Then

    Sheets("Value").Select
    Range("B5").Select
    Cd = ActiveCell.Value ' Drag Coefficient, Unit: dim

    ActiveCell.Offset(0, 1).Select
    Area = ActiveCell.Value ' Reference Area, Unit: m^2

    ActiveCell.Offset(0, 1).Select
    rho = ActiveCell.Value 'Density of air, 1.225kg/cu.meter

End If

Sheets("DragForce").Select

'Retrieve speed of the train
Range("C7").Select
Speed = ActiveCell.Value ' Speed, Unit: m/s

'Calculates Drag Force
Range("C8").Select
Call DragForceCalculation(Speed, rho, Area, Cd, Drag)
ActiveCell.Value = Drag

End Sub

'Subroutine that calculates drag force
Sub DragForceCalculation(Speed, rho, Area, Cd, Drag)
    Drag = 0.5 * rho * Speed ^ 2 * Area * Cd
End Sub
```

The results are shown below. I tested with 40 m/s (around 89 mph).



	A	B	C	D	E	F	G
1		CEE3804 Solution - Assignment 4					
2		Programmer: Jeongwoo Park					
3		2/19/26 11:11					
4							
5							
6		Train	High-Speed Train				
7		Speed	40	m/s			
8		Drag Force	1772.820054	N			
9						Calculation	
10							



	A	B	C	D	E	F	G
1		CEE3804 Solution - Assignment 4					
2		Programmer: Jeongwoo Park					
3		2/19/26 11:11					
4							
5							
6		Train	Cargo Train				
7		Speed	40	m/s			
8		Drag Force	4688.320004	N			
9						Calculation	
10							
11							

c) **Add VBA code to part (a) to calculate the power required to overcome the drag force.**

The subroutine code and results are shown below.

```
'Calculates Power to Overcome Drag Force
Range("C9").Select
Call PowerCalculation(Speed, rho, Area, Cd, Power)
ActiveCell.Value = Power 'Unit: Watt (W)
End Sub
```

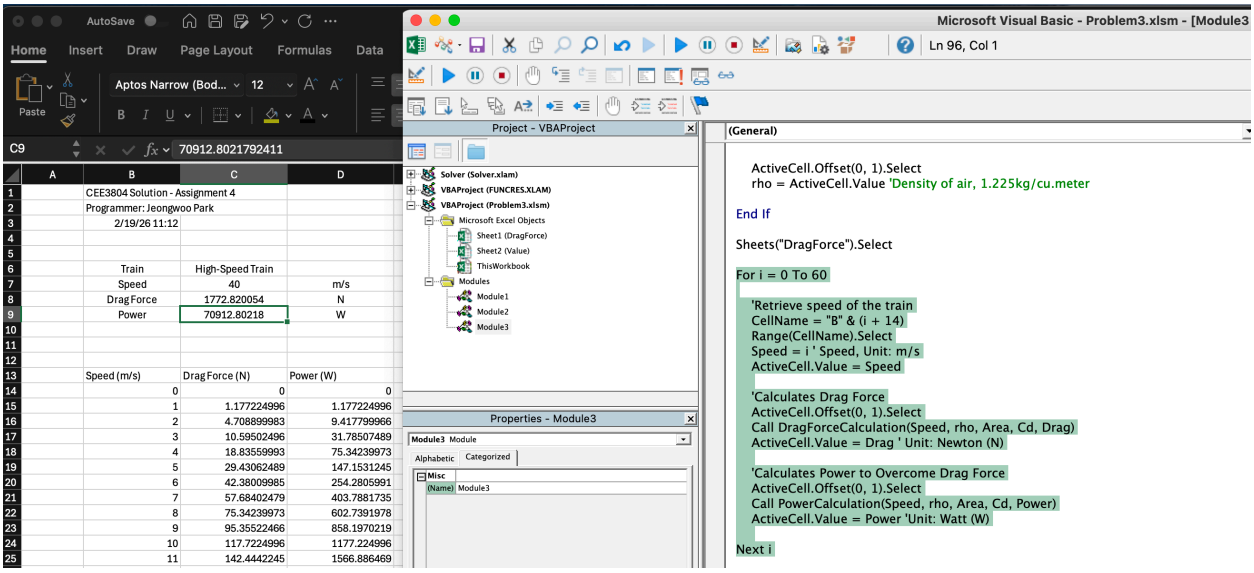
```
'Subroutine that calculates the power to overcome the drag force
Sub PowerCalculation(Speed, rho, Area, Cd, Power)
    ' If you take Drag as inputs, you can express the same formula as below:
    ' Sub PowerCalculation(Speed, Drag, Power)
    ' Power = Drag*Speed
    ' End Sub

    Power = 0.5 * rho * Speed ^ 3 * Area * Cd 'Unit: Watts W (N* m/s = W)

End Sub
```

	A	B	C	D	E	F	G
1		CEE3804 Solution - Assignment 4					
2		Programmer: Jeongwoo Park					
3		2/19/26 11:12					
4							
5							
6		Train	High-Speed Train				
7		Speed	40	m/s			
8		Drag Force	1772.820054	N			
9		Power	70912.80218	W			
10						Calculation	
11							

	A	B	C	D	E	F	G
1		CEE3804 Solution - Assignment 4					
2		Programmer: Jeongwoo Park					
3		2/19/26 11:11					
4							
5							
6		Train	Cargo Train				
7		Speed	40	m/s			
8		Drag Force	4688.320004	N			
9		Power	187532.8002	W			
10						Calculation	
11							

d) **Add code to the VBA program created in parts (a-c) to estimate the drag and power required for speeds ranging from 0 to 60 m/s.** Display three columns with speed, drag, and power required in the Excel spreadsheet. **Included headers and show the units of each column. Make a screen capture of the three columns and the program inputs for a subway train.**

The subroutine code and results are shown below.



	A	B	C	D	E	F	G
1		CEE3804 Solution - Assignment 4					
2		Programmer: Jeongwoo Park					
3		2/19/26 12:13					
4							
5							
6		Train	Subway				
7		Speed	40	m/s			
8		Drag Force	1772.820054	N			
9		Power	70912.80218	W			
10						Calculation	
11							
12							
13		Speed (m/s)	Drag Force (N)	Power (W)		Cal - Part d	
14		0	0	0			
15		1	1.177224996	1.177224996			
16		2	4.708899983	9.417799966			
17		3	10.59502496	31.78507489			
18		4	18.83559993	75.34239973			
19		5	29.43062489	147.1531245			
20		6	42.38009985	254.2805991			
21		7	57.68402479	403.7881735			
22		8	75.34239973	602.7391978			
23		9	95.35522466	858.1970219			
24		10	117.7224996	1177.224996			

```
For i = 0 To 60

    'Retrieve speed of the train
    CellName = "B" & (i + 14)
    Range(CellName).Select
    Speed = i ' Speed, Unit: m/s
    ActiveCell.Value = Speed

    'Calculates Drag Force
    ActiveCell.Offset(0, 1).Select
    Call DragForceCalculation(Speed, rho, Area, Cd, Drag)
    ActiveCell.Value = Drag ' Unit: Newton (N)

    'Calculates Power to Overcome Drag Force
    ActiveCell.Offset(0, 1).Select
    Call PowerCalculation(Speed, rho, Area, Cd, Power)
    ActiveCell.Value = Power 'Unit: Watt (W)

Next i
```

	A	B	C	D
12				
13		Speed (m/s)	Drag Force (N)	Power (W)
14		0	0	0
15		1	1.177224996	1.177224996
16		2	4.708899983	9.417799966
17		3	10.59502496	31.78507489
18		4	18.83559993	75.34239973
19		5	29.43062489	147.1531245
20		6	42.38009985	254.2805991
21		7	57.68402479	403.7881735
22		8	75.34239973	602.7391978
23		9	95.35522466	858.1970219
24		10	117.7224996	1177.224996
25		11	142.4442245	1566.886469
26		12	169.5203994	2034.244793
27		13	198.9510243	2586.363316
28		14	230.7360992	3230.305388
29		15	264.875624	3973.134361
30		16	301.3695989	4821.913583
31		17	340.2180238	5783.706404
32		18	381.4208986	6865.576175
33		19	424.9782235	8074.586246
34		20	470.8899983	9417.799966
35		21	519.1562231	10902.28069
36		22	569.7768979	12535.09175
37		23	622.7520228	14323.29652
38		24	678.0815976	16273.95834
39		25	735.7656223	18394.14056
40		26	795.8040971	20690.90653
41		27	858.1970219	23171.31959
42		28	922.9443967	25842.44311
43		29	990.0462214	28711.34042
44		30	1059.502496	31785.07489