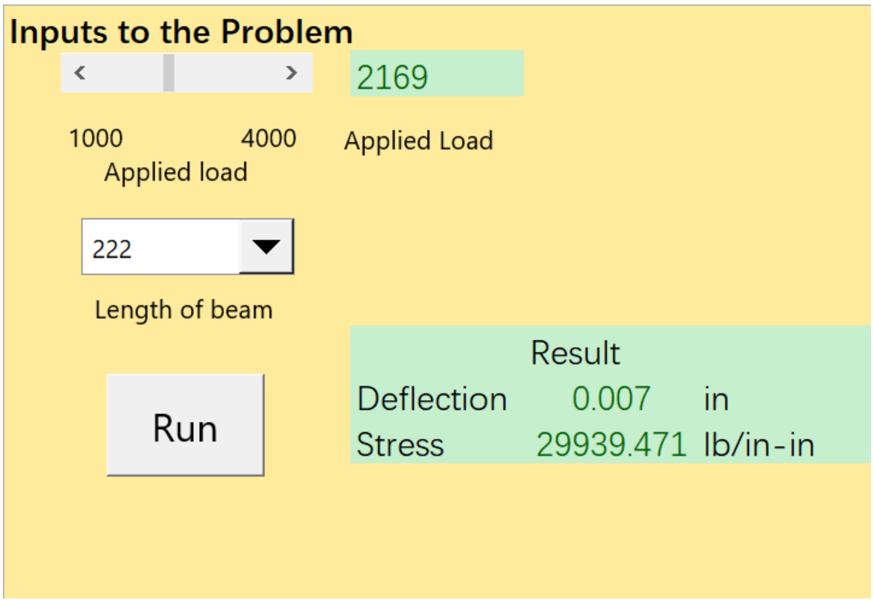
CEE 3804 – Computer Applications in CEE - Assignment 5 Solution

Problem 1

a) Example interface for Problem 1.



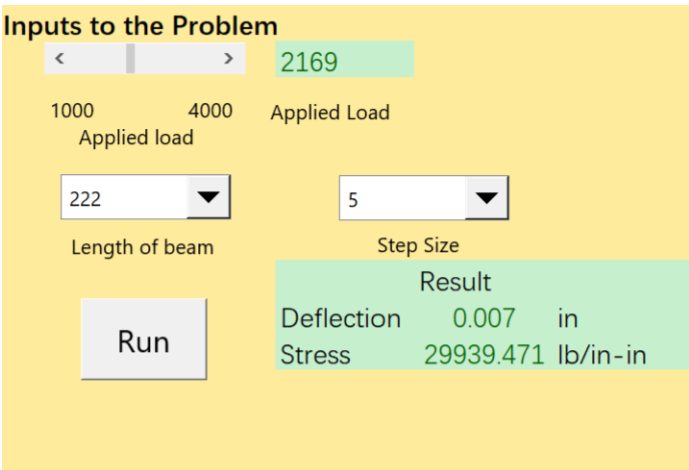
b) Code associated with Problem 1.

```
    Call calculationForMultipleLoad(W, E, I, x, l, dN)

End Sub

Sub DeflectionCalculation(W, E, I, x, l, dN, s, y)

' Estimates the hang time and the distance traveled by the ball
' Uses simple equations learned in Physics

s = W / (2 * I / dN * l) * (l - x) ^ 2  'stress at the cross-section being evaluated(lb/in-in)
y = W * (x) ^ 2 / (24 * E * I * l) * (2 * (l) ^ 2 + (2 * l - x) ^ 2) 'deflection(in)

' Things to do next:
' a) output the values of vx0 and vy0 to the worksheet,
' b) write another sub to estimate multiple values of distance and hang time

End Sub

Sub calculationForMultipleLoad(Load, E, I, x, l, dN)

' 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 = "Applied load (lb)"

        ActiveCell.Offset(0, 1).Select
        ActiveCell.Value = "s(lb/in-in)"

        ActiveCell.Offset(0, 1).Select
        ActiveCell.Value = "y(in))"

' start a loop to calculate hangtime and distance for each angle
' note that we do the calculation every 5 degrees

  For Load = 1000 To 4000 Step 50

       s = Load / (2 * I / dN * l) * (l - x) ^ 2  'stress at the cross-section being evaluated(lb/in-in)
       y = Load * (x) ^ 2 / (24 * E * I * l) * (2 * (l) ^ 2 + (2 * l - x) ^ 2) 'deflection(in)

        Range("A" & rowToStartTable + 1).Select
        ActiveCell.Value = Load                  ' load(lb)
        ActiveCell.NumberFormat = 0#             ' format numbers


        ActiveCell.Offset(0, 1).Select
        ActiveCell.Value = s                     ' stress at the cross-section being evaluated(lb/in-in)
        ActiveCell.NumberFormat = "0.00"         ' format numbers

        ActiveCell.Offset(0, 1).Select
        ActiveCell.Value = y           'deflection(in)
        ActiveCell.NumberFormat = "00.00000"

        rowToStartTable = rowToStartTable + 1
  Next Load

End Sub
```

Table with results of applied load, stress and deflections.

Applied load (lb)	s(lb/in-in)	y(in))
1000	8137.94	00.00180
1050	8544.83	00.00189
1100	8951.73	00.00198
1150	9358.63	00.00207
1200	9765.52	00.00216
1250	10172.42	00.00225
1300	10579.32	00.00234
1350	10986.21	00.00243
1400	11393.11	00.00252
1450	11800.01	00.00261
1500	12206.91	00.00271
1550	12613.80	00.00280
1600	13020.70	00.00289
1650	13427.60	00.00298
1700	13834.49	00.00307
1750	14241.39	00.00316
1800	14648.29	00.00325
1850	15055.18	00.00334
1900	15462.08	00.00343
1950	15868.98	00.00352
2000	16275.87	00.00361
2050	16682.77	00.00370
2100	17089.67	00.00379
2150	17496.56	00.00388
2200	17903.46	00.00397
2250	18310.36	00.00406
2300	18717.26	00.00415
2350	19124.15	00.00424
2400	19531.05	00.00433
2450	19937.95	00.00442
2500	20344.84	00.00451
2550	20751.74	00.00460
2600	21158.64	00.00469
2650	21565.53	00.00478
2700	21972.43	00.00487
2750	22379.33	00.00496
2800	22786.22	00.00505

GUI Control Interface with step size.



Excel interface.

Parameter	Definition	Value	Units
W	Applied Load	3679	lb
E	Modulus of Elasticity	30000000	lb/sq-in
I	Moment of inertia	100	in^4
x	distance from datum point	10	in
l	beam length	223	in
dN	distance from edge of beam to neutral axis	8	in
Z	section modulus of the cross section of the beam	12.5	
Step Size	The interval for the applied load	5	
	Results		
s	stress at the cross-section being evaluated	29939.471	lb/in-in
y	Deflection	0.007	in
Applied load (lb)	s(lb/in-in)	y(in))	
1000	8137.94	00.00180	
1005	8178.63	00.00181	
1010	8219.32	00.00182	
1015	8260.01	00.00183	
1020	8300.70	00.00184	
1025	8341.39	00.00185	
1030	8382.08	00.00186	
1035	8422.77	00.00187	
1040	8463.46	00.00188	
1045	8504.14	00.00188	
1050	8544.83	00.00189	
1055	8585.52	00.00190	
1060	8626.21	00.00191	
1065	8666.90	00.00192	
1070	8707.59	00.00193	
1075	8748.28	00.00194	
1080	8788.97	00.00195	
1085	8829.66	00.00196	
1090	8870.35	00.00197	

Results with a step size of 5.

Parameter	Definition	Value	Units
W	Applied Load	3500	lb
E	Modulus of Elasticity	30000000	lb/sq-in
I	Moment of inertia	100	in^4
x	distance from datum point	10	in
l	beam length	200	in
dN	distance from edge of beam to neutral axis	8	in
Z	section modulus of the cross section of the beam	12.5	
Step Size	The interval for the applied load	5	
	Results		
s	stress at the cross-section being evaluated	25270.000	lb/in-in
y	Deflection	0.006	in
Applied load (lb)	s(lb/in-in)	y(in))	
1000	7220.00	00.00161	
1005	7256.10	00.00162	
1010	7292.20	00.00163	
1015	7328.30	00.00164	
1020	7364.40	00.00164	
1025	7400.50	00.00165	
1030	7436.60	00.00166	
1035	7472.70	00.00167	
1040	7508.80	00.00168	
1045	7544.90	00.00168	
1050	7581.00	00.00169	
1055	7617.10	00.00170	
1060	7653.20	00.00171	
1065	7689.30	00.00172	
1070	7725.40	00.00172	
1075	7761.50	00.00173	
1080	7797.60	00.00174	
1085	7833.70	00.00175	
1090	7869.80	00.00176	
1095	7905.90	00.00176	
1100	7942.00	00.00177	
1105	7978.10	00.00178	
1110	8014.20	00.00179	
1115	8050.30	00.00180	
1120	8086.40	00.00181	

Results with Step Size of 10 inches.

Parameter	Definition	Value	Units
W	Applied Load	3500	lb
E	Modulus of Elasticity	30000000	lb/sq-in
I	Moment of inertia	100	in^4
x	distance from datum point	10	in
1	beam length	200	in
dN	distance from edge of beam to neutral axis	8	in
Z	section modulus of the cross section of the beam	12.5	
Step Size	The interval for the applied load	10	
	Results		
s	stress at the cross-section being evaluated	25270.000	lb/in-in
y	Deflection	0.006	in
Applied load (lb)	s(lb/in-in)	y(in))	
1000	7220.00	00.00161	
1010	7292.20	00.00163	
1020	7364.40	00.00164	
1030	7436.60	00.00166	
1040	7508.80	00.00168	
1050	7581.00	00.00169	
1060	7653.20	00.00171	
1070	7725.40	00.00172	
1080	7797.60	00.00174	
1090	7869.80	00.00176	
1100	7942.00	00.00177	
1110	8014.20	00.00179	
1120	8086.40	00.00181	
1130	8158.60	00.00182	
1140	8230.80	00.00184	
1150	8303.00	00.00185	
1160	8375.20	00.00187	
1170	8447.40	00.00189	
1180	8519.60	00.00190	
1190	8591.80	00.00192	
1200	8664.00	00.00193	
1210	8736.20	00.00195	
1220	8808.40	00.00197	
1230	8880.60	00.00198	
1240	8952.80	00.00200	
1250	9025.00	00.00201	

Problem 2

a)

Set up the Import Options and import the data

```matlab
opts = delimitedTextImportOptions("NumVariables", 8);

% Specify range and delimiter
opts.DataLines = [2, Inf];
opts.Delimiter = "\t";

% Specify column names and types
opts.VariableNames = ["Model", "Country", "Type", "Weight", "TurningCircle", "Displacement", "Horsepower", "GasTankSize"];
opts.VariableTypes = ["string", "categorical", "categorical", "double", "double", "double", "double", "double"];

% Specify file level properties
opts.ExtraColumnsRule = "ignore";
opts.EmptyLineRule = "read";

% Specify variable properties
opts = setvaropts(opts, "Model", "WhitespaceRule", "preserve");
opts = setvaropts(opts, ["Model", "Country", "Type"], "EmptyFieldRule", "auto");

% Import the data
Cardata1 = readtable("C:\Users\SBLBC\Desktop\A5\Car data.txt", opts)
```

Clear temporary variables

```matlab
clear opts
```

b)

Set up the Import Options and import the data

```matlab
opts = delimitedTextImportOptions("NumVariables", 8);

% Specify range and delimiter
opts.DataLines = [2, Inf];
opts.Delimiter = "\t";

% Specify column names and types
opts.VariableNames = ["Weight", "TurningCircle", "Horsepower"];
opts.VariableTypes = ["double", "double", "double"];

% Specify file level properties
opts.ExtraColumnsRule = "ignore";
opts.EmptyLineRule = "read";

% Specify variable properties
opts = setvaropts(opts, "Model", "WhitespaceRule", "preserve");
opts = setvaropts(opts, ["Model", "Country", "Type"], "EmptyFieldRule", "auto");

% Import the data
Cardata1 = readtable("C:\Users\SBLBC\Desktop\A5\Car data.txt", opts)
```

Clear temporary variables

```matlab
clear opts
```

c) Matlab script to plot car weight versus horsepower.

```matlab
carWeight = Cardata.Weight;
carHorsepower = Cardata.Horsepower;
carTurningCircle = Cardata.TurningCircle;

figure

plot(carWeight, carHorsepower, 'ro', 'MarkerSize', 10)

xlabel('carWeight(lb)', 'FontSize', 20);
ylabel('carHorsepower(hp)', 'Fontsize', 20);
set(gca, 'color', 'w');
grid on

```

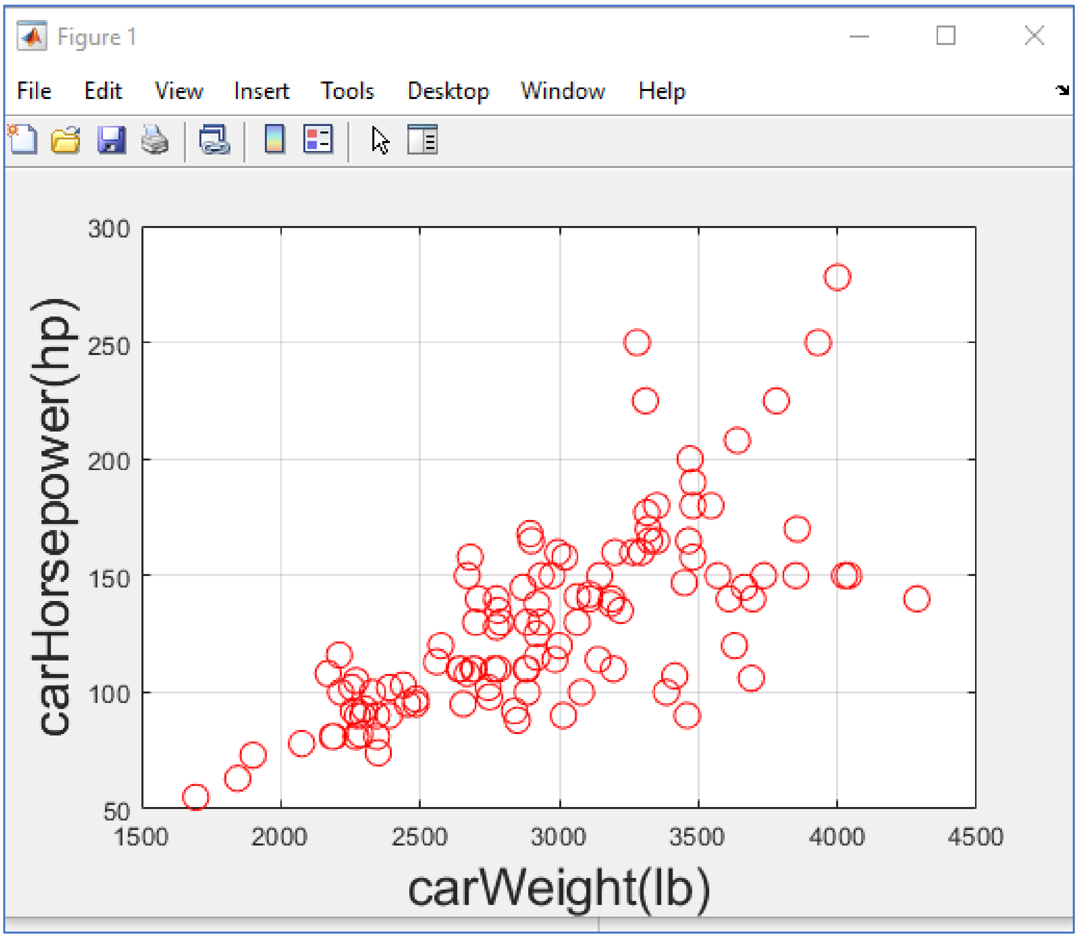


Figure 1
File Edit View Insert Tools Desktop Window Help
carHorsepower(hp)
carWeight(lb)

d) .

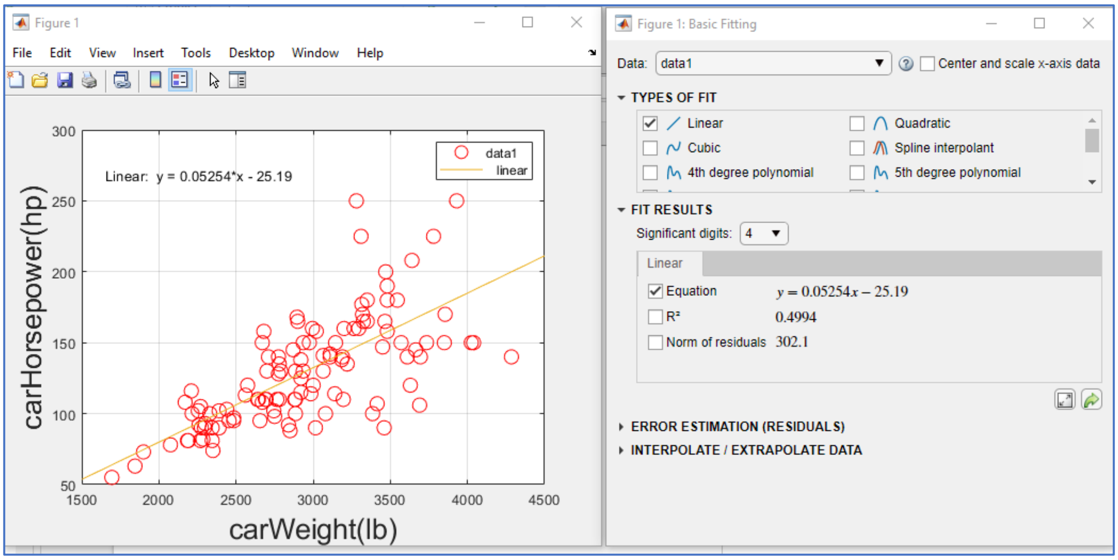
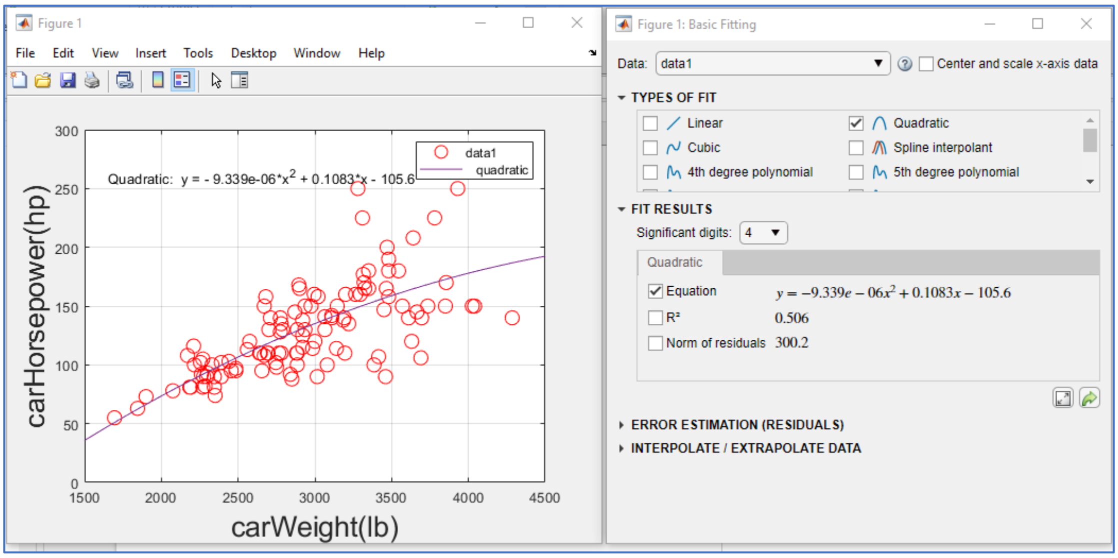


Figure 1
File Edit View Insert Tools Desktop Window Help
Linear: y = 0.05254*x - 25.19
data1
linear
carHorsepower(hp)
carWeight(lb)
Figure 1: Basic Fitting
Data: data1
Center and scale x-axis data
TYPES OF FIT
Linear
Quadratic
Cubic
Spline interpolant
4th degree polynomial
5th degree polynomial
FIT RESULTS
Significant digits: 4
Linear
Equation y = 0.05254x – 25.19
R² 0.4994
Norm of residuals 302.1
ERROR ESTIMATION (RESIDUALS)
INTERPOLATE / EXTRAPOLATE DATA



Compare linear regression versus the quadratic polynomial (2nd order polynomial), the R^2 value improves from 0.4994 to 0.506. The quadratic polynomial fits the data better.