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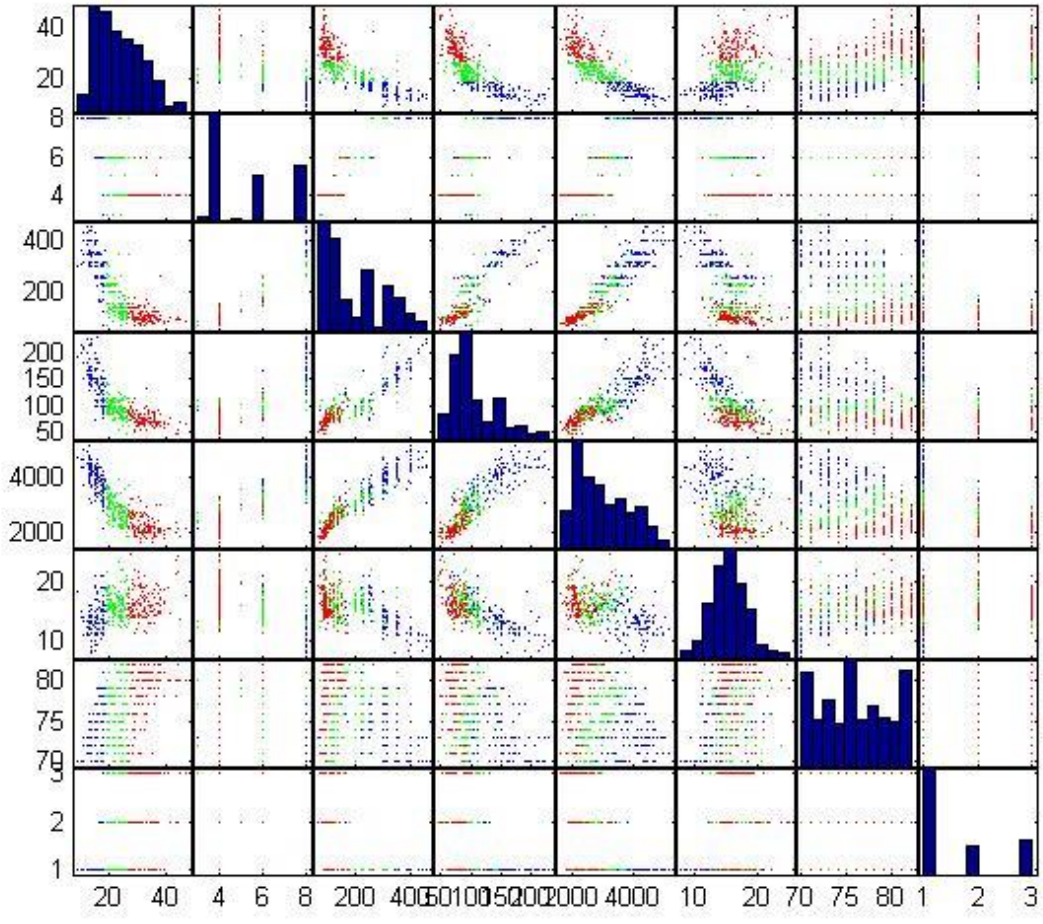
ECS 171 Fall 2016

Homework 1

1.

```
>> [t1,t2,t3]=Problem1()
t1 =
   9.0000   18.6000
t2 =
   19    27
t3 =
  27.0000   46.6000
```

2. From looking at the data we see most clumped and distinguished grouping in row 5 col 1, which is for mpg vs weight. This correlation makes sense since heavier cars need more powerful engines to break inertia. Second would be horsepower by visual inspection.



3.

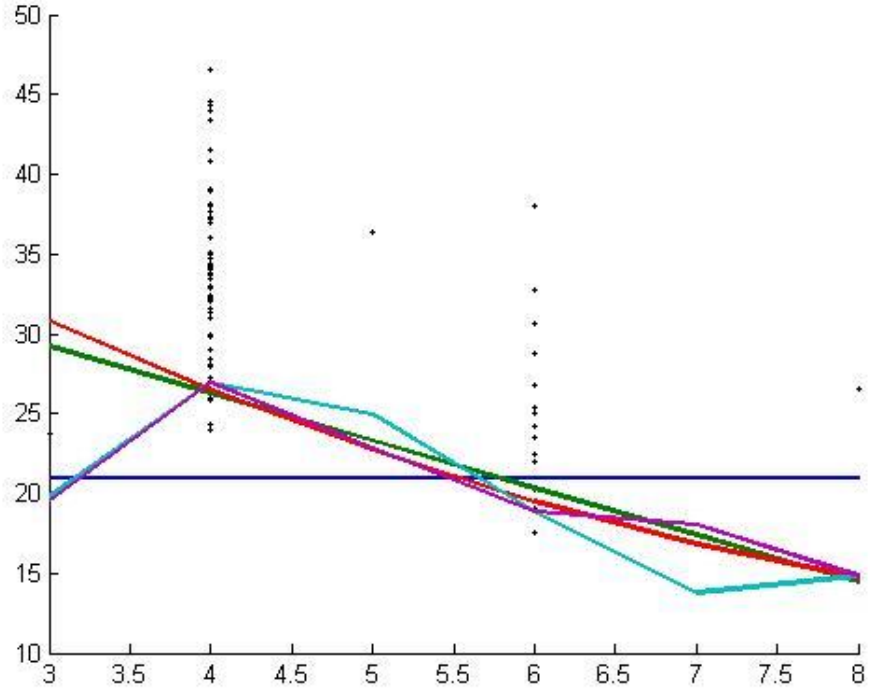
See the function ‘Problem3’ which is also used for Problem 4

4.

Note that all the training errors go in order from 0th order, 1st order, 2nd order, 3rd order…, 5th order, as they appear in the results below.

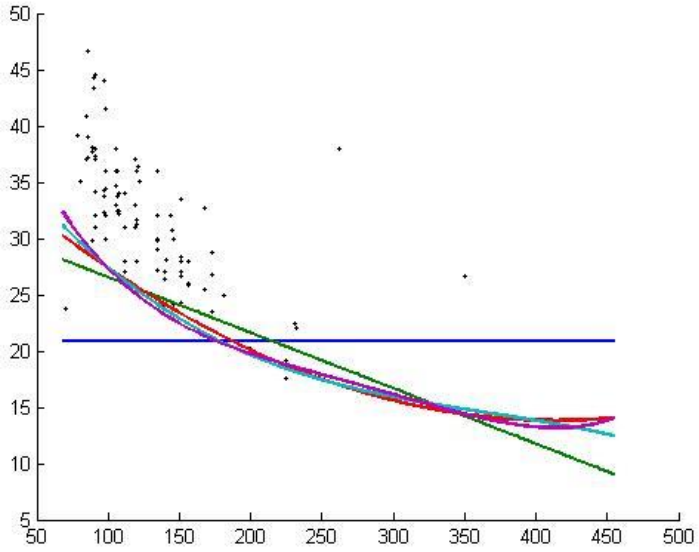
Cylinder training error =
40.6889 13.6794 13.4340 11.9984 11.9687
Cylinder mse =
155.8924 73.5274 73.1248 68.2405 68.5275

3rd order is best for this attribute set, since mse is better predictor



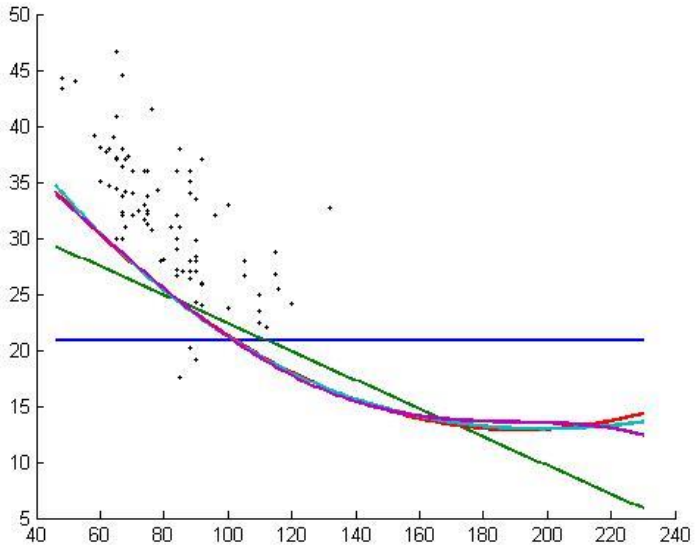
Displacement training error =
  40.6889 11.7841 9.9070 9.7481 9.5605
Displacement mse =
 155.8924 69.5172 64.1460 64.8623 66.7271

2nd order is best for this attribute set since mse better predictor



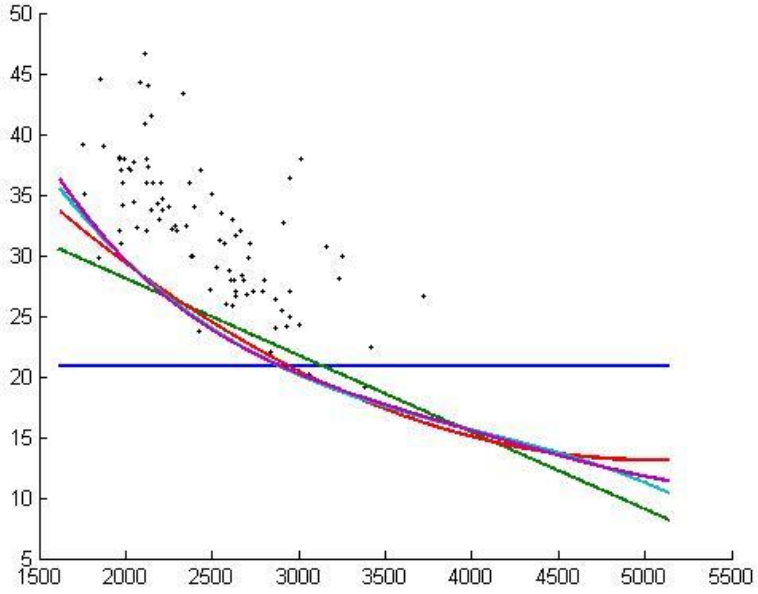
Horsepower training error =
  40.6889 14.5618 10.9514 10.9245 10.8724
Horsepower mse =
 155.8924 73.1724 60.3076 60.1029 59.8016

4th order is best for this attribute set



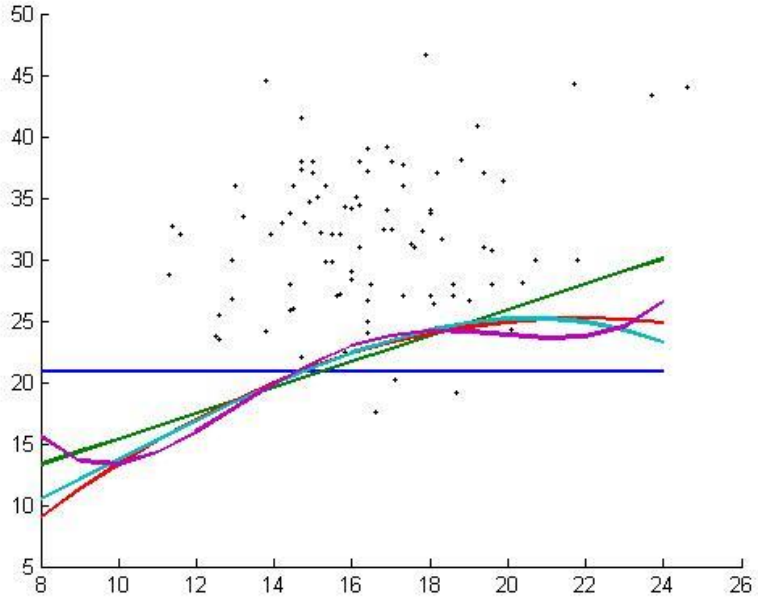
Weight training error =
  40.6889 9.3042 7.7351 7.4836 7.4565
Weight mse =
 155.8924 66.2068 64.7402 67.2976 67.9022

2nd order is best for this attribute set



Acceleration training error =
  40.6889 32.3425 31.3901 31.3197 30.6303
Acceleration mse =
 155.8924 131.3637 130.9554 132.2631 128.8050

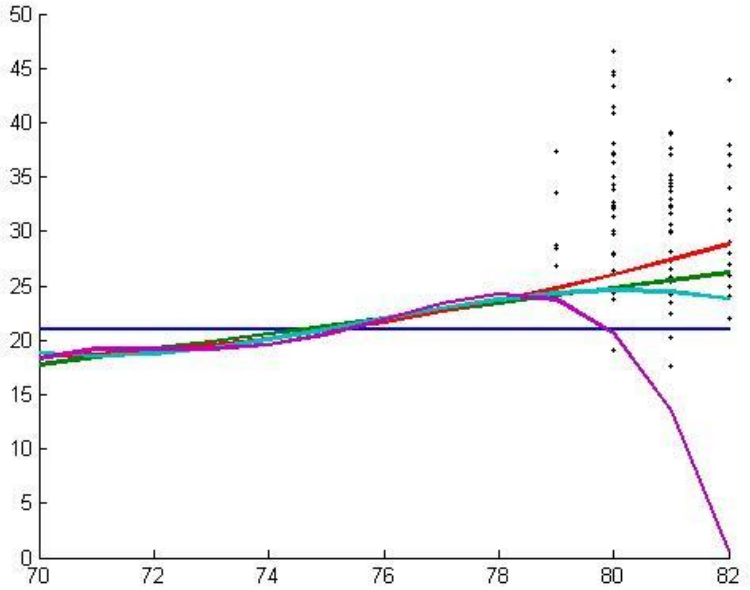
4th order is best for this attribute set



Model training error =
  40.6889 36.7878 36.6419 36.5696 36.3779

Model Year mse =
155.8924 77.9547 59.0355 93.4685 503.1113

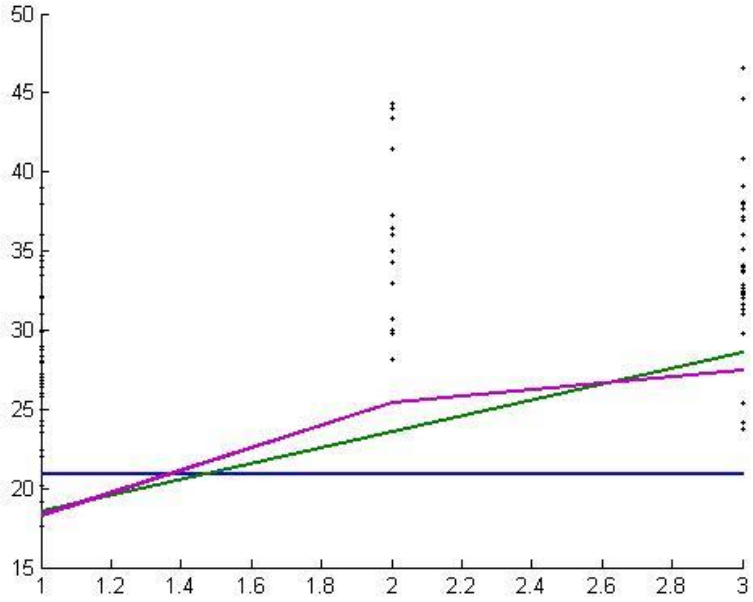
2nd order is best for this attribute set



Origin training error =
40.6889 26.8123 25.9535 25.9535 25.9535
Origin mse =
155.8924 108.5153 109.5944 109.5944 109.5944

1st order is best for this attribute set

"Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND = 1.253782e-19."



Notes on results: I found that shuffling the data prior to running my 'Problem3' function drastically reduced the calculated error. I believe this is due to the data not being randomly distributed very well, from looking at it we can see that there does appear to be on average a

higher mpg mean for the last 90 results. However, note that the above results are not shuffled because in the instructions it seems to indicate to use the dataset as it came in the file.

5.

Note that all the training errors go in order from 0^{th} order, 1^{st} order, 2^{nd} order as they appear in the results.

```
Multivariable training error =
  40.6889    7.2103    4.3717

Multivariable mse =
 155.8924   32.7617    2.7996

Poly0 w values:
 155.8924

Poly1 w values:
   4.2567
  -0.4329
   0.0095
  -0.0177
  -0.0054
  -0.0462
   0.4759
   0.8732

Poly2 w values:
 575.2568
   1.4507
  -0.0452
  -0.1122
  -0.0133
  -0.7084
 -14.2363
  -1.3365
  -0.0904
   0.0001
   0.0002
   0.0000
   0.0144
   0.0990
   0.3404
```

The large w0 for Poly2 seems a bit fishy, but the calculated error seems to indicate that this is a good fit for the data set. I'm unsure of whether there was a miscalculation in my code or whether the curve is just very sharp at the extrema since graphing this multivariable function would be somewhat difficult.

6. Wasn't sure how to proceed, code is very minimal with no final solution

7.

mpg =
20.8510

As discovered in Problem 1, this vehicle would fall into the medium mpg category. From looking at general trends in the data, this seems to make sense, the car has a high displacement, a heavy weight, and a fairly high horsepower, which would all decrease it's mpg considerably. If I had to guess more, I'd say it's probably a mini van or some type of SUV since it has very slow acceleration and is somewhat heavy.

8.

Since that is a donkey driving the car, I would say it costs 0 miles per gallon of gasoline! However, if we are talking gallons of water or milk to power the donkey then probably about 1 liter of water/milk per mile for the donkey to stay hydrated. At 3.785 liters per gallon, that would come out to approximately 0.264 gallons of water per mile, or 3.785 miles per gallon of water. If this doesn't get me 3 points then I am a llama.