CPT_S 575 Data Science: Assignment 2

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Excercise 1

(a) Use the read.csv() function to read the data into R, or the csv library to read in the data with python. In R you will load the data into a dataframe. In python you may store it as a list of lists or use the pandas dataframe. Call the loaded data college. Ensure that your column headers are not treated as a row of data.

```
college = read.csv("https://scads.eecs.wsu.edu/wp-
content/uploads/2017/09/College.csv")
head(college)
```

```
##                              X Private Apps Accept Enroll Top10perc
## 1 Abilene Christian University     Yes 1660   1232    721        23
## 2           Adelphi University     Yes 2186   1924    512        16
## 3               Adrian College     Yes 1428   1097    336        22
## 4          Agnes Scott College     Yes  417    349    137        60
## 5    Alaska Pacific University     Yes  193    146     55        16
## 6            Albertson College     Yes  587    479    158        38
##   Top25perc F.Undergrad P.Undergrad Outstate Room.Board Books Personal PhD
## 1        52        2885         537     7440       3300   450     2200  70
## 2        29        2683        1227    12280       6450   750     1500  29
## 3        50        1036          99    11250       3750   400     1165  53
## 4        89         510          63    12960       5450   450      875  92
## 5        44         249         869     7560       4120   800     1500  76
## 6        62         678          41    13500       3335   500      675  67
##   Terminal S.F.Ratio perc.alumni Expend Grad.Rate
## 1       78      18.1          12   7041        60
## 2       30      12.2          16  10527        56
## 3       66      12.9          30   8735        54
## 4       97       7.7          37  19016        59
## 5       72      11.9           2  10922        15
## 6       73       9.4          11   9727        55
```

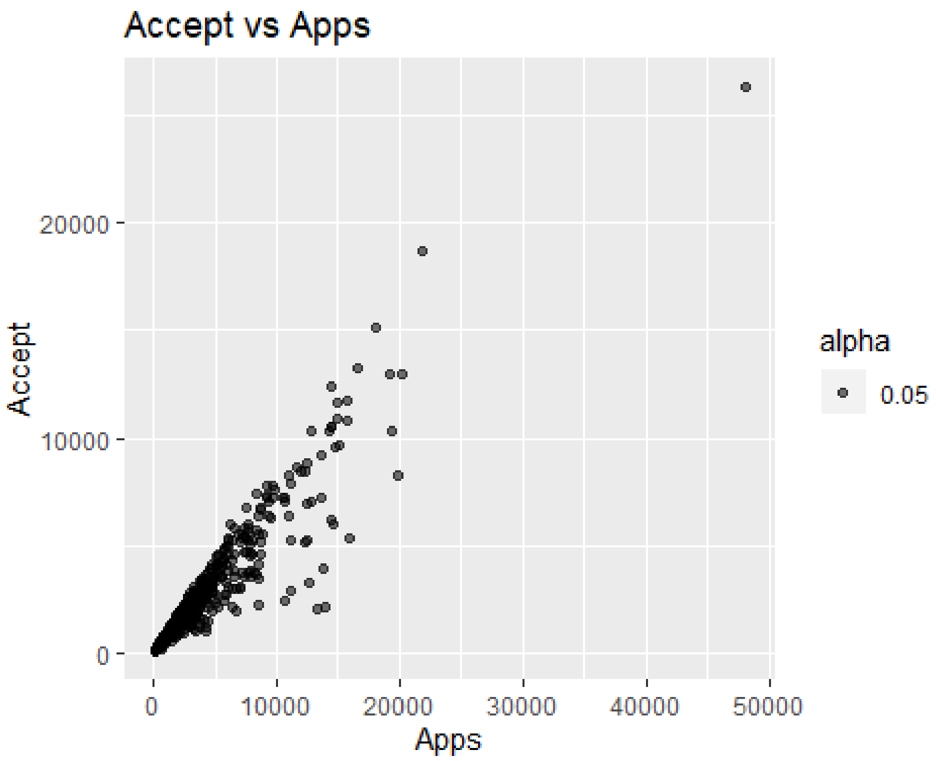
(b) Find the median cost of books for all schools in this dataset.

```
books = summary(college$Books)
books['Median']
```

```
## Median
##    500
```

(c) Produce a scatterplot that shows a relationship between two features of your choice in the dataset. Ensure it has appropriate axis labels and a title.

Relationship between Acceptence and Applications :



(d) Produce a histogram showing the overall enrollment numbers (P.Undergrad plus F.Undergrad) for both public and private (Private) schools. Ensure it has appropriate axis labels and a title.

Adding both the fields P.Undergrad and F.undergrad gives us the overall enrollment

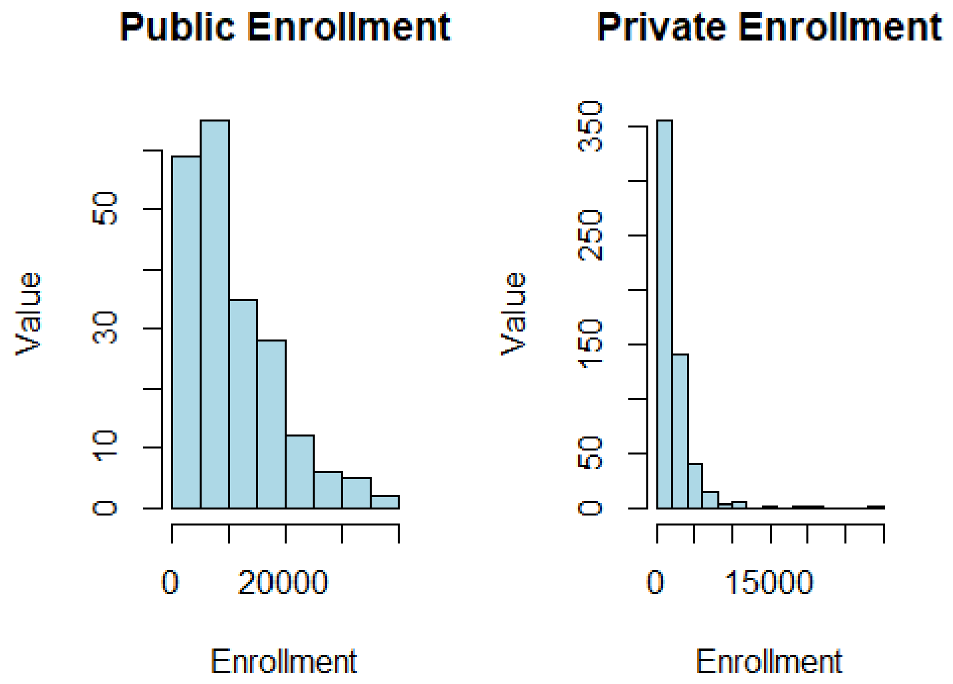
```
enrollTotal = college$P.Undergrad+college$F.Undergrad
```

Splitting public and private colleges

```
pub = which(college$Private=="No")
pri = which(college$Private =="Yes")
```

Overall Enrollment plots

```
par(mfcol = c(1,2))
hist(enrollTotal[pub], col="light Blue", main="Public Enrollment",
xlab="Enrollment", ylab="Value")
hist(enrollTotal[pri],  col="light Blue", main="Private Enrollment",
xlab="Enrollment", ylab="Value")
```

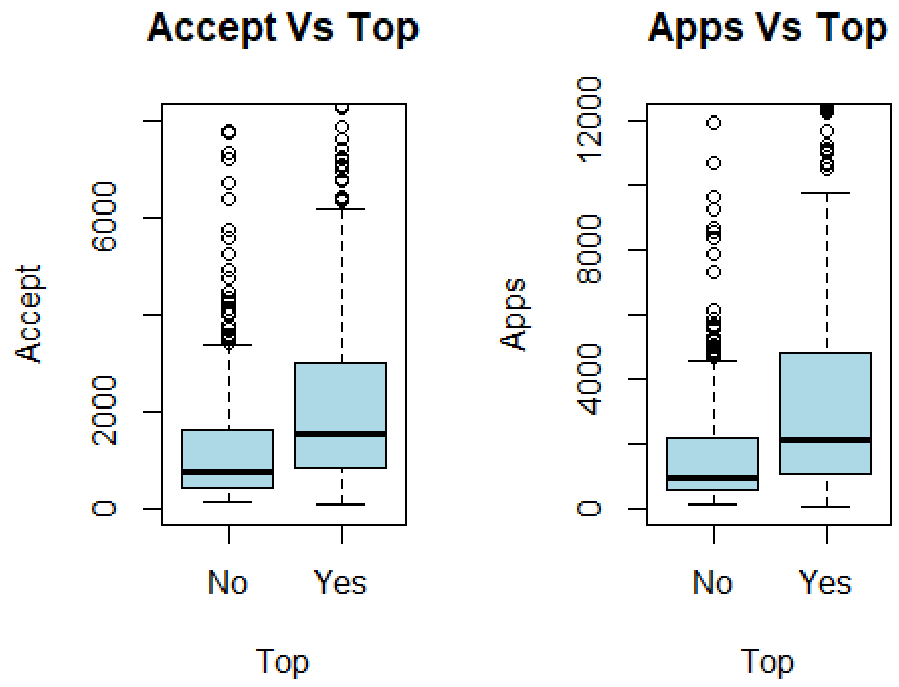


(e) Create a new qualitative variable, called Top, by binning the Top25perc variable into two categories. Specifically, divide the schools into two groups based on whether or not the proportion of students coming from the top 25% of their high school classes exceeds 50%. Now produce side-by-side boxplots of acceptance rate (based on Accept and Apps) with respect to the two Top categories (Yes and No). How many top universities are there?

```
top = rep("No",nrow(college))
top[college$Top25perc > 50] = "Yes"
top= as.factor(top)
college = data.frame(college, top)
summary(college$top)

##  No Yes
## 328 449
```

Acceptance and Applications for Top

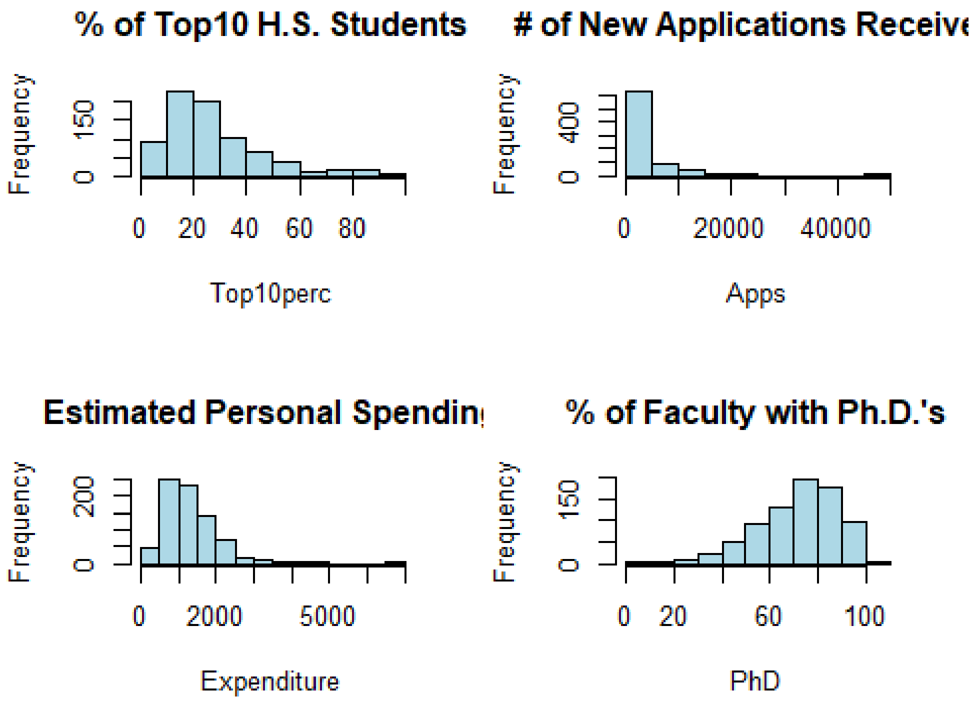
```
par(mfcol = c(1,2))

topUni = boxplot(college$Accept ~ college$top, col = "light blue", main =
"Accept Vs Top", xlab = "Top", ylab = "Accept", ylim = c(0, 8000))
boxplot(college$Apps ~ college$top, col = "light blue", main = "Apps Vs Top",
xlab = "Top", ylab = "Apps",  ylim = c(0, 12000))
```



From the above, it is observed that number of top universities are 449.

(f) Continue exploring the data, producing two or more new plots of any type, and provide a brief summary of your hypotheses and what you discover. You may use additional plots or numerical descriptors as needed. Feel free to think outside the box on this one but if you want something to point you in the right direction, look at the summary statistics for various features, and think about what they tell you. Perhaps try plotting various features from the dataset against each other and see if any patterns emerge.

The following 4 histograms show us the frequency distrbution over the variables ‘Top10perc’, ‘Apps’, ‘Personal’ and ‘PhD’. This gives us some idea of the demographic of the total college population in terms of the mentioned features.



Excercise 2

Handling missing values using na.strings parameter and na.omit function

```
auto = read.csv("https://scads.eecs.wsu.edu/wp-
content/uploads/2017/09/Auto.csv",
na.strings = "?")
auto <- na.omit(auto)
head(auto)
```

```
##   mpg cylinders displacement horsepower weight acceleration year origin
## 1  18         8          307        130   3504         12.0   70      1
## 2  15         8          350        165   3693         11.5   70      1
## 3  18         8          318        150   3436         11.0   70      1
## 4  16         8          304        150   3433         12.0   70      1
## 5  17         8          302        140   3449         10.5   70      1
## 6  15         8          429        198   4341         10.0   70      1
##                        name
## 1 chevrolet chevelle malibu
## 2         buick skylark 320
## 3        plymouth satellite
## 4             amc rebel sst
## 5               ford torino
## 6          ford galaxie 500
```

(a) Specify which of the predictors are quantitative, and which are qualitative? Keep in mind that a qualitative variable may be represented as a quantitative type in the dataset, or the reverse. You may wish to adjust the types of your variables based on your findings.

Quantitative varibles are numeric while qulitative variables are descriptions, which categorizes the data

- Quantitative variables
  - mpg
  - Cylinders
  - Displacement
  - Horsepower
  - Weight
  - Acceleration
  - Year
  - Origin
- Qualitative variables
  - Name

(b) What is the range, mean and standard deviation of each quantitative predictor?

Range:

```
sapply(auto[, -9], range)

##       mpg cylinders displacement horsepower weight acceleration year
## [1,]  9.0         3           68         46   1613          8.0   70
## [2,] 46.6         8          455        230   5140         24.8   82
##      origin
## [1,]      1
## [2,]      3
```

Mean:

```
sapply(auto[, -9], mean)

##          mpg    cylinders displacement   horsepower       weight
##    23.445918     5.471939   194.411990   104.469388  2977.584184
## acceleration         year       origin
##    15.541327    75.979592     1.576531
```

Standard Deviation:

```
sapply(auto[, -9], sd)

##          mpg    cylinders displacement   horsepower       weight
##    7.8050075    1.7057832  104.6440039   38.4911599  849.4025600
## acceleration         year       origin
##    2.7588641    3.6837365    0.8055182
```

(c) Now remove the 45th through 85th (inclusive) observations from the dataset. What is the range, mean, and standard deviation of each predictor in the subset of the data that remains?

```
auto_d = auto[-c(45:85), -9]
```

Range:

```
sapply(auto_d, range)

##       mpg cylinders displacement horsepower weight acceleration year
## [1,]  9.0         3           68         46   1649          8.0   70
## [2,] 46.6         8          455        230   5140         24.8   82
##      origin
## [1,]      1
## [2,]      3
```

Mean:

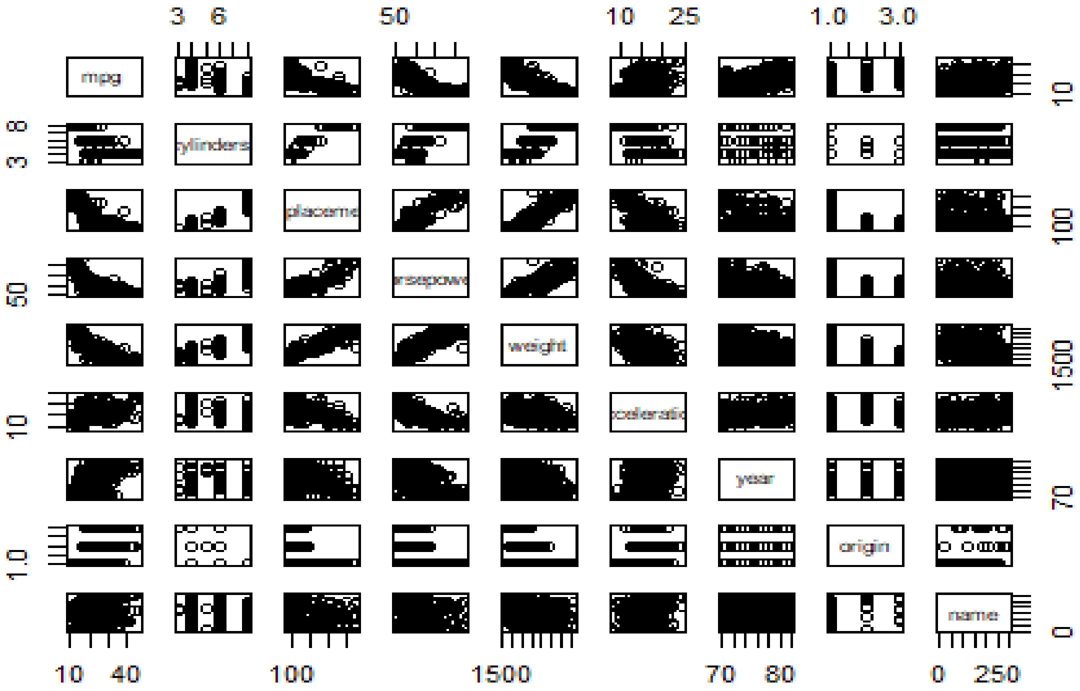
```
sapply(auto_d, mean)

##          mpg    cylinders displacement   horsepower       weight
##    23.780057     5.470085   194.048433   103.863248  2977.233618
## acceleration         year       origin
##    15.541880    76.475783     1.578348
```

Standard Deviation:

```
sapply(auto_d, sd)

##          mpg    cylinders displacement   horsepower       weight
##    7.9008789    1.6830550  103.2050688   38.2367600  835.3627353
## acceleration         year       origin
##    2.7525751    3.5735313    0.8099302
```

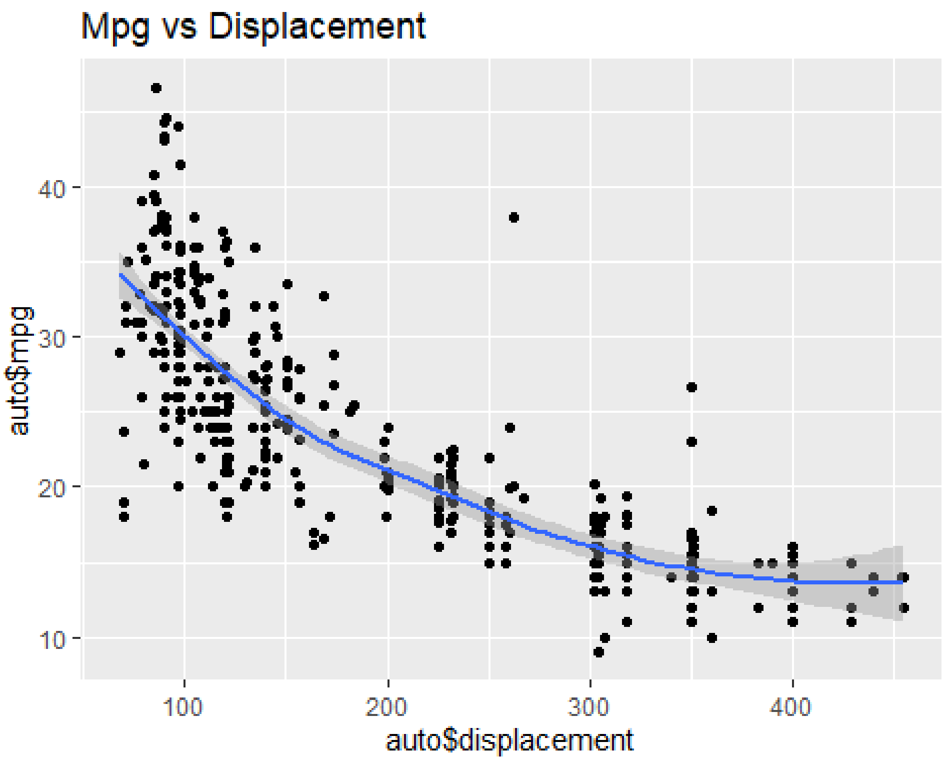
(d) Using the full data set, investigate the predictors graphically, using scatterplots, correlation scores or other tools of your choice. Create some plots highlighting the relationships you find among the predictors. Explain briefly what the relationships between variables are, and what they mean.

```
pairs(auto)
```

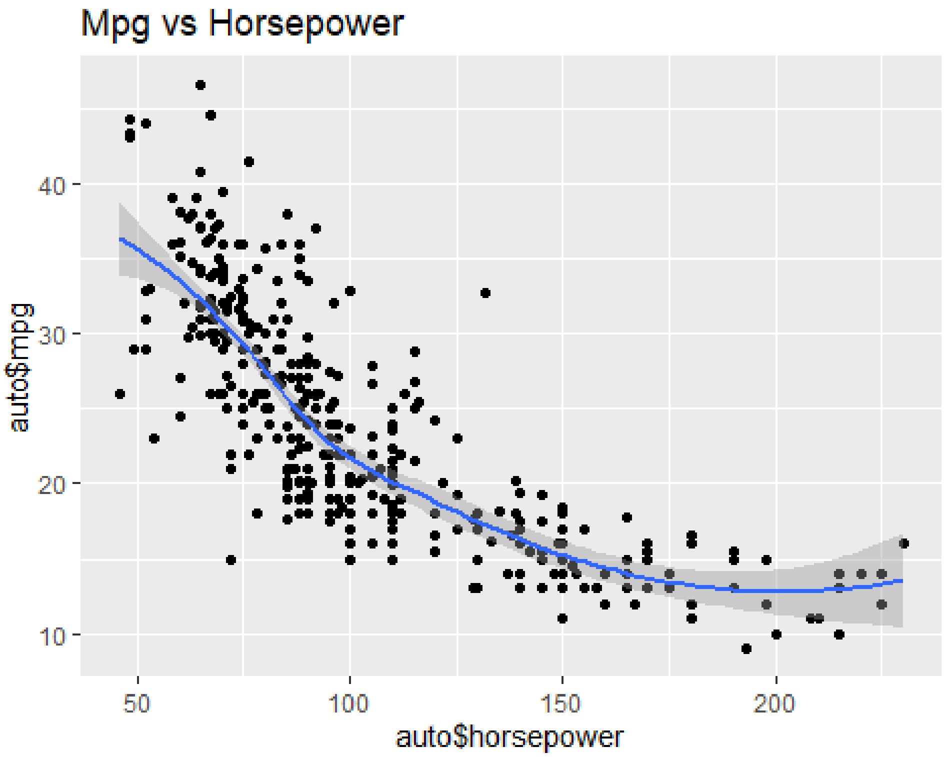


From the scatterplots, we find that there might be a relationship between the following features: * mpg vs displacement * mpg vs horsepower * mpg vs weight * weight vs horsepower * weight vs displacement * horsepower vs displacement * acceleration vs horsepower

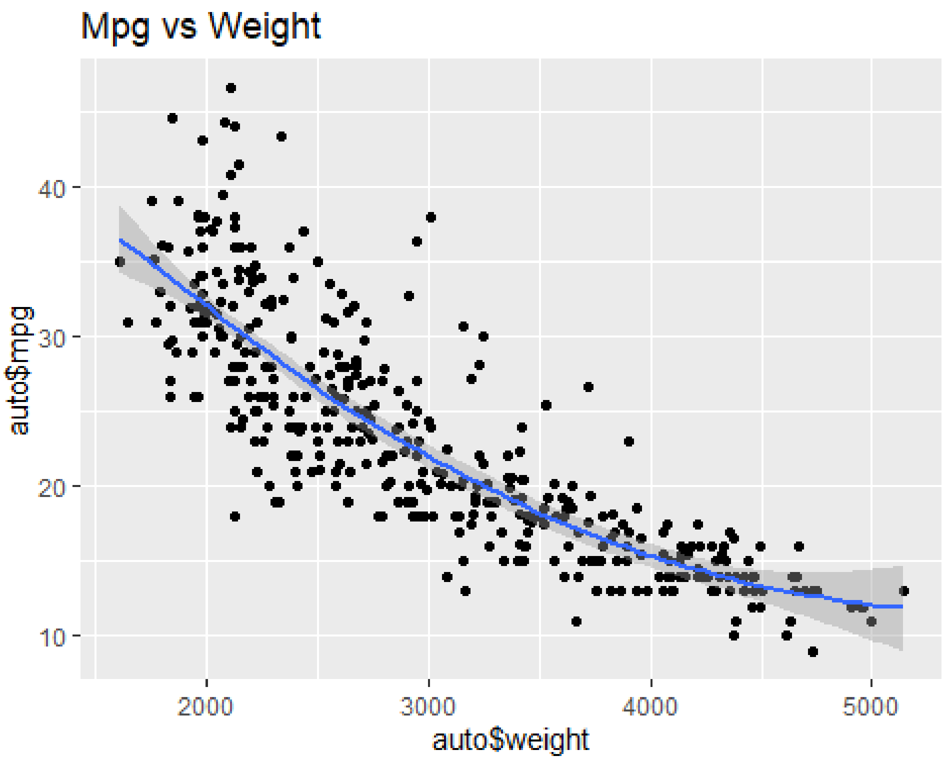
Taking a closer look at the dependence between 'mpg' and other features:



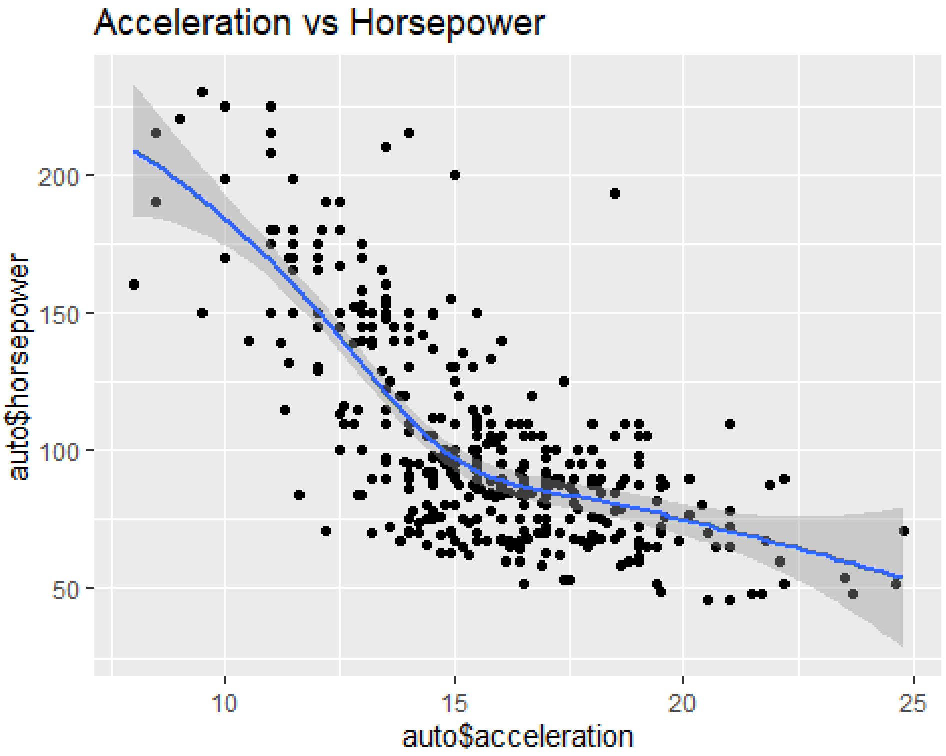
Mpg vs Displacement



Mpg vs Horsepower



From the following plot, we also see that acceleration and horsepower are inversely proportional:



This seems to follow basic physics which says that at lower gears, where horsepower is more, acceleration is less.

(e) Suppose that we wish to predict gas mileage (mpg) on the basis of the other variables. Which, if any, of the other variables might be useful in predicting mpg? Justify your answer.

Horsepower, cylinders, year and origin can be used as predictors for mpg. Displacement and Weight can not be used as they are highly correlated to each other and to horsepower as seen from the scatterplot.