# DS311 - R Lab Assignment

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## R Assignment 1

- In this assignment, we are going to apply some of the build in data set in R for descriptive statistics analysis.
- To earn full grade in this assignment, students need to complete the coding tasks for each question to get the result.
- After finished all the questions, knit the document into HTML format for submission.

### Question 1

Using the **mtcars** data set in R, please answer the following questions.

```r
# Loading the data
data(mtcars)

# Head of the data set
head(mtcars)
```

```
##                    mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

a. Report the number of variables and observations in the data set.

```r
# Enter your code here!
dim(mtcars)
```

```
## [1] 32 11
```

```r
# Answer:
print("There are total of 11 variables and 32 observations in this data set.")
```

```
## [1] "There are total of 11 variables and 32 observations in this data set."
```

b. Print the summary statistics of the data set and report how many discrete and continuous variables are in the data set.

```r
# Enter your code here!
summary(mtcars)
```

```
##       mpg             cyl             disp             hp       
##  Min.   :10.40   Min.   :4.000   Min.   : 71.1   Min.   : 52.0  
##  1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5  
##  Median :19.20   Median :6.000   Median :196.3   Median :123.0  
##  Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7  
##  3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0  
##  Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0  
##       drat             wt             qsec             vs        
##  Min.   :2.760   Min.   :1.513   Min.   :14.50   Min.   :0.0000  
##  1st Qu.:3.080   1st Qu.:2.581   1st Qu.:16.89   1st Qu.:0.0000  
##  Median :3.695   Median :3.325   Median :17.71   Median :0.0000  
##  Mean   :3.597   Mean   :3.217   Mean   :17.85   Mean   :0.4375  
##  3rd Qu.:3.920   3rd Qu.:3.610   3rd Qu.:18.90   3rd Qu.:1.0000  
##  Max.   :4.930   Max.   :5.424   Max.   :22.90   Max.   :1.0000  
##        am              gear            carb      
##  Min.   :0.0000   Min.   :3.000   Min.   :1.000  
##  1st Qu.:0.0000   1st Qu.:3.000   1st Qu.:2.000  
##  Median :0.0000   Median :4.000   Median :2.000  
##  Mean   :0.4062   Mean   :3.688   Mean   :2.812  
##  3rd Qu.:1.0000   3rd Qu.:4.000   3rd Qu.:4.000  
##  Max.   :1.0000   Max.   :5.000   Max.   :8.000  
```

```r
# Answer:
print("There are 3 discrete variables (cyl, vs, am, gear, carb) and 6 continuous variables in this data
```

```
## [1] "There are 3 discrete variables (cyl, vs, am, gear, carb) and 6 continuous variables in this data
```

c. Calculate the mean, variance, and standard deviation for the variable **mpg** and assign them into variable names m, v, and s. Report the results in the print statement.

```r
# Enter your code here!
mean(mtcars$mpg)
```

```
## [1] 20.09062
```

```r
v <- var(mtcars$mpg)
s <- sd(mtcars$mpg)




# print(paste("The average of Mile Per Gallon from this data set is", m, "with variance", v, "and stand
```

d. Create two tables to summarize 1) average mpg for each cylinder class and 2) the standard deviation of mpg for each gear class.

```r
# Enter your code here!
avg_mpg_cyl <- aggregate(mpg ~ cyl, data=mtcars, mean)
sd_mpg_gear <- aggregate(mpg ~ gear, data=mtcars, sd)

avg_mpg_cyl
```

```
##   cyl      mpg
## 1   4 26.66364
## 2   6 19.74286
## 3   8 15.10000
```

```r
sd_mpg_gear
```

```
##   gear      mpg
## 1    3 3.371618
## 2    4 5.276764
## 3    5 6.658979
```

e. Create a crosstab that shows the number of observations belong to each cylinder and gear class combinations. The table should show how many observations given the car has 4 cylinders with 3 gears, 4 cylinders with 4 gears, etc. Report which combination is recorded in this data set and how many observations for this type of car.

```r
# Enter your code here!
crosstab <- table(mtcars$cyl, mtcars$gear)
crosstab
```

```
##
##      3  4  5
##   4  1  8  2
##   6  2  4  1
##   8 12  0  2
```

```r
max_combination <- which(crosstab == max(crosstab), arr.ind = TRUE)

print(paste("The most common car type in this data set is car with", rownames(crosstab)[max_combination
```

```
## [1] "The most common car type in this data set is car with 8 cylinders and 3 gears. There are total
```

---

### Question 2

Use different visualization tools to summarize the data sets in this question.

a. Using the **PlantGrowth** data set, visualize and compare the weight of the plant in the three separated group. Give labels to the title, x-axis, and y-axis on the graph. Write a paragraph to summarize your findings.

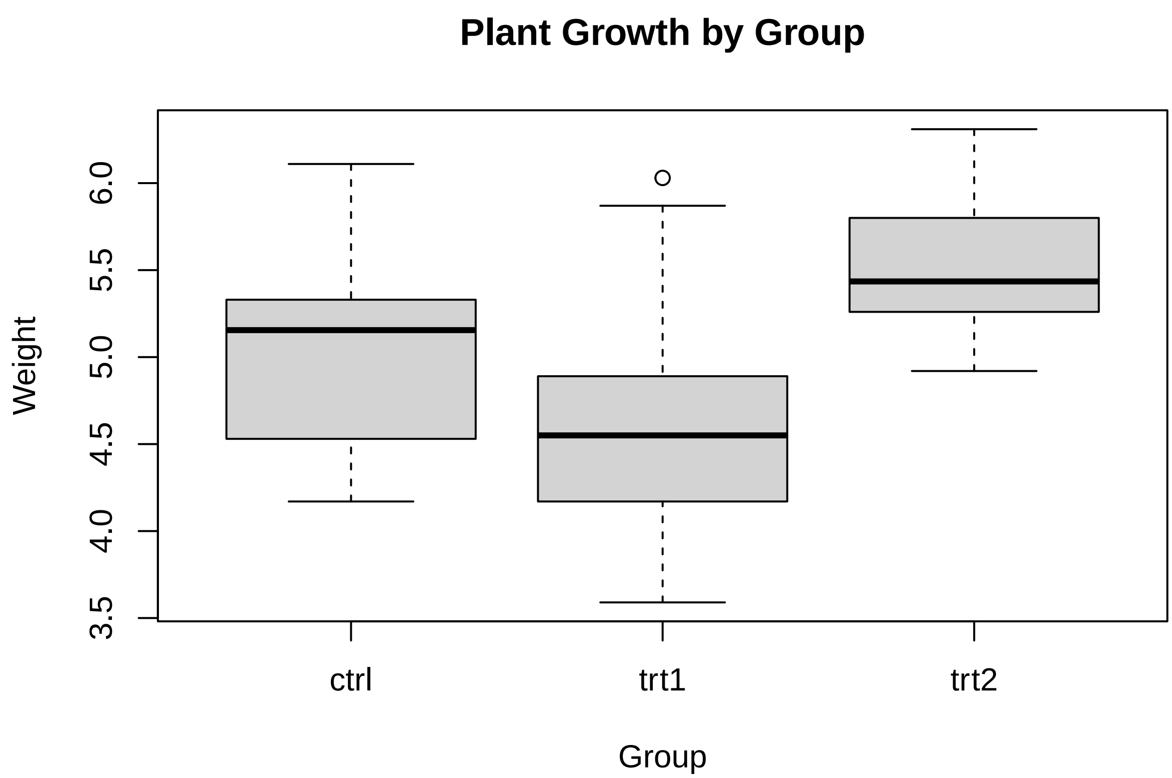
```r
# Load the data set
data("PlantGrowth")

# Head of the data set
head(PlantGrowth)
```

```
##   weight group
## 1   4.17  ctrl
## 2   5.58  ctrl
## 3   5.18  ctrl
## 4   6.11  ctrl
## 5   4.50  ctrl
## 6   4.61  ctrl
```

```r
# Enter your code here!
data("PlantGrowth")
head(PlantGrowth)
```

```
##   weight group
## 1   4.17  ctrl
## 2   5.58  ctrl
## 3   5.18  ctrl
## 4   6.11  ctrl
## 5   4.50  ctrl
## 6   4.61  ctrl
```

```r
boxplot(weight ~ group, data=PlantGrowth,
        main="Plant Growth by Group",
        xlab="Group", ylab="Weight")
```

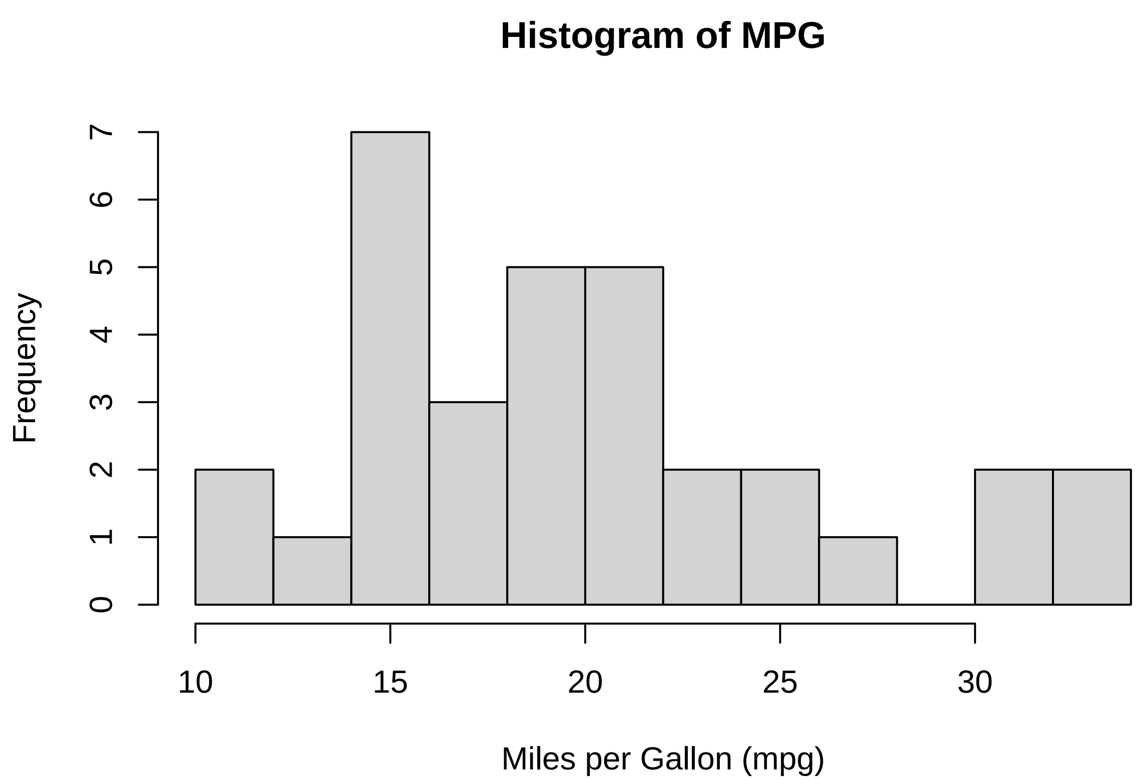



Result:

=> Report a paragraph to summarize your findings from the plot! Plants in group 2 appear to have higher median weight compared to groups 1 and 3. The variance is quite similar among the groups, though group 3 shows slightly higher variability.

b. Using the **mtcars** data set, plot the histogram for the column **mpg** with 10 breaks. Give labels to the title, x-axis, and y-axis on the graph. Report the most observed mpg class from the data set.

```
hist(mtcars$mpg, breaks=10,
     main="Histogram of MPG",
     xlab="Miles per Gallon (mpg)", ylab="Frequency")
```




```
print("Most of the cars in this data set are in the class of 15-20 mile per gallon.")
```

```
## [1] "Most of the cars in this data set are in the class of 15-20 mile per gallon."
```

c. Using the **USArrests** data set, create a pairs plot to display the correlations between the variables in the data set. Plot the scatter plot with **Murder** and **Assault**. Give labels to the title, x-axis, and y-axis on the graph. Write a paragraph to summarize your results from both plots.

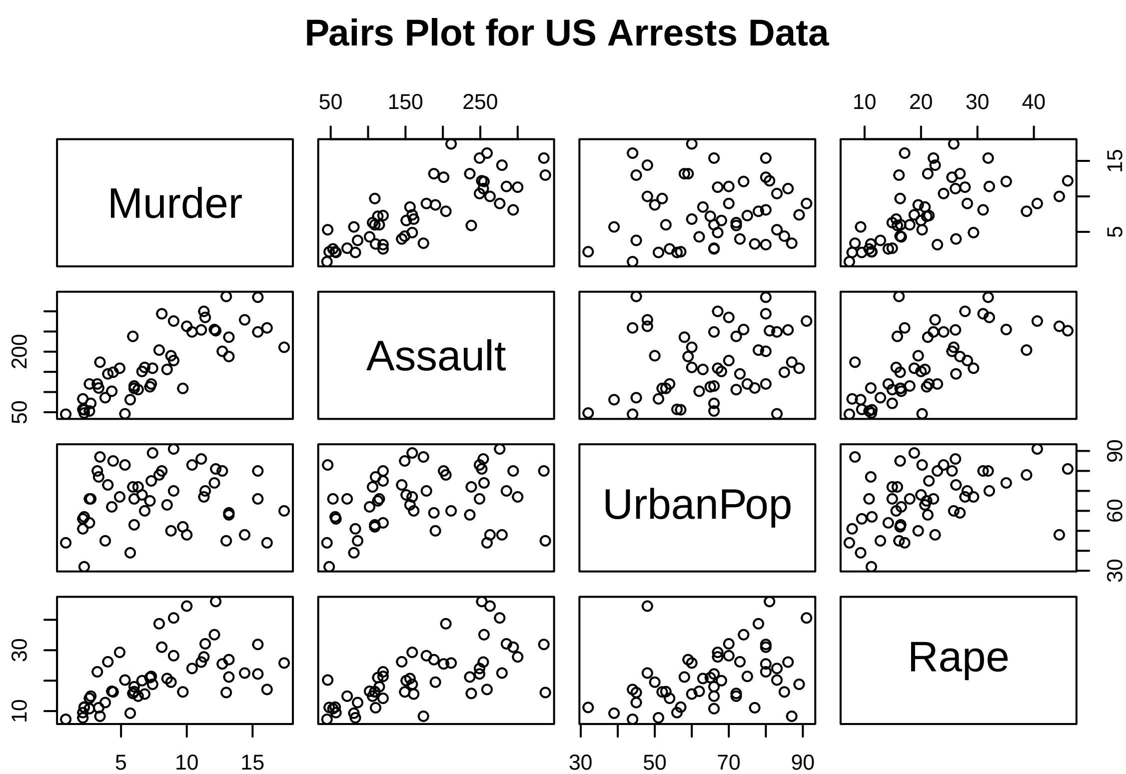
```
# Load the data set
data("USArrests")

# Head of the data set
head(USArrests)
```

```
##            Murder Assault UrbanPop Rape
## Alabama      13.2     236       58 21.2
## Alaska       10.0     263       48 44.5
## Arizona       8.1     294       80 31.0
## Arkansas      8.8     190       50 19.5
## California    9.0     276       91 40.6
## Colorado      7.9     204       78 38.7
```

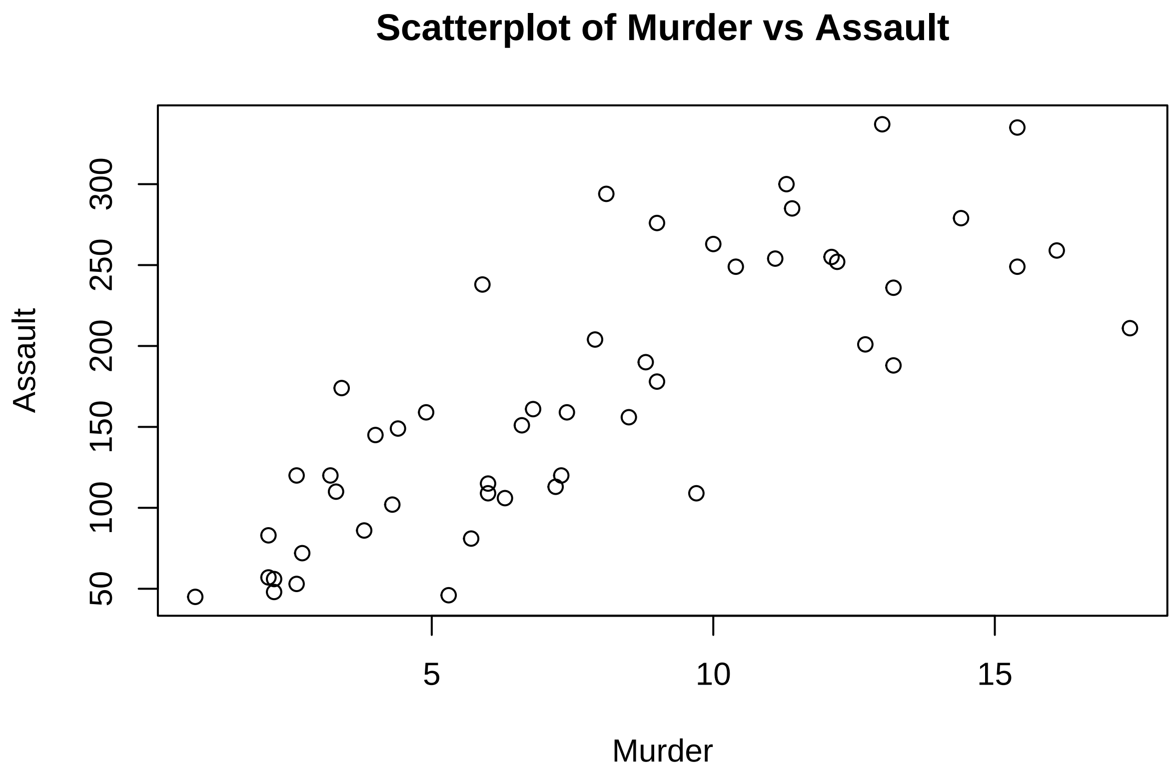
```r
# Enter your code here!
data("USArrests")
head(USArrests)
```

```
##            Murder Assault UrbanPop Rape
## Alabama      13.2     236       58 21.2
## Alaska       10.0     263       48 44.5
## Arizona       8.1     294       80 31.0
## Arkansas      8.8     190       50 19.5
## California    9.0     276       91 40.6
## Colorado      7.9     204       78 38.7
```

```r
pairs(USArrests, main="Pairs Plot for US Arrests Data")
```




```r
plot(USArrests$Murder, USArrests$Assault,
     main="Scatterplot of Murder vs Assault",
     xlab="Murder", ylab="Assault")
```




Result:

=> Report a paragraph to summarize your findings from the plot! The pairs plot and scatter plot indicate a strong positive correlation between Murder and Assault rates. States with higher murder rates also have higher assault rates. There also appears to be moderate positive correlations between these two crime variables and urban population.

---

**Question 3**

Download the housing data set from www.jaredlander.com and find out what explains the housing prices in New York City.

Note: Check your working directory to make sure that you can download the data into the data folder.

a. Create your own descriptive statistics and aggregation tables to summarize the data set and find any meaningful results between different variables in the data set.

```
# Head of the cleaned data set
head(housingData)
```

```
##   Neighborhood Market.Value.per.SqFt      Boro Year.Built
## 1    FINANCIAL                200.00 Manhattan       1920
## 2    FINANCIAL                242.76 Manhattan       1985
```

```
## 4    FINANCIAL                 271.23 Manhattan       1930
## 5      TRIBECA                 247.48 Manhattan       1985
## 6      TRIBECA                 191.37 Manhattan       1986
## 7      TRIBECA                 211.53 Manhattan       1985
```

```r
# Enter your code here!
aggregate(Market.Value.per.SqFt ~ Boro, data=housingData, mean)
```

```
##            Boro Market.Value.per.SqFt
## 1         Bronx              47.93232
## 2      Brooklyn              80.13439
## 3     Manhattan             180.59265
## 4        Queens              77.38137
## 5 Staten Island              41.26958
```

```r
aggregate(Market.Value.per.SqFt ~ Neighborhood, data=housingData, mean)
```

```
##                 Neighborhood Market.Value.per.SqFt
## 1              ALPHABET CITY             148.35500
## 2       ARROCHAR-SHORE ACRES              57.75000
## 3                    ASTORIA              91.48167
## 4                 BATH BEACH              70.34000
## 5                  BAY RIDGE              68.03500
## 6                    BAYSIDE              71.42111
## 7       BEDFORD PARK/NORWOOD              38.24500
## 8         BEDFORD STUYVESANT              83.24172
## 9                    BELMONT              56.45000
## 10               BENSONHURST              71.70429
## 11              BERGEN BEACH              73.27000
## 12               BOERUM HILL              96.57600
## 13              BOROUGH PARK              64.10857
## 14                 BRIARWOOD              75.36250
## 15            BRIGHTON BEACH              81.91429
## 16             BRONX-UNKNOWN              32.06500
## 17                 BRONXDALE              28.94333
## 18          BROOKLYN HEIGHTS             114.11778
## 19             BUSH TERMINAL              60.95000
## 20                  BUSHWICK              76.13500
## 21                  CANARSIE              46.58000
## 22           CARROLL GARDENS              93.40556
## 23                   CHELSEA             215.94932
## 24                 CHINATOWN             154.17952
## 25               CITY ISLAND              40.83000
## 26              CIVIC CENTER             174.06696
## 27                   CLINTON             176.70032
## 28              CLINTON HILL              88.97385
## 29               COBBLE HILL             120.69800
## 30          COBBLE HILL-WEST              85.71125
## 31             COLLEGE POINT              65.05000
## 32              CONEY ISLAND              55.05750
## 33                    CORONA              94.20706
## 34            CROWN HEIGHTS              64.26286
## 35      DOWNTOWN-FULTON FERRY            103.26857
```

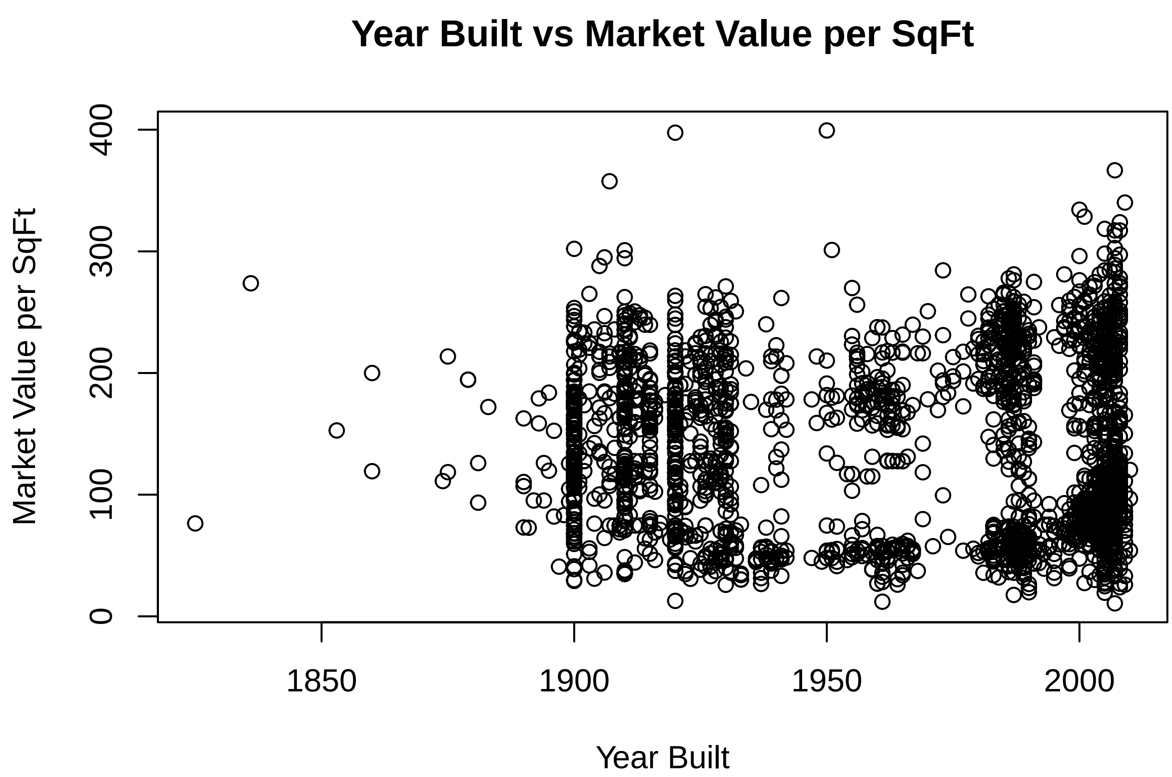
```
## 36        DOWNTOWN-FULTON MALL              132.42500
## 37          DOWNTOWN-METROTECH              122.48000
## 38               DYKER HEIGHTS               68.36000
## 39               EAST NEW YORK               36.99167
## 40                EAST TREMONT               72.33333
## 41                EAST VILLAGE              207.46115
## 42                    ELMHURST               69.80564
## 43                FAR ROCKAWAY               74.88500
## 44                     FASHION              194.81067
## 45                   FINANCIAL              199.30917
## 46            FLATBUSH-CENTRAL               65.71167
## 47   FLATBUSH-LEFFERTS GARDEN               46.27000
## 48              FLATBUSH-NORTH               54.00000
## 49                    FLATIRON              223.30311
## 50        FLUSHING MEADOW PARK               58.59000
## 51              FLUSHING-NORTH               80.16992
## 52              FLUSHING-SOUTH               89.62750
## 53                FOREST HILLS               70.20706
## 54                 FORT GREENE               81.76900
## 55                    GLENDALE               57.39667
## 56                     GOWANUS               82.45333
## 57                    GRAMERCY              188.68471
## 58                  GRANT CITY               47.60000
## 59                   GRAVESEND               75.63526
## 60                 GREAT KILLS               33.74000
## 61                  GREENPOINT               86.18053
## 62  GREENWICH VILLAGE-CENTRAL              142.57767
## 63     GREENWICH VILLAGE-WEST              202.13667
## 64                 GRYMES HILL               50.09000
## 65                     HAMMELS              139.07200
## 66              HARLEM-CENTRAL              102.79106
## 67                 HARLEM-EAST              139.93972
## 68                HARLEM-UPPER               79.25667
## 69                 HARLEM-WEST               95.20500
## 70  HIGHBRIDGE/MORRIS HEIGHTS               61.82000
## 71                   HILLCREST               53.95000
## 72                      HOLLIS              109.56000
## 73                HOWARD BEACH               55.06000
## 74                      INWOOD               62.05500
## 75             JACKSON HEIGHTS               47.79238
## 76                     JAMAICA              104.76600
## 77             JAMAICA ESTATES               79.69500
## 78               JAVITS CENTER              125.09000
## 79                  KENSINGTON               56.87500
## 80                 KEW GARDENS               69.64300
## 81   KINGSBRIDGE HTS/UNIV HTS               23.86000
## 82    KINGSBRIDGE/JEROME PARK               58.37800
## 83                    KIPS BAY              191.31769
## 84                LITTLE ITALY              142.52308
## 85                 LITTLE NECK               65.85000
## 86            LONG ISLAND CITY              108.16667
## 87             LOWER EAST SIDE              173.56262
## 88                     MADISON               71.26000
## 89            MANHATTAN VALLEY              111.30043
```

```
## 90                    MASPETH                  53.32750
## 91             MIDDLE VILLAGE                  78.35857
## 92                MIDTOWN CBD                 234.36154
## 93               MIDTOWN EAST                 211.04750
## 94               MIDTOWN WEST                 222.06489
## 95                    MIDWOOD                  79.50273
## 96        MORNINGSIDE HEIGHTS                  74.63000
## 97        MORRIS PARK/VAN NEST                 26.90000
## 98        MORRISANIA/LONGWOOD                  44.21250
## 99     MOTT HAVEN/PORT MORRIS                  30.96000
## 100               MURRAY HILL                 206.26795
## 101              NEW BRIGHTON                  41.47667
## 102    NEW BRIGHTON-ST. GEORGE                 41.06000
## 103           NEW SPRINGVILLE                  40.47000
## 104           OAKLAND GARDENS                  66.94000
## 105                OCEAN HILL                  37.92900
## 106       OCEAN PARKWAY-NORTH                  76.51111
## 107       OCEAN PARKWAY-SOUTH                  75.08000
## 108                OZONE PARK                  54.10000
## 109                PARK SLOPE                  88.01774
## 110          PARK SLOPE SOUTH                  95.84200
## 111               PARKCHESTER                  32.67500
## 112        PELHAM PARKWAY SOUTH                30.55000
## 113          PROSPECT HEIGHTS                  79.16200
## 114                 REGO PARK                  62.13630
## 115                 RIDGEWOOD                  64.28667
## 116                 RIVERDALE                  57.10176
## 117             ROCKAWAY PARK                  88.13600
## 118  SCHUYLERVILLE/PELHAM BAY                  49.68000
## 119            SHEEPSHEAD BAY                  79.79704
## 120               SILVER LAKE                  35.80500
## 121                      SOHO                 162.72473
## 122                 SOUNDVIEW                  43.40333
## 123          SOUTH OZONE PARK                  40.78000
## 124               SOUTHBRIDGE                 159.53333
## 125                 SUNNYSIDE                  61.61818
## 126               SUNSET PARK                  80.58348
## 127               THROGS NECK                  53.70667
## 128             TOMPKINSVILLE                  35.81000
## 129                   TRIBECA                 180.18473
## 130    UPPER EAST SIDE (59-79)                216.83715
## 131    UPPER EAST SIDE (79-96)                202.45179
## 132   UPPER EAST SIDE (96-110)                167.41600
## 133    UPPER WEST SIDE (59-79)                200.24391
## 134    UPPER WEST SIDE (79-96)                171.84515
## 135   UPPER WEST SIDE (96-116)                134.09353
## 136  WASHINGTON HEIGHTS LOWER                  65.29600
## 137  WASHINGTON HEIGHTS UPPER                  93.50833
## 138         WEST NEW BRIGHTON                  39.69000
## 139                WHITESTONE                  72.90000
## 140            WILLIAMSBRIDGE                  42.46000
## 141      WILLIAMSBURG-CENTRAL                  79.97017
## 142         WILLIAMSBURG-EAST                  84.32605
## 143        WILLIAMSBURG-NORTH                  84.10577
```

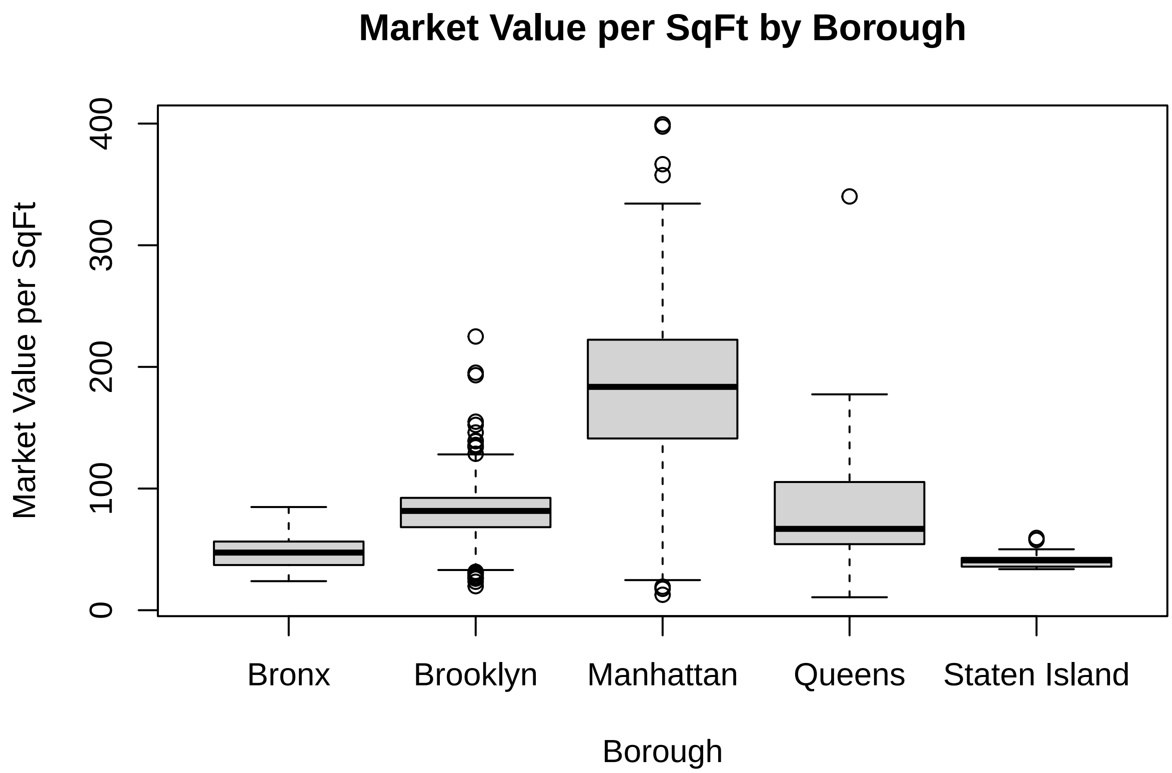
```
## 144        WILLIAMSBURG-SOUTH                82.27618
## 145           WINDSOR TERRACE                70.21200
## 146                 WOODHAVEN                38.61000
## 147                  WOODSIDE                80.52625
## 148           WYCKOFF HEIGHTS                84.93000
```

b. Create multiple plots to demonstrates the correlations between different variables. Remember to label all axes and give title to each graph.

```r
# Enter your code here!
plot(housingData$Year.Built, housingData$Market.Value.per.SqFt,
     main="Year Built vs Market Value per SqFt",
     xlab="Year Built", ylab="Market Value per SqFt")
```




```r
boxplot(Market.Value.per.SqFt ~ Boro, data=housingData,
        main="Market Value per SqFt by Borough",
        xlab="Borough", ylab="Market Value per SqFt")
```




c. Write a summary about your findings from this exercise.

=> Enter your answer here! The analysis reveals a clear relationship between housing characteristics and market values in New York City. Properties built more recently generally command higher prices per square foot, suggesting a preference for newer construction. Additionally, location significantly affects property values, with Manhattan showing notably higher values compared to other boroughs, reflecting strong demand and economic status differences. Neighborhood-level analysis further emphasizes these variations, highlighting socioeconomic diversity and differential housing demand across the city.