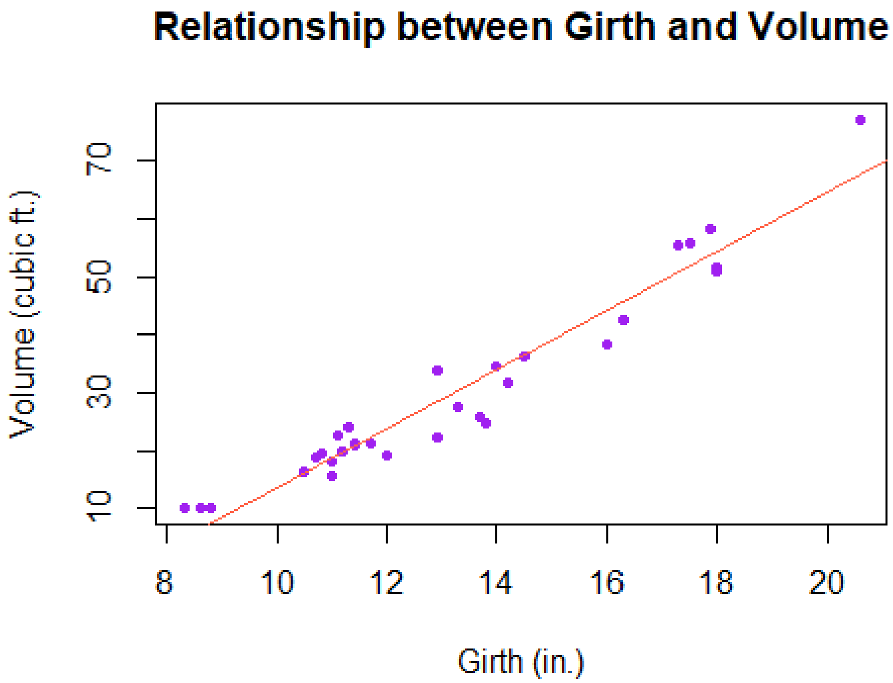
ALY 6015 M1 Report - Thota, Sunil Raj.R

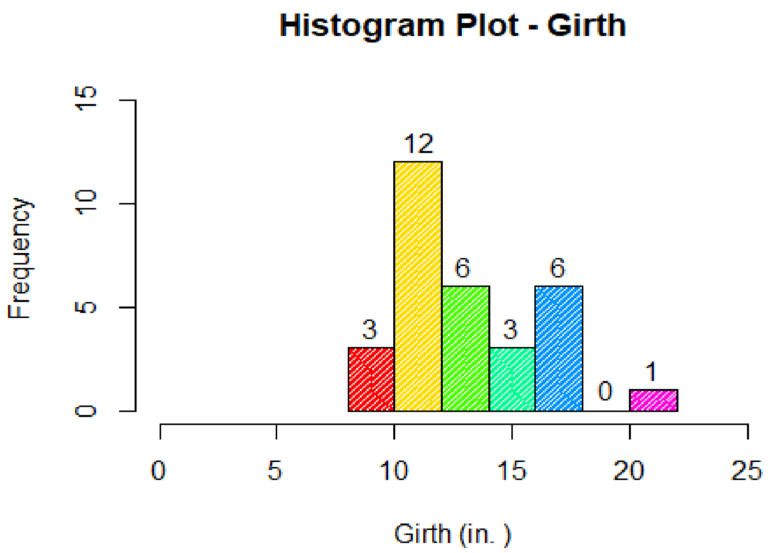
```
# Intermediate Analytics
# ALY 6015
# Module 1 - Descriptive Statistics and Regression Analysis with R
# 01/21/2021
# Sunil Raj Thota
# NUID: 001099670

# Get and set the working directories
getwd()

## [1] "G:/NEU/Coursework/2021 Q1 Winter/ALY 6015 IA/Discussions &
Assignments"

setwd('G:/NEU/Coursework/2021 Q1 Winter/ALY 6015 IA/Discussions &
Assignments')
getwd()

## [1] "G:/NEU/Coursework/2021 Q1 Winter/ALY 6015 IA/Discussions &
Assignments"

# Installed the above packages into the workspace
install.packages("datasets")
install.packages("plyr")
install.packages("dplyr")
install.packages("tidyr")
install.packages("tidyverse")
install.packages("ggplot2")
install.packages("ggcorrplot")
install.packages("e1071")
install.packages("DAAG")
install.packages("MASS")
install.packages("GGally")

# Loaded the below libraries into the workspace
library(plyr)
library(dplyr)
library(tidyr)
library(tidyverse)
library(ggplot2)
library(e1071)
library(MASS)
library(DAAG)
library(ggcorrplot)
library(GGally)
require(grDevices)
require(datasets)
```

```
# Part A

data(trees) # Load the Trees Data set into the Environment
View(trees) # To View the Trees Data set
str(trees) # To observe the structure of the Data set

## 'data.frame':    31 obs. of  3 variables:
##  $ Girth : num  8.3 8.6 8.8 10.5 10.7 10.8 11 11 11.1 11.2 ...
##  $ Height: num  70 65 63 72 81 83 66 75 80 75 ...
##  $ Volume: num  10.3 10.3 10.2 16.4 18.8 19.7 15.6 18.2 22.6 19.9 ...

head(trees) # It shows first few rows in the Data set

##   Girth Height Volume
## 1   8.3     70   10.3
## 2   8.6     65   10.3
## 3   8.8     63   10.2
## 4  10.5     72   16.4
## 5  10.7     81   18.8
## 6  10.8     83   19.7

summary(trees) # Provides the Descriptive Stats of the Trees Data set

##      Girth           Height       Volume
##  Min.   : 8.30   Min.   :63   Min.   :10.20
##  1st Qu.:11.05   1st Qu.:72   1st Qu.:19.40
##  Median :12.90   Median :76   Median :24.20
##  Mean   :13.25   Mean   :76   Mean   :30.17
##  3rd Qu.:15.25   3rd Qu.:80   3rd Qu.:37.30
##  Max.   :20.60   Max.   :87   Max.   :77.00

cor(trees) # Shows the Correlation of the 3 variables in the Trees Data set

##            Girth    Height    Volume
## Girth  1.0000000 0.5192801 0.9671194
## Height 0.5192801 1.0000000 0.5982497
## Volume 0.9671194 0.5982497 1.0000000

plot(
  x = trees$Girth,
  y = trees$Volume,
  xlab = "Girth (in.)",
  ylab = "Volume (cubic ft.)",
  main = "Relationship between Girth and Volume",
  col = "purple",
  pch = 20,
  xlim = c(min(trees$Girth), max(trees$Girth)),
  ylim = c(min(trees$Volume), max(trees$Volume))
) # Scatter Plot is used to depict the relationship between the Girth and
Volume
lm(Volume ~ Girth, data = trees) # Linear Model between the Volume and Girth
```

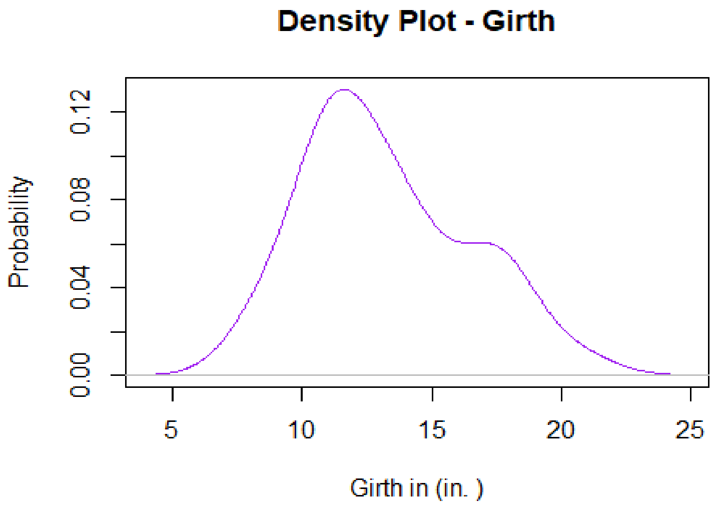
```
##
## Call:
## lm(formula = Volume ~ Girth, data = trees)
##
## Coefficients:
## (Intercept)        Girth
##     -36.943        5.066

abline(lm(Volume ~ Girth, data = trees), col = "tomato") # To observe the
Regression Line
```



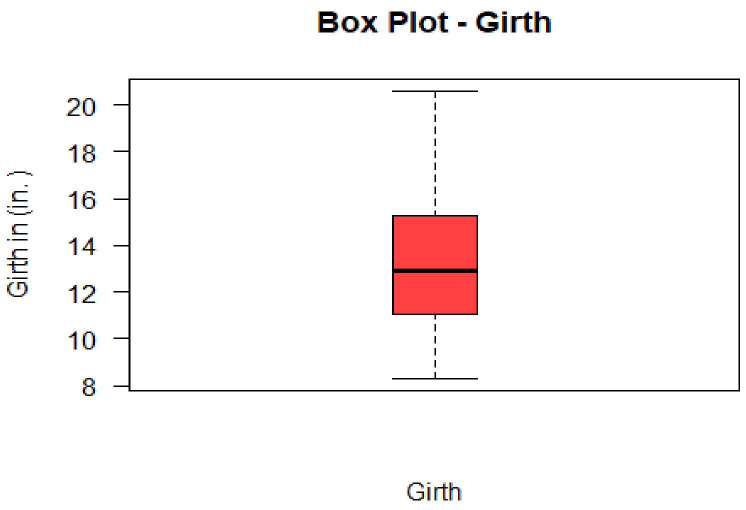
```
hist(
  trees$Girth,
  main = "Histogram Plot - Girth",
  xlab = "Girth (in. )",
  ylab = "Frequency ",
  border = "black",
  labels = TRUE,
  xlim = c(0, 25),
  ylim = c(0, 15),
  col = rainbow(7),
  density = 100
) # Histogram Plot is used to show case the Frequency Distribution of the
Girth
```



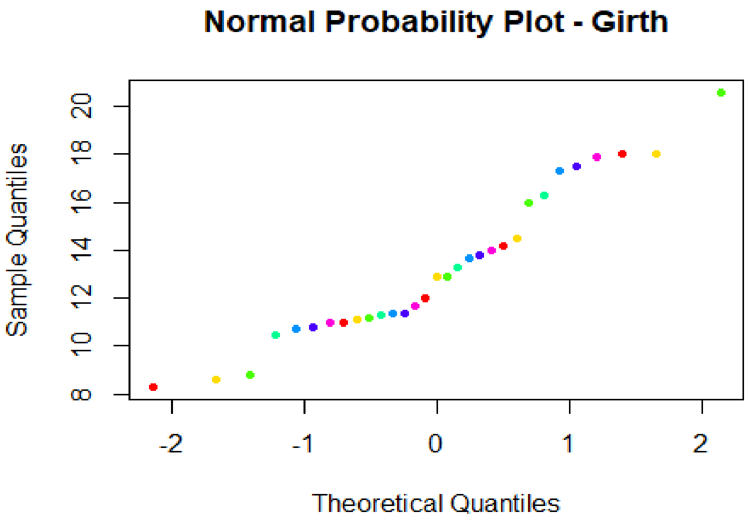
```
plot(
  density(trees$Girth),
  main = "Density Plot - Girth",
  xlab = "Girth in (in. )",
  ylab = "Probability",
  col = "purple"
) # Density Plot is used to show case the Probability Distribution of the
Girth
```



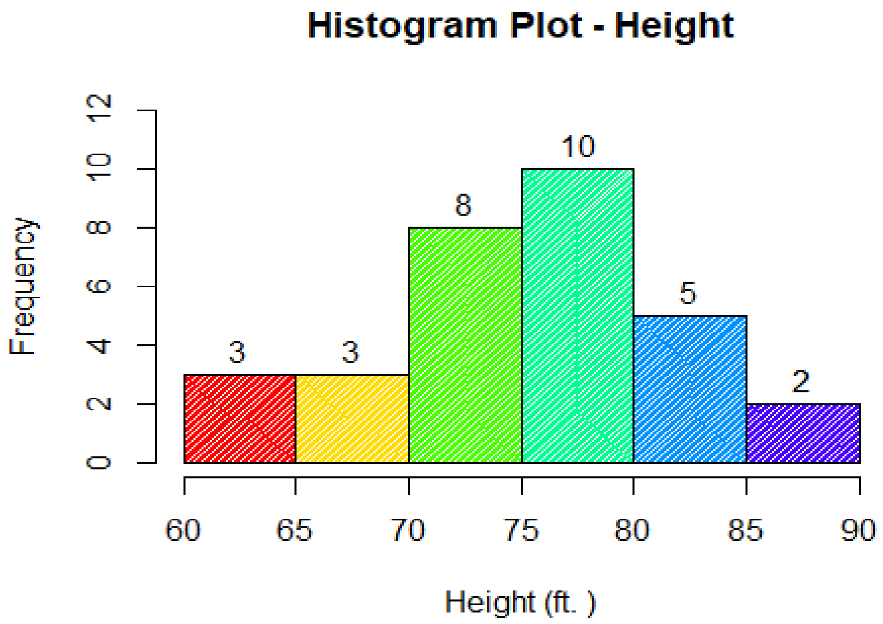
```
boxplot(
  trees$Girth,
  main = "Box Plot - Girth",
  ylab = "Girth in (in. )",
  xlab = "Girth",
  col = "brown1",
  boxwex = 0.3,
  outline = TRUE,
  outpch = 16,
  outcol = "seagreen3",
  las = 1,
  notch = FALSE,
  staplewex = 1
) # Box Plot is used to determine the Quartiles of the Girth
```



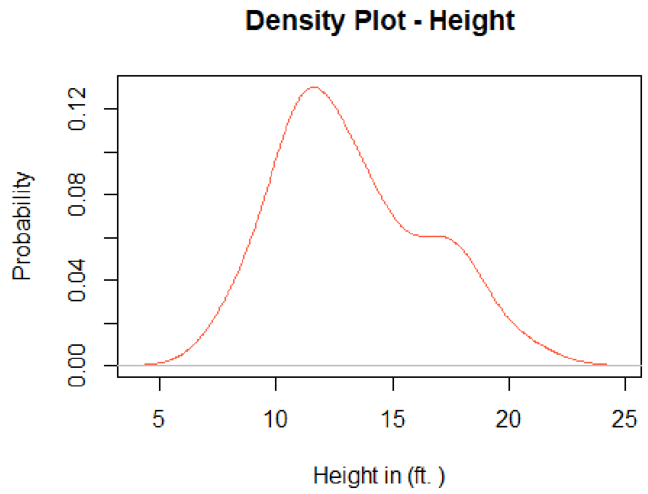
```
qqnorm(trees$Girth,
       main = "Normal Probability Plot - Girth",
       col = rainbow(7),
       pch = 20) # Normal Probability Plot of the Girth
```



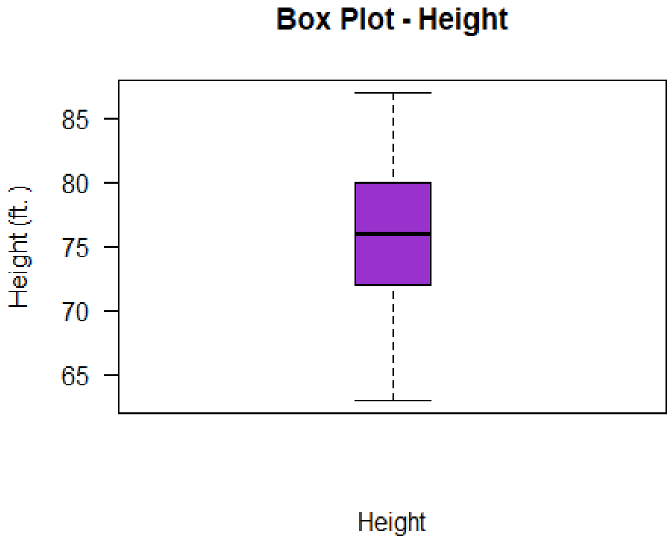
```
skewness(trees$Girth) # Skewness measures the relative size of the Girth

## [1] 0.5010559

kurtosis(trees$Girth) # Kurtosis measures the amount of Prob. in the Girth

## [1] -0.7109412

hist(
  trees$Height,
  main = "Histogram Plot - Height",
  xlab = "Height (ft. )",
  ylab = "Frequency",
  border = "black",
  labels = TRUE,
  xlim = c(60, 90),
  ylim = c(0, 12),
  col = rainbow(7),
  density = 100,
) # Histogram Plot is used to show case the Frequency Distribution of the
Height
```



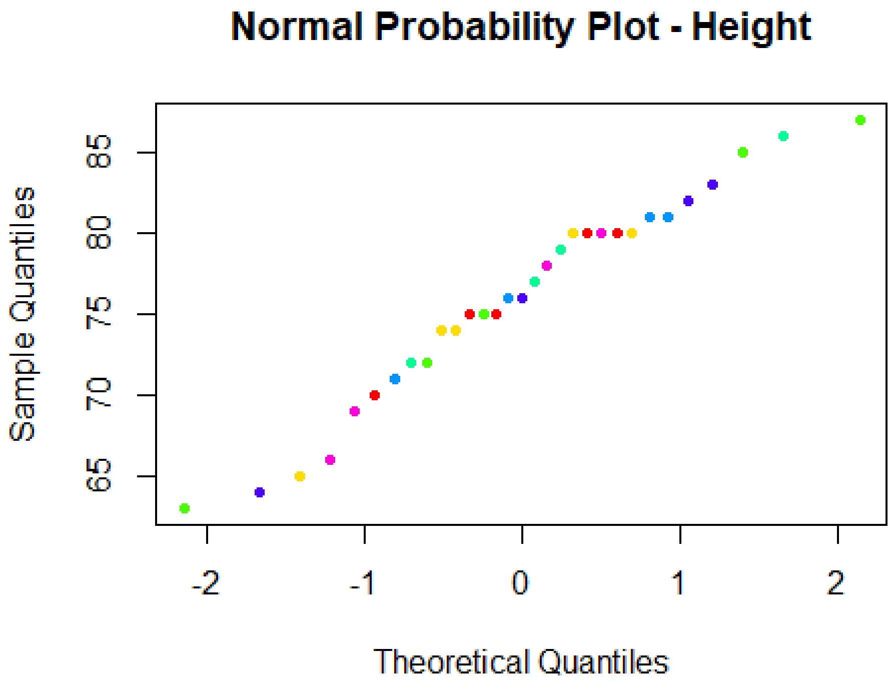
```
plot(
  density(trees$Girth),
  main = "Density Plot - Height",
  xlab = "Height in (ft. )",
  ylab = "Probability",
  col = "tomato"
) # Density Plot is used to show case the Probability Distribution of the
Height
```



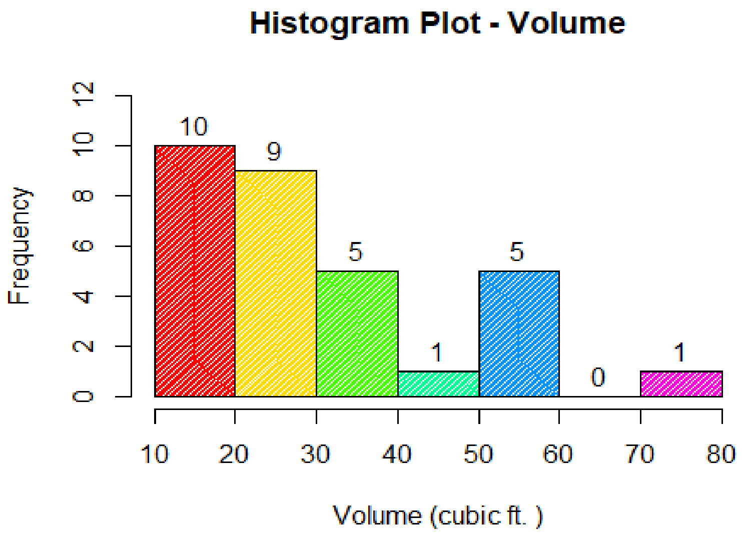
```
boxplot(
  trees$Height,
  main = "Box Plot - Height",
  ylab = "Height (ft. )",
  xlab = "Height",
  col = "darkorchid",
  boxwex = 0.3,
  outline = TRUE,
  outpch = 16,
  outcol = "seagreen3",
  las = 1,
  notch = FALSE,
  staplewex = 1
) # Box Plot is used to determine the Quartiles of the Height
```



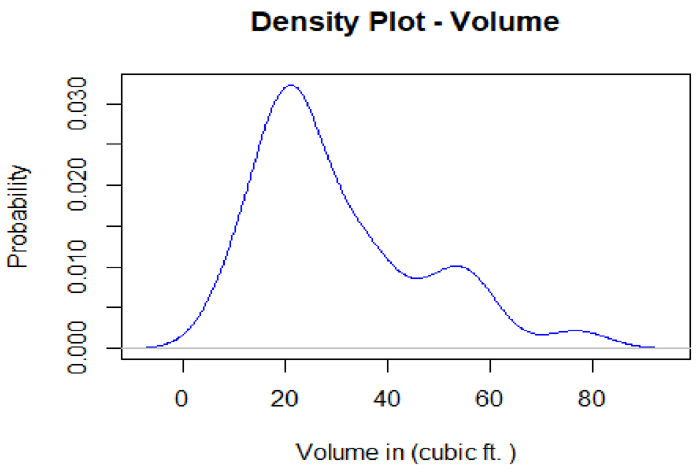
```
qqnorm(trees$Height,
       main = "Normal Probability Plot - Height",
       col = rainbow(7),
       pch = 20) # Normal Probability Plot of the Height
```



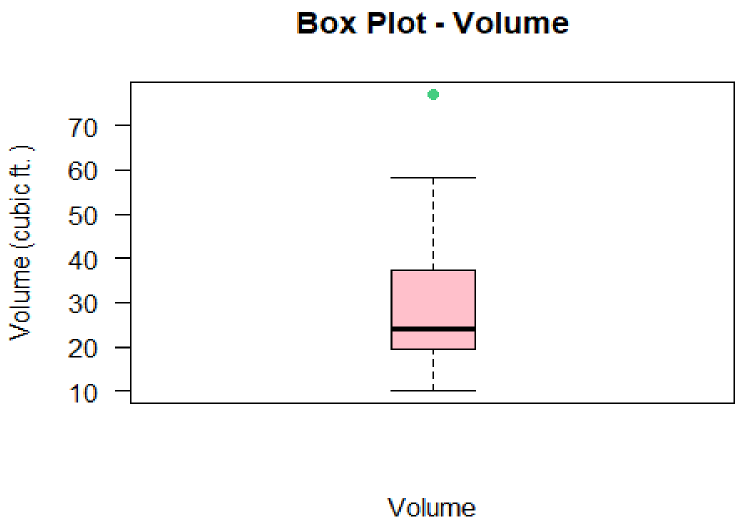
```
skewness(trees$Height) # Skewness measures the relative size of the Height

## [1] -0.3568773

kurtosis(trees$Height) # Kurtosis measures the amount of Prob. in the Height

## [1] -0.7233677

hist(
  trees$Volume,
  main = "Histogram Plot - Volume",
  xlab = "Volume (cubic ft. )",
  ylab = "Frequency",
  border = "black",
  labels = TRUE,
  xlim = c(10, 80),
  ylim = c(0, 12),
  col = rainbow(7),
  density = 100,
) # Histogram Plot is used to show case the Frequency Distribution of the
Volume
```



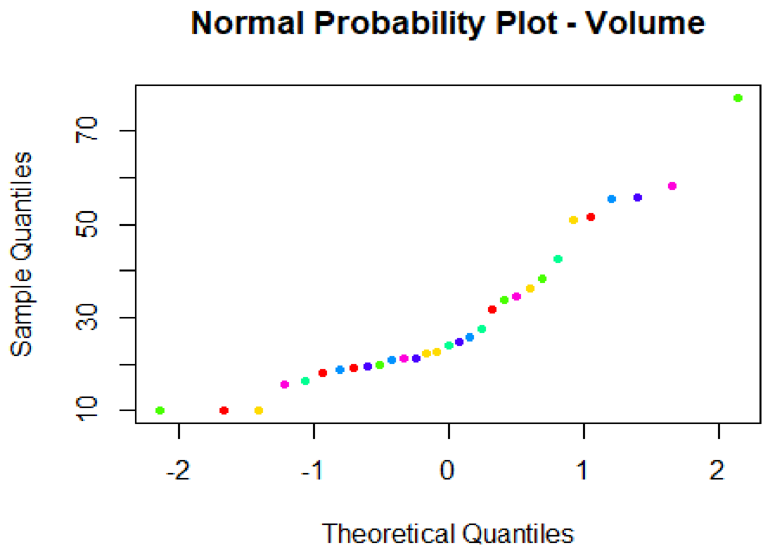
```
plot(
  density(trees$Volume),
  main = "Density Plot - Volume",
  xlab = "Volume in (cubic ft. )",
  ylab = "Probability",
  col = "blue"
) # Density Plot is used to show case the Probability Distribution of the
Volume
```



```
boxplot(
  trees$Volume,
  main = "Box Plot - Volume",
  ylab = "Volume (cubic ft. )",
  xlab = "Volume",
  col = "pink",
  boxwex = 0.3,
  outline = TRUE,
  outpch = 16,
  outcol = "seagreen3",
  las = 1,
  notch = FALSE,
  staplewex = 1
) # Box Plot is used to determine the Quartiles of the Volume
```



```
qqnorm(trees$Volume,
       main = "Normal Probability Plot - Volume",
       col = rainbow(7),
       pch = 20) # Normal Probability Plot of the Volume
```



```
skewness(trees$Volume) # Skewness measures the relative size of the Volume

## [1] 1.013274

kurtosis(trees$Volume) # Kurtosis measures the amount of Prob. in the Volume

## [1] 0.2460393

# Part B

data(Rubber) # Load the Rubber Data set into the Environment
View(Rubber) # To View the Rubber Data set
str(Rubber) # To observe the structure of the Data set

## 'data.frame':    30 obs. of  3 variables:
##  $ loss: int  372 206 175 154 136 112 55 45 221 166 ...
##  $ hard: int  45 55 61 66 71 71 81 86 53 60 ...
##  $ tens: int  162 233 232 231 231 237 224 219 203 189 ...

head(Rubber) # It shows first few rows in the Data set

##   loss hard tens
## 1  372   45  162
## 2  206   55  233
## 3  175   61  232
## 4  154   66  231
## 5  136   71  231
## 6  112   71  237

summary(Rubber) # Provides the Descriptive Stats of the Rubber Data set

##       loss            hard            tens      
##  Min.   : 32.0   Min.   :45.00   Min.   :119.0  
##  1st Qu.:113.2   1st Qu.:60.25   1st Qu.:151.0  
##  Median :165.0   Median :71.00   Median :176.5  
##  Mean   :175.4   Mean   :70.27   Mean   :180.5  
##  3rd Qu.:220.5   3rd Qu.:81.00   3rd Qu.:210.0  
##  Max.   :372.0   Max.   :89.00   Max.   :237.0  

log(Rubber) # Log computes Logarithms of the Rubber Data set

##        loss     hard     tens
## 1  5.918894 3.806662 5.087596
## 2  5.327876 4.007333 5.451038
## 3  5.164786 4.110874 5.446737
## 4  5.036953 4.189655 5.442418
## 5  4.912655 4.262680 5.442418
## 6  4.718499 4.262680 5.468060
## 7  4.007333 4.394449 5.411646
## 8  3.806662 4.454347 5.389072
## 9  5.398163 3.970292 5.313206
## 10 5.111988 4.094345 5.241747
## 11 5.099866 4.158883 5.347108
## 12 4.727388 4.219508 5.347108
## 13 4.406719 4.369448 5.278115
## 14 3.465736 4.394449 5.192957
## 15 5.429346 4.025352 5.298317
## 16 5.278115 4.219508 5.153292
## 17 4.852030 4.317488 5.236442
## 18 4.574711 4.418841 5.081404
## 19 4.158883 4.477337 4.779123
## 20 5.517453 4.077537 5.081404
## 21 5.389072 4.262680 5.017280
## 22 5.225747 4.382027 5.105945
## 23 5.043425 4.406719 5.017280
## 24 4.736198 4.488636 4.852030
## 25 5.831882 3.931826 5.081404
## 26 5.828946 4.077537 4.983607
## 27 5.645447 4.174387 4.997212
## 28 5.587249 4.304065 4.969813
## 29 5.370638 4.394449 4.897840
## 30 4.997212 4.454347 4.844187
```

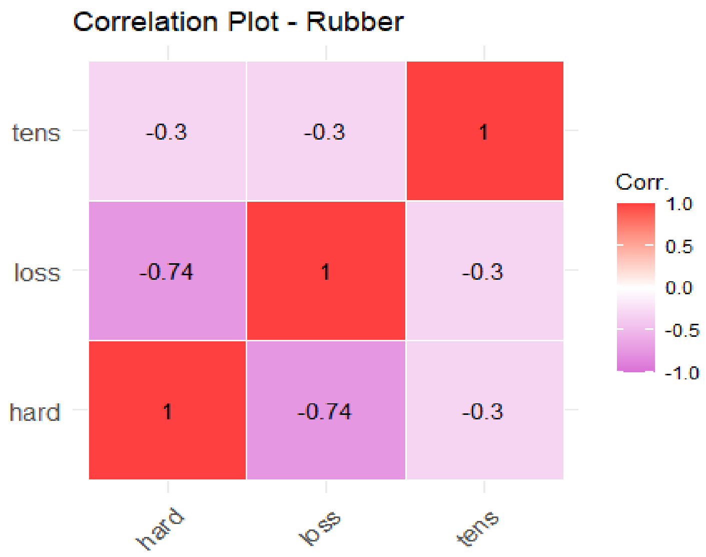
```
regRubber <-
  lm(loss ~ hard + tens, data = Rubber) # Linear Model between the Loss and
all others
regRubber
```

```
##
## Call:
## lm(formula = loss ~ hard + tens, data = Rubber)
##
## Coefficients:
## (Intercept)         hard         tens
##     885.161       -6.571       -1.374
```

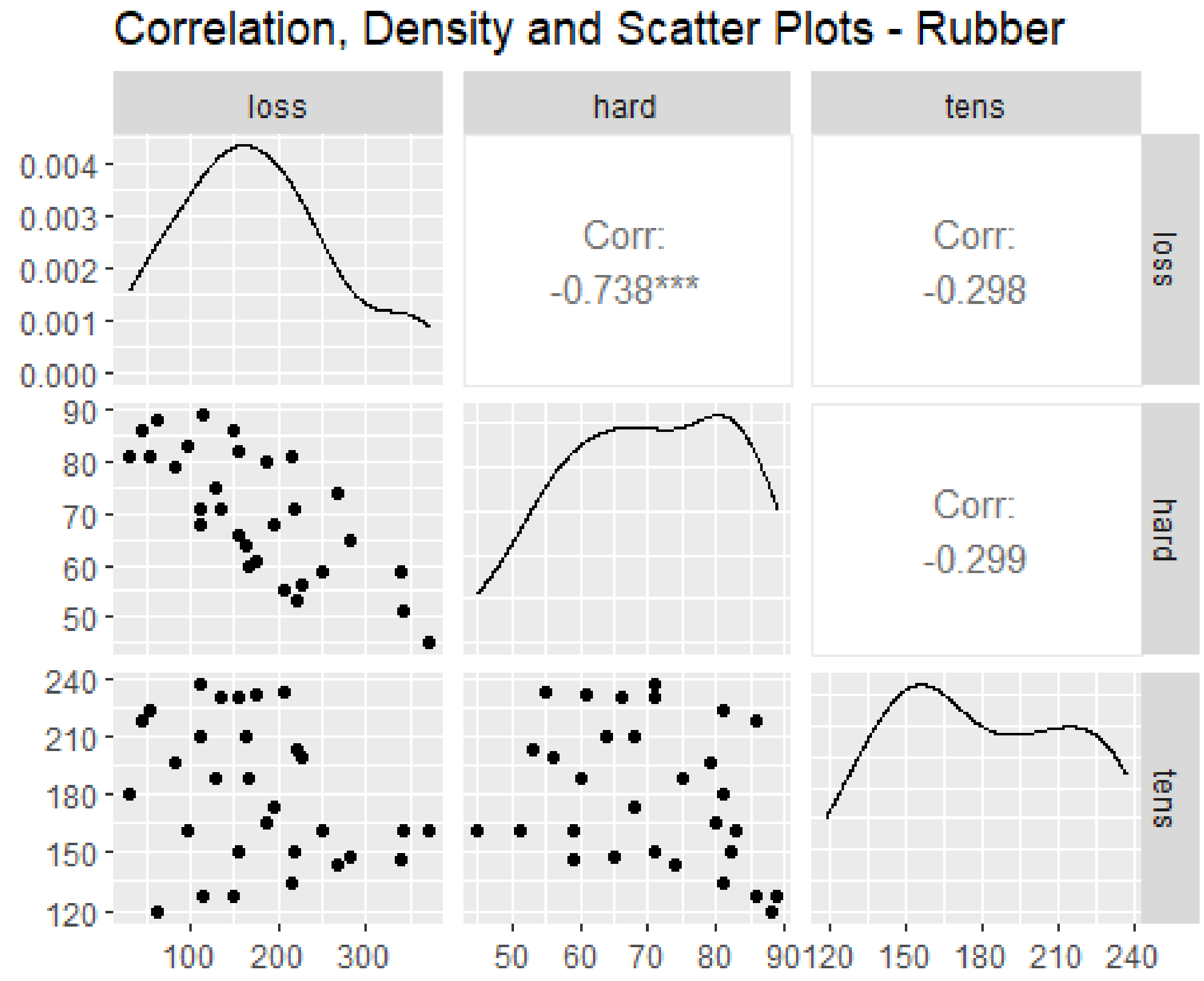
```
summary(regRubber) # Provides the Descriptive Stats of the Linear Model
```

```
##
## Call:
## lm(formula = loss ~ hard + tens, data = Rubber)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -79.385 -14.608   3.816  19.755  65.981
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 885.1611    61.7516  14.334 3.84e-14 ***
## hard         -6.5708     0.5832 -11.267 1.03e-11 ***
## tens         -1.3743     0.1943  -7.073 1.32e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 36.49 on 27 degrees of freedom
## Multiple R-squared:  0.8402, Adjusted R-squared:  0.8284
## F-statistic:    71 on 2 and 27 DF,  p-value: 1.767e-11

corrRubber <-
  cor(Rubber) # Shows the Correlation of the 3 variables in the Rubber Data
set

ggcorrplot(
  corrRubber,
  ggtheme = ggplot2::theme_minimal,
  title = "Correlation Plot - Rubber",
  hc.order = TRUE,
  colors = c("orchid", "white", "brown1"),
  outline.col = "white",
  lab = TRUE,
  method = "square",
  show.legend = TRUE,
  legend.title = "Corr.",
  lab_col = "black",
  lab_size = 4
) # Shows the Correlation Plot of the 3 variables in the Rubber Data set
```



```
ggpairs(
  Rubber,
  mapping = NULL,
  columns = 1:ncol(Rubber),
  title = "Correlation, Density and Scatter Plots - Rubber",
  upper = list(continuous = "cor"),
  lower = list(continuous = "points"),
  diag = list(continuous = "densityDiag"),
  axisLabels = c("show", "internal", "none"),
) # Shows the Correlation, Density, and Scatter Plots of the 3 variables in
the Rubber Data set
```



```
data(oddbooks) # Load the Odd Books Data set into the Environment
View(oddbooks) # To View the Odd Books Data set
str(oddbooks) # To observe the structure of the Data set

## 'data.frame':    12 obs. of  4 variables:
##  $ thick  : int  14 15 18 23 24 25 28 28 29 30 ...
##  $ height : num  30.5 29.1 27.5 23.2 21.6 23.5 19.7 19.8 17.3 22.8 ...
##  $ breadth: num  23 20.5 18.5 15.2 14 15.5 12.6 12.6 10.5 15.4 ...
##  $ weight : int  1075 940 625 400 550 600 450 450 300 690 ...

head(oddbooks) # It shows first few rows in the Data set

##   thick height breadth weight
## 1    14   30.5    23.0   1075
## 2    15   29.1    20.5    940
## 3    18   27.5    18.5    625
## 4    23   23.2    15.2    400
## 5    24   21.6    14.0    550
## 6    25   23.5    15.5    600
```

```
summary(oddbooks) # Provides the Descriptive Stats of the Odd Books Data set
```

```
##      thick           height         breadth          weight
##  Min.   :14.00   Min.   :13.50   Min.   : 9.20   Min.   : 250.0
##  1st Qu.:21.75   1st Qu.:19.23   1st Qu.:12.20   1st Qu.: 400.0
##  Median :26.50   Median :22.20   Median :14.60   Median : 500.0
##  Mean   :26.17   Mean   :22.19   Mean   :14.83   Mean   : 560.8
##  3rd Qu.:29.25   3rd Qu.:24.50   3rd Qu.:16.25   3rd Qu.: 641.2
##  Max.   :44.00   Max.   :30.50   Max.   :23.00   Max.   :1075.0
```

```
logOddBooks <-
  log(oddbooks) # Log computes logarithms of the Odd Books Data set
logOddBooks
```

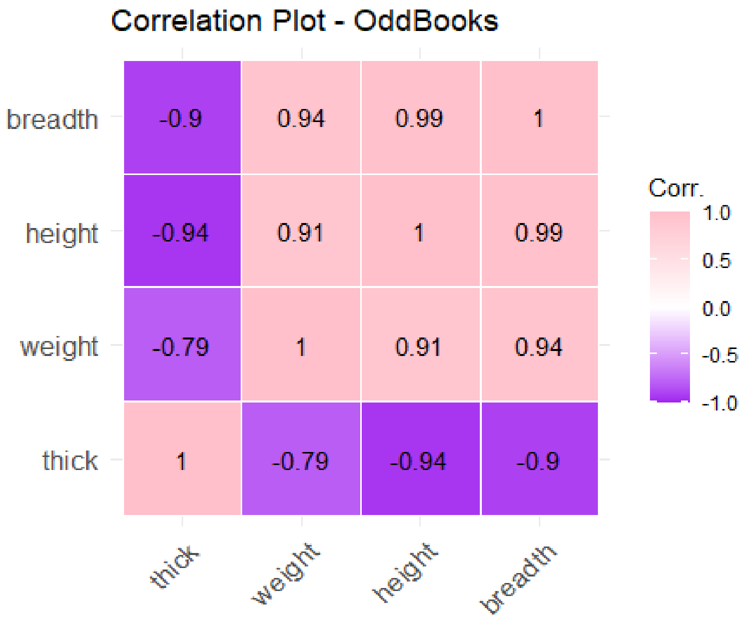
```
##       thick   height  breadth   weight
## 1  2.639057 3.417727 3.135494 6.980076
## 2  2.708050 3.370738 3.020425 6.845880
## 3  2.890372 3.314186 2.917771 6.437752
## 4  3.135494 3.144152 2.721295 5.991465
## 5  3.178054 3.072693 2.639057 6.309918
## 6  3.218876 3.157000 2.740840 6.396930
## 7  3.332205 2.980619 2.533697 6.109248
## 8  3.332205 2.985682 2.533697 6.109248
## 9  3.367296 2.850707 2.351375 5.703782
## 10 3.401197 3.126761 2.734368 6.536692
## 11 3.583519 2.879198 2.397895 5.991465
## 12 3.784190 2.602690 2.219203 5.521461
```

```
regOddBooks <-
  lm(weight ~ thick + height + breadth, data = logOddBooks) # Linear Model
between the Weight and all others
regOddBooks
```

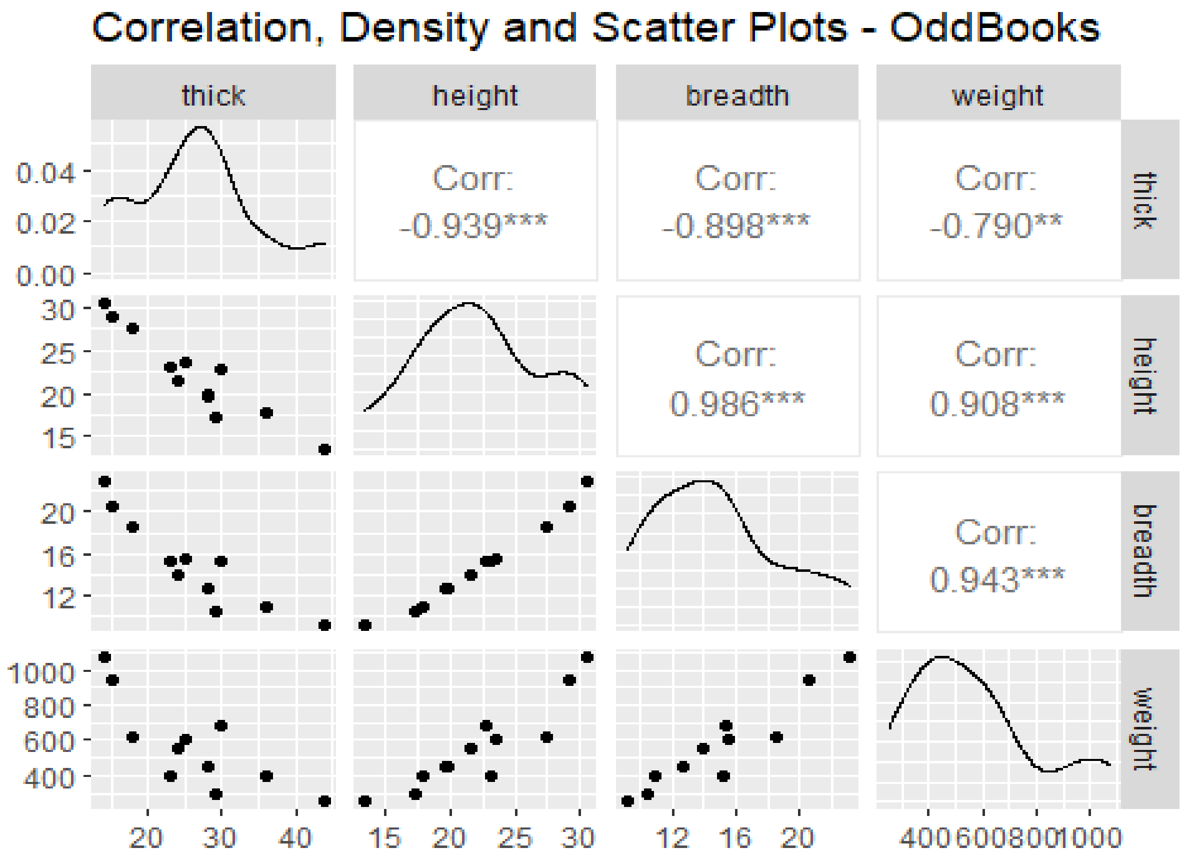
```
##
## Call:
## lm(formula = weight ~ thick + height + breadth, data = logOddBooks)
##
## Coefficients:
## (Intercept)        thick       height      breadth
##     -0.7191       0.4648       0.1537       1.8772
```

```
summary(regOddBooks) # Provides the Descriptive Stats of the Linear Model
```

```
##
## Call:
## lm(formula = weight ~ thick + height + breadth, data = logOddBooks)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.33818 -0.02858  0.06164  0.07445  0.12585
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -0.7191     3.2162  -0.224    0.829
## thick         0.4648     0.4344   1.070    0.316
## height        0.1537     1.2734   0.121    0.907
## breadth       1.8772     1.0696   1.755    0.117
##
## Residual standard error: 0.1611 on 8 degrees of freedom
## Multiple R-squared:  0.8978, Adjusted R-squared:  0.8595
## F-statistic: 23.43 on 3 and 8 DF,  p-value: 0.000257

corrOddBooks <-
  cor(oddbooks) # Shows the Correlation of the 4 variables in the Odd Books
Data set

ggcorrplot(
  corrOddBooks,
  ggtheme = ggplot2::theme_minimal,
  title = "Correlation Plot - OddBooks",
  hc.order = TRUE,
  colors = c("purple", "white", "pink"),
  outline.col = "white",
  lab = TRUE,
  method = "square",
  show.legend = TRUE,
  legend.title = "Corr.",
  lab_col = "black",
  lab_size = 4
) # Shows the Correlation Plot of the 4 variables in the Odd Books Data set
```



```
ggpairs(
  oddbooks,
  mapping = NULL,
  columns = 1:ncol(oddbooks),
  title = "Correlation, Density and Scatter Plots - OddBooks",
  upper = list(continuous = "cor"),
  lower = list(continuous = "points"),
  diag = list(continuous = "densityDiag"),
  axisLabels = c("show", "internal", "none"),
) # Shows the Correlation, Density, and Scatter Plots of the 4 variables in
the Odd Books Data set
```


Correlation, Density and Scatter Plots - OddBooks
thick
height
breadth
weight
Corr:
-0.939***
Corr:
-0.898***
Corr:
-0.790**
Corr:
0.986***
Corr:
0.908***
Corr:
0.943***
thick
height
breadth
weight