EXPERIMENT 8.1

Name : Jvn Ganesh

Roll N.o : 21BDS0085

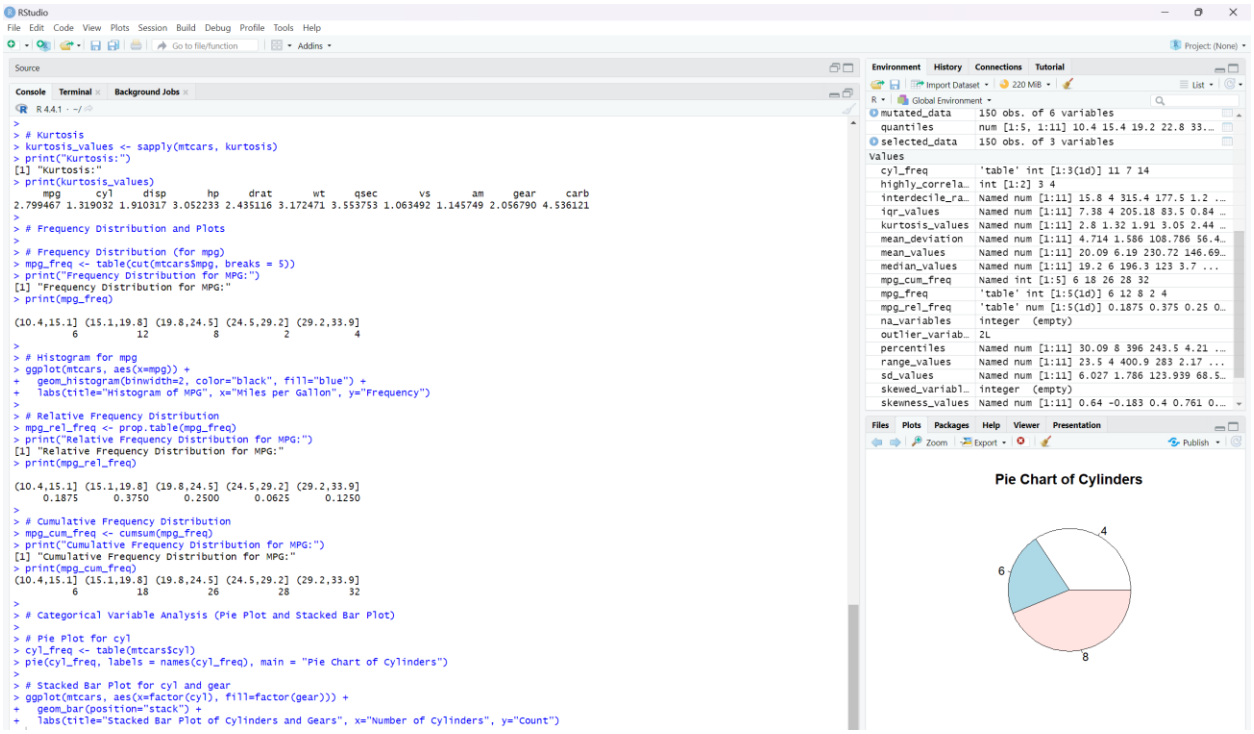
```
Console  Terminal  Background Jobs
R 4.4.1 · ~/
> library(psych)
> library(moments)
> library(ggplot2)
Learn more about the underlying theory at https://ggplot2-book.org/

Attaching package: 'ggplot2'

The following objects are masked from 'package:psych':

    %+%, alpha

>
> # Load the mtcars dataset
> data(mtcars)
> 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
>
> # Measures of Central Tendency
> print("JVNGANESH 21BDS0085")
[1] "JVNGANESH 21BDS0085"
> # Mean
> mean_values <- sapply(mtcars, mean)
> print("Mean Values:")
[1] "Mean Values:"
> print(mean_values)
       mpg        cyl       disp         hp       drat         wt       qsec         vs         am       gear       carb
 20.090625   6.187500 230.721875 146.687500   3.596563   3.217250  17.848750   0.437500   0.406250   3.687500   2.812500
>
> # Median
> median_values <- sapply(mtcars, median)
> print("Median Values:")
[1] "Median Values:"
> print(median_values)
    mpg     cyl    disp      hp    drat      wt    qsec      vs      am    gear    carb
 19.200   6.000 196.300 123.000   3.695   3.325  17.710   0.000   0.000   4.000   2.000
>
> # Quantiles (25%, 50%, 75%)
> quantiles <- apply(mtcars, 2, quantile)
> print("Quantiles (25%, 50%, 75%):")
[1] "Quantiles (25%, 50%, 75%):"
> print(quantiles)
        mpg cyl    disp    hp  drat      wt    qsec vs am gear carb
0%   10.400   4  71.100  52.0 2.760 1.51300 14.5000  0  0    3    1
25%  15.425   4 120.825  96.5 3.080 2.58125 16.8925  0  0    3    2
50%  19.200   6 196.300 123.0 3.695 3.32500 17.7100  0  0    4    2
75%  22.800   8 326.000 180.0 3.920 3.61000 18.9000  1  1    4    4
100% 33.900   8 472.000 335.0 4.930 5.42400 22.9000  1  1    5    8
```

Console | Terminal | Background Jobs

R 4.4.1 · ~/

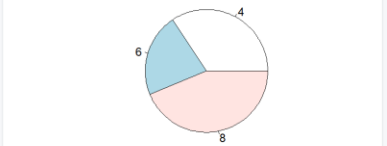
```
> # Deciles (ntile)
> deciles <- apply(mtcars, 2, function(x) quantile(x, probs = seq(0, 1, 0.1)))
> print("Deciles:")
[1] "Deciles:"
> print(deciles)
       mpg cyl   disp    hp  drat     wt   qsec vs  am gear carb
0%   10.40   4  71.10  52.0 2.760 1.5130 14.500  0 0.0    3  1.0
10%  14.34   4  80.61  66.0 3.007 1.9555 15.534  0 0.0    3  1.0
20%  15.20   4 120.14  93.4 3.072 2.3490 16.734  0 0.0    3  1.2
30%  15.98   4 142.06 106.2 3.150 2.7730 17.020  0 0.0    3  2.0
40%  17.92   6 160.00 110.0 3.354 3.1580 17.340  0 0.0    3  2.0
50%  19.20   6 196.30 123.0 3.695 3.3250 17.710  0 0.0    4  2.0
60%  21.00   8 275.80 165.0 3.818 3.4400 18.180  1 0.6    4  3.0
70%  21.47   8 303.10 178.5 3.914 3.5550 18.607  1 1.0    4  4.0
80%  24.08   8 350.80 200.0 4.048 3.7700 19.332  1 1.0    4  4.0
90%  30.09   8 396.00 243.5 4.209 4.0475 19.990  1 1.0    5  4.0
100% 33.90   8 472.00 335.0 4.930 5.4240 22.900  1 1.0    5  8.0
>
> # Percentiles (90th percentile)
> percentiles <- apply(mtcars, 2, function(x) quantile(x, probs = 0.9))
> print("90th Percentiles:")
[1] "90th Percentiles:"
> print(percentiles)
     mpg      cyl     disp       hp     drat       wt     qsec       vs       am     gear     carb
 30.0900   8.0000 396.0000 243.5000   4.2090   4.0475  19.9900   1.0000   1.0000   5.0000   4.0000
>
> # Measures of Dispersion
>
> # Range
> range_values <- sapply(mtcars, function(x) diff(range(x)))
> print("Range:")
[1] "Range:"
> print(range_values)
    mpg     cyl    disp      hp    drat      wt    qsec      vs      am    gear    carb
 23.500   4.000 400.900 283.000   2.170   3.911   8.400   1.000   1.000   2.000   7.000
>
> # Interquartile Range (IQR)
> iqr_values <- sapply(mtcars, IQR)
> print("Interquartile Range (IQR):")
[1] "Interquartile Range (IQR):"
> print(iqr_values)
      mpg       cyl      disp        hp      drat        wt      qsec        vs        am      gear      carb
  7.37500   4.00000 205.17500  83.50000   0.84000   1.02875   2.00750   1.00000   1.00000   1.00000   2.00000
>
> # Interdecile Range
> interdecile_range <- apply(mtcars, 2, function(x) quantile(x, probs = 0.9) - quantile(x, probs = 0.1))
> print("Interdecile Range:")
[1] "Interdecile Range:"
> print(interdecile_range)
    mpg     cyl    disp      hp    drat      wt    qsec      vs      am    gear    carb
 15.750   4.000 315.390 177.500   1.202   2.092   4.456   1.000   1.000   2.000   3.000
>
> # Mean Deviation
```

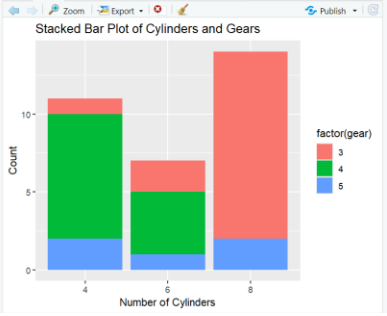
```
> print(interdecile_range)
    mpg     cyl    disp      hp    drat      wt    qsec      vs      am    gear    carb
 15.750   4.000 315.390 177.500   1.202   2.092   4.456   1.000   1.000   2.000   3.000
>
> # Mean Deviation
> mean_deviation <- apply(mtcars, 2, function(x) mean(abs(x - mean(x))))
> print("Mean Deviation:")
[1] "Mean Deviation:"
> print(mean_deviation)
       mpg        cyl       disp         hp       drat         wt       qsec         vs         am       gear       carb
 4.7144531  1.5859375 108.7857422  56.4804688  0.4532422  0.7301875  1.3761719  0.4921875  0.4824219  0.6445312  1.3007812
>
> # Standard Deviation
> sd_values <- sapply(mtcars, sd)
> print("Standard Deviation:")
[1] "Standard Deviation:"
> print(sd_values)
       mpg        cyl       disp         hp       drat         wt       qsec         vs         am       gear       carb
 6.0269481  1.7859216 123.9386938  68.5628685  0.5346787  0.9784574  1.7869432  0.5040161  0.4989909  0.7378041  1.6152000
>
> # Skewness
> skewness_values <- sapply(mtcars, skewness)
> print("Skewness:")
[1] "Skewness:"
> print(skewness_values)
       mpg        cyl       disp         hp       drat         wt       qsec         vs         am       gear       carb
 0.6404399 -0.1831287  0.4002724  0.7614356  0.2788734  0.4437855  0.3870456  0.2519763  0.3817709  0.5546495  1.1021304
>
> # Kurtosis
> kurtosis_values <- sapply(mtcars, kurtosis)
> print("Kurtosis:")
[1] "Kurtosis:"
> print(kurtosis_values)
     mpg      cyl     disp       hp     drat       wt     qsec       vs       am     gear     carb
2.799467 1.319032 1.910317 3.052233 2.435116 3.172471 3.553753 1.063492 1.145749 2.056790 4.536121
>
> # Frequency Distribution and Plots
>
> # Frequency Distribution (for mpg)
> mpg_freq <- table(cut(mtcars$mpg, breaks = 5))
> print("Frequency Distribution for MPG:")
[1] "Frequency Distribution for MPG:"
> print(mpg_freq)

(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9]
          6          12           8           2           4
>
> # Histogram for mpg
> ggplot(mtcars, aes(x=mpg)) +
+   geom_histogram(binwidth=2, color="black", fill="blue") +
+   labs(title="Histogram of MPG", x="Miles per Gallon", y="Frequency")
```

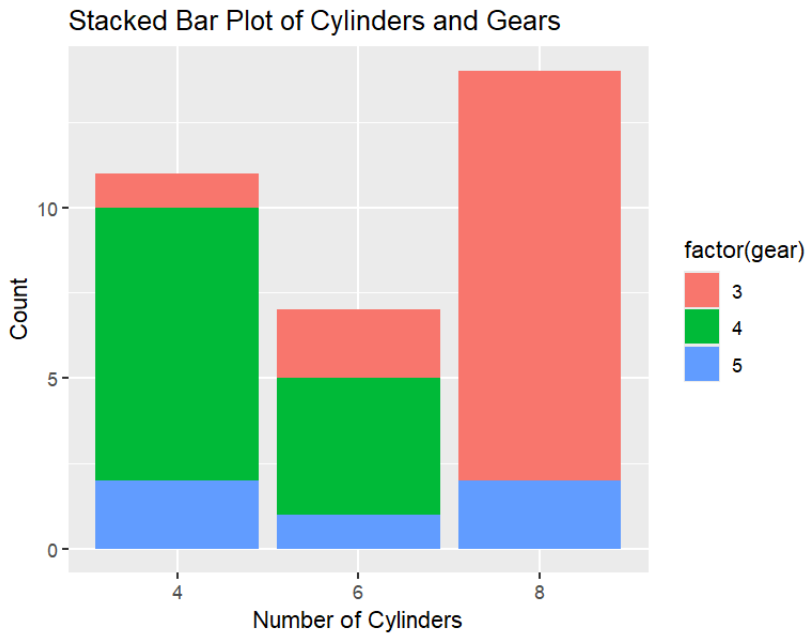



```
> # Kurtosis
> kurtosis_values <- sapply(mtcars, kurtosis)
> print("Kurtosis:")
[1] "Kurtosis:"
> print(kurtosis_values)
     mpg      cyl     disp       hp     drat       wt     qsec       vs       am     gear     carb
2.799467 1.319032 1.910317 3.052233 2.435116 3.172471 3.553753 1.063492 1.145749 2.056790 4.536121
>
> # Frequency Distribution and Plots
>
> # Frequency Distribution (for mpg)
> mpg_freq <- table(cut(mtcars$mpg, breaks = 5))
> print("Frequency Distribution for MPG:")
[1] "Frequency Distribution for MPG:"
> print(mpg_freq)

(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9]
          6          12           8           2           4
>
> # Histogram for mpg
> ggplot(mtcars, aes(x=mpg)) +
+   geom_histogram(binwidth=2, color="black", fill="blue") +
+   labs(title="Histogram of MPG", x="Miles per Gallon", y="Frequency")
>
> # Relative Frequency Distribution
> mpg_rel_freq <- prop.table(mpg_freq)
> print("Relative Frequency Distribution for MPG:")
[1] "Relative Frequency Distribution for MPG:"
> print(mpg_rel_freq)

(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9]
     0.1875      0.3750      0.2500      0.0625      0.1250
>
> # Cumulative Frequency Distribution
> mpg_cum_freq <- cumsum(mpg_freq)
> print("Cumulative Frequency Distribution for MPG:")
[1] "Cumulative Frequency Distribution for MPG:"
> print(mpg_cum_freq)
(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9]
          6          18          26          28          32
>
> # Categorical Variable Analysis (Pie Plot and Stacked Bar Plot)
>
> # Pie Plot for cyl
> cyl_freq <- table(mtcars$cyl)
> pie(cyl_freq, labels = names(cyl_freq), main = "Pie Chart of Cylinders")
>
> # Stacked Bar Plot for cyl and gear
> ggplot(mtcars, aes(x=factor(cyl), fill=factor(gear))) +
+   geom_bar(position="stack") +
+   labs(title="Stacked Bar Plot of Cylinders and Gears", x="Number of Cylinders", y="Count")
```

```
> # Kurtosis
> kurtosis_values <- sapply(mtcars, kurtosis)
> print("Kurtosis:")
[1] "Kurtosis:"
> print(kurtosis_values)
      mpg       cyl      disp        hp      drat        wt      qsec        vs        am      gear      carb 
2.799467 1.319032 1.910317 3.052233 2.435116 3.172471 3.553753 1.063492 1.145749 2.056790 4.536121 
> 
> # Frequency Distribution and Plots
> 
> # Frequency Distribution (for mpg)
> mpg_freq <- table(cut(mtcars$mpg, breaks = 5))
> print("Frequency Distribution for MPG:")
[1] "Frequency Distribution for MPG:"
> print(mpg_freq)

(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9] 
          6          12           8           2           4 
> 
> # Histogram for mpg
> ggplot(mtcars, aes(x=mpg)) +
+   geom_histogram(binwidth=2, color="black", fill="blue") +
+   labs(title="Histogram of MPG", x="Miles per Gallon", y="Frequency")
> 
> # Relative Frequency Distribution
> mpg_rel_freq <- prop.table(mpg_freq)
> print("Relative Frequency Distribution for MPG:")
[1] "Relative Frequency Distribution for MPG:"
> print(mpg_rel_freq)

(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9] 
     0.1875      0.3750      0.2500      0.0625      0.1250 
> 
> # Cumulative Frequency Distribution
> mpg_cum_freq <- cumsum(mpg_freq)
> print("Cumulative Frequency Distribution for MPG:")
[1] "Cumulative Frequency Distribution for MPG:"
> print(mpg_cum_freq)
(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9] 
          6          18          26          28          32 
> 
> # Categorical Variable Analysis (Pie Plot and Stacked Bar Plot)
> 
> # Pie Plot for cyl
> cyl_freq <- table(mtcars$cyl)
> pie(cyl_freq, labels = names(cyl_freq), main = "Pie Chart of Cylinders")
> 
> # Stacked Bar Plot for cyl and gear
> ggplot(mtcars, aes(x=factor(cyl), fill=factor(gear))) +
+   geom_bar(position="stack") +
+   labs(title="Stacked Bar Plot of Cylinders and Gears", x="Number of Cylinders", y="Count")
> 
```







Code :

```
# Install and load required packages
install.packages("psych")
install.packages("moments")
install.packages("ggplot2")

library(psych)
library(moments)
library(ggplot2)

# Load the mtcars dataset
data(mtcars)
head(mtcars)

# Measures of Central Tendency
```

```
print("JVNGANESH 21BDS0085")
# Mean
mean_values <- sapply(mtcars, mean)
print("Mean Values:")
print(mean_values)

# Median
median_values <- sapply(mtcars, median)
print("Median Values:")
print(median_values)

# Quantiles (25%, 50%, 75%)
quantiles <- apply(mtcars, 2, quantile)
print("Quantiles (25%, 50%, 75%):")
print(quantiles)

# Deciles (ntile)
deciles <- apply(mtcars, 2, function(x) quantile(x, probs = seq(0, 1, 0.1)))
print("Deciles:")
print(deciles)

# Percentiles (90th percentile)
percentiles <- apply(mtcars, 2, function(x) quantile(x, probs = 0.9))
print("90th Percentiles:")
print(percentiles)
```

```
# Measures of Dispersion

# Range
range_values <- sapply(mtcars, function(x) diff(range(x)))
print("Range:")
print(range_values)

# Interquartile Range (IQR)
iqr_values <- sapply(mtcars, IQR)
print("Interquartile Range (IQR):")
print(iqr_values)

# Interdecile Range
interdecile_range <- apply(mtcars, 2, function(x) quantile(x, probs = 0.9) - quantile(x, probs = 0.1))
print("Interdecile Range:")
print(interdecile_range)

# Mean Deviation
mean_deviation <- apply(mtcars, 2, function(x) mean(abs(x - mean(x))))
print("Mean Deviation:")
print(mean_deviation)

# Standard Deviation
sd_values <- sapply(mtcars, sd)
print("Standard Deviation:")
```

```
print(sd_values)

# Skewness
skewness_values <- sapply(mtcars, skewness)
print("Skewness:")
print(skewness_values)

# Kurtosis
kurtosis_values <- sapply(mtcars, kurtosis)
print("Kurtosis:")
print(kurtosis_values)

# Frequency Distribution and Plots

# Frequency Distribution (for mpg)
mpg_freq <- table(cut(mtcars$mpg, breaks = 5))
print("Frequency Distribution for MPG:")
print(mpg_freq)

# Histogram for mpg
ggplot(mtcars, aes(x=mpg)) +
 geom_histogram(binwidth=2, color="black", fill="blue") +
 labs(title="Histogram of MPG", x="Miles per Gallon", y="Frequency")

# Relative Frequency Distribution
mpg_rel_freq <- prop.table(mpg_freq)
```

```
print("Relative Frequency Distribution for MPG:")
print(mpg_rel_freq)

# Cumulative Frequency Distribution
mpg_cum_freq <- cumsum(mpg_freq)
print("Cumulative Frequency Distribution for MPG:")
print(mpg_cum_freq)

# Categorical Variable Analysis (Pie Plot and Stacked Bar Plot)

# Pie Plot for cyl
cyl_freq <- table(mtcars$cyl)
pie(cyl_freq, labels = names(cyl_freq), main = "Pie Chart of Cylinders")

# Stacked Bar Plot for cyl and gear
ggplot(mtcars, aes(x=factor(cyl), fill=factor(gear))) +
 geom_bar(position="stack") +
 labs(title="Stacked Bar Plot of Cylinders and Gears", x="Number of Cylinders", y="Count")
```

OUTPUT :

```
 R version 4.4.1 (2024-06-14 ucrt) -- "Race for Your Life"
 Copyright (C) 2024 The R Foundation for Statistical Computing
 Platform: x86_64-w64-mingw32/x64

 R is free software and comes with ABSOLUTELY NO WARRANTY.
```

You are welcome to redistribute it under certain conditions.

Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

R is a collaborative project with many contributors.

Type 'contributors()' for more information and

'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or

'help.start()' for an HTML browser interface to help.

Type 'q()' to quit R.

[Workspace loaded from ~/.RData]

> # Install and load required packages

> install.packages("psych")

WARNING: Rtools is required to build R packages but is not currently installed. Please download and inst

https://cran.rstudio.com/bin/windows/Rtools/

Installing package into ‘C:/Users/lenovo/AppData/Local/R/win-library/4.4’

(as ‘lib’ is unspecified)

trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.4/psych_2.4.6.26.zip'

Content type 'application/zip' length 3730235 bytes (3.6 MB)

downloaded 3.6 MB

package ‘psych’ successfully unpacked and MD5 sums checked

The downloaded binary packages are in

C:\Users\lenovo\AppData\Local\Temp\RtmpopuGIi\downloaded_packages

> install.packages("moments")

WARNING: Rtools is required to build R packages but is not currently installed. Please download and inst

https://cran.rstudio.com/bin/windows/Rtools/

Installing package into ‘C:/Users/lenovo/AppData/Local/R/win-library/4.4’

(as ‘lib’ is unspecified)

trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.4/moments_0.14.1.zip'

Content type 'application/zip' length 57241 bytes (55 KB)

downloaded 55 KB

package ‘moments’ successfully unpacked and MD5 sums checked

The downloaded binary packages are in

C:\Users\lenovo\AppData\Local\Temp\RtmpopuGIi\downloaded_packages

> install.packages("ggplot2")

WARNING: Rtools is required to build R packages but is not currently installed. Please download and inst

https://cran.rstudio.com/bin/windows/Rtools/

Installing package into ‘C:/Users/lenovo/AppData/Local/R/win-library/4.4’

(as ‘lib’ is unspecified)

```
trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.4/ggplot2_3.5.1.zip'
Content type 'application/zip' length 5011572 bytes (4.8 MB)
downloaded 1.6 MB

Warning in install.packages :
  downloaded length 1654221 != reported length 5011572
Warning in install.packages :
  URL 'https://cran.rstudio.com/bin/windows/contrib/4.4/ggplot2_3.5.1.zip': Timeout of 60 seconds was r
Error in download.file(url, destfile, method, mode = "wb", ...) :
  download from 'https://cran.rstudio.com/bin/windows/contrib/4.4/ggplot2_3.5.1.zip' failed
Warning in install.packages :
  download of package ‘ggplot2’ failed
>
> library(psych)
> library(moments)
> library(ggplot2)
Learn more about the underlying theory at https://ggplot2-book.org/

Attaching package: ‘ggplot2’

The following objects are masked from ‘package:psych’:

    %+%, alpha

>
```

```
> # Load the mtcars dataset
> data(mtcars)
> 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
>
> # Measures of Central Tendency
> print("JVNGANESH 21BDS0085")
[1] "JVNGANESH 21BDS0085"
> # Mean
> mean_values <- sapply(mtcars, mean)
> print("Mean Values:")
[1] "Mean Values:"
> print(mean_values)
     mpg      cyl     disp       hp     drat       wt     qsec       vs       am     gear     carb
 20.090625   6.187500 230.721875 146.687500   3.596563   3.217250  17.848750   0.437500   0.406250   3
>
> # Median
> median_values <- sapply(mtcars, median)
> print("Median Values:")
```

```
[1] "Median Values:"
> print(median_values)
   mpg    cyl   disp     hp   drat     wt   qsec     vs     am   gear   carb
 19.200   6.000 196.300 123.000   3.695   3.325  17.710   0.000   0.000   4.000   2.000
>
> # Quantiles (25%, 50%, 75%)
> quantiles <- apply(mtcars, 2, quantile)
> print("Quantiles (25%, 50%, 75%):")
[1] "Quantiles (25%, 50%, 75%):"
> print(quantiles)
      mpg cyl    disp    hp  drat     wt    qsec vs am gear carb
0%   10.400   4  71.100  52.0 2.760 1.51300 14.5000  0  0    3    1
25%  15.425   4 120.825  96.5 3.080 2.58125 16.8925  0  0    3    2
50%  19.200   6 196.300 123.0 3.695 3.32500 17.7100  0  0    4    2
75%  22.800   8 326.000 180.0 3.920 3.61000 18.9000  1  1    4    4
100% 33.900   8 472.000 335.0 4.930 5.42400 22.9000  1  1    5    8
>
> # Deciles (ntile)
> deciles <- apply(mtcars, 2, function(x) quantile(x, probs = seq(0, 1, 0.1)))
> print("Deciles:")
[1] "Deciles:"
> print(deciles)
     mpg cyl   disp    hp  drat    wt   qsec vs  am gear carb
0%   10.40   4  71.10  52.0 2.760 1.5130 14.500  0 0.0    3  1.0
10%  14.34   4  80.61  66.0 3.007 1.9555 15.534  0 0.0    3  1.0
```

```
20%  15.20   4 120.14  93.4 3.072 2.3490 16.734  0 0.0    3  1.2
30%  15.98   4 142.06 106.2 3.150 2.7730 17.020  0 0.0    3  2.0
40%  17.92   6 160.00 110.0 3.354 3.1580 17.340  0 0.0    3  2.0
50%  19.20   6 196.30 123.0 3.695 3.3250 17.710  0 0.0    4  2.0
60%  21.00   8 275.80 165.0 3.818 3.4400 18.180  1 0.6    4  3.0
70%  21.47   8 303.10 178.5 3.914 3.5550 18.607  1 1.0    4  4.0
80%  24.08   8 350.80 200.0 4.048 3.7700 19.332  1 1.0    4  4.0
90%  30.09   8 396.00 243.5 4.209 4.0475 19.990  1 1.0    5  4.0
100% 33.90   8 472.00 335.0 4.930 5.4240 22.900  1 1.0    5  8.0
>
> # Percentiles (90th percentile)
> percentiles <- apply(mtcars, 2, function(x) quantile(x, probs = 0.9))
> print("90th Percentiles:")
[1] "90th Percentiles:"
> print(percentiles)
    mpg     cyl    disp      hp    drat      wt    qsec      vs      am    gear    carb
 30.0900  8.0000 396.0000 243.5000  4.2090  4.0475 19.9900  1.0000  1.0000  5.0000  4.0000
>
> # Measures of Dispersion
>
> # Range
> range_values <- sapply(mtcars, function(x) diff(range(x)))
> print("Range:")
[1] "Range:"
> print(range_values)
```

```
   mpg    cyl   disp     hp   drat     wt   qsec     vs     am   gear   carb
 23.500   4.000 400.900 283.000   2.170   3.911   8.400   1.000   1.000   2.000   7.000
>
> # Interquartile Range (IQR)
> iqr_values <- sapply(mtcars, IQR)
> print("Interquartile Range (IQR):")
[1] "Interquartile Range (IQR):"
> print(iqr_values)
     mpg      cyl     disp       hp     drat       wt     qsec       vs       am     gear     carb
  7.37500   4.00000 205.17500  83.50000   0.84000   1.02875   2.00750   1.00000   1.00000   1.00000   2.000
>
> # Interdecile Range
> interdecile_range <- apply(mtcars, 2, function(x) quantile(x, probs = 0.9) - quantile(x, probs = 0.1))
> print("Interdecile Range:")
[1] "Interdecile Range:"
> print(interdecile_range)
   mpg    cyl   disp     hp   drat     wt   qsec     vs     am   gear   carb
 15.750   4.000 315.390 177.500   1.202   2.092   4.456   1.000   1.000   2.000   3.000
>
> # Mean Deviation
> mean_deviation <- apply(mtcars, 2, function(x) mean(abs(x - mean(x))))
> print("Mean Deviation:")
[1] "Mean Deviation:"
> print(mean_deviation)
      mpg       cyl      disp        hp      drat        wt      qsec        vs        am      gear      carb
```

```
 4.7144531   1.5859375 108.7857422  56.4804688   0.4532422   0.7301875   1.3761719   0.4921875   0.48
>
> # Standard Deviation
> sd_values <- sapply(mtcars, sd)
> print("Standard Deviation:")
[1] "Standard Deviation:"
> print(sd_values)
      mpg       cyl      disp        hp      drat        wt      qsec        vs        am      gear      carb
 6.0269481   1.7859216 123.9386938  68.5628685   0.5346787   0.9784574   1.7869432   0.5040161   0.49
>
> # Skewness
> skewness_values <- sapply(mtcars, skewness)
> print("Skewness:")
[1] "Skewness:"
> print(skewness_values)
     mpg      cyl     disp       hp     drat       wt     qsec       vs       am     gear     carb
 0.6404399 -0.1831287  0.4002724  0.7614356  0.2788734  0.4437855  0.3870456  0.2519763  0.3817709
>
> # Kurtosis
> kurtosis_values <- sapply(mtcars, kurtosis)
> print("Kurtosis:")
[1] "Kurtosis:"
> print(kurtosis_values)
    mpg     cyl    disp      hp    drat      wt    qsec      vs      am    gear    carb
2.799467 1.319032 1.910317 3.052233 2.435116 3.172471 3.553753 1.063492 1.145749 2.056790 4.536
```

```
>
> # Frequency Distribution and Plots
>
> # Frequency Distribution (for mpg)
> mpg_freq <- table(cut(mtcars$mpg, breaks = 5))
> print("Frequency Distribution for MPG:")
[1] "Frequency Distribution for MPG:"
> print(mpg_freq)

(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9]
          6          12           8           2           4
>
> # Histogram for mpg
> ggplot(mtcars, aes(x=mpg)) +
+   geom_histogram(binwidth=2, color="black", fill="blue") +
+   labs(title="Histogram of MPG", x="Miles per Gallon", y="Frequency")
>
> # Relative Frequency Distribution
> mpg_rel_freq <- prop.table(mpg_freq)
> print("Relative Frequency Distribution for MPG:")
[1] "Relative Frequency Distribution for MPG:"
> print(mpg_rel_freq)

(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9]
     0.1875      0.3750      0.2500      0.0625      0.1250
```

```
>
> # Cumulative Frequency Distribution
> mpg_cum_freq <- cumsum(mpg_freq)
> print("Cumulative Frequency Distribution for MPG:")
[1] "Cumulative Frequency Distribution for MPG:"
> print(mpg_cum_freq)
(10.4,15.1] (15.1,19.8] (19.8,24.5] (24.5,29.2] (29.2,33.9]
          6          18          26          28          32
>
> # Categorical Variable Analysis (Pie Plot and Stacked Bar Plot)
>
> # Pie Plot for cyl
> cyl_freq <- table(mtcars$cyl)
> pie(cyl_freq, labels = names(cyl_freq), main = "Pie Chart of Cylinders")
>
> # Stacked Bar Plot for cyl and gear
> ggplot(mtcars, aes(x=factor(cyl), fill=factor(gear))) +
+   geom_bar(position="stack") +
+   labs(title="Stacked Bar Plot of Cylinders and Gears", x="Number of Cylinders", y="Count")
```