Example 1: The data file Score.xlsx has final scores for STATS 101 class at a university. Test if the true mean μ for STATS 101 class equals 90.

This problem is formulated as testing $H_0: \mu = 90$ vs. $H_1: \mu \neq 90$.

Read datafile Score.csv in R.

d1<-read.csv("g:/Stats24x7/R/Score.csv",header=TRUE)

attach(d1)

Run the 1-sample t-test in R:

t.test(Score,mu=90)

Output from R is given below:

    One Sample t-test

data: Score
t = -11.0291, df = 59, p-value = 5.77e-16
alternative hypothesis: true mean is not equal to 90
95 percent confidence interval:
 72.14074 77.62593
sample estimates:
mean of x
 74.88333

One of the assumptions of 1-sample t-test is that the sample be normally distributed (or sample size n be sufficiently large, typically $n \geq 30$ is considered a large sample). We now show how to assess the normality of a sample by plotting the Q-Q Plot in R. Type the following two lines of code in R:

qqnorm(Score)
qqline(Score)

Normal Q-Q Plot
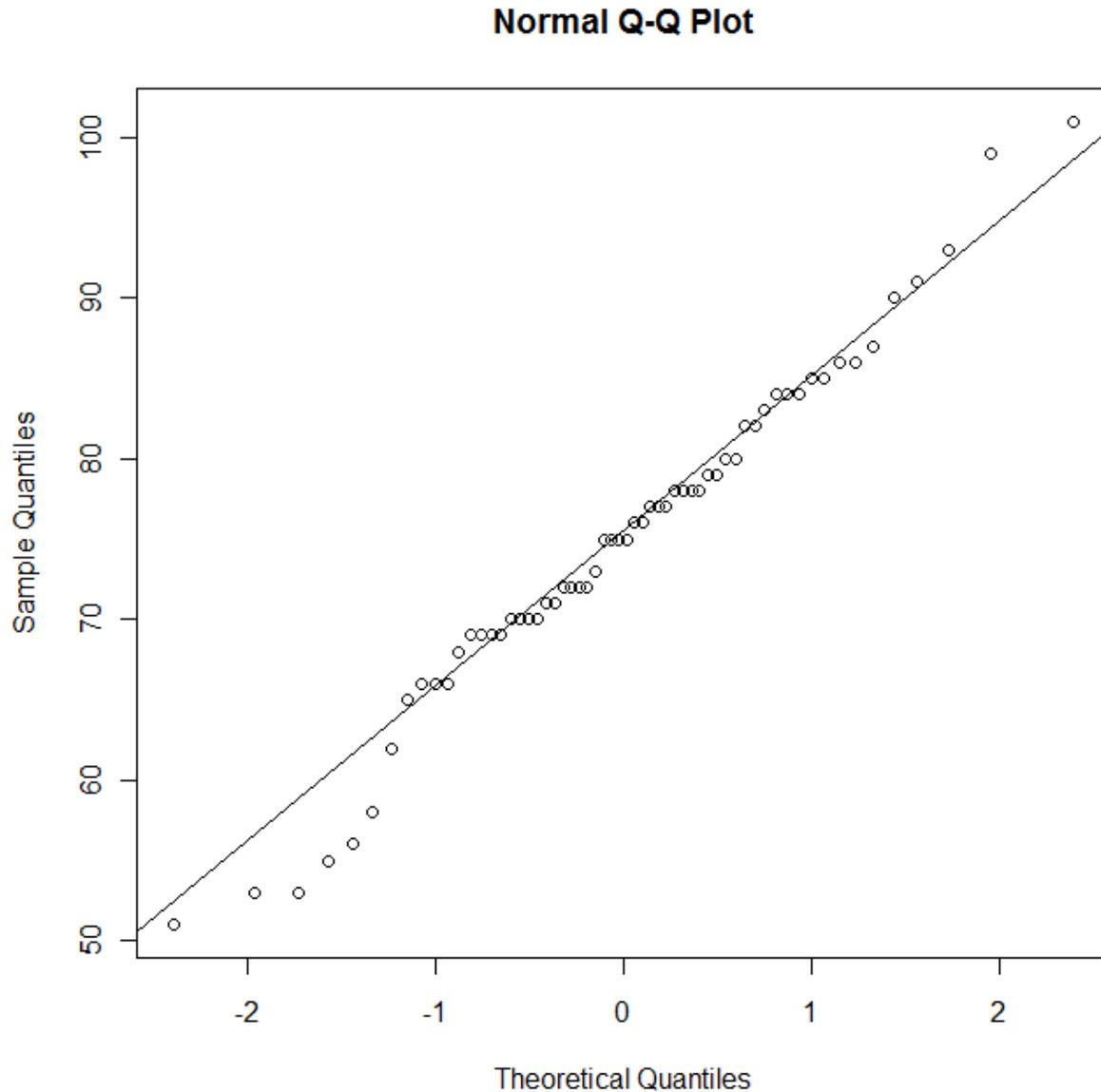
Example 2: Measured weights 0f 20 '3 lbs hamburger meat' packets from Grocery store A and 15 from Grocery Store B are given in the data file Weights.csv. Test if the true means of '3 lbs hamburger meat' packets from Grocery store A and Grocery Store B are equal.

The null hypothesis H_0: $\mu_1 = \mu_2$ is to be tested vs. the alternative H_1: $\mu_1 \neq \mu_2$. The T-Test depends on whether the two population variances are equal, or unequal. Instead of testing the equality of the two population variances, we will run the T-Test for comparing two means first assuming that both population variances are equal, and then assuming that they are unequal.

```
> d2<-read.csv("g:/Stats24x7/R/Weights.csv",header=TRUE)
> attach(d2)
> names(d2)
[1] "A" "B"

> t.test(A, B)
```

Read the datafile Weights.csv in R.
Attach the dataframe d2.
Look at the variable names.

Run UNEQUAL VARIANCE approximate t-test.

```
        Welch Two Sample t-test
data:  A and B
t = -1.6677, df = 14.472, p-value = 0.1169
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.30466801  0.03766801
sample estimates:
mean of x mean of y
  2.9845   3.1180
```

Run EQUAL VARIANCE t-test.

```
> t.test(A, B, var.equal=TRUE)

        Two Sample t-test
data:  A and B
t = -1.9226, df = 33, p-value = 0.06319
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.274767538  0.007767538
sample estimates:
mean of x mean of y
  2.9845   3.1180
```

Example 3: The data file Burger_Sales.csv shows daily sales of two adjacent fast food places for 14 randomly selected days. Test to see if the average sales of the two fast food restaurants are equal.

The data in this example is PAIRED since the *sales for the two restaurants are for same day, and we will need to run the paired T Test for this example.*

```
> d3<-read.csv("g:/Stats24x7/R/Burger_Sales.csv",header=TRUE)
> attach(d3)
> names(d3)
[1] "McB" "DK"
```

Read the datafile Weights.csv in R.

Attach the dataframe d3.

Look at the variable names.

```
> t.test(McB,DK, paired=TRUE)
```

Run PAIRED t-test.

```
	Paired t-test

data:  McB and DK
t = 2.3753, df = 13, p-value = 0.0336
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
  8.444656 178.178201
sample estimates:
mean of the differences
        93.31143
```

The normality of the difference   McB - DK   is required for the paired t-test.

Draw Q-Q Plot of the difference   McB - DK in R:

> qqnorm(McB-DK)
> qqline(McB-DK)

Normal Q-Q Plot