Exercise 1:

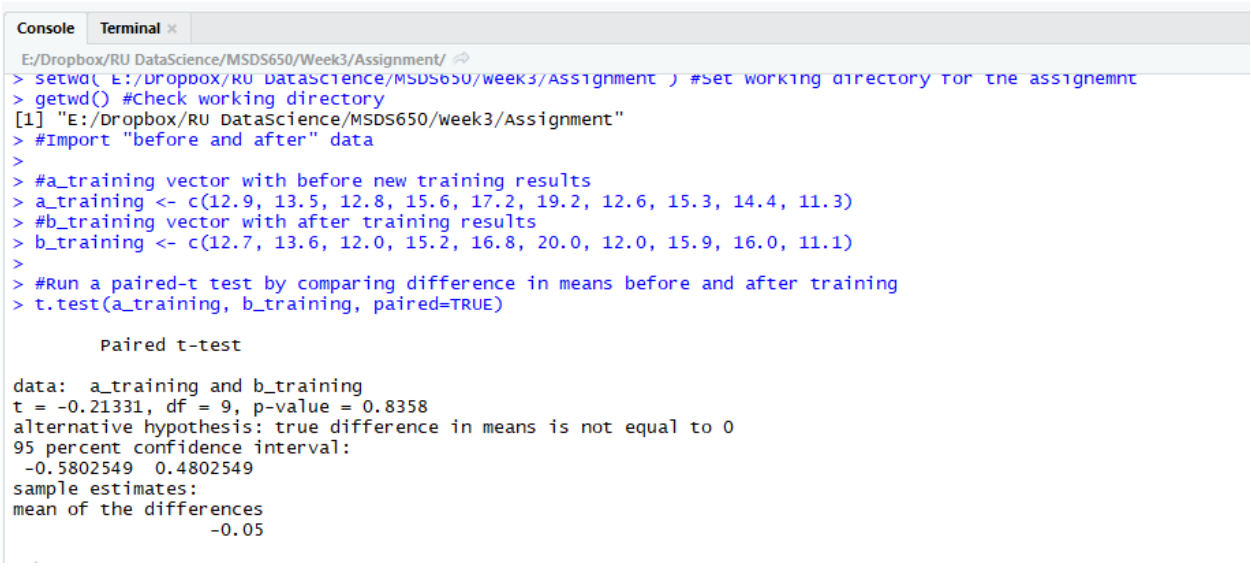
For the first exercise, I used paired t-test to study the effectiveness of a new training used by a schools's athletics coach. I loaded the before and after the training result and ran a t-test on them using the following code:

```
> #Import "before and after" data
>
> #a_training vector with before new training results
> a_training <- c(12.9, 13.5, 12.8, 15.6, 17.2, 19.2, 12.6, 15.3, 14.4, 11.3)
> #b_training vector with after training results
> b_training <- c(12.7, 13.6, 12.0, 15.2, 16.8, 20.0, 12.0, 15.9, 16.0, 11.1)
>
> #Run a paired-t test by comparing difference in means before and after training
> t.test(a_training, b_training, paired=TRUE)

        Paired t-test

data:  a_training and b_training
t = -0.21331, df = 9, p-value = 0.8358
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.5802549  0.4802549
sample estimates:
mean of the differences
                 -0.05
```

Which provided the following console window output:



The results show that p-value is equal to 0.8358, which is greater than the significance level of 0.05. It means that we cannot reject the null hypothesis. The new training did not have any influence on the team's results.

Exercise 2:

In the second exercise, coach #2 introduced yet another new training routine, and a second paired t-test was used to analyze its effectiveness. I used to following code to load the data and to pass it to the ***t.test()*** function (an alt="less" is used as an optional parameter to instruct R to test for a training mean to be less than b_training mean):

```
> #Import "before and after" data with a coach #2
>
> #a_training vector with before new training results
> a_training <- c(12.9, 13.5, 12.8, 15.6, 17.2, 19.2, 12.6, 15.3, 14.4, 11.3)
> #b_training vector with after training results with coach #2
> b_training <- c(12.0, 12.2, 11.2, 13.0, 15.0, 15.8, 12.2, 13.4, 12.9, 11.0)
>
> #Run a paired t-test: testing for the mean "before" being less than "after"
> #testing for the mean of the values in a_training to be less that mean of the values
> #in b_training
> t.test(a_training, b_training, paired=TRUE, alt="less")

          Paired t-test

data:  a_training and b_training
t = 5.2671, df = 9, p-value = 0.9997
alternative hypothesis: true difference in means is less than 0
95 percent confidence interval:
     -Inf 2.170325
sample estimates:
mean of the differences
                  1.61
```

The console window output is as follow:

```
Console  Terminal
E:/Dropbox/RU DataScience/MSDS650/Week3/Assignment/
                    -0.05

> ###Exercise Step 2
>
> #Import "before and after" data with a coach #2
>
> #a_training vector with before new training results
> a_training <- c(12.9, 13.5, 12.8, 15.6, 17.2, 19.2, 12.6, 15.3, 14.4, 11.3)
> #b_training vector with after training results with coach #2
> b_training <- c(12.0, 12.2, 11.2, 13.0, 15.0, 15.8, 12.2, 13.4, 12.9, 11.0)
>
> #Run a paired t-test: testing for the mean "before" being less than "after"
> #testing for the mean of the values in a_training to be less that mean of the values
> #in b_training
> t.test(a_training, b_training, paired=TRUE, alt="less")

        Paired t-test

data:  a_training and b_training
t = 5.2671, df = 9, p-value = 0.9997
alternative hypothesis: true difference in means is less than 0
95 percent confidence interval:
     -Inf 2.170325
sample estimates:
mean of the differences
                  1.61
```

The resulting p-values is 0.9997. Since we tested for the mean values in a_training being less than the mean of the values contained in the vector b_training, our calculations show that there was an improvement in the team's results after training with coach #2.

Exercise 3. Testing the effectiveness of two new drugs

Trial 1: XYZ Drug

As the next exercise, I compared the results of a trial study for a new blood pressure medication. I loaded the blood pressure measurements for before the trial and after the XYZ trial, an then used t.test() function to run a paired t-test to look for the equality of means using the following code:

```
> bp_before <-c(155, 142, 145, 160, 149, 152, 157, 159, 166, 163, 158, 161) #Blood pressure befor
e the trial
> bp_zyz <-c(152, 142, 144, 159, 150, 153, 156, 160, 165, 162, 159, 160) #Blood pressure after XY
Z drug trial
> #Run a paired t-test by comparing mean blood pressure before and after the XYZ trial
> t.test(bp_before, bp_zyz, paired=TRUE)
```

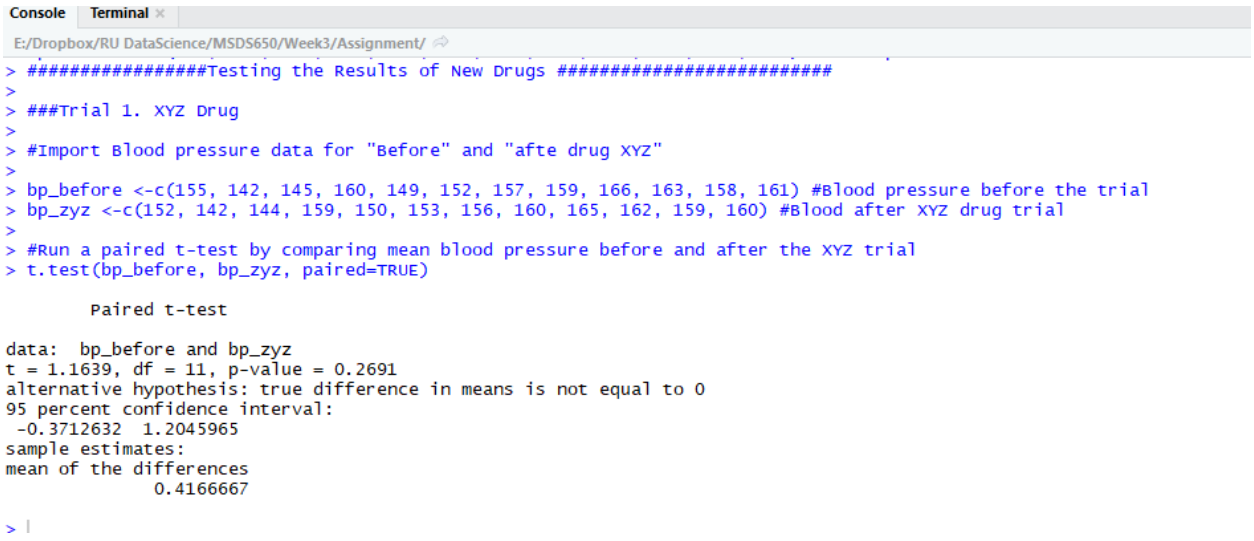
I received the following results:

```
        Paired t-test

data:  bp_before and bp_zyz
t = 1.1639, df = 11, p-value = 0.2691
```

```
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.3712632  1.2045965
sample estimates:
mean of the differences
              0.4166667
```

The console window output:



The resulting p-value is equal to 0.2691 which is higher than the significance level (p-value>0.05). This means that we can not reject the null hypothesis, stating that the drug XYZ did not cause any blood pressure changes in the subjects of this drug trial.

Trial 2: ABC Drug

In the second trial a different blood pressure medication was tested. I used similar procedure to load before and after data and ran a paired t-test to compare the means. Since after looking blood pressure measurements after the ABC trial I noticed that blood pressure decreased for all subjects, I decided to use a one-sided test. Adding an optional parameter alt=”greater” to the **t.test ()** function instructed R to test if bp_before is greater than bp_abc.

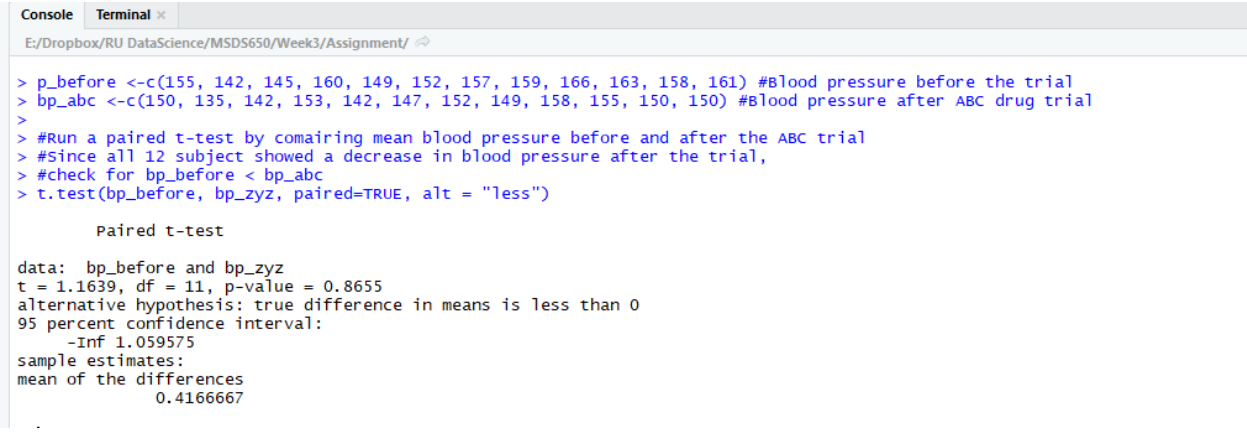
```
> p_before <-c(155, 142, 145, 160, 149, 152, 157, 159, 166, 163, 158, 161) #Blood pressure before
the trial
> bp_abc <-c(150, 135, 142, 153, 142, 147, 152, 149, 158, 155, 150, 150) #Blood pressure after AB
C drug trial
>
> #Run a paired t-test by comairing mean blood pressure before and after the ABC trial
> #Since all 12 subject showed a decrease in blood pressure after the trial,
> #check for bp_before < bp_abc
> t.test(bp_before, bp_zyz, paired=TRUE, alt = "less")

         Paired t-test

data:  bp_before and bp_zyz
```

```
t = 1.1639, df = 11, p-value = 0.8655
alternative hypothesis: true difference in means is less than 0
95 percent confidence interval:
     -Inf 1.059575
sample estimates:
mean of the differences
              0.4166667
```

Console window output:



The output p-value =0.8655 is greater than the statistical significance level of 0.05. It means that there is not enough evidence to reject the null hypothesis. The improvements in blood pressure measurements that I noticed while looking at the input data might have happened purely by chance and have not resulted from the use of ABC medication.