Q1.

A school athletics has taken a new instructor, and want to test the effectiveness of the new type of training proposed by the new instructor comparing the average times of 10 runners in the 100 meters. The results are given below(time in seconds)

Before training	12.9	13.5	12.8	15.6	17.2	19.2	12.6	15.3	14.4	11.3
After training	12.7	13.6	12.0	15.2	16.8	20.0	12.0	15.9	16.0	11.1

```
> n = 10

> x1 = c(12.9, 13.5, 12.8, 15.6, 17.2, 19.2, 12.6, 15.3, 14.4, 11.3)

> x2 = c(12.7, 13.6, 12.0, 15.2, 16.8, 20.0, 12.0, 15.9, 16.0, 11.1)

>

> t.test(x1, x2, paired=TRUE)


        Paired t-test


data:  x1 and x2

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
```

P-value is greater than 0.05, thus Null Hypothesis of equality of averages is not rejected and the training has not made any significant improvement in the performance

Q2.

The manufacturer of a certain make of electric bulbs claims that his bulbs have a mean life of 25 months with a standard deviation of 5 months. Random samples of 6 such bulbs have the following values: Life of bulbs in months: 24, 20, 30, 20, 20, and 18. Can you regard the producer's claim to valid at 1% level of significance

```
> mean = 25

> sd = 5

> x = c(24, 20, 30, 20, 20, 18)

> n = 6

>

> t.test(x, mu=mean, alt='less')


        One Sample t-test


data:  x

t = -1.6771, df = 5, p-value = 0.07719

alternative hypothesis: true mean is less than 25

95 percent confidence interval:

     -Inf 25.60463

sample estimates:

mean of x

       22

> qt(1-0.01, 5)

[1] 3.36493
```

Since t-value is smaller than qt value and p-value is slightly greater than 0.05, Null hypothesis is accepted and the claims are correct

Q3.

Problem 3 *: Consider the paired data below that represents cholesterol levels on 10 men before and after a certain medication*

Before(x)	237	289	257	228	303	275	262	304	244	233
After(y)	194	240	230	186	265	222	242	281	240	212

Test the claim that, on average, the drug lowers cholesterol in all men. I.e., test the claim that $\mu_d > 0$. *Test this at the 0.05 significance level.*

```
> x = c(237, 289, 257, 228, 303, 275, 262, 304, 244, 233)

> y = c(194, 240, 230, 186, 265, 222, 242, 281, 240, 212)

> n = 10

>

> t.test(x, y, paired=TRUE, alt='less')


        Paired t-test

data:  x and y

t = 6.5594, df = 9, p-value = 0.9999

alternative hypothesis: true difference in means is less than 0

95 percent confidence interval:

     -Inf 40.94289

sample estimates:

mean of the differences

                    32

> qt(1-0.05, 9)

[1] 1.833113
```

Since p-value is more than 0.05, the null hypothesis is rejected

Since t-value is more than qt value, null hypothesis is rejected. The drug does not lower cholestrol.

Q4.

A study was performed to test whether cars get better mileage on premium gas than on regular gas. Each of 10 cars was first filled with either regular or premium gas, decided by a coin toss, and mileage for that tank was recorded. The mileage was recorded again for the same car using the other kind of gasoline. We use a paired t – test to determine whether cars get significant better mileage with premium gas.

Regular	***16***	***20***	***21***	***22***	***23***	***22***	***27***	***25***	***27***	***28***
Premium	*19*	*22*	*24*	*24*	*25*	*25*	*26*	*26*	*28*	

28

```
> r = c(16, 20, 21, 22, 23, 22, 27, 25, 27, 28)

> p = c(19, 22, 24, 24, 25, 25, 26, 26, 28, 28)

>

> t.test(r, p, paired=TRUE, alt='greater')


        Paired t-test


data:  r and p

t = -3.7482, df = 9, p-value = 0.9977

alternative hypothesis: true difference in means is greater than 0

95 percent confidence interval:

 -2.38251      Inf

sample estimates:

mean of the differences

                  -1.6


> qt(1-0.05, 9)

[1] 1.833113
```

Since p-value is greater than 0.05 and t-value is greater than qt value, The null hypothesis is rejected and the car gets significant better mileage on the premium fuel.

Q5.

Five Measurements of the output of two units have given the following results (in kilograms of material per one hour of operation) .Assume that both samples have been obtained from normal populations, test at 10% significance level if two populations have the same variance.

Unit A	*14.1*	*10.1*	*14.7*	*13.7*	*14.0*
Unit B	*14.0*	*14.5*	*13.7*	*12.7*	*14.1*

```
> a = c(14.1, 10.1, 14.7, 13.7, 14.0)

> b = c(14.0, 14.5, 13.7, 12.7, 14.1)

> t.test(a, b)


        Welch Two Sample t-test


data:  a and b

t = -0.54829, df = 5.0714, p-value = 0.6068

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

 -2.720901  1.760901

sample estimates:

mean of x mean of y

    13.32     13.80


> qt(1-0.1/2, 8)

[1] 1.859548
```

p-value is more than 0.05 and t value is less than qt value. Thus null hypothesis is accepted and machines have equal variance