

# t-Test & f-Test

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**Q.1) 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**

ANS:

```
> Regular=c(16,20,21,22,23,22,27,25,27,28)
> Premium=c(19,22,24,24,25,25,26,26,28,29)

> t.test(Regular,Premium,paired=TRUE)
```

Paired t-test

data: Regular and Premium  
 $t = -4.295$ ,  $df = 9$ ,  $p\text{-value} = 0.002005$

alternative hypothesis: true difference in means is not equal to 0  
95 percent confidence interval:

-2.5953876 -0.8046124 sample estimates:

mean of the differences -1.7

Interpretation:

p-value is greater than -1.7  $H_0$  is accepted, cars didn't get significant better mileage with premium gas.

**Q.2) The Scores of 10 candidates prior and after training are given below**  
**Prior 84 48 36 37 54 69 83 96 90 65**

**After 90 58 56 49 62 81 84 86 84 75** Test the training is Effective or Not?  
ANS:

```
> Prior=c(84,48,36,37,54,69,83,96,90,65)
> After=c(90,58,56,49,62,81,84,86,84,75)
> t.test(Prior,After,paired=TRUE)
```

Paired t-test

data: Prior and After

$t = -2.215$ ,  $df = 9$ ,  $p\text{-value} = 0.05401$

alternative hypothesis: true difference in means is not equal to 0 95 percent confidence interval:

-12.7342367 0.1342367 sample estimates:

mean of the differences -6.3

Interpretation:

p-value is greater than -6.3 so  $H_0$  is accepted, so training didn't make any significant improvement

**Q.3) An IQ test was administered to 5 persons before and after they were trained.**

**The results are given below Candidates I II III IV V**

**IQ before Training 110 120 123 132 125 IQ After Training 120 118 125  
136 121**

**Test whether there is any change in IQ after the training Programme.**

ANS:

```
> IQ_before_Training=c(110,120,123,132,125)
> IQ_After_Training=c(120,118,125,136,121)

> t.test(IQ_before_Training,IQ_After_Training,paired=TRUE)
```

Paired t-test

data: IQ\_before\_Training and IQ\_After\_Training t = -0.8165, df = 4, p-value = 0.4601

alternative hypothesis: true difference in means is not equal to 0 95 percent confidence interval:

-8.800874 4.800874 sample estimates: mean of the differences

-2 Interpretation:

Ho is accepted because p-value is greater than -2, therefore IQ training is substantial improvement

**Q.4 In order to compare the effectiveness of two sources of nitrogen, namely Ammonium chloride and urea on grain yield of paddy, an experiment was conducted. The results on the grain yield of paddy (kg/plot) under the two treatments are given below Ammonium**

**Chloride: 13.4 10.9 11.2 11.8 14.0 15.3 14.2 12.6 17.0 16.2 16.5 15.7 Urea  
12.0 11.7 10.7 11.2 14.8 14.4 13.9 13.7 16.9 16.0 15.6 16.0 Assess which  
sources nitrogen is better for paddy**

ANS:

```

>
chloride=c(13.4,10.9,11.2,11.8,14.0,15.3,14.2,12.6,17.0,16.2,16.5,15.
7)

> Urea=c(12.0,11.7,10.7,11.2,14.8,14.4,13.9,13.7,16.9,16.0,15.6,16.0)
> var.test(chloride,Urea)

```

F test to compare two variances data: chloride and Urea

F = 1.0309, num df = 11, denom df = 11, p-value = 0.9606 alternative hypothesis: true ratio of variances is not equal to 1 95 percent confidence interval:

0.2967779 3.5810956 sample estimates: ratio of variances  
1.030917

Interpretation:

p-value is less than 1.03 therefore  $H_0$  null hypothesis is rejected and there is no significant difference between both of them.

Challenging Experiment:

**Q.) Take your last semester or this semester (if possible) marks data. Test the teaching method for open book exam is effective or not.**

**Marks obtained without open book: 32 34 38 30 29 Marks obtained with open book: 30 33 29 22 27**

ANS:

```

> without_open_book=c(32,34,38,30,29)
> with_open_book=c(30,33,29,22,27)

> t.test(with_open_book,without_open_book,paired=TRUE)

```

Paired t-test

data: with\_open\_book and without\_open\_book t = -2.6018, df = 4, p-value = 0.05994

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

95 percent confidence interval: -9.0953947 0.2953947 sample estimates:

mean of the differences -4.4

Interpretation:

$H_0$  is accepted because  $p\text{-value}(|t\alpha|)$  is greater than  $-4.4(|t|)$

Therefore it can be said that open book didn't made any significant improvement in marks.