**Lab no.1**

* From the following trivalent distribution compute all possible partial correlations.

|  |  |  |
| --- | --- | --- |
| X1 | X2 | X3 |
| 8 | 10 | 7 |
| 20 | 30 | 12 |
| 16 | 25 | 8 |
| 9 | 14 | 6 |
| 12 | 16 | 5 |
| 20 | 24 | 4 |
| 15 | 20 | 6 |
|  |  |  |

Solution:

The partial correlation between the first and second variables keeping the effect of the third variable constant is given by 0.970.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Correlations | | | | |
| Control Variables | | | X1 | X2 |
| X3 | X1 | Correlation | 1.000 | .970\*\* |
| X2 | Correlation | .970\*\* | 1.000 |
|  | | | | |
|  | | | | |

The partial correlation between the second and third variable keeping the effect of the first variable constant is given by 0.775.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Correlations | | | | |
| Control Variables | | | X2 | X3 |
| X1 | X2 | Correlation | 1.000 | .775 |
| X3 | Correlation | .775 | 1.000 |

The partial correlation between the First and third variables keeping the effect of the second variable constant is given by -0.707.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Correlations | | | | |
| Control Variables | | | X1 | X3 |
| X2 | X1 | Correlation | 1.000 | -.707 |
| X3 | Correlation | -.707 | 1.000 |

**Lab no.2:**

* A researcher wants to study the correlation between rent no of room and distance from town. The following data are gathered by him.

|  |  |  |
| --- | --- | --- |
| Rent (000) | No of room | Distance |
| 10 | 1 | 3 |
| 15 | 2 | 5 |
| 30 | 5 | 2 |
| 25 | 3 | 2 |
| 45 | 6 | 1 |
| 35 | 5 | 3 |
| 50 | 6 | 3 |

1. Compute the correlation between rent and no of rooms and keep the as distance constant.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Correlations | | | | |
| Control Variables | | | X1 | X2 |
| X3 | X1 | Correlation | 1.000 | .950\*\* |
| X2 | Correlation | .950\*\* | 1.000 |

The correlation between rent and no of rooms and keeping the distance constant is 0.950.

1. Compute the correlation between rent and distance and keep the no of room constant.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Correlations | | | | |
| Control Variables | | | X1 | X3 |
| X2 | X1 | Correlation | 1.000 | .065 |
| X3 | Correlation | .065 | 1.000 |

The correlation between rent and no of rooms and keeping the distance constant is 0.065.

**Lab no. 3** (INDEPENDENT T TEST)

* The operating time of two different brands of mobile is given below:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| color | 4.6 | 5.4 | 3.9 | 6.0 | 5.6 | 7.2 | 5.6 | 5.8 | 6.2 |
| vivo | 5.1 | 6.8 | 4.9 | 7.2 | 7 | 6.5 | 5.2 | 4.8 | 4 |

Is there any significant difference between operating time of two brands of mobile?

Hypothesis:

Null hypothesis H0:µ1=µ2 i.e. there is no significant difference between operating time of different brands of mobile.

Alternative hypothesis H1:µ1≠µ2 i.e. there is significant difference between operating time of different brands of mobile.

Level of significance:

Alpha= 5%

Test statistics:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| t-Test: Two-Sample Assuming Equal Variances | | | | |
|  |  |  |  |  |
|  | *Variable 1* | *Variable 2* |  |  |
| Mean | 5.588889 | 5.722222 |  |  |
| Variance | 0.881111 | 1.341944 |  |  |
| Observations | 9 | 9 |  |  |
| Pooled Variance | 1.111528 |  |  |  |
| Hypothesized Mean Difference | 0 |  |  |  |
| df | 16 |  |  |  |
| t Stat | -0.26828 |  |  |  |
| P(T<=t) one-tail | 0.395957 |  |  |  |
| t Critical one-tail | 1.745884 |  |  |  |
| P(T<=t) two-tail | 0.791914 |  |  |  |
| t Critical two-tail | 2.119905 |  |  |  |

Decision:

Tcal<Ttab so, we accept H0

Hence, we conclude that there is no significant difference between operating time of different brands of mobile.

**Lab no.4**

* The reaction time of two different brands of drug of two group of patient is given below:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Group A | 10 | 14 | 8 | 16 | 13 |  |
| Group B | 11 | 9 | 12 | 17 | 14 | 16 |

At alpha = 5%, test whether two brands of drugs are equally efficient.

Hypothesis:

Null hypothesis H0:µ1=µ2 i.e. both brands are equally efficient.

Alternative hypothesis H1:µ1≠µ2 i.e. both brands aren’t equally efficient.

Alpha= 5%

Test statistics:

|  |  |  |  |
| --- | --- | --- | --- |
|  | t-Test: Two-Sample Assuming Equal Variances |  |  |
|  |  |  |  |
|  |  | *Variable 1* | *Variable 2* |
|  | Mean | 12.2 | 13.16667 |
|  | Variance | 10.2 | 9.366667 |
|  | Observations | 5 | 6 |
|  | Pooled Variance | 9.737037 |  |
|  | Hypothesized Mean Difference | 0 |  |
|  | df | 9 |  |
|  | t Stat | -0.5116 |  |
|  | P(T<=t) one-tail | 0.310624 |  |
|  | t Critical one-tail | 1.833113 |  |
|  | P(T<=t) two-tail | 0.621248 |  |
|  | t Critical two-tail | 2.262157 |  |

Decision

Since Tcal<Ttab so we accept H0

Hence, we conclude that both brands of drugs are equally efficient.

**Lab no. 5**(paired t test)

* The marks obtained by 8 students in two attempts is given below:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| student | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| First attempt | 50 | 25 | 44 | 45 | 30 | 38 | 55 | 60 |
| Second attempt | 52 | 23 | 46 | 50 | 27 | 41 | 56 | 66 |

At 5% level of significance can you conclude that there is no significance difference between score of students in two attempts.

Hypothesis:

Null hypothesis H0: µ1=µ2 i.e. there is no significant difference between score of students in two attempt.

Alternative hypothesis H1: µ1≠µ2 i.e. there is significant difference between score of students in two attempt.

Level of significance, alpha = 5%

Test statistics:

|  |  |  |
| --- | --- | --- |
| t-Test: Paired Two Sample for Means |  |  |
|  |  |  |
|  | *Variable 1* | *Variable 2* |
| Mean | 43.375 | 45.125 |
| Variance | 143.4107143 | 208.6964 |
| Observations | 8 | 8 |
| Pearson Correlation | 0.989776148 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 7 |  |
| t Stat | 1.593970119 |  |
| P(T<=t) one-tail | 0.077485852 |  |
| t Critical one-tail | 1.894578605 |  |
| P(T<=t) two-tail | 0.154971704 |  |
| t Critical two-tail | 2.364624252 |  |

Decision

Here, Tcal<Ttab, so we accept H0**.** Hence we conclude that there is no significant difference between score of students in two attempt.

**Lab no.6**

* The performance score of employee before and after training is given below:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Employee | A | B | C | D | E | F |
| Before | 6 | 7 | 6 | 11 | 16 | 12 |
| After | 9 | 8 | 4 | 15 | 21 | 13 |

At alpha= 5%, test whether the training is effective or not.

Hypothesis:

Null hypothesis H0: µ1=µ2 i.e. the training isn’t effective.

Alternative hypothesis H1: µ2>µ1 i.e. the training is effective.

Alpha = 5%

Test statistics:

|  |  |  |
| --- | --- | --- |
| t-Test: Paired Two Sample for Means |  |  |
|  |  |  |
|  | *Variable 1* | *Variable 2* |
| Mean | 9.666666667 | 11.66667 |
| Variance | 16.26666667 | 35.86667 |
| Observations | 6 | 6 |
| Pearson Correlation | 0.946690609 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 5 |  |
| t Stat | -1.936491673 |  |
| P(T<=t) one-tail | 0.055283345 |  |
| t Critical one-tail | 2.015048373 |  |
| P(T<=t) two-tail | 0.110566691 |  |
| t Critical two-tail | 2.570581836 |  |

Decision

Here, Tcal<Ttab, so we accept H0

i.e. We conclude that the training isn’t effective.

**Lab no.7** (Wilcoxon sign rank test)

* The performance score of students before and after training is given below:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| before | 44 | 48 | 70 | 65 | 35 | 55 | 48 | 52 | 65 |
| after | 43 | 52 | 73 | 62 | 39 | 54 | 56 | 53 | 67 |

At 5% level of significance test whether training is beneficial or not.

Hypothesis

Null hypothesis: Md1=Md2 i.e. training isn’t beneficial

Alternative hypothesis: Md2>Md2 i.e. training is beneficial.

Level of significance

Alpha= 5%

Test statistics:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ranks | | | | |
|  | | N | Mean Rank | Sum of Ranks |
| after - before | Negative Ranks | 3a | 3.17 | 9.50 |
| Positive Ranks | 6b | 5.92 | 35.50 |
| Ties | 0c |  |  |
| Total | 9 |  |  |
| a. after < before | | | | |
| b. after > before | | | | |
| c. after = before | | | | |

|  |  |
| --- | --- |
| Test Statisticsa | |
|  | after - before |
| Z | -1.548b |
| Asymp. Sig. (2-tailed) | .122 |
| a. Wilcoxon Signed Ranks Test | |
| b. Based on negative ranks. | |

Since, pval>alpha so we accept H0**.** Hence we conclude that training isn’t beneficial.

**Lab No.8**

* The following dataset represents the score of 7 students in two attempts.

|  |  |
| --- | --- |
| Before | After |
| 4 | 8 |
| 6 | 5 |
| 7 | 9 |
| 11 | 12 |
| 15 | 18 |
| 19 | 17 |
| 5 | 10 |

Use Wilcoxon sign rank test to test whether there is significant difference between score of students in two attempts.

Solution:

Hypothesis

H0:Md1=Md2 i.e. there is no significance difference between score of students in 2 attempts.

H1: Md1≠ Md2 i.e. there is significance difference between score of students in 2 attempts.

Level of significance

Alpha= 5%

Critical value:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ranks | | | | |
|  | | N | Mean Rank | Sum of Ranks |
| after - before | Negative Ranks | 2a | 2.50 | 5.00 |
| Positive Ranks | 5b | 4.60 | 23.00 |
| Ties | 0c |  |  |
| Total | 7 |  |  |
| a. after < before | | | | |
| b. after > before | | | | |
| c. after = before | | | | |

|  |  |
| --- | --- |
| Test Statisticsa | |
|  | after - before |
| Z | -1.527b |
| Asymp. Sig. (2-tailed) | .127 |
| a. Wilcoxon Signed Ranks Test | |
| b. Based on negative ranks. | |
| Since Pval>alpha so we accept H0.  Hence we conclude that there is no significance difference between score of students in two attempts. | |

**Lab no. 9** (Mann Whitney U test)

The following dataset represent the age of male and female employee of certain company.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Age of male | 36 | 48 | 25 | 33 | 22 | 40 | 35 |
| Age of female | 20 | 28 | 35 | 42 | 46 | 25 | 29 |

At 5% level of significant test whether there is significance difference between age of male and female employee. Use man Whitney U test.

Solution:

Hypothesis:

H0:Md1=Md2 i.e. there is no significant difference between age of male and female.

H1: Md1≠ Md2 i.e. there is significant difference between age of male and female.

Level of significance

Alpha= 5%

Test statistics:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ranks | | | | |
|  | group | N | Mean Rank | Sum of Ranks |
| age | male | 7 | 8.00 | 56.00 |
| female | 7 | 7.00 | 49.00 |
| Total | 14 |  |  |

|  |  |
| --- | --- |
| Test Statisticsa | |
|  | age |
| Mann-Whitney U | 21.000 |
| Wilcoxon W | 49.000 |
| Z | -.448 |
| Asymp. Sig. (2-tailed) | .654 |
| Exact Sig. [2\*(1-tailed Sig.)] | .710b |
| a. Grouping Variable: group | |
| b. Not corrected for ties. | |

Since, Pval >alpha so we accept H0.Hence we conclude that there is no significant difference between age of male and female employee.

**Lab No.10**

* The following datasets represents the problem solving time of two groups of students.

|  |  |
| --- | --- |
| Group I | Group II |
| 12 | 16 |
| 20 | 10 |
| 16 | 18 |
| 22 | 24 |
| 30 | 19 |
| 11 | 21 |
| 39 | 40 |

At 5% level of significance, test whether the problem solving time of two group of student is similar. Use Mann- Whitney U test.

Solution:

Hypothesis

H0:Md1=Md2 i.e. the problem solving time is similar

H1: Md1≠Md2 i.e. the problem solving time isn’t similar.

Level of significance

Alpha= 5%

Test statistics:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ranks | | | | |
|  | group | N | Mean Rank | Sum of Ranks |
| time | group I | 7 | 7.50 | 52.50 |
| group II | 7 | 7.50 | 52.50 |
| Total | 14 |  |  |

|  |  |
| --- | --- |
| Test Statisticsa | |
|  | time |
| Mann-Whitney U | 24.500 |
| Wilcoxon W | 52.500 |
| Z | .000 |
| Asymp. Sig. (2-tailed) | 1.000 |
| Exact Sig. [2\*(1-tailed Sig.)] | 1.000b |
| a. Grouping Variable: group | |
| b. Not corrected for ties. | |

Here Pval>alpha so we accept H0

Hence we conclude that the problem solving time is similar.

**Lab no. 11**

* The marks obtained by 2 groups of student is given below:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group a | 44 | 46 | 60 | 50 | 66 | 52 | 35 | 62 |  |
| Group b | 50 | 53 | 40 | 51 | 62 | 63 | 54 | 48 |  |

At 5% level of significance test whether there is significant difference between marks of two groups of student use median test

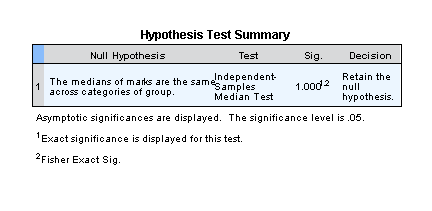
Hypothesis:

H0: md1=md2 i.e. there is no significant difference between marks of two group of students.

H1: md1≠md2 i.e. there is significant difference between marks of two group of students.

Alpha = 5%

Test statistics:



Decision

Hence we accept h0.

i.e. There is no significant difference between marks of two group of students.

**lab no. 12**

* The following data represents output of two different treatments.

|  |  |
| --- | --- |
| Treatment 1 | Treatment 2 |
| 46 | 56 |
| 65 | 40 |
| 48 | 52 |
| 55 | 61 |
| 70 | 72 |
| 47 | 64 |

At alpha =5%, test whether output of two different treatment are similar. Use median test.

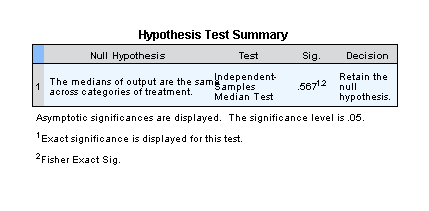
Hypothesis:

H0: Md1=Md2 i.e. the output of two treatments are similar.

H1: Md1≠Md2 i.e. the output of two treatments aren’t similar.

Alpha = 5%

Test statistics:



Decision

Here we accept h0,

We conclude that the output of two treatments are similar.

**Lab no 13**

* The following table represents the operating time of 3 different brands of scientific calculator.

|  |  |  |
| --- | --- | --- |
| A | B | C |
| 4.8 | 3.8 | 3.9 |
| 5.9 | 4.0 | 5.0 |
| 6.4 | 5.9 | 6.2 |
| 5.0 | 6.1 | 5.2 |
| 4.4 | 4.7 | 5.7 |
|  | 7.0 |  |

At 5% level of significance test whether there is significance difference between operating time of 3 different brands of calculator using kruskal wallis H test.

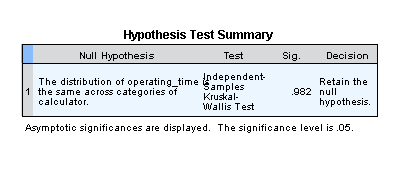
Hypothesis:

H0: There is no significance difference between operating time of 3 brands.

H1: There is significance difference between operating time of 3 brands.

Alpha = 5%

Test statistics:



Hence we conclude that There is no significance difference between operating time of 3 brands.

**Lab no 14:**

* In an experiment to determine which of 3 different missile system is preferable, the propellent burning rate is measured. The data after coding are given in the table. Use Kruskal wallis test significace level of 0.01 to test the hypothesis that the propellent burning rates are same for the three missiles system.

|  |  |  |
| --- | --- | --- |
| Missile system A | Missile system B | Missile system c |
| 22.3 | 23.4 | 18.4 |
| 16.7 | 19.5 | 19.5 |
| 22.7 | 17.5 | 17.8 |
| 19.3 | 20.8 | 18.0 |
| 18.5 | 16.0 | 19.6 |
|  | 19.9 | 22.8 |
|  |  | 17.1 |

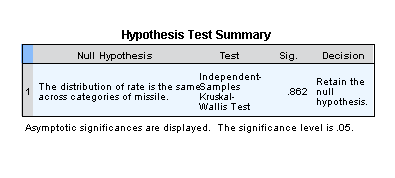
Hypothesis:

H0: the propellent burning rates are same for the three missiles system.

H1: the propellent burning rates aren’t same for the three missiles system.

Alpha =5%

Test statistics:



Conclusion:

Here we accept h0 i.e. the propellent burning rates are same for the three missiles system.

**Lab no 15**(Regression):

* A computer manager needs to know how the efficiency of her new computer program depends on the size of incoming data and how many tables are used to arrange each data set. Efficiency will be measured by the number of processed requests per hour. Applying the program to data sets of different sizes and number of tables, she gets the following results.

|  |  |  |
| --- | --- | --- |
| Processed requests Y | Data size, (GB), X1 | Number of tables, X2 |
| 16 | 15 | 1 |
| 26 | 10 | 10 |
| 41 | 8 | 10 |
| 50 | 7 | 20 |
| 55 | 7 | 20 |
| 40 | 6 | 4 |

1. Write the regression equation for the processed request.
2. Interpret the parameters of the regression model.
3. What percentage of variation on processed requests is explained by two independent variables?
4. Compute the standard error of the estimate.
5. Also compute adjusted R square.
6. Test the significance of each of the regression coefficients.
7. Test the overall goodness of fit of the model.

Solution  


Let the regression equation be : Y=a+b1x1+b2x2

From the coefficient table,

1. Y=51.56-2.62x1+0.89x2 which is a required equation.
2. Here,

a= 51.56 i.e. if x1 and x2 become zero then efficiency becomes 51.56.

b1=-2.62 i.e. if we increase the data size by one unit then efficiency decreases by 2.62 units keeping the effect of several tables as constant.

B2=0.89 i.e. if we increase the number of tables by one unit then efficiency increases by 0.89 keeping the effect of data size constant.

1. R2 = 0.91 i.e. 91% of total variation on processed requests is explained by two independent variables.
2. Standard error = 5.65 i.e. the average deviation of observation from the fitted regression line is 5.65.
3. Adjusted R2= 0.85
4. Test for B1,

Hypothesis:

H0: The regression coefficient isn’t significant.

H1: The regression coefficient is significant.

Alpha = 5%

Test statistics:

T=2.81

P value =0.066

The decision, since the p-value is greater than alpha so we don’t reject H0.

Hence, we conclude that the regression coefficient is not significant.

Test for B2,

Hypothesis:

H0: The regression coefficient isn’t significant.

H1: The regression coefficient is significant.

Alpha = 5%

Test statistics:

T=2.28

P value =0.01

Decision, since the p value is less than alpha we reject H0.

Hence, we conclude that the regression coefficient is significant.

1. Test for regression model

Hypothesis:

H0: The regression model isn’t significant.

H1: regression model is significant.

Alpha = 5%

Test statistics:

F =15.31

P value =0.026

The decision, since the p value is greater than alpha so we reject H0.

Hence, we conclude that the regression model is significant.

**Lab no. 16**

* It was reported somewhere that children whenever playing the game on computer, they use the computer very roughly which may reduce the lifetime of a computer. The random access memory (RAM) of a computer also plays a crucial role in the lifetime of a computer. A researcher wanted to examine how the lifetime of a personal computer that is used by children is affected by the time (in hours) spent by the children per day playing games and the available random access memory (RAM) measured in megabytes (MB) of a used computer. The data is provided in the following table.

|  |  |  |
| --- | --- | --- |
| Lifetime(years) | Play time(hours)/day | RAM in Mb |
| 5 | 2 | 8 |
| 1 | 8 | 2 |
| 7 | 1 | 6 |
| 2 | 5 | 3 |
| 3 | 6 | 2 |
| 4 | 3 | 4 |
| 6 | 2 | 7 |

1. Write the estimated regression equation for the lifetime.
2. Interpret the parameters of the regression model.
3. What percentage of variation in lifetime is explained by two independent variables?
4. Compute the standard error of the estimate.
5. Also compute adjusted R square.
6. Test the significance of each of the regression coefficients.
7. Test the overall goodness of fit of the model.

Solution:



Let the regression equation be: Y=a+b1x1+b2x2

From the coefficient table,

1. Y= 6.91 – 0.78x1+0.01x2.
2. Here a= 6.91 i.e. the lifetime will be 6.91 if we keep both independent variables zero

B1=-0.78 i.e. if we increase the value of playtime by one unit then the lifetime will be decreased by 0.78 keeping the effect of RAM constant

B2= 0.01 i.e. if we increase the value of RAM by one unit then the lifetime will be increased by 0.01 keeping the effect of play time constant.

1. R Square = 0.88 i.e. 88% of total deviation on lifetime is explained by two independent variables.
2. Standard error = 0.90 i.e. the average deviation from the fitting regression line is 0.90.
3. Adjusted R square = 0.82
4. Test for B1,

Hypothesis:

H0: The regression coefficient isn’t significant.

H1: The regression coefficient is significant.

Alpha = 5%

Test statistics:

T=2.66

P value =0.056

The decision, since the p-value is greater than alpha so we don’t reject H0.

Hence, we conclude that the regression coefficient is not significant.

Test for B2,

Hypothesis:

H0: The regression coefficient isn’t significant.

H1: The regression coefficient is significant.

Alpha = 5%

Test statistics:

T=0.04

P value =0.96

The decision, since the p-value is greater than the alpha so we accept H0.

Hence, we conclude that the regression coefficient isn’t significant.

1. Test for regression model

Hypothesis:

H0: The regression model isn’t significant.

H1: The regression model is significant.

Alpha = 5%

Test statistics:

F =15.14

P value =0.01

The decision, since the p-value is smaller than alpha we don’t reject H0.

Hence, we conclude that the regression model isn’t significant.

**Lab No. 17**

* The Following table represents the layout of CRD of four treatments.

|  |  |  |  |
| --- | --- | --- | --- |
| A (9) | B (14) | D (11) | C (10) |
| D (8) | A (14) | B (13) | C (16) |
| B (7) | C (12) | D (5) | A (11) |
| A (14) | B (12) | C (6) | D (5) |

At 5% level of significance test whether there is significant difference between mean of 4 treatments.

Solution:

Hypothesis:

H0: There is no significant difference between treatment.

H1: There is significant difference between treatment.

Alpha = 5%

Test statistics:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Anova: Single Factor |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | SUMMARY |  |  |  |  |  |  |  |
|  | *Groups* | *Count* | *Sum* | *Average* | *Variance* |  |  |  |
|  | A | 4 | 48 | 12 | 6 |  |  |  |
|  | B | 4 | 46 | 11.5 | 9.666667 |  |  |  |
|  | C | 4 | 44 | 11 | 17.33333 |  |  |  |
|  | D | 4 | 39 | 9.75 | 18.25 |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | ANOVA |  |  |  |  |  |  |  |
|  | *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |  |
|  | Between Groups(treatment) | 11.1875 | 3 | 3.729167 | 0.291057 | 0.831069 | 3.490295 |  |
|  | ERROR | 153.75 | 12 | 12.8125 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | Total | 164.9375 | 15 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | Decision, |  |  |  |  |  |  |  |

Since Fcal<Ftab so we accept H0.

Hence we conclude that there is no significance difference between mean of 4 treatments.

**Lab no 18**

* There are three brands of computers namely dell, Lenovo, and HP. The following are the lifetime of 15 computers in years.

|  |  |  |
| --- | --- | --- |
| Serial Number | Computer Brand | Lifetime in Years |
| 1 | Dell | 15 |
| 2 | Lenovo | 10 |
| 3 | HP | 9 |
| 4 | Dell | 12 |
| 5 | Lenovo | 6 |
| 6 | HP | 7 |
| 7 | Dell | 4 |
| 8 | Lenovo | 8 |
| 9 | HP | 13 |
| 10 | Dell | 11 |
| 11 | HP | 5 |
| 12 | Lenovo | 7 |
| 13 | Dell | 3 |
| 14 | HP | 5 |
| 15 | Lenovo | 4 |

Apply appropriate statistical tests to identify whether the average lifetime (in years) is significantly different across three brands of computers at a 5% level of significance. You can again tabulate the data initially in the required format for statistical analysis.

Hypothesis:

H0: There is no significance difference among average lifetime of three brands of computers.

H1: There is significance difference among average lifetime of three brands of computers.

Alpha = 5%

Test statistics:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Anova: Single Factor |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  | SUMMARY |  |  |  |  |  |  |
|  | *Groups* | *Count* | *Sum* | *Average* | *Variance* |  |  |
|  | Row 1 | 5 | 45 | 9 | 27.5 |  |  |
|  | Row 2 | 5 | 35 | 7 | 5 |  |  |
|  | Row 3 | 5 | 39 | 7.8 | 11.2 |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  | ANOVA |  |  |  |  |  |  |
|  | *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|  | Between Groups | 10.13333333 | 2 | 5.066666667 | 0.347826087 | 0.713111407 | 3.885294 |
|  | ERROR | 174.8 | 12 | 14.56666667 |  |  |  |
|  |  |  |  |  |  |  |  |
|  | Total | 184.9333333 | 14 |  |  |  |  |

Decision,

Fcal<ftab, so we accept H0,

Hence we conclude that There is no significance difference among average lifetime of three brands of computers.

**Lab no. 19**

* The following table represents the layout of R.B.D of 4 treatments (fertilizers) which is measured under 4 different conditions.

Conditions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatments | I | II | III | IV |
| A | 16 | 19 | 18 | 10 |
| B | 11 | 17 | 15 | 9 |
| C | 8 | 19 | 11 | 17 |
| D | 10 | 15 | 8 | 18 |

Carry out the analysis of the design.

Hypothesis:

H0T: There is no significance difference between treatments.

H1T: There is significance difference between treatments.

H0B : There is no significant difference between blocks.

H1B : There is significant difference between blocks.

Level of significance,

Alpha = 5%

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test statistics: | | |  |  |  |  |
|  |  |  |  |  |  |  |
| *SUMMARY* | *Count* | *Sum* | *Average* | *Variance* |  |  |
| A | 4 | 63 | 15.75 | 16.25 |  |  |
| B | 4 | 52 | 13 | 13.33333 |  |  |
| C | 4 | 55 | 13.75 | 26.25 |  |  |
| D | 4 | 51 | 12.75 | 20.91667 |  |  |
|  |  |  |  |  |  |  |
| 1 | 4 | 45 | 11.25 | 11.58333 |  |  |
| 2 | 4 | 70 | 17.5 | 3.666667 |  |  |
| 3 | 4 | 52 | 13 | 19.33333 |  |  |
| 4 | 4 | 54 | 13.5 | 21.66667 |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| ANOVA |  |  |  |  |  |  |
| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
| treatment | 22.1875 | 3 | 7.395833 | 0.454158 | 0.720775 | 3.862548 |
| Block | 83.6875 | 3 | 27.89583 | 1.713006 | 0.233458 | 3.862548 |
| Error | 146.5625 | 9 | 16.28472 |  |  |  |
|  |  |  |  |  |  |  |
| Total | 252.4375 | 15 |  |  |  |  |

Decision:

Since in both cases, fcal < ftab, so we accept H0

i.e. There is no significance difference between treatments and blocks.

**Lab no. 20**

* The following table gives the result of the experiment on four varieties of a crop in 5 blocks of plot.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Block I | Block II | Block III | Block IV | Block V |
| A 32 | B 33 | D 30 | A 35 | C 36 |
| B 34 | C 34 | C 35 | C 32 | D 29 |
| C 31 | A 34 | B 36 | B 37 | A 37 |
| D 29 | D 26 | A 33 | D 28 | B 35 |

Analyse the above result to test whether there is significant difference between yields of four varieties and also test whether blocks are homogenous or not.

Hypothesis:

H0T : There is no significant difference between treatments.

H1T : There is significant difference between treatments.

H0B : There is no significant difference between blocks.

H1B : There is significant difference between blocks.

Level of significance:

α=5%

Test statistics:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Anova: Two-Factor Without Replication | | |  |  |  |  |
|  |  |  |  |  |  |  |
| *SUMMARY* | *Count* | *Sum* | *Average* | *Variance* |  |  |
| A | 5 | 171 | 34.2 | 3.7 |  |  |
| B | 5 | 175 | 35 | 2.5 |  |  |
| C | 5 | 168 | 33.6 | 4.3 |  |  |
| D | 5 | 148 | 29.6 | 11.3 |  |  |
|  |  |  |  |  |  |  |
| I | 4 | 126 | 31.5 | 4.333333 |  |  |
| II | 4 | 127 | 31.75 | 14.91667 |  |  |
| III | 4 | 134 | 33.5 | 7 |  |  |
| IV | 4 | 132 | 33 | 15.33333 |  |  |
| V | 4 | 143 | 35.75 | 0.916667 |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| ANOVA |  |  |  |  |  |  |
| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
| treatments | 86.6 | 3 | 28.86667 | 8.469438 | 0.00272 | 3.490295 |
| Blocks | 46.3 | 4 | 11.575 | 3.396088 | 0.044567 | 3.259167 |
| Error | 40.9 | 12 | 3.408333 |  |  |  |
|  |  |  |  |  |  |  |
| Total | 173.8 | 19 |  |  |  |  |

Decision:

In both cases, fcal> ftab, so we reject H0

Hence we conclude that there is significant difference between treatments and blocks.