**LAB 1**

**Q) The table given below represents the strength of two different types of cable. Test whether there is significance difference between mean strength of two type’s cable at 5% level of significance.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type 1** | **12** | **16** | **19** | **14** | **15** | **18** | **18** |
| **Type 2** | **11** | **13** | **17** | **15** | **19** | **19** | **21** |

→

**Hypothesis:**

H0: µ1 = µ2 i.e. mean strength between two types are equal. H1: µ1 ≠ µ2 i.e. mean strength between two types are equal.

**Level of significance**: α = 5%=0.05

**Test statistics:**

|  |  |  |
| --- | --- | --- |
| t-Test: Two-Sample Assuming Equal Variances | | |
|  | *Variable 1* | *Variable*  *2* |
| Mean | 16.5 | 17.25 |
| Variance | 7.428571429 | 16.5 |
| Observations | 8 | 8 |
| Pooled Variance | 11.96428571 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 14 |  |
| t Stat | -  0.433658508 |  |
| P(T<=t) one-tail | 0.335572081 |  |
| t Critical one-tail | 1.761310136 |  |
| P(T<=t) two-tail | 0.671144161 |  |
| t Critical two-tail | 2.144786688 |  |

**Decision:**

t cal < t tab ,so we do not reject H0. Hence there is no significance difference between two types.

**LAB 2**

**Q) Following table represents the time taken by the students of two groups to complete the certain programming. At 5% level of significance can you conclude that time taken by students of group B is less than group A.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Group**  **A** | **22** | **28** | **25** | **30** | **27** | **38** |  |
| **Group**  **B** | **23** | **26** | **24** | **33** | **27** | **30** | **38** |

→

**Hypothesis:**

|  |
| --- |
| H0: µ1 = µ2 i.e. time taken by group A is equal to  group B |
| H1: µ2 < µ1 i.e. time taken by Group B is less  than group A |

**Level of significance**: α = 5%

=0.05

**Test statistics:**

|  |  |  |
| --- | --- | --- |
| t-Test: Two-Sample Assuming Equal Variances | | |
|  | *Variable 1* | *Variable 2* |
| Mean | 28.3333333 | 28.71428571 |
| Variance | 29.8666667 | 28.57142857 |
| Observations | 6 | 7 |
| Pooled Variance | 29.1601732 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 11 |  |
| t Stat | -  0.12680273 |  |
| P(T<=t) one-tail | 0.45069236 |  |
| t Critical one-tail | 1.79588482 |  |
| P(T<=t) two-tail | 0.90138472 |  |
| t Critical two-tail | 2.20098516 |  |

**Decision:**

cal < tab ,so we do not reject H0. Hence time taken is less.

**LAB 3**

**Q) The table given below represents the score before and after training. Can you conclude that there is significance difference between before and after?**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **before** | **54** | **65** | **43** | **77** | **68** | **70** | **75** |
| **after** | **52** | **66** | **46** | **79** | **69** | **69** | **78** |

→

**Hypothesis:**

H0: µ1 = µ2 i.e. there is no significance difference between before and after

H1: µ1 ≠ µ2 i.e. there is significance difference between before and after

**Level of significance**: α =5% **Test statistics:**

|  |  |  |
| --- | --- | --- |
| t-Test: Paired Two Sample for Means | | |
|  | *Variable 1* | *Variable 2* |
| Mean | 64.57142857 | 65.57143 |
| Variance | 146.952381 | 154.2857 |
| Observations | 7 | 7 |
| Pearson Correlation | 0.988120849 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 6 |  |
| t Stat | -  1.381698559 |  |
| P(T<=t) one-tail | 0.108154642 |  |
| t Critical one-tail | 1.943180281 |  |
| P(T<=t) two-tail | 0.216309283 |  |
| t Critical two-tail | 2.446911851 |  |

**Decision:**

t cal < t tab, so we do not reject H0. Hence there is no significance difference between before and after.

**LAB 4**

**Q) The following table represents the sales of electronic device before and after. At 5% level of significance can you conclude that advertisement is effective?**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **device** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** |
| **before** | **22** | **32** | **25** | **21** | **15** | **20** | **30** | **35** |
| **after** | **23** | **31** | **28** | **22** | **19** | **22** | **29** | **39** |

→

**Hypothesis:**

H0: µ1 = µ2 i.e. advertisement is not effective H1: µ1 > µ2 i.e. advertisement is effective

**Level of significance**: α = 5% = 0.05

**Test statistics:**

|  |  |  |
| --- | --- | --- |
| t-Test: Paired Two Sample for Means | | |
|  | *Variable*  *1* | *Variable*  *2* |
| Mean | 25 | 26.625 |
| Variance | 46.28571 | 41.98214 |
| Observations | 8 | 8 |
| Pearson Correlation | 0.956023 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 7 |  |
| t Stat | -2.30324 |  |
| P(T<=t) one-tail | 0.027364 |  |
| t Critical one-tail | 1.894579 |  |
| P(T<=t) two-tail | 0.054729 |  |
| t Critical two-tail | 2.364624 |  |

**Decision:**

t cal > t tab, so we reject H0. Hence advertisement is effective.

**LAB 5**

**Q1) The following data set represents the monthly income of programmer in thousand. At 5% level of significance test whether average monthly income of programmer is 40 thousand.**

**45,50,25,30,45,60,40,48,28,35,42**

→

**Hypothesis:**

H0: µ1 = 40 K i.e. the average monthly income of programmer is 40 thousand.

H1: µ1 ≠ 40K i.e. the average monthly income of programmer is not 40 thousand.

**Level of significance** = α = 5% = 0.05 Step 3: **Test statistics:**

**One-Sample Statistics**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | | Mean | Std. Deviation | Std. Error Mean |
| income | 11 | 40.73 | 10.518 | 3.171 |

**One-Sample Test**

Test Value = 40

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| t | | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| Lower | Upper |
| income | .229 | 10 | .823 | .727 | -6.34 | 7.79 |

**Decision**:

since P > α, then we do not reject H0. Hence the average monthly income of a programmer is 40 thousand.

**Lab 6**

**Q2)The life of two different brands of device is given below. Test whether there is significance difference between score f student before and after training.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Before** | **23** | **27** | **35** | **22** | **33** | **24** | **21** |
| **After** | **24** | **32** | **33** | **24** | **36** | **31** | **26** |

→

**Hypothesis:**

H0: µ1 = µ2 i.e. there is no significance difference between score of student before and after training.

H1: µ1≠ µ2 i.e. there is significance difference between score of student before and after training.

**Level of significance**: α = 5% = 0.05

**Test statistics**:

**Paired Samples Statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mean | | | N | Std. Deviation | Std. Error Mean |
| Pair 1 | Before | 26.43 | 7 | 5.533 | 2.091 |
| After | 29.43 | 7 | 4.756 | 1.798 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Paired Samples Test** | | | | | | | |
|  |  |  |  | Paired Differenc | es |  |  |
| 95% Confidence Interval of the Difference | | | | | | | |
|  |  | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | t |
| Pair 1 | Before - After | -3.000 | 3.000 | 1.134 | -5.775 | -.225 | -2.646 |

**Decision:**

since P < α so we reject H0. Hence there is significance difference between score of student before and after training.

**Lab 7**

**Q) The marks obtained by two group of student is given below. Test whether there is significance difference between marks of two groups?**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Group**  **A** | **22** | **29** | **43** | **35** | **40** | **45** |
| **Group B** | **21** | **34** | **48** | **36** | **42** | **46** |

→

**Hypothesis:**

H0: µ1 = µ2. No significance difference between marks of two groups. H1: µ1 ≠ µ2. Significance difference between two groups of marks **Level of significance:** α = 5% = 0.05

**Test statistics**:

**Group Statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 group A | N | Mean | Std. Deviation | Std. Error Mean |
| marks | 1 | 6 | 35.67 | 8.847 | 3.612 |
| 2 | 6 | 37.83 | 9.888 | 4.037 |

**Independent Samples Test**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Levene's Test for Equality of Variances | | | |  | | |
| F | | | Sig. | t | df | Sig. (2-tailed) |
| marks | Equal variances assumed | .030 | .866 | -.400 | 10 | .698.698 |
| Equal variances not assumed |  |  | -.400 | 9.879 | .698.698 |

**Decision:** Pα < P tab so we do not reject H0. Hence, we conclude that there is no significance difference between marks of two groups.

**Lab 8**

**Q) The following table represents the time taken by the two groups if students complete programming.Can you conclude time taken by group B is less than A?**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Grp A** | **22** | **28** | **25** | **30** | **21** | **28** | **31** |
| **Grp B** | **23** | **26** | **24** | **33** | **27** | **30** | **28** |

→

**Hypothesis:**

H0: µ1 = µ2 i.e. time taken by students of group B is not less than group A.

H1: µ2 < µ1 i.e. time taken by students of group B is less than group A. **Level of significance**: α = 5%=0.05

**Test statistics:**

|  |  |  |
| --- | --- | --- |
| t-Test: Two-Sample Assuming Equal Variances | | |
|  | *Variable*  *1* | *Variable*  *2* |
| Mean | 25.66667 | 27.28571 |
| Variance | 13.06667 | 11.90476 |
| Observations | 6 | 7 |
| Pooled Variance | 12.4329 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 11 |  |
| t Stat | -0.82533 |  |
| P(T<=t) one-tail | 0.213361 |  |
| t Critical one-tail | 1.795885 |  |
| P(T<=t) two-tail | 0.426722 |  |
| t Critical two-tail | 2.200985 |  |

**Decision:**

t cal < t tab so we do not reject H0. Hence, we conclude that time taken by students of group B is not less than group A.

**Lab 9**

**Q) The performance score of employee before and after training is below. Using Wilcoxon sign rank test is there any significance difference before and after training.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **before** | **57** | **80** | **64** | **90** | **59** | **76** | **98** | **70** | **83** |
| **after** | **80** | **90** | **62** | **95** | **58** | **80** | **99** | **75** | **94** |

→

**Hypothesis:**

H0: md1 = md2 i.e. there is no significance difference before and after training

H1: md1≠md2 i.e. there is significance difference before and after training

**Level of significance**: α = 0.05

**Test statistics:**

**Ranks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | | | Mean Rank | Sum of Ranks |
| after - before | Negative Ranks | 2a | 2.25 | 4.50 |
| Positive Ranks | 7b | 5.79 | 40.50 |
| Ties | 0c |  |  |
| Total | 9 |  |  |

1. after < before
2. after > before
3. after = before Test Statisticsa

after - before

|  |  |
| --- | --- |
| Z | -2.136b |
| Asymp. Sig. (2-tailed) | .033 |

1. Wilcoxon Signed Ranks Test
2. Based on negative ranks.

**Decision:** P value < α so we reject H0. Hence, there is significance difference before and after training.

**Lab 10**

**Q) The consumption of fuel in travelling a certain distance by 8 motorbikes before and after service is given.Is there change in consumption of fuel before and after service draw conclusion using Wilcoxon signed rank test.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **before** | **5.2** | **4.8** | **4.7** | **6.0** | **5.3** | **6.1** |
| **after** | **5.1** | **4.2** | **5.0** | **5.8** | **5.1** | **6.2** |

→

**Hypothesis:**

H0: md1 = md2i.e.there is no change in consumption H1: md1 ≠ md2i.e.there is change is consumption of fuel **Level of significance:** α = 5%=0.05

**Test statistics:**

**Ranks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | | | Mean Rank | Sum of Ranks |
| after - before | Negative Ranks | 4a | 3.63 | 14.50 |
| Positive Ranks | 2b | 3.25 | 6.50 |
| Ties | 0c |  |  |
| Total | 6 |  |  |

1. after < before
2. after > before
3. after = before Test Statisticsa

after - before

|  |  |
| --- | --- |
| Z | -.843b |
| Asymp. Sig. (2-tailed) | .399 |

1. Wilcoxon Signed Ranks Test
2. Based on positive ranks.

**Decision:**

P value > α so we do not reject H0. Hence, there is no change in consumption in fuel.

**LAB 11**

1. **Following table represents the data of rents which depends upon no. of rooms and distance from down town**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **rent** | **45** | **40** | **60** | **30** | **35** | **70** | **33** |
| **No. of**  **room** | **3** | **3** | **5** | **2** | **3** | **5** | **2** |
| **distance** | **3** | **5** | **4** | **6** | **6** | **2** | **5** |

* 1. **Fit the multiple regression from the data**

Let their multiple equation be Y = a + b1x1 + b2x2 From table, Y = 33.72 + 8.32x1 – 3.69x2

* 1. **Compute coefficient of determination and standard error**

Coefficient of determination = 0.98 i.e. 98%

Standard error = 2.13

* 1. **Test for regression coefficient** :

Test for b1:

Hypothesis:

H0: regression coefficient is not significant. H1: regression coefficient is significant.

**Level of significance:** α = 5%

**Test statistics:** t =8.67 **Probability value:** p =0.00097

**Decision:** p value < α so we reject H0. Hence, regression coefficient is not significant.

Test for b2:

**Hypothesis:**

H0: regression coefficient is not significant. H1: regression coefficient is significant.

**Level of significance:** α = 5%

**Test statistics:** t = -4.64 **Probability value:** p =0.0096

**Decision:** p value < α so we reject H0. Hence, regression coefficient is not significant.

* 1. **Regression modeltest**

**Hypothesis:**

H0: regression model is not significant. H1: regression model is significant.

**Level of significance**: α =5% **Test statistics:** F = 146 **Probability:** p = 0.00091

**Decision:**

p-value < alpha so we reject H0. Hence we conclude that regression model is significant.

**LAB 12**

**Q) The following represents monthly income, expenditure and family size of six families. Obtain the multiple regression equation to predict the expenditure of family whose monthly income is 28 and family size**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **expenditure** | **10** | **12** | **14** | **15** | **10** | **11** |
| **income** | **25** | **30** | **25** | **22** | **20** | **21** |
| **Family size** | **5** | **6** | **3** | **6** | **2** | **1** |

* 1. Fit the multiple regression from the data

Let their multiple equation be Y = a + b1x1 + b2x2 From table, Y = -6.81 + 1.05x1 – 2.01x2

* 1. Compute coefficient of determination and standard error Coefficient of determination = 69%

Standard error = 1.49

* 1. Test for regression coefficient Test for b1:

**Hypothesis:**

H0: regression coefficient is not significant. H1: regression coefficient is significant.

**Level of significance:** α = 5%

**Test statistics:** t =0.34

**Probability value**: p =0.73

**Decision:** p value < α so we reject H0. Hence, regression coefficient is not significant.

Test for b2:

**Hypothesis:**

H0: regression coefficient is not significant. H1: regression coefficient is significant.

**Level of significance**: α = 5% Test statistics: t =0.34

Probability value: p = .73

**Decision:** p value < α so we reject H0. Hence, regression coefficient is not significant.

* 1. **Regression modeltest**

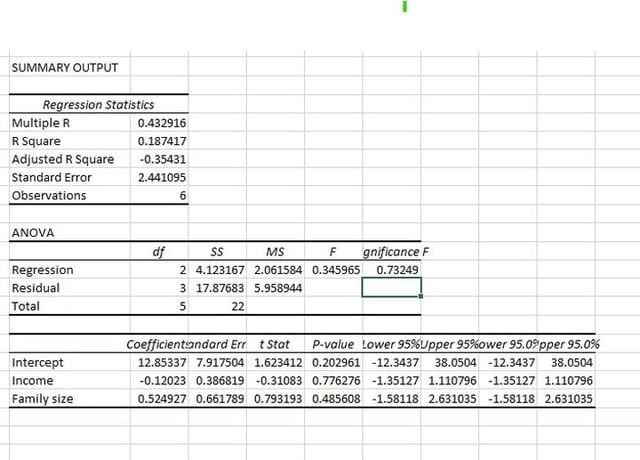
**Hypothesis:**

H0: regression model is not significant. H1: regression model is significant.

**Level of significance:** α = 5%

=0.05

**Test statistics:**



**Decision:**

p-value < alpha so we reject H0. Hence we conclude that regression model is significant.

* 1. when monthly income is 28 and family size is 4

Multiple regression equation is,

Y = -6.81 + 1.05x1 – 2.01x2

x1 = 28,x2 = 4

Y = -6.81 + 1.05(28) – 2.01(4)

= 14.55

**LAB 13**

**Q1) The layout of CRD is given below. Carry out the analysis of design**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **A** | **12** | **23** | **17** | **19** | **15** |
| **B** | **14** | **13** | **18** | **16** | **22** |
| **C** | **15** | **19** | **21** | **13** | **17** |
| **D** | **24** | **18** | **19** | **12** | **17** |

→

**Hypothesis:**

H0: there is no significance difference between treatments. H1: there is significance difference between treatments.

**Level of significance:** α =5% **Test statistics:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Anova: Single Factor | | | | | | |
| SUMMARY | | | | |  |  |
| *Groups* | *Count* | *Sum* | *Average* | *Variance* |  |  |
| Row 1 | 5 | 86 | 17.2 | 17.2 |  |  |
| Row 2 | 5 | 83 | 16.6 | 12.8 |  |  |
| Row 3 | 5 | 85 | 17 | 10 |  |  |
| Row | 5 | 90 | 18 | 18.5 |  |  |
| ANOVA | | | | | | |
| *Source of*  *Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
| Between Groups | 5.2 | 3 | 1.733333 | 0.118519 | 0.947905 | 3.238872 |
| Within Groups | 234 | 16 | 14.625 |  |  |  |
| Total | 239.2 | 19 |  |  |  |  |

**Decision:**

f cal < f tab so we do not reject H0. Hence, we conclude that there is no significant difference between 4 treatments.

**Q2) The following table represents the layout of CRD of 3 treatments in 4 replication. At 5% level of significance is there any significance difference between mean of 3 treatments.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **A** | **12** | **11** | **9** | **11** |
| **B** | **9** | **13** | **14** | **12** |
| **C** | **10** | **12** | **8** | **14** |

→

**Hypothesis:**

H0: there is no significance difference between mean of treatments. H1: there is significance difference between mean of treatments.

**Level of significance:** α =5% **Test statistics:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Anova: Single Factor | | | | | | |
| SUMMARY | | | | |  |  |
| *Groups* | *Count* | *Sum* | *Average* | *Variance* |  |  |
| Row 1 | 4 | 43 | 10.75 | 1.583333 |  |  |
| Row 2 | 4 | 48 | 12 | 4.666667 |  |  |
| Row 3 | 4 | 44 | 11 | 6.666667 |  |  |
| ANOVA | | | | | | |
| *Source of*  *Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
| Between Groups | 3.5 | 2 | 1.75 | 0.406452 | 0.677645 | 4.256495 |
| Within Groups | 38.75 | 9 | 4.305556 |  |  |  |
| Total | 42.25 | 11 |  |  |  |  |

**Decision:** f cal < f tab so we do not reject H0. Hence, there is no significance difference between mean of 3 treatments.

**LAB 14**

**Q1) The layout of RBD is given below. Carry out the analysis of design**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **treatment** | **Block I** | **II** | **III** | **IV** |
|  | **1** | **2** | **3** | **4** |
| **A** | **45** | **51** | **43** | **46** |
| **B** | **41** | **52** | **46** | **50** |
| **C** | **47** | **52** | **40** | **42** |
| **D** | **44** | **48** | **50** | **54** |

→

**Hypothesis:**

**For treatment**

H0: there is no significance difference between the treatments H1: there is significance difference between the treatments.

**For block**

H0: there is no significance difference between the blocks H1: there is significance difference between the blocks

**Level of significance:** α = 5%=0.05

**Test statistics:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Anova: Two-Factor Without Replication | | | | | | |
| *SUMMARY* | *Count* | *Su*  *m* | *Averag*  *e* | *Varianc*  *e* |  |  |
| Row 1 | 4 | 18  5 | 46.25 | 11.583  33 |  |  |
| Row 2 | 4 | 18  9 | 47.25 | 23.583  33 |  |  |
| Row 3 | 4 | 18  1 | 45.25 | 28.916  67 |  |  |
| Row 4 | 4 | 19  6 | 49 | 17.333  33 |  |  |
| Column 1 | 4 | 17  7 | 44.25 | 6.25 |  |  |
| Column 2 | 4 | 20  3 | 50.75 | 3.5833  33 |  |  |
| Column 3 | 4 | 17  9 | 44.75 | 18.25 |  |  |
| Column 4 | 4 | 19  2 | 48 | 26.666  67 |  |  |
| ANOVA |  |  |  |  |  |  |
| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
| Rows | 30.687  5 | 3 | 10.229  17 | 0.6892  84 | 0.5810  67 | 3.8625  48 |
| Columns | 110.68  75 | 3 | 36.895  83 | 2.4861  96 | 0.1268  13 | 3.8625  48 |
| Error | 133.56  25 | 9 | 14.840  28 |  |  |  |

**Decision:**

For both cases, f cal < f tab so we do not reject H0. Hence, we conclude that there is no significant difference between treatment and block.

**Q2) The following table given below the layout of RBD of 4 treatments if four replication. Carry out the analysis of design.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **treatment** | **1** | **2** | **3** | **4** |
| **A** | **14** | **15** | **10** | **14** |
| **B** | **10** | **16** | **12** | **10** |
| **C** | **18** | **12** | **16** | **10** |
| **D** | **12** | **14** | **13** | **9** |

→

**Hypothesis:**

**For treatment:-**

H0: there is no significance difference between the treatments H1: there is significance difference between the treatments.

**For block:-**

H0: there is no significance difference between the blocks H1: there is significance difference between the blocks.

**Level of significance:** α = 5%=0.05

Test statistics:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Anova: Two-Factor Without Replication | | | | | | |
| *SUMMARY* | *Count* | *Su*  *m* | *Average* | *Variance* |  |  |
| Row 1 | 4 | 53 | 13.25 | 4.91666  7 |  |  |
| Row 2 | 4 | 48 | 12 | 8 |  |  |
| Row 3 | 4 | 56 | 14 | 13.3333  3 |  |  |
| Row 4 | 4 | 48 | 12 | 4.66666  7 |  |  |
| Column 1 | 4 | 54 | 13.5 | 11.6666  7 |  |  |
| Column 2 | 4 | 57 | 14.25 | 2.91666  7 |  |  |
| Column 3 | 4 | 51 | 12.75 | 6.25 |  |  |
| Column 4 | 4 | 43 | 10.75 | 4.91666  7 |  |  |
| ANOVA |  |  |  |  |  |  |
| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
| Rows | 11.6875 | 3 | 3.89583  3 | 0.53479  5 | 0.66993  3 | 3.86254  8 |
| Columns | 27.1875 | 3 | 9.0625 | 1.24404  2 | 0.35001  4 | 3.86254  8 |
| Error | 65.5625 | 9 | 7.28472  2 |  |  |  |
| Total | 104.437  5 | 15 |  |  |  |  |

**Decision:**

For both cases, f cal < f tab so we do not reject H0. Hence, we conclude that there is no significance difference between 4 treatments and blocks.