**Practical No: 08**

**OBJECT:** The yield of treatments in different plots are as shown in the following plots. Carry out analysis. Use CRD.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1401 | 2536 | 2459 | 2537 | 2827 | 2069 |
| 2211 | 1797 | 1170 | 1516 | 2104 | 2385 |
| 3366 | 2104 | 2591 | 2406 | 1077 | 2544 |

**WORKING EXPRESSION:**

CRD is simplest of all the design which is based upon only two principles of design namely replication and randomization. In this design treatments are assigned completely at random manner so that each experimental unit has equal chance of receiving any treatment. It is appropriate for homogeneous experimental material.

The placement of the treatments on the experimental units along with the arrangement of experimental unit is known as the layout of an experiment. For example, consider t = 3 (A, B, C) and r= 3 then treatments are allocated as shown below:

Layout of CRD:

|  |  |  |  |
| --- | --- | --- | --- |
| C | A | B | A |
| C | B | A | A |
| B | B | C | C |

**Mathematical Model:**

𝒚𝒊𝒋 = 𝛍 + 𝜶𝒊 +𝒆𝒊𝒋; (𝒊 = 𝟏, 𝟐, … 𝒕;𝒋 = 𝟏, 𝟐, … 𝒓)

Where,

𝒚𝒊𝒋 = 𝒋 𝒕𝒉 𝐫𝐞𝐩𝐥𝐢𝐜𝐚𝐭𝐢𝐨𝐧 𝐨𝐟 𝒊 𝒕𝒉 𝒕𝒓𝒆𝒂𝒕𝒎𝒆𝒏𝒕.

𝝁 = 𝒈𝒆𝒏𝒆𝒓𝒂𝒍 𝒎𝒆𝒂𝒏 𝒆𝒇𝒇𝒆𝒄𝒕

𝜶𝒊 = 𝑻𝒉𝒆 𝒆𝒇𝒇𝒆𝒄𝒕 𝒅𝒖𝒆 𝒕𝒐 𝒊 𝒕𝒉 𝒕𝒓𝒆𝒂𝒕𝒎𝒆𝒏𝒕

𝒆𝒊𝒋 = 𝒆𝒓𝒓𝒐𝒓 𝒅𝒖𝒆 𝒕𝒐 𝒄𝒉𝒂𝒏𝒄𝒆

**Hypothesis Setting:**

Null hypothesis (𝑯𝒐𝑻): μ₁ = μ₂ =μ₃………. = μₖ i.e., there is no significant difference between the treatment effects.

Alternative hypothesis(𝑯𝟏𝑻): At least one μᵢ is different. (i= 1, 2, 3……. k)

**Total sum of square (TSS)** = Sum of square due to treatment (SST)+ Sum of square due to error (SSE)

TSS = SST + SSE

**ANOVA Table:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source of variation**  **(S.V)** | **Degree of freedom**  **(d.f)** | **Sum of Square**  **(S.S)** | **Mean Sum of Square**  **(M.S.S)** | **Fcal** | **Ftab** |
| **Treatment** | **t-1** | **SST** | **MST=SST/t-1** | **Fcal=MST/MSE** | **Ftab=Fα{(t-1) (N-t)}** |
| **Error** | **N-t** | **SSE** | **MSE=SSE/N-t** |  |  |
| **Total** | **N-1** | **TSS** |  |  |  |

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source of variation**  **(S.V)** | **Degree of freedom**  **(d.f)** | **Sum of Square**  **(S.S)** | **Mean Sum of Square**  **(M.S.S)** | **Fcal** | **Ftab** |
| **Treatment** | **t-1** | **SST** | **MST=SST/t-1** | **Fcal=MST/MSE** | **Ftab=Fα{(t-1) (N-t)}** |
| **Error** | **N-t** | **SSE** | **MSE=SSE/N-t** |
| **Total** | **N-1** | **TSS** |  |

Practical No: 08

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Subject: Statistics

Date: 2080/04/15

Faculty: BSc. CSIT 3rd Semester

**OUTPUT:**

ONEWAY Values BY Treatments

/STATISTICS DESCRIPTIVES

/MISSING ANALYSIS

/POSTHOC=TUKEY ALPHA(0.05).

**One way**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Descriptives** | | | | | | | | |
| Values of observations | | | | | | | | |
|  | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Minimum | Maximum |
| Lower Bound | Upper Bound |
| t1 | 4 | 2126.7500 | 305.99169 | 152.99585 | 1639.8489 | 2613.6511 | 1797.00 | 2537.00 |
| t2 | 4 | 2678.0000 | 488.86194 | 244.43097 | 1900.1116 | 3455.8884 | 2211.00 | 3366.00 |
| t3 | 5 | 2522.6000 | 179.87023 | 80.44041 | 2299.2616 | 2745.9384 | 2385.00 | 2827.00 |
| t4 | 5 | 1453.6000 | 403.71314 | 180.54601 | 952.3239 | 1954.8761 | 1077.00 | 2104.00 |
| Total | 18 | 2172.2222 | 594.41663 | 140.10534 | 1876.6258 | 2467.8187 | 1077.00 | 3366.00 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Test of Homogeneity of Variances** | | | |
| Values of observations | | | |
| Levene Statistic | df1 | df2 | Sig. |
| .874 | 3 | 14 | .478 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ANOVA** | | | | | |
| Values of observations | | | | | |
|  | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 4227427.961 | 3 | 1409142.654 | 11.088 | .001 |
| Within Groups | 1779201.150 | 14 | 127085.796 |  |  |
| Total | 6006629.111 | 17 |  |  |  |

**Post Hoc Tests**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Multiple Comparisons** | | | | | | |
| Dependent Variable: Values  Tukey HSD | | | | | | |
| (I) There are four treatments t1, t2, t3, t4 | (J) There are four treatments t1, t2, t3, t4 | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
| Lower Bound | Upper Bound |
| t1 | t2 | -551.25000 | 252.07717 | .175 | -1283.9292 | 181.4292 |
| t3 | -395.85000 | 239.14140 | .382 | -1090.9305 | 299.2305 |
| t4 | 673.15000 | 239.14140 | .059 | -21.9305 | 1368.2305 |
| t2 | t1 | 551.25000 | 252.07717 | .175 | -181.4292 | 1283.9292 |
| t3 | 155.40000 | 239.14140 | .914 | -539.6805 | 850.4805 |
| t4 | 1224.40000\* | 239.14140 | .001 | 529.3195 | 1919.4805 |
| t3 | t1 | 395.85000 | 239.14140 | .382 | -299.2305 | 1090.9305 |
| t2 | -155.40000 | 239.14140 | .914 | -850.4805 | 539.6805 |
| t4 | 1069.00000\* | 225.46467 | .002 | 413.6718 | 1724.3282 |
| t4 | t1 | -673.15000 | 239.14140 | .059 | -1368.2305 | 21.9305 |
| t2 | -1224.40000\* | 239.14140 | .001 | -1919.4805 | -529.3195 |
| t3 | -1069.00000\* | 225.46467 | .002 | -1724.3282 | -413.6718 |
| \*. The mean difference is significant at the 0.05 level. | | | | | | |

**Homogeneous Subsets**

|  |  |  |  |
| --- | --- | --- | --- |
| **Values of observations** | | | |
| Tukey HSD | | | |
| There are four treatments (t1,t2,t3,t4) | N | Subset for alpha = 0.05 | |
| 1 | 2 |
| t4 | 5 | 1453.6000 |  |
| t1 | 4 | 2126.7500 | 2126.7500 |
| t3 | 5 |  | 2522.6000 |
| t2 | 4 |  | 2678.0000 |
| Sig. |  | .059 | .144 |

|  |
| --- |
| Means for groups in homogeneous subsets are displayed. |
| a. Uses Harmonic Mean Sample Size = 4.444. |
| b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed. |

**RESULTS:**

**Post Hoc Tests:**

There are four treatments t1, t2, t3, t4.

For t1: t1=t2, t1=t3, t1=t4

For t2: t2=t1, t2=t3, t2 **≠** t4 (0.05>0.01)

For t3: t3 **≠** t4 (0.05>0.02)

For t4: t4=t1, t4 **≠** t2 (0.05>0.01), t4 **≠** t3 (0.05>0.02)

**From the ANOVA table obtained:**

Mean sum of square due to treatment (M.S.T) = 1409142.654

Fcal = 11.088 also P-value = 0.001.

**Decision:**

Since p value = 0.001 < α = 0.05. Hence, we accept H1t.

Hence, we can conclude that the treatment difference is highly significant.

**CONCLUSION:**

Hence, we have yield of treatment in different plots using CRD. There are altogether 18 observations and four treatments (t1, t2, t3, t4). We have calculated post hoc tests where the mean difference is significant at 5% level. If the p value is greater than 0.05 then it is insignificant and if less, it is significant. At last, from ANOVA table, we came to know that Fcal= 11.088 and p-value = 0.01. Hence, we have taken the decision comparing p value with level of significance where the p-value is less than level of significance and at last we conclude at least one μ₁ is different.