Appendix 2- Part II

When the “X” seed" was introduced into the market in 2019, it was purchased and grown by many farmers. One farmer per state reported the three main costs associated with growing the plant: A, B, and C. The states were separated in regions 1-5. All these costs were summed into the total cost of growing the plant.

See dataset used below:

Table 1: Regions_Data

Region	A	B	C	Total_Cost
Region 1	1594.53	104.43	588.84	2287.80
Region 1	2259.97	122.89	393.78	2776.64
Region 1	954.37	111.20	431.73	1497.30
Region 1	931.80	141.87	249.40	1323.07
Region 1	857.33	153.38	484.82	1495.53
Region 1	1453.55	138.10	358.18	1949.83
Region 1	1246.11	185.92	483.35	1915.37
Region 1	1780.28	189.15	421.86	2391.29
Region 1	1492.55	140.77	464.32	2097.64
Region 1	1465.55	116.38	490.41	2072.34
Region 2	910.70	217.17	376.87	1504.73
Region 2	1211.35	48.62	350.52	1610.49
Region 2	1057.05	118.42	502.71	1678.18
Region 2	2016.91	95.60	554.17	2666.69
Region 2	1285.52	82.58	427.60	1795.70
Region 2	1591.34	132.12	253.67	1977.13
Region 2	1535.39	48.95	358.66	1943.01
Region 2	1712.72	57.20	452.73	2222.65
Region 2	1594.78	107.60	345.89	1933.03
Region 2	701.06	63.82	522.92	1287.80
Region 3	1029.61	145.55	325.05	1500.21
Region 3	2538.05	75.50	415.19	3028.75
Region 3	1677.14	187.37	206.34	2070.85
Region 3	1122.35	110.09	350.56	1583.01
Region 3	1032.29	119.12	452.46	1603.87
Region 3	1620.01	97.69	290.73	2008.44
Region 3	258.94	186.39	337.28	782.61
Region 3	733.30	87.25	411.85	1232.40
Region 3	699.78	72.22	590.32	1362.32
Region 3	1172.15	99.46	583.98	1855.59
Region 4	521.42	80.62	429.80	2026.21
Region 4	556.41	165.97	366.54	1317.43
Region 4	517.26	68.15	445.26	1582.79
Region 4	438.47	186.50	151.41	1520.01
Region 4	331.12	183.50	291.83	2123.25
Region 4	434.05	201.28	240.21	2141.68
Region 4	479.14	154.61	476.62	1957.07
Region 4	667.03	135.05	369.33	1260.02
Region 4	516.67	130.18	528.25	1898.00
Region 4	566.61	59.24	320.34	1629.47
Region 5	568.88	113.20	305.38	1382.78
Region 5	482.11	74.65	464.36	1950.66
Region 5	700.27	143.84	338.94	1499.43

Region	A	B	C	Total_Cost
Region 5	621.44	103.06	281.04	937.72
Region 5	550.91	115.41	465.21	2078.15
Region 5	438.32	144.00	258.52	2389.35
Region 5	395.00	109.87	420.48	827.88
Region 5	487.61	204.44	376.18	1937.15
Region 5	664.26	120.95	708.42	2310.73
Region 5	469.10	183.22	444.36	1871.34

Appendix 2.1 ANOVA

The null hypothesis is that the mean of price A (U_a) is the same across all regions. The alternative hypothesis is that they are not all equal, i. e., there is at least one mean that is not equal to the remaining.

Null Hypothesis: U_a of each region is equal

Alternative Hypothesis: U_a of each region are not all equal

```
Regions_Anova<-aov(A~Region, data=Regions_Data)
anova(Regions_Anova)
```

```
## Analysis of Variance Table
##
## Response: A
##           Df  Sum Sq Mean Sq F value    Pr(>F)
## Region     4 7900117 1975029  12.881 4.542e-07 ***
## Residuals 45 6899780  153328
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Reject the Null hypothesis- The data collected provides evidence that the mean price of cost A is not the same for all regions, with a significance level of 0.05.

Appendix 2.2 Pairwise *t*-test

But which are the regions that differ?

To do this we must run a pairwise *t*-test. In this example, we are not going to adjust the pairwise t-test error for multiple comparison, i.e., we are not controlling the family-wise error rate.

```
pairwise.t.test(A,Region,p.adj="none")
```

```
##
##  Pairwise comparisons using t tests with pooled SD
##
## data:  A and Region
##
##          Region 1 Region 2 Region 3 Region 4
## Region 2 0.81189  -        -        -
## Region 3 0.22541  0.32759  -        -
## Region 4 5.7e-06  1.3e-05  0.00030  -
```

```
## Region 5 1.1e-05  2.4e-05  0.00056  0.84261
##
## P value adjustment method: none
```

The data collected provides evidence that mean of cost A of Region 4 and 5 differ from the remaining average regional costs, with a significance level of 0.05. Comparing the cost of region 4 and the cost of region 5, there is no evidence that they differ, with this significance level.