**IME 503 (Fall 22) Take-home Question as a part of Exam #2**

**Q3:**  The type of material used and the temperature of the usage environment affect the maximum output voltage of a particular storage battery. An experiment is designed to determine the significant source (s) of variability for the maximum output voltage. The following data set shows the laboratory results for this experiment. The data entries are the recorded maximum voltages in proper units. The material type and the temperature are both fixed effects.

Temperature (F)

|  |  |  |  |
| --- | --- | --- | --- |
| **Material Type** | **50 Degrees** | **65 Degrees** | **80 Degrees** |
| **A** | 130 155 74 | 34 40 80 | 20 70 82 |
| **B** | 150 188 159 | 136 122 106 | 25 70 58 |
| **C** | 138 110 168 | 174 120 150 | 96 104 82 |

**Part A:** Conduct the proper ANOVA model **without** including the replication effect as a source of variation. Report **only** the relevant results that explain the significant source(s) of variability for LOS=5%.

**All original hypotheses:**

1. H0 : μA = μB = μC

HA : Otherwise

1. H0 : μ50 = μ65 = μ80

HA : Otherwise

1. H0 : There is not a significant interaction between factors

HA : There is a significant interaction between factors

D.R. Reject H0 if P < 0.05

**Results (F and P values for only the impacting hypothesis (ses)):**

**F** = 3.24

**P** = 0.036

**Actionable conclusion (with supportive plots):**

The interaction between material type and temperature is significant since P = 0.036 < 0.05. The interaction shows that material type B at 50 degrees has the highest mean maximum output voltage in this test.

**Chart, line chart

Description automatically generated**

**Part B:** Do the above analysis but include the replication effect as a source of variation. Again, use p<0.05.

**All Hypotheses:**

1. H0 : μA = μB = μC

HA : Otherwise

1. H0 : μ50 = μ65 = μ80

HA : Otherwise

1. H0 : There is not a significant interaction between factors

HA : There is a significant interaction between factors

D.R. Reject H0 if P < 0.05

**Results (F and P values for only the impacting hypothesis (ses)):**

Material Type: **F** = 8.08, **P** = 0.004

Temperature: **F** = 16.10, **P** = 0.000

**Actionable conclusion (with supportive plots):**

The interaction effect was notable, but P > 0.05 so it fails to reject the null hypothesis. Both main effects are significant with P-values less than 0.05. The plot below shows that the mean maximum voltage is best for material type C and at a temperature of 50 Degrees.

Chart, line chart

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