1. In order to determine if there are significant differences in average lives (in months) of three different brands of batteries experimental results yielded the following observations:

| Brand | Lifetimes (in months) |
|-------|-----------------------|
| A | 40, 30, 50, 50, 30 |
| B | 60, 40, 55, 65 |
| C | 60, 50, 70, 65, 75, 40 |

Carry out the One Way Analysis of Variance. Test whether the three brands have different average lifetimes? If they have different lifetimes, use the Fisher least significant difference method to detect that which brands cause the difference?
(Given $F_{2,12,0.1} = 2.81$, $F_{2,12,0.05} = 3.89$, $t_{12,0.05} = 1.782$, $t_{12,0.025} = 2.179$).

2. The following table gives the yield (quintals per plot) of three varieties of rice, obtained with four different kinds of fertilizers. Carry out the Two Way Analysis of Variance assuming no interaction effect. Test the hypotheses of (i) equality in the average yields of the three varieties of rice, and (ii) homogeneity of effects of four types of fertilizers. $(F_{2,6,0.1} = 3.46, F_{2,6,0.05} = 5.14, F_{3,6,0.1} = 3.29, F_{3,6,0.05} = 4.76)$

| | Variety of Rice | | |
|-----------|----|----|----|
| Fertilizer | A | B | C |
| α | 8 | 3 | 7 |
| β | 10 | 4 | 8 |
| γ | 6 | 5 | 6 |
| δ | 8 | 4 | 7 |

3. A photographer who wishes to improve the clarity of developed pictures adds two amounts of Metol (1.5 and 2.5 grams) and two amounts of hydroquinone (4 and 6 grams) to a liter of negative developer. The resulting clarity readings appear below. Carry out the Analysis of Variance assuming interaction effect. Test the hypotheses about homogeneity of effects of Metol, Hydroquinone and interaction between the two.
(Given $F_{1,4,0.05} = 7.71$).

| | Hydroquinone | |
|-------|-------|-------|
| Metol | 4 | 6 |
| 1.5 | 28.30 | 33.33 |
| 2.5 | 42.38 | 40.42 |

4. To investigate the effect of four assembly methods (A, B, C, D) on the assembly line for a colour television component, four operators are selected. Since each assembly method produces such fatigue that the time required for the last assembly will be much more than the time required for the first regardless of the method. So a Latin square is chosen and the data is given below. Analyze the data and draw your conclusions.
(Given $F_{3,6,0.1} = 3.29, F_{3,6,0.05} = 4.76$).

| Order of Assembly | Operator | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | C = 10 | D = 14 | A = 7 | B = 8 |
| 2 | B = 7 | C = 18 | D = 11 | A = 8 |
| 3 | A = 5 | B = 10 | C = 11 | D = 9 |
| 4 | D = 10 | A = 10 | B = 12 | C = 14 |

5. Suppose in Problem 4, the engineer suspects that the choice of the workplace may also affect the outcome. So a fourth factor, workplace (α, β, γ, δ) is introduced and a Graeco-Latin square is used. Analyze the data below and draw your conclusions.
(Given $F_{3,3,0.1} = 5.39, F_{3,3,0.05} = 9.28$).

| Order of Assembly | Operator | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | Cβ = 11 | Bγ = 10 | Dδ = 14 | Aα = 8 |
| 2 | Bα = 8 | Cδ = 12 | Aγ = 10 | Dβ = 12 |
| 3 | Aδ = 9 | Dα = 11 | Bβ = 7 | Cγ = 15 |
| 4 | Dγ = 9 | Aβ = 8 | Cα = 18 | Bδ = 6 |