

- Q1. A model was used to determine the response time (in milliseconds) for three different types of circuits used in an automatic valve shutoff mechanism. The results are given below.

	Circuit Type			
	X	Y	Z	
	18	5	8	
	19	4	11	
	23	8	10	
	16	14	7	
	28	6	13	
Total	104	37	49	190
S^2	22.7	15.8	5.7	

$$18^2 + 19^2 + 23^2 + \dots + 7^2 + 13^2 = 3,094$$

$$104^2 + 37^2 + 49^2 = 14,586$$

You are required to perform an analysis of variance (ANOVA) and test the hypothesis that the three circuit types have the same response time at the level of significance 5%.

- Q2. A study was conducted to evaluate three programs X, Y and Z for improving the reading skills of Primary Six pupils. Twenty seven pupils were randomly assigned to one of three groups; each group used one of the programs. A test of reading skills was administered at the beginning and end of the school year. The dependent variable was the amount of increase from the pretest to the post test. The following data were obtained.

	Program X	Program Y	Program Z	
	19	14	11	
	17	19	14	
	17	12	17	
	22	11	19	
	21	15	17	
	16	16	16	
	14	20	9	
	12	14	23	
	20	12	15	
Total	158	133	141	432
$\sum X^2$	2,860	2,043	2,347	7,250
S^2	10.78	9.69	17.25	

You are required to obtain an analysis of variance (ANOVA) table and test whether the three programs are equally effective in improving the reading skills of Primary Six pupils. Use the level of significance 5%.

- Q3. Consider the correlation between the scores on an total sales (x) and mileage claim (y). The first two columns in the table contain the identification number of the macro unit (j) which is the marketing departments for different products, and the micro-unit (i). The other two columns contain the data.

j	i	x_{ij}	y_{ij}
1	1	2	5
1	2	3	6
1	3	4	7
1	4	5	3
2	1	4	5
2	2	5	6
2	3	6	7
2	4	6	9
3	1	1	2
3	2	2	3
3	3	3	4
3	4	7	2
4	1	2	3
4	2	4	4
4	3	6	5
4	4	8	3
5	1	3	4
5	2	4	5
5	3	5	6
5	4	2	4
6	1	6	5
6	2	7	6
6	3	8	7
6	4	4	3

- Q3. You are require to
- Estimate the total regression
 - Estimate the regression between group means.
 - Estimate the regression within groups
 - Estimate the multilevel regression.
 - Discuss the above four results.