Exercises for Lectures 5 and 6

1. Suppose we want to make a randomly complete design considering one factor A. The five levels of A are A1 to A5. For each level, there are 7 samples. Show how to design this experiment.

2. Suppose we want to make a randomly complete block design considering one factor A. The five levels of A are A1 to A5. And the number of blocks is 4. Show how to design this experiment.

3. Suppose we have the observed data from a single factor design as follows:

Level	Data	Sum $\overline{T}_i$	Mean $\bar{y}_i$	Sum of squares within groups Q_i	Degree of freedom
A1	4, 8, 5, 7, 6	30			
A2	2, 0, 2, 2, 4	10			
A3	3, 4, 6, 2, 5	20			

Fill the uncompleted table.

4. Suppose we are investigating the effects of four antirusting agents. A total of 40 ferric samples were available. Ten samples were randomly selected and assigned to one antirusting agent. A score between 0 and 100 was measured for each ferric sample. Scores of the 40 samples were given in the following table

Sample	Antirusting agents			
	A1	A2	A3	A4
1	43.9	89.8	68.4	36.2
2	39.0	87.1	69.3	45.2
3	46.7	92.7	68.5	40.7
4	43.8	90.6	66.4	40.5
5	44.2	87.7	70.0	39.3
6	47.7	92.4	68.1	40.3
7	43.6	86.1	70.6	43.2
8	38.9	88.1	65.2	38.7
9	43.6	90.8	63.8	40.9
10	40.0	89.1	69.2	39.7

Suppose there is no block effect (randomly complete design). (1) Try to compare if the effects of the four antirusting agents are different. (2) Use P-P plot and Q-Q plot to test if the data obeys Normal distribution.

5. Assume there are 5 mutants A to E. Test the yield of them for 3 replications (i.e. 3 blocks). The data is as follows:

Mutant	**Observations**		
	Rep I	Rep II	Rep III
A	y_{11} = 4.9	y_{12} = 5.8	y_{13} = 6.3
B	y_{21} = 5.3	y_{22} = 6.2	y_{23} = 6.5
C	y_{31} = 4.3	y_{32} = 5.9	y_{33} = 4.1
D	y_{41} = 5.1	y_{42} = 4.8	y_{43} = 5.6
E	y_{51} = 3.5	y_{52} = 4.9	y_{53} = 3.9

Suppose there is block effect (randomly complete block design). Try to compare if the effects of the five mutants are different in yield.

6. The yields of wheat in a randomly complete block (RBD) design is as follows (the area of each block is 60 square foot):

Cultivar	I	II	III	IV
A	6.2	6.6	6.9	6.1
B	5.8	6.7	6.0	6.3
C	7.2	6.6	6.8	7.0
D	5.6	5.8	5.4	6.0
E	6.9	7.2	7.0	7.4
F	7.5	7.8	7.3	7.6

(1) Considering the effect of blocks, work out the table of ANOVA and test if the six cultivars have significantly different yields.

(2) By ignoring the effect of blocks, work out the table of ANOVA and test if the six cultivars have significantly different yields.

7. In Excel, generate 100 pseudo-random numbers between 0 and 1. Use P-P plot and Q-Q plot to test if the data obeys Normal distribution.

8. Do the multiple tests for the data in Ex4 under the significance level 0.05. Use Tukey–Kramer method. Note: $q_{0.95}(4,36) = 3.82$.

9. Use the LSD method to work out the multiple tests for the example of Folic acid

content in green tea in Lecture 5 under the significance level 0.1. The data is as follows:

Levels of factor A	Observed data (mg)	Sample mean
A1	7.9, 6.2, 6.6, 8.6, 8.9, 10.1, 9.6	8.27
A2	5.7, 7.5, 9.8, 6.1, 8.4	7.50
A3	6.4, 7.1, 7.9, 4.5, 5.0, 4.0	5.82
A4	6.8, 7.5, 5.0, 5.3, 6.1, 7.4	6.35

10. Use the Scheffe method to do the multiple tests for the data in Ex9 under the significance level 0.1.

11. The following data doesn't obey the Normal distribution: 32.4, 310.7, 216.5, 130.0, 93.0, 361.3, 905.3, 2.2, 9.7, and 14.1. Do the data transformation to change them into Normal distribution. Use Q-Q plot to prove it.