Lecture.19

2^2 Factorial Experiments in RBD – lay out – analysis

2^2 Factorial Experiments in RBD

2^2 factorial experiment means two factors each at two levels. Suppose the two factors are A and B and both are tried with two levels the total number of treatment combinations will be four i.e. a0b0, a0b1, a1b0 and a1b1.

The allotment of these four treatment combinations will be as allotted in RBD. That is each block is divided into four experimental units. By using the random numbers these four combinations are allotted at random for each block separately.

The analysis of variance table for two factors A with a levels and B with b levels with r replications tried in RBD will be as follows:

Sources of Variation	d.f.	SS	MS	F
Replications	r-1	RSS	RMS	
Factor A	a-1	ASS	AMS	AMS / EMS
Factor B	b-1	BSS	BMS	BMS / EMS
AB (interaction)	(a-1)(b-1)	ABSS	ABMS	ABMS / EMS
Error	(r-1)(ab-1)	ESS	EMS	
Total	rab-1	TSS		

As in the previous designs calculate the replication totals to calculate the RSS, TSS in the usual way. To calculate ASS, BSS and ABSS, form a two way table A X B by taking the levels of A in rows and levels of B in the columns. To get the values in this table the missing factor is replication. That is by adding over replication we can form this table.

$$\text{CF} = \frac{(G\ T)^2}{r \times a \times b}$$

$$\text{RSS} = \frac{\sum_{i=1}^{r} R_i^2}{a \times b} - CF$$

A X B Two way table

B / A	b_0	b_1	Total
a_0	$a_0 b_0$	$a_0 b_1$	A_0
a_1	$a_1 b_0$	$a_1 b_1$	A_1
Total	B_0	B_1	Grand Total

$$\text{ASS} = \frac{A_0^2 + A_1^2}{b \times r} - CF$$

$$\text{BSS} = \frac{B_0^2 + B_1^2}{a \times r} - CF$$

$$\text{ABSS} = \frac{(a_0 b_0)^2 + (a_0 b_1)^2 + (a_1 b_0)^2 + (a_1 b_1)^2}{r} - CF - ASS - BSS$$

ESS= TSS-RSS-ASS-BSS-ABSS

By substituting the above values in the ANOVA table corresponding to the columns sum of squares, the mean squares and F value can be calculated.

Questions

1. 2^2 factorial experiment means two factors each at
a) two levels b) three levels c) four levels d) one level

Ans: two levels

2. If the total number of combinations are four then each block is divided into _____ experimental units
a) Two b) three c) four d) none of the above
Ans: four

3. The two factors are A and B and both are tried with three levels the total number of combinations will be nine.

Ans: True

4. The error degrees of freedom for an experiment with one factor at 2 levels and another at three levels and 3 replications will be 10.

Ans: True

5. In a two factor experiment the highest order interaction will be the two factor interaction.

Ans: True

6. In a factorial experiment with two factors the treatment sum of squares will be split up into factor 1, factor 2 and factor 1x factor 2 interaction sum of squares.

Ans: True

7. How to calculate the replication sum of squares in a two factor experiment.

8. In a factorial experiment what is the total number of experimental units when there are 3 replications, 4 levels for factor A and 3 levels for factor B

9. Furnish the ANOVA table for a two factor experiment with factor A at a levels, Factor B at b levels and the number of replication r.

10. Explain the procedure of forming a A X B two way table and calculating the factor ASS, BSS and A X BSS.