Factorial Experiments (UNIT - 2)

The factorial expts are particularly useful in experimental situations which require the examination of the effects of varying two or more factors. In the analysis of the experimental results, the effect of each factor can be determined with the same accuracy as if only one factor had been varied at a time and the interaction effects between the factors can also be evaluated.

In facto. expt. the effect of several factors of Variation are studied and investigated simultaneously, the treatments being all the combinations

of different factors under study. These experiments estimates the effect of each of the factors and also the interaction effects. ie., the variation in the effect of one factor as a result to different levels of other factors.

For example let us consider two fertilizers, say, Potash (K) and Nitrogen (N). Let us suppose that there are 'p' different varieties of Potash and 'q' different varieties of Nitrogen. p and q are termed as the levels of the factors Potash and Nitrogen respectively. To find the effectiveness of various treatments, viz., different levels of potash or ~~and~~ nitrogen we might conduct two simple expts, one for potash and one for Nitrogen. Moreover, these simple expts. do not give us any information regarding the dependence or independence of one factor on the other, ie., they do not tell us anything about the interaction effect (NK). This is done by conducting the above expts. as a $p \times q$ factorial expts., where p and q are the levels of various

factors under considerations. In general, if the levels of various factors are equal then it is called factorial expt. means an expts. with n-factors, each at s levels where n is any +ve integer greater than or equal to 2, example 2^3 - expt. means an expt. with 3 factors at 2 levels each and 3^2 - expt. means an expt. with 2 factors at 3 levels each.

Advantages:

1) It increases the scope of the expt. and its instructive value and it does so mainly by giving information not only on the main factors but on their interactions.

2) The various levels of one factor constitute replications of ~~each~~ other factors and increases the amount of information obtained on all factors.

3) When there are no interactions, the factorial design gives the maximum efficiency in the estimate of the effects.

4) When interaction exists, ~~their~~ their nature being unknown a factorial design is necessary to avoid misleading conclusions.

5) In the factorial design the effect of a factor is estimated at several levels of other factors and the conclusion holds over a wide range of conditions.

2^2 - Factorial Design :

We have two factors each at two levels (0, 1), say, so that there are $2 \times 2 = 4$ treatment combinations in all. Due to yate's, let the letters A and B indicates the name of the two factors under study and let the letters a & b denote one of the two levels of each of the corresponding factor and this is called second level. The four treatment combinations are

$a_0 b_0$ (or) 1 : Factors A and B, both at 1st level

$a_1 b_0$ (or) a : A at 2nd level & B at 1st level

$a_0 b_1$ (or) b : A at 1st level & B at 2nd level

$a_1 b_1$ (or) ab : A & B at 2nd level.

These four treatment combinations can be compared by laying out the expt. in

(i) RBD with 'r' replicates (say), each replicate containing 4 units (or)

(ii) 4 x 4 LSD and ANOVA can be carried out accordingly.

In factorial expt. our main objective is to carry out seperate test for the main effects A, B and the interaction effect AB, splitting the treatment S.S with 3 d.f. into three orthogonal components each with 1 d.f and each associated either with the main effects A & B or the interaction AB.