BASIC PRINCIPLES OF DESIGN :-

According to Prof. R. A Fisher The basic principles of The design of experiment are :-

(i) Randomisation.
(ii) Replication and
(iii) Local Control.

(i) **Randomisation :-** The allocation of treatment to experimental units is done in such a ~~way~~ manner That each experimental Unit has equal chance of receiving a particular experimental material i.e. treatment. This is done to average out of The influence of The chance factor or different experimental Unit.

Thus The randomisation of treatment results in more reliable estimates. The main objectives of randomisation are as follows :-

(a) ~~To obtain valid estimate of experimental error~~ Variance.

(b) Large number of replications reduces The standard error of The treatment means. But Practically one cannot take infinite number of replication since The sources are limited.

(c) Replication enables The experimenter to find out ~~wether~~ whether The difference between treatment means are actually more Than The sampling fluctuation.

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(d) replications of treatment also eliminate the chance of any favour obtained by a particular treatment from an experimental unit.

(ii) **Local Control** :- Local control is a device to maintain greater homogenity of experimental units within a block of an experimental unit as a whole. This is achieved by considering the natural factors likely to influence the treatment effect within experimental unit.

Local control is also called as a error control. It contributes a lot in increasing the efficiency of an experiment. Some points in favour of local control are stated below :-

(a) With the help of knowledge about fertility gradient one can form blocks which are homogeneous in the real sense.

(b) Local control reduces experimental error.

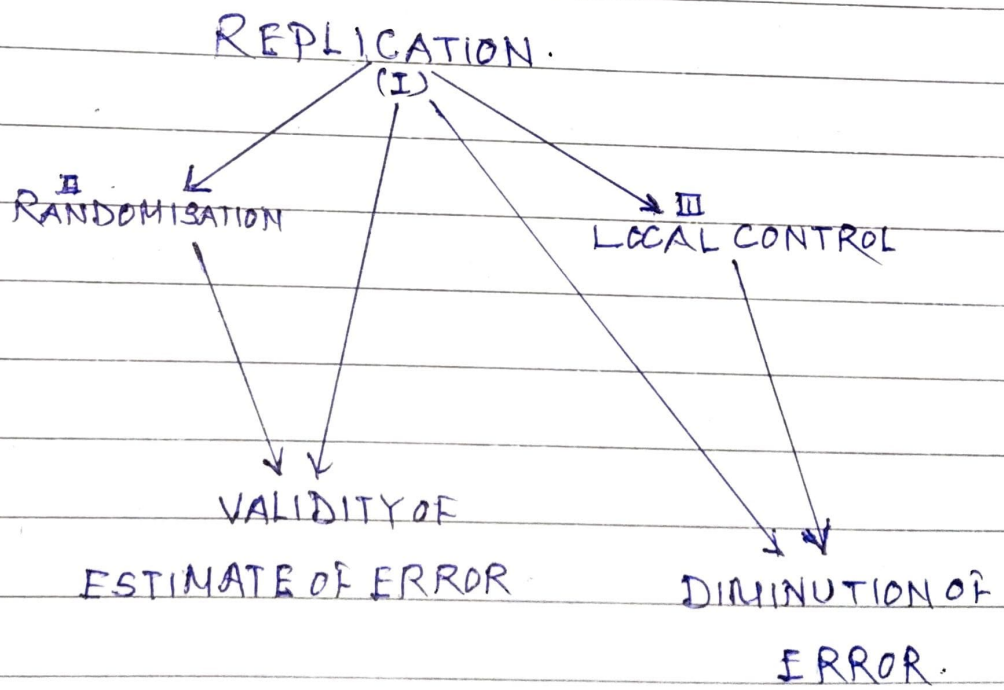
(c) Local control is meant to make designs more efficient.

(d) It make test of significance more sensitive and powerful.

(iii) **Replication :-** Replication is the repetation of treatment on a number of experiment units under similar condition. A treatment is repeated a number of times in order to obtain more reliable estimate. The main purpose for replication can be summarised as follows :-

(a) To obtain valid estimate of experimental error variance.

(b) Large number of replications reduces the standard error of the treatment means. But practically one cannot take infinit number of replication since the sources are limited.



Fisher's Diagram.

Completely Randomised Design (C.R.D):-

The simplest of all designs of experiment is C.R.D. where the principle of replication and randomisation are used. In this design the treatment are allocated at random to the experimental units over the entire experimental materials.

The number of replications may vary from treatment to treatment. The C.R.D. is most useful in laboratory technique and in biological and chemical experiments, but C.R.D. is seldom used in field experiments becauseof the plots are not in general homogeneous.

In this design the whole experiment area is devided in to a number of experimental units N (say) and suppose that there are 'p' treatments. A random selection of n_1 experimental units is made and one of the treatment is applied to these unit. A random selection of n_2 units being made from the remaining $(N-n_1)$ experimental units and any one of the $(p-1)$ treatment is applied to this unit. The process is continued until all the treatments being replicated. When each of the treatment replicated an equal number of times i.e. when $n_i = n \ \forall \ i$ then $N = np$ and randomisation

gives every group of 'n' units an equal chance of receiving the treatments.

Statistical Analysis :-

Let us consider an agricultural experiment and also let us consider a design in which we are ~~to~~ to test p-variates $t_1, t_2, \ldots t_p$. Again let t_1 be applied to n_1 plots, t_2 be applied to n_2 plots ..... t_p to n_p plots. The total number of plots which are supposed to be homogeneous is $n_1 + n_2 + n_3 + \cdots + n_p = N$.

The yield of the plots will be

Treatments	Yields					Mean
t_1	y_{11}	y_{12}	$\cdots$	y_{1j} $\cdots$	y_{1n_1}	$\bar{y}_1$
t_2	y_{21}	y_{22}	$\cdots$	y_{2j}	y_{2n_2}	$\bar{y}_2$
t_3	y_{31}	y_{32}	$\cdots$	y_{3j} $\cdots$	y_{3n_3}	$\bar{y}_3$
$\vdots$	$\vdots$	$\vdots$		$\vdots$	$\vdots$	$\vdots$
t_i	y_{i1}	y_{i2}	$\cdots$	y_{ij} $\cdots$	y_{in_i}	$\bar{y}_i$
$\vdots$	$\vdots$	$\vdots$		$\vdots$	$\vdots$	$\vdots$
t_p	y_{p1}	y_{p2}	$\cdots$	y_{pj} $\cdots$	y_{pn_p}	$\bar{y}_p$

Where y_{ij} denotes the yield of the jth plot receiving the ith treatment. Here the fixed effect linear model is

$$y_{ij} = \mu + \alpha_i + \epsilon_{ij} \longrightarrow (1)$$

Where μ denotes the general mean effect.

$\alpha_i \Rightarrow$ Effect due to ith treatment.

$\epsilon_{ij} \Rightarrow$ Error effect.

Now $\bar{y}_{i0} = \frac{1}{n_i} \sum_{j=1}^{n_i} y_{ij}$

and $\bar{y}_{00} = \frac{1}{\sum n_i} \sum_{i=1}^{p} \sum_{j=1}^{n_i} y_{ij} = \frac{1}{N} \sum_{i=1}^{p} \sum_{j=1}^{n_i} y_{ij}$

Here we make the following assumption:

(i) $\sum_{i=1}^{p} n_i \alpha_i = 0$; (ii) ϵ_{ij}'s are independently and identically distributed as $N(0, \sigma^2)$

We estimate the μ and α_i by the principle of least square i.e. by minimizing the sum of square of errors i.e. by minimizing

$$S = \sum_i \sum_j \epsilon_{ij}^2 = \sum_{i=1}^{p} \sum_{j=1}^{n_i} (y_{ij} - \mu - \alpha_i)^2$$

Now applying the principle of least square method. We get

$$\frac{\partial S}{\partial \mu} = 0 \Rightarrow -2 \sum \sum (y_{ij} - \mu - \alpha_i) = 0$$

$$\Rightarrow \sum_i \sum_j y_{ij} - N\mu - \sum_i n_i \alpha_i = 0$$

$$\Rightarrow \mu = \frac{1}{N} \sum \sum y_{ij} \Rightarrow \mu = \bar{y}_{00}.$$

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