Basic Principles of Experimental Design

The basic principles of experimental design are (i) [***Randomization***](https://itfeature.com/design-of-experiment-doe/basic-principles-of-experimental-design#randomization)***,*** (ii) [***Replication***](https://itfeature.com/design-of-experiment-doe/basic-principles-of-experimental-design#replication) and (iii) [***Local******Control***](https://itfeature.com/design-of-experiment-doe/basic-principles-of-experimental-design#local)***.***

## ***Randomization***

Randomization is the cornerstone underlying the use of statistical methods in [experimental designs](https://itfeature.com/design-of-experiment-doe/design-of-experiments-overview).  Randomization is the random process of assigning treatments to the experimental units. The random process implies that every possible allotment of treatments has the same probability. For example, if number of treatment = 3 (say, A, B, and C) and replication = r = 4, then the number of elements = t \* r = 3 \* 4 = 12 = n. Replication means that each treatment will appear 4 times as r = 4. Let the design is

|  |  |  |  |
| --- | --- | --- | --- |
| A | C | B | C |
| C | B | A | B |
| A | C | B | A |

Note from the design elements 1, 7, 9, 12 are reserved for treatment A, element 3, 6, 8 and 11 are reserved for Treatment B and elements 2, 4, 5 and 10 are reserved for Treatment C. P(A)= 4/12, P(B)= 4/12, and P(C)=4/12, meaning that Treatment A, B, and C have equal chances of its selection.

## ***Replication***

By replication, we mean that repetition of the basic experiments. For example, If we need to compare the grain yield of two varieties of wheat then each variety is applied to more than one experimental units. The number of times these are applied to experimental units is called their number of replication. It has two important properties:

* + It allows the experimenter to obtain an estimate of the experimental error.
  + The more replication would provide the increased precision by reducing the [standard error (SE)](https://itfeature.com/statistics/standard-error-of-estimate)of mean as sy¯¯¯=sr√sy¯=sr, where ss is sample standard deviation and rr is number of replications. Note that increase in rr value sy¯¯¯sy¯ (standard error of y¯¯¯y¯).

## ***Local Control***

It has been observed that all extraneous source of variation is not removed by randomization and replication, i.e. unable to control the extraneous source of variation.  
Thus we need to a refinement in the experimental technique. In other words, we need to choose a design in such a way that all extraneous source of variation is brought under control. For this purpose we make use of local control, a term referring to the amount of (i) balancing, (ii) blocking and (iii) grouping of experimental units.

Balancing: Balancing means that the treatment should be assigned to the experimental units in such a way that the result is a balanced arrangement of treatment.

Blocking: Blocking means that the like experimental units should be collected together to far relatively homogeneous groups. A block is also a replicate.

The main objective/ purpose of local control is to increase the efficiency of experimental design by decreasing the experimental error.