Design and Analysis of Experiments

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2023 - 2024

Introduction
Experimental Design

- **Experimental design** is the part of statistics that happens *before* you carry out an experiment ,or

Or A system of allocating توزيع treatments to experimental units so that the effects of the treatments may be estimated by statistical methods.

Some Definitions

Experiment : An investigation (لێکۆلینەوە) in which the investigator (توێژەرەوە) applies some treatments to experimental units and then observes the effect of the treatments on the experimental units by measuring one or more response variables.

Treatment : a condition or set of conditions applied to experimental units in an experiment.

Experimental Unit : the physical entity to which a treatment is randomly assigned and independently applied. Or

Experimental units: are the objects of interest in the experiment. which may be people, parts of people, groups of people, plants, animals.

Factor : Is a variable that the experimenter has selected for investigation. Or Factor is – an explanatory تفسيري variable that can take any one of two or more values.

Replication: Applying a treatment independently to two or more experimental units. We have included more than one individual in each treatment group.

Basic Principles of Experimental Design

The basic principles of experimental designs are randomization, replication and local control. These principles make a valid test of significance possible.

(1) Randomization:

The first principle of an experimental design is randomization, which is a random process of assigning treatments to the experimental units. The random process implies يتضمن that every possible allotment حصة of treatments has the same probability. The purpose of randomization is to remove bias and other sources of extraneous متفرق variation, which are not controllable.

(2) Replication: which is a repetition of the basic experiment. In other words, it is a complete run for all the treatments to be tested in the experiment. In all experiments, some variation is introduced because of the fact that the experimental units such as individuals or plots of land in agricultural experiments cannot be identical. This type of variation can be removed by using a number of experimental units. We therefore perform the experiment more than once.

(3) Local Control: It has been observed that all extraneous متفرق sources of variation are not removed by randomization and replication, therefore we need to choose a design in such a manner طرقة that all extraneous sources of variation are brought under control. For this purpose, we make use of local control, a term referring to the amount كمية of balancing, blocking and grouping of the experimental units. The main purpose of the principle of local control is to increase the efficiency of an experimental design by decreasing the experimental error.

Analysis of Variance

The ANOVA is a technique or statistical methods that sub dividing the total variation in an experiment design to its different resource then testing about them. To use ANOVA, these assumptions must be satisfied:

Assumption 1:- Additivity of the Main Effects.

This assumption means that the value of any observation will be effect by treatments and other effects in the experiment. Which means:-

a) **Treatment effect are constant (fixed).**

Which means inexistence وجود of any interferes تداخل between the treatment effect and observation unit.

b) **The effect of the treatments on the experimental unit** dose not effect on the other experimental unit.

c) **The difference between two treatments** means the difference between the mean of treatment

Assumption 2: $\varepsilon_{ij} \sim N(0, \sigma^2)$

This assumption means that all ε_{ij} must be normally distributed with zero mean and constant variance.

Assumption 3: Homogeneity of variance.

The variances among of all observational units must be the same (are equal for different treatment).

Assumption 4:

Independence of means and variance

This assumption means that μ and σ are uncorrelated.

Data Transformation

We convert the data's in the case when one of assumption for ANOVA isn't exist .These transformations methods are:

i) LOG Transformation

The log transformation method used when the main effects in the model are multiplicative (not-additive), and when the mean and standard variations are correlated.

Note: When is zero as values, we add the (1) for each data values. We can't able to make this transformation when the negative values are available in data.

ii) Square Root Transformation

These transformation used when the distribution of data is Poisson distribution.

iii) The Arcsine Transformation

Is the most popular transformation used when the data's are in percentage form, for example success rate or death or born rate.