**BASIC EXPERIMENT DESIGNS**

i)Completely Randomised Design (CRD)   
ii)Randomised Block Design (RBD)   
iii)Latin Square Design (LSD)

**Completely Randomisation Design (CRD).**

Consider the problem of determining whether or not different types of tyres exhibit different amounts of tread loss after 20,000km of driving.

A manager wishes to consider 4 tyres that are available and make some decision about which type or brand might show the least amount of tread wear or loss.

The brands to be considered are A, B, C, and D and she wants to try these 4 brands under actual driving conditions. The variable to be measured is the difference in maximum tread thickness on the tyre between the time it is mounted on the wheel of a car and after it has completed 20,000km

1 on a car. The measured variable 𝑦

ii)The statistical analysis and interpretation of results are straight forward.

iii)This design does not require the use of equal sample sizes for each treatment level i.e one can use unequal number of observations per treatment.

iv)It allows the maximum number of degrees of freedom for the error sum of squares.

v)It does not require an experimental unit to participate under more than one treatment level therefore the sample size is maximised.

**Disadvantages**   
i)Effects of differences among subjects are controlled by random assignment of subjects to treatment levels. For this to be more effective, subjects should be relatively homogeneous or a large number of subjects should be used (as many replications as possible).

ii)When many treatment levels are included in the experiment, the required sample size may be prohibitive especially from the point of view of costs.

iii)This design does not offer the possibility of evaluating the interaction effect (you can find out the interaction effect if you have more than one factor).

**Analysis**   
To carry out ANOVA for one factor experiment, the total sums of squares (SST) is partitioned or broken down into sums of squares due to the treatments which we donate as SSB and the error sums of squares (SSE)   
SST = SSB + SSE

Randomisation and lay out of the CRD with equal number of observations/treatments

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1** | **2** | **3 ....... a** | | |
| y11 | y21 | y31 ......ya1 | | |
| y12 | y22 | y32 ......ya2 | | |
| y13 | y23 | y33 ......ya3 | | |
| **:** | **:** | **:** | **:** | |
| **:** | **:** | **:** | **:** | |
| y1n | y2n | y3n | yan | |
| **Totals y1o** | **y2o** | **y3o** | **yao => yoo (grand total)** | |
| **Means**𝒚̅**1o** | 𝒚̅**2o** | 𝒚̅**3o** | 𝒚̅**ao** | 𝒚̅ **oo(grand mean)** |

𝑦

yio and 𝑦̅io are the total and mean respectively of the observations in the *i*th treatment. yoo and 𝑦̅ooare the grand total and mean of all the **N = an** observations

|  |  |  |
| --- | --- | --- |
| 𝑦̅oo = 𝑦𝑜𝑜 | | |
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Fc < FT , Accept Ho=> Treatment effects are equal to zero/Treatment means are equal

**Example 1**   
The data in the table below gives the number of hours of pain relief provided by 4 different types of headache tablets administered to 24 people. The 24 experimental units were randomly divided into 4 groups and each group was treated with a different brand/type. Do the different drug types give significantly different hours of pain relief?

Brands

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **1** | **2** | **3** | **4** | |  | 12.2 | 4.9 | 8.0 | 4.6 | |  | 9.5 | 10.6 | 12.1 | 6.1 | |  | 11.6 | 7.0 | 5.7 | 5.0 | |  | 13.0 | 8.3 | 8.6 | 3.8 | |  | 10.1 | 5.5 | 7.2 | 8.2 | |  | 9.6 | 11.7 | 12.4 | 7.7 | | 𝒚𝒊𝒐 | **66.0** | **48.0** | **54.0** | **36.0** | | 𝒚̅𝒊𝒐 | **11.0** | **8.0** | **9.0** | **6.0** | | 𝑦 |

Computations

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Correction factor = | | | | 𝑦𝑜𝑜 2 | | |  |
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| --- | --- | --- | --- | --- |
| 2  SSB = Σ [ 𝑦𝑖𝑜 𝑛𝑖] − | 𝑦𝑜𝑜 2 | [∑𝑎  𝑖=1 | ∑𝑛𝑖 |  |
|  |  |
|  |  |  |  |  |

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**Estimation of effects**   
Given the data table e.g example 2 and the ANOVA table, we can make the following inferences/conclusions concerning the population from which the data was obtained.

i)The grand mean 𝑦̅