Indira Gandhi National Open University
School of Sciences

MST - 005
Statistical Techniques

Block

3

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Acknowledgement: We gratefully acknowledge Prof. Geeta Kaicker, Director, School of Sciences for her great support and guidance.

December, 2011

ISBN – 978-81-266-5786-5

Further information on the Indira Gandhi National Open University courses may be obtained from the University's office at Maidan Garhi, New Delhi-110 068.

Printed and published on behalf of the Indira Gandhi National Open University, New Delhi by Director, School of Sciences.

Laser Type set by: Rajshree Computers, V-166A, Bhagwati Vihar, (Near Sector-2, Dwarka), Uttam Nagar, New Delhi-110059

Printed at: Gita Offset Printers Pvt. Ltd., C-90, Okhla Industrial Area, Phase-I, New Delhi-110020.

DESIGN OF EXPERIMENTS

In Block 2, we have discussed the concept of analysis of variances, its definition, terminology used, assumptions of analysis of variance and its uses. The concept of linear models in one-way as well as in two-way analysis of variance technique is also explained. In this block, we shall discuss some experimental designs.

In any field of study either in life sciences or some other it is essential to plan an experiment, i.e. what is the object and which type of data is required. In order to make use of time and energy spent on experiment, it should be planned with a careful designing.

Design of experiments is a logical construction of the experiment in which the degree of uncertainty with which the inference about the population is drawn may be well defined. The experimental designs are formed by following these steps:

1. Planning of the experiments;
2. Obtaining relevant information from it regarding the statistical hypothesis under study;
3. Making a statistical analysis of the data.

Once a design of experiment is decided, the observations are obtained from it and with the technique of analysis of variance, the data is analysed.

In Unit 9 of this block, we have discussed the basic principles of design of experiments. The layout and statistical analysis of the completely randomised design is also discussed in this unit. In Unit 10 we have elaborated the basic idea about the randomised block design with its layout and statistical analysis. Similarly, the layout and statistical analysis of the latin square design is discussed in Unit 11. In the last unit of this block, Unit 12, we have explored the basic idea about the factorial experiments with the layout and statistical analysis of 2^2 and 2^3 factorial experiments.

Suggested Readings:

1. Cochran, W. G. and Cox, G. M.; Experimental Designs (Chs. 1-7, 14), Asia Publishing House, 1959.
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3. Fisher, R. A.; The Design of Experiment, Oliver and Boyd, 1947.
4. Kempthorne, O.; The Design and Analysis of Experiments (Chs. 1-3, 5-11, 13-15, 28), John Wiley, 1965, and Wiley Eastern.
5. Mann, H. B.; Analysis and Design of Experiments, Dover, 1949.
6. Quenouille, M. H.; The Design and Analysis of Experiment (Chs. 1-3), Charles Griffin, 1953.
7. Yates, F.; The Design and Analysis of Factorial Experiments (Chs. 1-4, 16), Imperial Bureau of Science, Tech. Com. No. 35, 1937.

Notations and Symbols

y_{ij}	:	The j^{th} observation in the i^{th} level of a factor A
μ `	:	An over all mean or grand mean
y_{ijk}	:	k^{th} observation / response / dependent variable under i^{th} level of factor A and j^{th} level of factor B
μ_i	:	Mean of i^{th} level of a factor
α_i	:	Effect due to i^{th} level of factor A
β_j	:	Effect due to j^{th} level of factor B
$(\alpha\beta)_{ij}$	:	Interaction effect between the i^{th} level of factor A and j^{th} level of factor B
e_{ij}	:	Error term
n_i	:	Number of observations in i^{th} level of factor
E	:	Residual sum of squares
H_0	:	Null hypothesis
H_1	:	Alternative hypothesis
$\bar{y}_{i.}$	:	$\frac{1}{n_i}\sum_{j=1}^{n_i} y_{ij}$
$\bar{y}_{..}$	:	$\frac{1}{N}\sum_{i=1}^{k}\sum_{j=1}^{n_i} y_{ij}$
N	:	$\sum_{i=1}^{k} n_i$ = Total number of observations
TSS	:	Total Sum of Squares
SST	:	Sum of Squares due to Treatments or different levels of a factor
SSE	:	Sum of Squares due to Error
DF	:	Degrees of freedom
$V(e_{ij})$	:	Variance of error e_{ij}
F	:	F- statistic/ Variation Ratio
α	:	Level of significance
CRD	:	Completely Randomised Design
RBD	:	Randomised Block Design
LSD	:	Latin Square Design
CD	:	Critical Difference
p	:	Number of levels of factor A
q	:	Number of levels of factor B
SSA	:	Sum of Squares due to factor A
SSB	:	Sum of Squares due to factor B