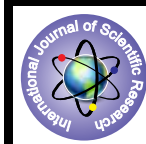


Importance of Statistical Techniques in Agriculture and Other Fields



Agriculture

KEYWORDS :

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ABSTRACT

Statistics is important in the field of social science, agriculture, medical, engineering, etc because it provides tools to analyze collected data. Scientists frequently use statistics to analyze research data. Statistics provides scientific methods for appropriate data collection, analysis and summarization of data and inferential statistical methods for drawing conclusions in the face of uncertainty. Agricultural researchers and statistician have an important role to play in the agricultural production and development of a nation. Statistical Science is concerned with the twin aspect of theory of design of experiments and sample surveys and drawing valid inferences there from using various statistical techniques/methods. The art of drawing valid conclusions depends on how the data have been collected and analyzed. This paper describes the basic concept of statistical research design and techniques used for analysis and interpretation of investigations.

Introduction

Statistical education for agriculturists tries to give them a solid foundation in statistics. A wide use of statistical methods in order to allow the students to apply these techniques in many fields of agricultural science like: field crops production, vegetable crop production, horticulture, fruit growing, grape production, plant protection, livestock, veterinary medicine, agricultural mechanization, water resources, agricultural economics and other fields. The field of agricultural statistics has developed in the past few decades and it deals with the growing amount of information inherent in the agricultural sciences. The agricultural investigations are based on the application of statistical methods and procedures which are helpful in testing hypotheses using observed data, in making estimations of parameters and in predictions. The application of statistical principles and methods is necessary for effective practice in resolving the different problems that arise in the many branches of agricultural activity. This article describes the basic concept of statistical research design and techniques used for analysis and interpretation of investigations and also discuss the experimental error and biasness in the Agricultural research investigation and other fields.

Area and Types of Research

Generally, there are two types of research investigations, experimental and non-experimental/observational study. There are different types of investigation in the agricultural research. Agricultural research investigations can be broadly classified in to four sections.

Planning of research proposal
Execution of the investigation
Appropriate analysis of data
Meaningful interpretation of the results.

Statistical techniques used in Agricultural research

Sample Design and Sampling Techniques

Several sampling designs are available depending upon the type and nature of population as well as objectives of the research investigation. Some important sampling designs are discussed below.

Purposive Sampling: In this approach sampling units are selected according to our purpose. This technique can be used only for some specific purposes.

Random Sampling/ Probability Sampling: In this method of sampling each unit included in the sample will have certain pre assigned probability of inclusion in the sample. This sampling

method provides better estimate of parameters compared to purposive sampling.

Simple Random Sampling: In the simple random sampling method each unit of the population have equal chance of inclusion in the sample. This technique provides the unbiased and better estimate of the parameters if the population is homogeneous.

Stratified Random Sampling: Stratified random sampling is useful techniques for data collection if the population is heterogeneous. In this technique, the entire heterogeneous population is divided into a number of homogeneous groups, usually known as strata. Each of these groups is homogeneous within itself and then units are sampled at random from each of these strata. The technique of drawing the stratified sample is known as Stratified Sampling.

Systematic Random Sampling: In this method of sampling the first unit of the sample selected at random and the subsequent units are selected in a systematic way.

Multistage Random Sampling: In Multistage random sampling units are selected at various stages. The sampling designs may be either same or different at each stage. The principle advantage of this sampling technique is that it permits the available resources to be concentrated on a limited number of units of the frame.

Analysis of Variance (ANOVA)

Analysis of variance is more useful technique used in agricultural research. If three or more than two groups / means to be tested. However, a comparison of three or more than three or more series observation can be compared through analysis of variance. Analysis of variance is based on t-distribution. In this technique total variation present in the sample data is expressed as the sum of its non negative components where each of these components is measure of variation due to some specific independent source or factor or cause. In other words, amount of variation due to each of the independent factors separately and then comparing these estimates due to assignable factors with the due to chance factor or experimental error.

Design of Experimental Techniques Commonly Used in Agricultural Research

The use of statistical techniques in agriculture goes back many years, and, in fact, many of the modern statistical techniques were first developed for use in agricultural research. Design of

experiments deals with the study of methods for comparing the treatment, varieties, factors etc. under different experimental situations faced by agricultural research worker. Experimental design provides maximum amount of information at minimum cost.

Completely Randomized Design (CRD): The structure of the experiment in a CRD is assumed to be such that the treatments are allocated to the experimental units completely at random. In the design of experiments, CRDs are for studying the effects of one primary factor without the need to take other irrelevant variables into account. The CRDs have one primary factor. It is the simplest design for researcher of agricultural sciences based on principle of randomization and replication.

Randomized Complete Block Design (RCBD): The RCB is the standard design for agricultural experiments. The RCBD is the standard design for agricultural experiments where similar experimental units are grouped into blocks or replicates. It is used to control variation in an experiment by accounting for spatial effects in field or greenhouse.

Factorial Design: Factorial indicates the effect of several factors at different levels estimate the effects of each factors and also the interaction effect. In other words, a factorial design is used to evaluate two or more factors simultaneously. The treatments are combinations of levels of the factors. The main feature of factorial designs over one-factor at a time experiment is that they are more efficient and they allow interactions to be detected. In the simple example, if two fertilizers potash (K) and nitrogen (N) used and let p different levels of potash and K different levels of nitrogen and interaction NK.

Split-Plot Designs: The split-plot design is an experimental design that is applicable when a factorial treatment structure has two levels of experimental units. In the case of the split-plot design, two levels of randomization are applied to assign experimental units to treatments. The first level of randomization is applied to the whole plot and is used to assign experimental units to levels of treatment factor A. The whole plot is split into sub plots and the second level of randomization is used to assign the sub plot experimental units to levels of treatment factor B. Since the split-plot design has two levels of experimental units, the whole plot and sub-plot portions have separate experimental errors.

Multivariate Analysis of Variance (MANOVA)

It is a statistical test procedure for comparing multivariate (population) means of several groups. Unlike ANOVA, it uses the variance-covariance between variables in testing the statistical significance of the mean differences. MANOVA is useful in experimental situations where at least some of the independent variables are manipulated.

5. Principal Component Analysis

The purpose of principal component analysis is to derive a small number of linear combinations (principal components) of a set of variables that retain as much information in the original variables as possible. Often a small number of principal components can be used in place of the original variables for plotting, regression, clustering and so on. Principal component analysis can also be viewed as a technique to remove multi-co linearity in the data. In this technique, we transform the original set of variables to a new set of uncorrelated random variables.

Importance of Statistics in Different Fields

Now statistics holds a central position in almost every field like Industry, Commerce, Trade, Physics, Chemistry, Economics, Mathematics, Biology, Botany, Psychology, Astronomy etc., so application of statistics is very wide. Now we discuss some important fields in which statistics is commonly applied.

In Business: Statistics play an important role in business. A successful businessman must be very quick and accurate in decision making. Statistics helps businessman to plan production according to the taste of the costumers, the quality of the products can also be checked more efficiently by using statistical methods. So all the activities of the businessman based on statistical information.

In Economics: Statistics play an important role in economics. Economics largely depends upon statistics. National income accounts are multipurpose indicators for the economists and administrators. Statistical methods are used for preparation of these accounts. In economics research statistical methods are used for collecting and analysis the data and testing hypothesis.

In Mathematics: Statistical helps in describing these measurements more precisely. The large number of statistical methods like probability averages, dispersions, estimation etc. is used in mathematics and different techniques of pure mathematics like integration, differentiation and algebra are used in statistics.

In Accounting, Banking and Auditing: Accounting is impossible without exactness. But for decision making purpose, so much precision is not essential the decision may be taken on the basis of approximation, know as statistics. In auditing sampling techniques are commonly used. An auditor determines the sample size of the book to be audited on the basis of error. Statistics play an important role in banking. The banks make use of statistics for a number of purposes. The banks work on the principle that all the people who deposit their money with the banks do not withdraw it at the same time. The bank earns profits out of these deposits by lending to others on interest.

In Natural and Social Sciences: Statistics plays a vital role in almost all the natural and social sciences. Statistical methods are commonly used for analyzing the experiments results, testing their significance in Biology, Physics, Chemistry, Mathematics, Meteorology, Research chambers of commerce, Sociology, Business, Public Administration, Communication and Information Technology etc.

Conclusion

Statistics is the backbone of the agriculture and other research fields. In order to make our research globally competitive, it is important that sound statistical methodologies be developed and used in the collection of data (both under controlled and uncontrolled conditions), analysis of data and interpretation of results. Thus, there is need to devise strategies of data generation based on statistical principles. In the advance agricultural research with the help of appropriate statistical tools and research designs provide the unbiased estimates, conclusions and appropriate interpretation. In this paper, the role of statistical research design and applications of basic techniques in agricultural research, have been emphasized scientifically. The use of principal component analysis has been explained with the help of one case study.

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