Significance and consequence of statistical Methods in science and Engineering Research

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Abstract *:* Statistics is an essential device to deal with the information available in existing age as it can deduce the entire evidence in in beautiful manner such that inferences become easy from that. The objective of this paper is to apply quantitative technics in the research field of science and engineering. An engineer or scientist is the one who applies his knowledge to solve the problems in the society, by effectively using the scientific relevance and practical approach.
They need to define an approach and construct the problem and method of solving it,to meet the needs of society. So the engineers and scientists must know how to plan effective experimentation, collecting the data, inferring about the information and its analysis and correlate with the proposed model or project to be studied.

Key words: quantitative, qualitative, significance, hypothesis.

INTRODUCTION

Statistical methods are used to explain and know the variability. Variability means the successive observation of the concept. It is not always sure to have reputation in observations in terms of the value obtained in repeated sequence of experiment. Statistical thinking can provide us a way to deal with the variations and decision making. For example, if we consider the petrol mileage performance of a car. The mileage is not consistently the same for every time intake of fuel. The performance is subjected to many factors like, Vehicle maintenance for wears and compressions, the brand of fuel, weather conditions, Where you are driving? etc. These points signify a good amount of variability in the organization. Statistics provides a structure for relating the variant.Quantitative techniques have been widely used in decision making. The responsibility of statistics is extensively established and accredited as a potent tool in the systematic exploration activities. The fame and vast amplification in the application of statistical methods, has been pragmatic for a variety of medical and other journals over the past few decades They are effectively tempting the researchers working in various environments.

The role of statistics in engineering: (Inferential Statistics)

1.1 The engineering method and statistical thinking:

The need for statistical thinking arises often in the solution of engineering problems. .The stages in the methods used in Engineering are as given follows.

- Construct a strong and precise description of the problem.
- Find the constraints that may influence the solution.
- Suggest a model for the problem, using scientific or engineering base of the concept.
- Describe the scope and restrictions of the prototype.
- Perform adequate number of experiments and gather data for validation, and conclusion.
- Direct the model to help in generating solution.
- Refining the model for efficient output.

Concluding and giving suggestions based on the solution. The engineering method features a strong interplay between the problem, the factors that may influence its solution, a model of the phenomenon, and experimentation to verify the adequacy of the model and the proposed solution to the problem. So engineer should know the planning, gathering the data analysis, interpretations.

1-2 Gathering Engineering data(Crucial ideology)

In engineering background, the statistics is almost always a sample that has been chosen from some population. The fundamental technique of collecting data are

A retrospective study using historical data, An observational study, A designed experiment. The

better the method of data gathering the more is the effectiveness in perception of the sample and population.

A demonstration study would use the historical development data archived over some period of time. The study aim might be to find out the associations between the two parameters. As seen, a retrospective study may have a lot of **information,** but that may include comparatively less practical **information** related to the problem. Some of the pertinent data may be absent, there may be copy or footage lacunas followed-on in unusual values. Aa retrospective study may involve a lot of **data,** but that data may contain relatively little useful **information** about the problem.

In observational study case , the engineers examine the method or universe, troubling it the minimum probable, and account the quantities of attention. since these studies are typically conducted for a comparatively short time phase, sometimes variables that are not regularly calculated can be incorporated.

In an intended research the engineer creates *conscious* or *determined transforms* in the convenient variables of the structure or method, studies the ensuing structure output statistics, and then asks an conclusion or judgment regarding which variables are accountable for the practical change in final show. Designed experiments are a very influential method to study intricate systems. Many a times information is composed over time. In such situations, it is regularly extremely supportive to plan the data against time in a **time series plot. A c**oncept that may influence the scheme or procedure frequently turn into more noticeable in a time-oriented design and the thought of steadiness can be nicely refereed.

1-3 EMPIRICAL MODELS

Models play an significant role in the investigation of almost all engineering problems. Many of the recognized schooling of engineers engage learning about the models applicable to precise fields and the tools for using these models in designing and solving the problem. We describe this kind of model a **mechanistic model** as it is constructed from our fundamental facts of the fundamental material means that correlates these variables. A model is called an **empirical model, which** uses our engineering and scientific awareness of the concept, but it is not openly designed from our hypothetical or first-principles perceptive of the original method.

1.4 PROBABILITY MODELS

Conclusions regularly require to be dependent on dimensions from only a division of things chosen in a sample. This method of analysis from a sample of objects to inferences for universe of objects was understood as statistical inference. To make good Conclusions, an analysis of how well a sample represents a population is clearly necessary. If the lot contains defective wafers, how well will the sample detect this? How can we quantify the criterion to “detect well”? Basically, how can we quantify the risks of decisions based on samples? Furthermore, how should samples be selected to provide good decisions—ones with acceptable risks? **Probability** models help quantify the risks involved in statistical inference, that is, the risks involved in decisions made every day.

1-5 QUANTITATIVE METHODS

A good amount of engineering research asks for identification of how conclusions , are derived by dropping probable reasons to an isolated set of sign or variables. Quantitative methods are a good fit for obtaining ways out, in which a proposition stands for the variables, the primary statement, and the way of the strongly described research problems. The hypothesis to be tested and the verbal form of the research problems leads , how data will be gathered as well as the process of statistical investigation employed to study the data (Creswell, 2002). The rationale of quantitative examination revises is for the examiner to plan the conclusions onto the bigger population throughout an incentive method. Information gathered using reviews governed to a model or split of the entire population, lets the researcher to take a broad view or formulate deductions. Outcomes are deduced to find out the chance that the results established with the sample can be simulated within the bigger universe. Conclusions are derivative of the data collected and procedures of statistical analysis (Creswell, 2002; Thorne and Giesen, 2002).

Many areas in technology education have been observed in the course of a quantitative orientation. The survey editorial from the JEE 2005 special issue, Olds, Moskal and Miller (2005) end with a number of statistical numerical estimation methods applicable to engineering , involving reviews, analysis and tentative models.

Although engineers repeatedly exercise statistical methods
in their research or practical surroundings, this paper is planned to deal with
multi- displinary consultation that may utilize a quantitative verification inside an didactic background. Parts of the paper pursue quantitative methods ,as per the need, have been included to investigate areas in technology education are talked about. Initially, meaningful statistics such as percentages, means of central tendency and measurers of central deviation, as been used to demonstrate different facts and explain a condition, predominantly the one that has not been considered before (Todd, Magleby, Sorensen, Swan, and Anthony, 1995) and (Dorato and Abdallah, 1993; Hodge and Steele, 2002). Quantitative research flowcharts via statistical examination to study whether there are significant differences between groups on different display (Carpenter, Harding, Finelli, Montgomery, and Passow, 2006; Davis, 1996);

1-6 Vivid Statistics:

In many of the studies, the authors accounted only the number or proportion of data in each type. These are known as descriptive studies, because they illustrate the condition without accounting any correlation between variables. As stated rarlier, this a way can be valuable in the case of unknown topics.

Investigative Relations linking diverse signifiers:

In few types, researchers wish for examining cause and effect or disparity between a range of groups or action. Pre-existing hypothesis is classically applied to steer the shape of hypotheses about associations that may be about a specific group, theme, or circumstances. The hypothesis is normally prepared as a research problem, and then statistics are gathered and evaluated to respond the research
problem. Following information collection, the hypothesis will be also acknowledged or abandoned depending on the outcomes of the analysis. The sign, or variables, which are being used to evaluate a specific presumption will find out what type of analysis is used. Investigations that have examined how different variables are related to build up a hypothesis and how a suitable technique is preferred for analysis depending on the indicative parameters included. It is found in different studies which have checked whether there is a distinction in subject proficiency between the data.(Trussell and Dietz (2003).

As the dependent variables tested in these examinations are continuous , Pearson's correlation, t-tests, ANOVAs, or MANOVAs can be exercised to study the outcomes to find out whether there is a considerable relationship between indicative parameters or whether the means of one group disagrees considerably from another. If indicative parameters being tested are definite (e.g., male/female, course section, pass/fail), statistics are examined using Chi-square to inspect the differences between groups in accounted occurrence of responses. (Shiavi and Brodersen's,2005) .

specific exercise of hypothesis:

In few cases, investigators look for to inspect relationships between different indicative parameters, hence they can create guesses. When more intricate statistical studies are carried out, theory is applied to justify the review mechanism used (Felder, Felder, and Dietz, 2002);With the same, in the case of regression analysis, hypothesis guides how independent attributes get into the regression equation and how the effect of some variables is balanced for the duration of the analysis.

The exercise of statistical analysis as given here been illustrated is repeatedly well-known to engineering researchers, and it offers well recognized techniques for carrying out quantitative research. There are various well-established quantitative methods, there are a lot of course books that offer a detail knowledge about the efficacy of statistical analysis and suitable research plan when using them (Thorne and Giesen, 2002). Though, researchers need also to think about the questions that are come across while implementing quantitative methods in engineering (Tebbs and Bower, 2003). Quantitative methods are the skills which could be consulted while studying specific problems, but other research models, like qualitative methods, can provide more precise details.

1-7 QUAITATIVE METHODS:

Qualitative research is differentiated by the compilation and examination of non numerical rather text form data. To make the conclusions based on experimentation with such data more emphatic and verified one the textual data can be converted into statistical variables, and employing

proper hypothesis and its testing with appropriate analysis and significance tests, the results can be found to be reliable and strong enough to say about the facts transparently.

1-8 ASSESSMENT CRITERIONS FOR DIFFERENT TYPES OF RESEARCH:

Valuation of quantitative, qualitative, and mixed methods research has comparable plans, though the details vary. In every method, the objective is to set up that the outcomes say about believable proofs adequate to respond the exploring questions.

In quantitative research, these standards are met through independence, consistency, and strength of the instrument (e.g., questionnaire), and generalizing of the outcomes. Results of studies are additionally by giving concern to the validity, or whether the device employed truly accounts the variables . Reliability of measurement related with the devices used, or if the similar outcome is obtained on recurring experiments, is as well significant concern. Moskal et al. (2002) demonstrate the concepts and its effective usage to modify evaluation labors in Technical learning experiences. Blumner et al. (1997) has mentioned about validity and reliability.

Analogous criteria is present for qualitative research, even if the language used and the heart of how these standards are met are different. The term credibility is frequently exercised to explain the level at which a study matches the standards. The imperative mode in which credibility can be achieved is a clear announcement
of the abstract outlook of the study, member inspecting, use of multiple data sources, broad explanation, inquiring other researchers not directly involved in the research to review the findings, producing an review trail and an account of researcher prejudice , as well as subjectivity.

The merged methods and their strategies are decided after surveying the qualitative and quantitative standards. The agenda is decided depending on the approaches of collecting the information, analyzing the same and the perspectives of both methods. Also the feasibility of detailing in the design and its reliability using the combination of methods is needed with detailed processes and the conclusions. It also essentially needs the reasoning of including a combined technique with respect to the variety in design, a flow chart of processes, the hypothesis for mixed standards, techniques for analysis, etc. one of essential points
Which cannot be neglected is, flexibility of combined methods for design and its potential to accept the challenge, like validity in sampling, its size etc. (crite, Creswell and Piano Clark ;2007).

Types of study methods: Action research, Case study, Experimental design, comparative/model, Comparative approach, Co relational study , Cross culture, Survey, Ethnography, Histograms, Interpretative/rhetorical,

Types of statistical quantitative tools for study: ANCOVA , ANOVA, Bi-variate correlation,
Canonical correlation ,Chi-square, Cluster analysis, Descriptive statistics, Discriminant analysis, Effect size/power analysis ,Factor analysis , Kruskal Wallis H test, Kormogrov Smirnov, Linear regression, MANCOVA,
MANOVA, Many Whitney-U Test, Meta-analysis , Multiple regression, Psychometric statistics ,T-test,

CONCLUSION:

Quantitative Statistical methods suitable in study are been illustrated. Content enclosed comprises of the selection of correct averages and measures of deviation to sum up data sets, and the proper choice of tests of significance, including *t*-tests, z – test, F- test, chi square test and a one- and a two-way analysis of variance, also the post-tests for normally distributed (Gaussian) and their non-parametric equivalents. Techniques for transforming non-normally distributed samples more Gaussian distributions are explained. Notion of statistical command, errors and the use of the same in shaping the best possible size of experiments are measured. Statistical aspects of linear and non-linear regression are very useful for concluding cause and effect relations, including tests for goodness-of-fit to the selected model and techniques for comparing fitted lines and curves.

For validity , reliability and strength as potential conclusions for research problems the need of verified results is undoubted. Such results are significant and carry good weight age in future scope of the topic for more research, it could also help in overcoming the limitations in present studies. This strength in the conclusions is possible by using various statistical inferential, quantitative tools.

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