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Chi-square test in business research

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Abstract
Research is highly organized and systematic study of existing data with an objective of getting a conclusion to a fact, business research finds answers to problems facing in the management, it explores, diagnose a phenomenon. A hypothesis helps a researcher to frame a suitable design and this hypothesis has to be testable and verified using some kind of statistical test. Hypothesis tests are parametric test which are based on some assumptions about population and non-parametric which are not dependent on the assumptions regarding a population distribution. The chi-square test can be used as parametric as well as nonparametric test for comparing the variance of the population; as a test of independence or as a test of goodness of fit, it is one of the commonly used test and is widely applicable in the field of research to draw the significant conclusions. This paper gives a overview of Chi-square test, its conditions for use merits, demerits and application in Business and Management research.

Keywords: Statistics, Chi-square test, Hypothesis, Non parametric test, Decision Making

Introduction

Research Methodology

A research aims to a solve a problem Research Methods helps us to be specific about the research and to make sure that research comes from a valid source and was collected and analysed appropriately. Many surveys are conducted every day throughout the world to prove a particular point, to support an ideological argument, or just to sound authoritative. Researchers try very hard to be objective and balanced in their enquiries and their writing. However, there is no such thing as totally impersonal objective research. Business research is the systematic collection, analysis of the data to find out the answers to problems that are faced time to time in management. Good management decisions can be brought up if Research Methodology is used. Research design and methodology adopted for the study deals with the terms and concepts used in the study. It is necessary to define the problem, formulation of hypothesis, collecting data and analysis of the data and finally relating the findings to existing theories.

Statistics Tools

Statistical methods are extensively used in research. They provide a tool for collecting, organizing, analyzing and interpreting data expressed in numeric terms, facilitate the derivation of conclusions and formulation of generalizations. there are a number of limitations that should be recognized in using statistical methods, before taking out conclusions Best (1977) pointed out that it only has value if it verifies, clarifies, and measures relationship. should not be employed in the analysis of data unless the basic assumptions and limitations underlying its uses are clearly understood.

Statistics plays an important role in research as research aims to solve a problem with a specified purpose and a hypothesis is created for the same purpose. To check whether the hypothesis is correct or not we need to apply the tools. All treatment of data must be checked and double checked frequently to minimize the errors. Data analysis can involve both descriptive and inferential statistics. According to Ingula, Gatimu (1996) [4], descriptive statistics involves tabulating, graphing and describing data using measures of central tendency, variability, relative position, relations and association. The data regarding the purpose of research is collected, tabulated and classified and test to check the significance is selected for the hypothesis which researcher had formulated in the beginning of the research process.

Hypothesis testing

Hypothesis helps a researcher in framing out a research design, it helps the researcher to decide the most appropriate instrument for statistical analysis. A hypothesis must be valid, clear, should be accessible to all

A hypothesis is a transitory phase of a research process since it is provisional, it is yet to be proved that it is correct or not. Two types of hypothesis are used Null Hypothesis and Alternate Hypothesis The null hypothesis H_0expresses the independence of variables, the alternative hypothesis Ha, which we want to prove to be true in the majority of cases, mostly expresses a statistical association of the variables. Alpha (α) is traditionally set at 5% (= 0.05), or 1% (= 0.01). Variations that occur with a probability less than the chosen significance level are called statistically significant at the selected significance level

Inferential statistics provides statistics that provides the method to be used for making inferences about a large group on the basis of small group findings (Mutai, 2000). Inferential method falls into two major categories: parametric and non-parametric approaches. Parametric tests are more powerful than non-parametric statistics. According to Koul (1984) [7]. use of parametric tests is based upon certain assumptions of ordinal scale of measurement, samples have equal or nearly equal variances, normally distributed population. According to Gay (1976) [2], nonparametric tests make no assumptions about the shape of the distribution. They are used when the data represent an ordinal or nominal scale, when a parametric assumption has been violated, or when the nature of the

distribution is not known (Gay 1976) [2]. Non-parametric tests are distribution free tests, these are comparatively advantageous as, they can be used in situations where stringent assumptions required by parametric tests do not have to be met, and they are less cumbersome. And these tests are most useful when dealing with qualitative values with data that can be classified in order of ranks. One cannot use parametric test if the sample size is small, unless the population distribution is exactly known which is generally not possible. There are number of non-parametric test which are known Chi-square, Mann-Whitney U, Sign, Wilcoxon, McNemar.

The Chi-square test is the one commonly used by researchers in comparison to the other non-parametric tests. Its correct application is an uphill task to most researchers (Kothari 2007) [6]. Kothari (2007) [6] notes that possible reasons of the improper application or misuse of this test can be neglect of frequencies of non-occurrence, failure to equalize the sum of observed and sum of expected frequencies, wrong determination of degrees of freedom and wrong computations.

Chi Square test

A Chi-square test compares proportions actually observed in a study with the expected to establish if they are significantly different. Chi Square Test Chi-square is an important non-parametric test and as such no rigid assumptions are necessary in respect of the type of population. It is an important test of significance, it is written by symbol "$\chi 2$ "As a non-parametric test, it can be used to determine whether data shows dependency or the two classifications are independent.

$$\chi 2 = \frac{\sum(O-E)2}{E}$$

The Chi-square value increases as the difference between observed and expected increase. Whether the calculated Chi-square value is significant is determined by comparing it with the value from table. If the calculated value exceeds the table value, the difference between the observed and expected frequencies is taken as significant otherwise it is considered insignificant. The degree of freedom must be known, more the degree of freedom, the more skewed will be the distribution.

Acceptance criteria: - If for a specified significance level the value of $\chi 2$ is less than the tabulated value of $\chi 2$, the hypothesis considered holds good and it can be concluded that the attributes are independent. Rejection Criteria: - If for a specified significance level the value of is greater than the tabulated value of, the hypothesis is rejected and it can be concluded that the attributes are related

The test should satisfy some condition necessary for its use:- 1) Observations recorded and used are collected on a random basis 2)All items in the sample must be independent 3)The overall number of items must also be large, at least 50. 4) The constraints must be linear

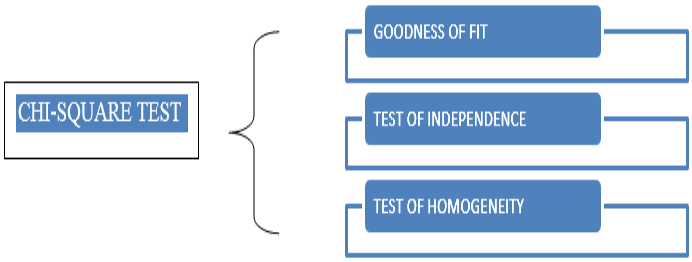

Fig 1: Applications of Chi-Square test

As a non-parametric test, this test can be used (1) as a Goodness of fit- This enables us to know how assumed theoretical distributions (Normal, Binomial, Poission Distributions) fit to the observed data If the calculated value of $\chi 2$ is less than the table value at a certain level of significance, the fit is considered to be a good one which means that the divergence between the observed and expected frequencies is attributable to fluctuations of sampling. (2) As a test of Interdependence: - This test helps us to explain if two or more attributes are associated. If the calculated value of $\chi 2$ is less than the table value at a certain level of significance for given degrees of freedom, we conclude that null hypothesis stands which means that the two attributes are independent or not associated. (3) As a test of Homogeneity: - it is used to find out two or more randomly selected independent samples have been drawn from the same population or not. (Fig no.1)

Importance of Chi-square

This test helps to compare variance of the population with an objective of finding out if the sample has been drawn from a normally distributed population with a specified variance. The chi square test as a goodness of fit judges whether a theoretical distribution fits the observed data. The Chi-square test as a test of homogeneity determines if two or more independent sample samples have been drawn from the sample population.

Merits of Chi-square Test: Chi-square test is used commonly by researchers as it has certain merits (1) It is a distribution free test and it can be used in any type of population distribution (2) It is widely applicable not only in social sciences but in Business research as well (3)It is easy to calculate and to conclude (4) Chi –Square test provides an additive property that allows the researcher to add the result of independence but related samples(5) This test is based on observed frequency and not on parameters like Mean, standard deviation

Demerits of Chi-square Test: With a view of merit, this test also have some limitations (1) it is applicable to certain conditions being satisfied (2) it is useful in testing hypothesis but not used for estimation

Application in Business Research and Management

The Chi-square test is commonly used by the researchers due to its above discussed advantageous, it is been widely analyzed in research field. Some of the cases are discussed here to know its application in Business Research. Chi-square test for independence helped to unearth possible dependency between variables in the study of the laptop brands preferred by the engineering and management students determine the laptop usage in the study (Sharma, 2012)

To analyse the investors attitude towards tax saving schemes, a chi-square test is used to check the significance (Mane and Shetty, 2013) [8] Chi-square test explores employee's insight of marketing strategies such as low cost strategies, non-pricing factors, Integrated Marketing Communication, customer relationship management, product distribution etc. (Jain and Dixit, 2014) [5] Chi-square checked the significance of the data when hypothesis were framed to have a meaningful study of stress management among student in Salem city (Jaykumar, Sumanthi, 2014) [11] Chi-Square test of Independence is helpful in finding the relationship between Demographic variable and Enterpreneurial Characterstics The study provides an insight into the intensity of Entrepreneurial characteristics of the students which can be helpful from the perspective of designing Entrepreneurship education curriculum, focusing more on the skills found to have lesser intensity among the students (Gandhi, Taneja. 2015) no statistically significant impact of demographic variables was observed on most of the entrepreneurial characteristics under study. Chi-square is applied to study the perception of undergraduate students towards MBA education with reference to different region (Prashant Guha 2013) [10]

Conclusion

In Business analytics problems, the Chi-square test can be used to establish or invalidate that a relationship exists between two given business parameters**.** Chi-squared test of independence is a very useful tool for predictive analytics professional. It is used very commonly in Clinical research, Social sciences and Business research. Researchers using this test must check the conditions applicable for this and must understand the significance of this test. Some applications of Chi-square as goodness of fit, independence and homogeneity is discussed in the paper.

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