A STUDY OF RESEARCH DATA PROCESSING USING STATISTICAL TESTS AND ANALYSIS ISSUES AND CHALLENGES

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1. Introduction:

Statistics as one of the famous statistician puts as "half-truth" and stretched to the convenience of the interpreters of data and their requirements and self-interests. But the statistical tests and analysis are very vital , necessary and important requirement to find the strength of data (factor analysis) for corporate and research decision process in many spectrums like management, commerce, economics, market analysis (correlation and extrapolation, Anova etc.). The tests like t-test, f-test, chi-square tests - are used to validate the hypothesis in the lens of the result of statistical test results. Now with the advent of statistical packages like SPSS the application of statistics , tests, factor analysis, graphs and diagrams for better understanding of the data and its behavior in a given system and its extrapolation for future and research and corporate decision process.

2. Introduction to research :

The statistical tests when used for research data analysis and processing and further interpretations for arriving at conclusions and useful suggestions for a corporate or any other system from which the data is collected, it should be used with great care and diligence . The statistical test when used calls for many of the parameters which make them fit for the particular case –set of data and situations. It's proper selection of test most vital to arrive at correct and useful interpretations otherwise the researcher may land up with wrong interpretations and conclusions for set of data and related business or economic system.

The choice of test, the sample size, the calculation of sample size w.r.t to the sample study, the size and nature of population – limited or unlimited, really random or not, convenient sample, the quality of questionnaire, the simplicity (understanblity to all respondents or not) , whether structured or not, the Likert scale used , the size of total population w.r.t survey sample, the homogenous or heterogeneous nature of data and the total population are some of the vital parameters which make the test results useful and reliable for future use.

The research would design the null hypothesis with regard to the objectives of the research and the same would be tested under suitable statistical study using, random sampling methods, stratification techniques and suitable statistical tests.

3. The objective and research methodology :

The broad objective of the research is focused on finding the utility, application, interpretations of data, use, misuse, misinterpretations w.r.t the application of statistical tests and analysis in research data of management and commerce field.

The specific objectives and hypothesis would be designed for the analysis of survey research thesis (random number of thesis) focused to find the reliability of the ways the statistical applications are used in these thesis for research data analysis and validation of the research hypothesis based on the research parameters (selection –choice of test, sample size, structure of questionnaire , quality, likert scale used and its suitability to the research objectives and hypothesis , population v/s sample size, truly random or not etc.)

For the primary survey the researcher wants to select suitable number (to fit into the duration of research – research period) the research (Ph.D) thesis randomly selected from three universities library from the field of management, commerce and economics where statistical tests are used for testing their hypothesis of research .

The researcher would design null hypothesis regarding the subject matter of this research and test for results regarding the reliability of the data interpretations in these research thesis on the research parameters such as suitability – proper selection –choice of test, the correctness of sample size, the total population, the analysis process used, the correctness of interpretations, quality of questionnaire, whether structured or not etc..

The researcher would first make a secondary survey with vast literature survey for conceptual frame work of the subject matter of research and the review of the previous research papers conducted in this research topic to find the correct research gap and design the research objectives and suitable hypothesis of my research .The researcher would like to make discussions with the guide , professors and other research scholars to get finer details of the way research scholars use the statistical test for their research data analysis , before final conclusions are drawn for research. Vast secondary survey was made in the following areas of literature review mentioned below .

4. Literature survey :

4.1 Introduction to Statistics:

Statistics is the science of learning from data, and of measuring, controlling, and communicating uncertainty; and it thereby provides the navigation essential for controlling the course of scientific and societal advances (Davidian, M. and Louis, T. A., 10.1126/science.1218685).

Statisticians apply statistical thinking and methods to a wide variety of scientific, social, and business endeavors in such areas as astronomy, biology, education, economics, engineering, genetics, marketing, medicine, psychology, public health, sports, among many. "The best thing about being a statistician is that you get to play in everyone else's backyard." (John Tukey, Bell Labs, Princeton University).Many economic, social, political, and military decisions cannot be made without statistical techniques, such as the design of experiments to gain federal approval of a newly manufactured drug.

Ref :ASA definition - The American Statistical Association is the world's largest community of statisticians, http:// www.amstat.org/ careers/ whatisstatistics. cfm

4.1.2 Data collection methods :

Statistics - Area of applied mathematics concerned with the data collection, analysis, interpretation and presentation. Statistics is used in almost every field of research: the discovery of the Higgs particle, social sciences, climate research,...

The main portion of Statistics is the display of summarized data. Data is initially collected from a given source, whether they are experiments, surveys, or observation, and is presented in one of four methods:

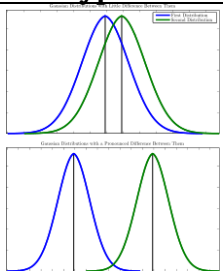
1. Textual Method
2. Tabular Method
3. Semi-tabular Method
4. Graphical Method

Data analysis is one of the more important stages in research. Without performing exploratory analyses of data, one is set for mistakes and loss of time. the goal is to "visualize" the data and get a sense of their values. So one plot histograms and compute summary statistics to observe the trends and the distribution of data.

Ref: en.wikibooks.org

4.2 Introduction to Statistical Tests and Factor Analysis:

4.2.1 Statistics – testing statistical hypothesis :



Equal distributions, but different means. :

There are many different tests for the many different kinds of data. Understand variables quantitative or qualitative . Certain tests are for certain types of data depending on the size, distribution or scale. Also, it is important to understand how samples of data can differ. The 3 primary characteristics of quantitative data are: central tendency, spread, and shape.When one "test" quantitative data, they tend test for central tendency. i.e to test this would be to test to see if their central tendency (their means for example) differ.. If one sample was a lot different than another (a lot higher in values ,etc.) then the means would be different typically. So when testing if two samples are different, usually two means are compared.Two medians (another measure of central tendency) can be compared also. One should follow different distributions - different testing procedures must be followed and utilized. One summarize the result of a hypothesis test into one particular value - the p-value. If the p-value is smaller than the level of significance (usually $\alpha = 5\%$, but even lower in other fields of science i.e. Medicine) then onereject the null-hypothesis, but this does not mean one accept the alternative hypothesis. The p-value is essentially the probability of obtaining a test statistic at least as extreme as the one observed. If the p-value is greater than the level of significance one fail to reject the null-hypothesis, but this does not mean that the null-hypothesis is correct.

Ref: en.wikibooks.org

4.2.2 Factor analysis :

Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors.
The main applications of factor analytic techniques are:
(1) to reduce the number of variables and
(2) to detect structure in the relationships between variables, that is to classify variables. Therefore, factor analysis is applied as a data reduction or structure detection method (the term factor analysis was first introduced by Thurstone, 1931). The topics listed below will describe the principles of factor analysis, and how it can be applied towards these two purposes.

Confirmatory factor analysis. Structural Equation Modeling (SEPATH) allows you to test specific hypotheses about the factor structure for a set of variables, in one or several samples **Correspondence analysis.** Correspondence analysis is a descriptive/exploratory technique designed to analyze two-way and multi-way tables containing some measure of correspondence between the rows and columns..
Factor Scores. the actual values of individual cases (observations) for the factors. These factor scores are particularly useful when one want to perform further analyses involving the factors that one has identified in the factor analysis.

Ref : http:// documents.software.dell.com /Statistics / Textbook / Principal-Components-Factor-Analysis-statistics –text book

A statistical test provides a mechanism for making quantitative decisions about a process or processes. The intent is to determine whether there is enough evidence to "reject" a conjecture or hypothesis about the process. The conjecture is called the null hypothesis. Not rejecting may be a good result if we want to continue to act as if we "believe" the null hypothesis is true. Or it may be a disappointing result, possibly indicating we may not yet have enough data to "prove" something by rejecting the null hypothesis.
Thus, a statistical test requires a pair of hypotheses; namely,
H0: a null hypothesis
Ha: an alternative hypothesis
Null and alternative hypotheses can also be one-sided. For example, to ensure that a lot of light bulbs has a mean lifetime of at least 500 hours, a testing program is implemented. The null hypothesis, in this case, is that the mean lifetime is greater than or equal to 500 hours. The complement or alternative hypothesis that is being guarded against is that the mean lifetime is less than 500 hours. The test statistic is compared with a lower critical value, and if it is less than this limit, the null hypothesis is rejected.
The null hypothesis is a statement about a belief. We may doubt that the null hypothesis is true, which might be why we are "testing" it. The alternative hypothesis might, in fact, be what we believe to be true. The test procedure is constructed so that the risk of rejecting the null hypothesis, when it is in fact true, is small. This risk, α, is often referred to as thesignificance level of the test. By having a test with a small value of α, we feel that we have actually "proved" something when we reject the null hypothesis
The risk of failing to reject the null hypothesis when it is in fact false is not chosen by the user but is determined, as one might expect, by the magnitude of the real discrepancy. This risk, β, is usually referred to as the error of the second kind. Large discrepancies between reality and the null hypothesis are easier to detect and lead to small errors of the second kind; while small discrepancies are more difficult to detect and lead to large errors of the second kind. Also the risk β increases as the risk α decreases. The risks of errors of the second kind are usually summarized by an operating characteristic curve (OC) for the test. OC curves for several types of tests are shown in (Natrella, 1962)

Ref: -NIST/SEMATECH e-Handbook of Statistical Methods, http:// www.itl.nist.gov / div898/handbook/, April, 2012

NIST is an agency of the U.S. Department of Commerce.

4.3 Introduction to the correlation , fitness, ANOVAs :

Correlation : The correlation is one of the most common and most useful statistics. A correlation is a single number that describes the degree of relationship between two variables.

The formula for the correlation is:

$$r = \frac{N\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{[N\Sigma x^2 - (\Sigma x)^2][N\Sigma y^2 - (\Sigma y)^2]}}$$

Where:

N	=	number of pairs of scores
Σxy	=	sum of the products of paired scores
Σx	=	sum of x scores
Σy	=	sum of y scores
Σx^2	=	sum of squared x scores
Σy^2	=	sum of squared y scores

the symbol **r** to stand for the correlation. Through the magic of mathematics it turns out that r will always be between -1.0 and +1.0. if the correlation is negative, we have a negative relationship; if it's positive, the relationship is positive. the formula to compute the correlation.

Testing the Significance of a Correlation

computed a correlation, one can determine the probability that the observed correlation occurred by chance. That is, one conduct a significance test. determining the probability that the correlation is a real one and not a chance occurrence.

Null Hypothesis:	r = 0
Alternative Hypothesis:	r <> 0

The easiest way to test this hypothesis is to find a statistics book that has a table of critical values of r. Most introductory statistics texts would have a table like this. As in all hypothesis testing, one need to first determine the significance level. Here, I'll use the common significance level of alpha = .05. This means that I am conducting a test where the odds that the correlation is a chance occurrence is no more than 5 out of 100.

Other Correlations :The specific type of correlation the Pearson Product Moment Correlation. It is appropriate when both variables are measured at an interval level. However there are a wide variety of other types of correlations for other circumstances. for instance, if you have two ordinal variables, you could use the Spearman rank Order Correlation (rho) or the Kendall rank order Correlation (tau).

ref: research methods knowledge base web site : www. social researchmethods.net /kb/statcorr.php

4.4 Review of previous research papers on this subject:

4.41 Burt, Cyril the author of research paper “Research in education” state in his paper that “The methods of research are much the same in education as in other sciences: observation and description of individual children; questionnaires seeking data from large numbers; experimental investigation of specific problems, particularly by means of tests; genetic studies of growing children; pathological studies of abnormal children; and statistical analysis of the data collected.

Teaching, however, consists in much more than mere applied psychology; problems which have formed the chief subjects for research fall under one or other of two main heads: (1) the development and peculiarities of the individual minds to be educated; (2) the best methods to be adopted in educating them. “

Ref : Burt, Cyril (1922). Research in education -Experimental psychology and child study. The new educators library., (pp. 1-5). London, Great Britain: Sir Isaac Pitman & Sons, vi, 122 pp.

4.4.2 The author of research from “American Psychologist” shows that “In the light of continuing debate over the applications of significance testing in psychology journals and following the publication of J. Cohen's (1994) article, the Board of Scientific Affairs (BSA) of the American Psychological Association (APA) convened a committee called the Task Force on Statistical Interference (TFSI) whose charge was "to elucidate some of the controversial issues surrounding applications of statistics including significance testing and its alternatives; alternative underlying models and data transformation; and newer methods made possible by powerful computers" (BSA, personal communication, February 28, 1996). After extensive discussion, the BSA recommended that publishing an article in American Psychologist, as a way to initiate discussion in the field about changes in current practices of data analysis and reporting may be appropriate. This report follows that request. Following each guideline are comments, explanations, or elaborations assembled by L. Wilkinson for the task force and under its review. The report is concerned with the use of statistical methods only and is not meant as an assessment of research methods in general. The title and format of the report are adapted from an article by J. C. Bailar and F. Mosteller (1988). (PsycINFO Database Record (c) 2012 APA, all rights reserved)

Ref :American Psychologist, Vol 54(8), Aug 1999, 594-604. ©2016 American Psychological Association | Statistical methods in psychology journals: Guidelines and explanations.-Wilkinson, Leland Task Force on Statistical Inference American Psychological Association, Science Directorate Washington DC US- http://dx.doi.org/10.1037/0003-066X.54.8.594 **Apa psycnet American psychological association web site**

4.4.3 The author chitu okoli and Suzanne d state in their article The Delphi method as a research tool: an example, design considerations and applications
“ that “The Delphi method has proven a popular tool in information systems research for identifying and prioritizing issues for managerial decision-making. However, many past studies have not adopted a systematic approach to conduct a Delphi study. This article provides rigorous guidelines for the process of selecting appropriate experts for the study and gives detailed principles for making design choices during the process that ensure a valid study. A detailed example of a study to identify key factors affecting the diffusion of e-commerce in Sub-Saharan Africa illustrates the design choices that may be involved. We conclude with suggestions for theoretical applications.”

Ref : Chitu Okoli and Suzanne D. Pawlowski, “The Delphi method as a research tool: an example, design considerations and applications, Information and management vol 42 issue 1 dec 2004 pages 15-29(Chitu Okoli is an assistant professor in the Department of Decision Sciences and Management Information Systems of the John Molson School of Business at Concordia University, Montréal, Canada. Suzanne Pawlowski is an assistant professor in the Department of Information Systems and Decision Sciences at Louisiana State University)

4.4.5 Elsevier in his research article summarise that "Since the original Data Envelopment Analysis (DEA) study by Charnes et al. [Measuring the efficiency of decision-making units. European Journal of Operational Research 1978;2(6):429–44], there has been rapid and continuous growth in the field. As a result, a considerable amount of published research has appeared, with a significant portion focused on DEA applications of efficiency and productivity in both public and private sector activities. While several bibliographic collections have been reported, a comprehensive listing and analysis of DEA research covering its first 30 years of history is not available."

Ref : Ali Emrouznejad and Barnett R. Parker research article - Socio-economic planning sciences vol 42, issue 3 sept 2008, pages 151-157 (Copyright © 2016 Elsevier B.V. Science Direct® is a registered trademark of Elsevier B.V.) - (Ali Emrouznejad is a Lecturer of Operational Research at Aston University, Birmingham, UK and Barnett R. Parker is a Professor, School of Graduate Studies and School of Business and Economics, Pfeiffer University, Charlotte and Misenheimer, NC **Gabriel Tavares** is a Senior Consultant at Dash Optimization, Englewood Cliffs, NJ).

Roger H. L. Chiang Carl H. and Roger H. L. Chiang Carl H. The research article Roger H. L. Chiang Carl H. and Roger H. L. Chiang Carl H. "Business intelligence and analytics (BI&A)" state in the research paper that "intelligence and analytics (BI&A) has emerged as an important area of study for both practitioners and researchers, reflecting the magnitude and impact of data-related problems to be solved in contemporary business organizations. This paper summarise and conclude that "initiatives, businesses and organizations from all sectors began to gain critical insights from the structured data collected through various enterprise systems and analyzed by commercial relational database management systems. Over the past several years, web intelligence, web analytics, web 2.0, and the ability to mine unstructured user generated contents have ushered in a new and exciting era of research, leading to unprecedented intelligence on consumer opinion, customer needs, and recognizing new business opportunities. Now, in this era of Big Data, even while is still maturing, we find ourselves poised at the brink of with all the attendant uncertainty that new and potentially revolutionary technologies bring. This MIS Quarterly Special Issue on Business Intelligence Research is intended to serve, in part, as a platform and conversation guide for examining how the IS discipline can better serve the needs of business decision makers in light of maturing and emerging technologies, ubiquitous Big Data, and the predicted shortages of data-savvy managers and of business professionals with deep analytical skills..

Ref : Roger H. L. Chiang Carl H. and Roger H. L. Chiang Carl H. "BUSINESS INTELLIGENCE AND ANALYTICS: FROM BIG DATA TO BIG IMPACT" . MIS Quarterly Vol. 36 No. 4/December 2012 1185 (Hsinchun Chen Eller College of Management, University of Arizona, Tucson, AZ 85721 U.S.A. {hchen@eller.arizona.edu} Roger H. L. Chiang Carl H. Lindner College of Business, University of Cincinnati, Cincinnati, OH 45221-0211 U.S.A.)

4.5 Research gap:

The research paper cited above show that there is great scope fro this research because no significant research has been conducted in this particular spectrum. so is this research.

5. Sample survey – objectives, methodology, survey , results and conclusions:

5.1 Previous to the beginning of main research a sample survey was conducted to correctness , reliability and suitability of the statistical tests used in ten research thesis from commerce and management field in one university library –selected randomly.

5.2 The research and statistical tests uses were checked on the following parameters

a) The quality of questionnaire (simple , number of questions and structured or not)
b) The design of hypothesis (correctness)
c) The suitability of test selected w.r.t sample size
d) Research Sample size v/s total population (representative nature)
e) Calculation of sample size- determination process (made or not , correctness etc..)
f) The test results and its interpretations
g) Factor analysis used to find the strength of data (or not used)

5.3 The following results and conclusions were arrived at by analysis of above mentioned parameters and analysis of the ten randomly selected survey thesis :

1) The research found that most of the thesis the questionnaire was instructed (7 out of ten).
2) The research found that most of the thesis have not used the survey sample size determining formula (9 out of ten).
3) The research found that the suitability of test used were mostly o.k (7ok out of 10).
4) The Likert scale was used correctly in most of thesis (9 out of 10).
5) The research found that the interpretations shown could not be drawn out of statistical results derived in the survey (6 out of 10).
6) The research found that the factor analysis were mostly not used.
7) The hypothesis were properly designed in most of the cases (9 out of 10)
8) The sample size was not matching to the total population (when infinite total population – the sample size too small or when total population was small the sample was large).
9) The heterogeneous nature of the total population was not represented properly in few cases (2 out of ten).

5.4 Final conclusions :

Overall the application of the statistical tests were not proper in most of the cases w.r.t the choice of test, the sample size determination, the representative nature of the sample size w.r.t to total population and interpretations .

Some of thesis used multiple statistical tests which were unnecessary for the interpretations and conclusions arrived at.

The researcher suggests that " advice of the expert statistician would be proper from the stage of design of hypothesis and questionnaires and selection of tests to lead ant management –commerce research for useful and true interpretation and reslts".

6. Significance and limitations:

The researcher feels that the this research conclusions would help the future researcher in the field of management , commerce and economics to select correct statistical test and proper use of statistical analysis for their research data analysis . The researcher feels that his work would give correct direction for new scholars and researchers for best and optimal use of statistics and lead towards arrival of reliable and correct corporate decisions which will be both of academic as well as of corporate value.

The limitations of the main research survey would be that only three fields were selected out multiple disciplines and among them only hundred thesis were selected done only in the three survey universities .

The limitation of the sample survey is only one university and two deciplines and only ten thesis were selected for study.

7. Last word.

The researcher sincerely would like to do research to help the researchers to find correct statistical tests and analysis processes for their research to arrive at truthfully useful conclusions for corporate decision process having both business and academic value.

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