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Chapter 1 : Analyzing, Interpreting and Reporting Basic Research Results

Using the model to find the solution: It is a simplified representation of the actual situation It need not be complete or exact in all respects It concentrates on the most essential relationships and ignores the less essential ones. It is more easily understood than the empirical i. It can be used again and again for similar problems or can be modified. The main objective of Business Statistics is to make inferences e. The condition for randomness is essential to make sure the sample is representative of the population. It provides knowledge and skills to interpret and use statistical techniques in a variety of business applications. Statistics is a science of making decisions with respect to the characteristics of a group of persons or objects on the basis of numerical information obtained from a randomly selected sample of the group. Statisticians refer to this numerical observation as realization of a random sample. However, notice that one cannot see a random sample. A random sample is only a sample of a finite outcomes of a random process. At the planning stage of a statistical investigation, the question of sample size n is critical. For example, sample size for sampling from a finite population of size N, is set at: Clearly, a larger sample provides more relevant information, and as a result a more accurate estimation and better statistical judgement regarding test of hypotheses. To reduce this uncertainty and having high confidence that statistical inferences are correct, a sample must give equal chance to each member of population to be selected which can be achieved by sampling randomly and relatively large sample size n. While business statistics cannot replace the knowledge and experience of the decision maker, it is a valuable tool that the manager can employ to assist in the decision making process in order to reduce the inherent risk, measured by, e. A population is any entire collection of people, animals, plants or things on which we may collect data. It is the entire group of interest, which we wish to describe or about which we wish to draw conclusions. In the above figure the life of the light bulbs manufactured say by GE, is the concerned population. Qualitative and Quantitative Variables: Any object or event, which can vary in successive observations either in quantity or quality is called a"variable. A qualitative variable, unlike a quantitative variable does not vary in magnitude in successive observations. The values of quantitative and qualitative variables are called"Variates" and"Attributes", respectively. A characteristic or phenomenon, which may take different values, such as weight, gender since they are different from individual to individual. The fascinating fact about inferential statistics is that, although each random observation may not be predictable when taken alone, collectively they follow a predictable pattern called its distribution function. For example, it is a fact that the distribution of a sample average follows a normal distribution for sample size over In other words, an extreme value of the sample mean is less likely than an extreme value of a few raw data. A subset of a population or universe. An experiment is a process whose outcome is not known in advance with certainty. An experiment in general is an operation in which one chooses the values of some variables and measures the values of other variables, as in physics. A statistical experiment, in contrast is an operation in which one take a random sample from a population and infers the values of some variables. For example, in a survey, we"survey" i. A random sample from the relevant population provides information about the voting intentions. Design of experiments is a key tool for increasing the rate of acquiring new knowledge. Primary data and Secondary data sets: If the data are from a planned experiment relevant to the objective s of the statistical investigation, collected by the analyst, it is called a Primary Data set. However, if some condensed records are given to the analyst, it is called a Secondary Data set. A random variable is a real function yes, it is called" variable", but in reality it is a function that assigns a numerical value to each simple event. You may assign any other two distinct real numbers, as you wish; however, non-negative integer random variables are easy to work with. Random variables are needed since one cannot do arithmetic operations on words; the random variable enables us to compute statistics, such as average and variance. Any random variable has a distribution of probabilities associated with it. Random phenomena are not haphazard: The mathematical description of variation is central to statistics. The probability required for statistical inference is not primarily

axiomatic or combinatorial, but is oriented toward describing data distributions. A unit is a person, animal, plant or thing which is actually studied by a researcher; the basic objects upon which the study or experiment is executed. A parameter is an unknown value, and therefore it has to be estimated. Parameters are used to represent a certain population characteristic. For example, the population mean m is a parameter that is often used to indicate the average value of a quantity. A statistic is a quantity that is calculated from a sample of data. It is used to give information about unknown values in the corresponding population. For example, the average of the data in a sample is used to give information about the overall average in the population from which that sample was drawn. The numerical statistical data should be presented clearly, concisely, and in such a way that the decision maker can quickly obtain the essential characteristics of the data in order to incorporate them into decision process. The principal descriptive quantity derived from sample data is the mean , which is the arithmetic average of the sample data. It serves as the most reliable single measure of the value of a typical member of the sample. If the sample contains a few values that are so large or so small that they have an exaggerated effect on the value of the mean, the sample is more accurately represented by the median -- the value where half the sample values fall below and half above. Inferential statistics is concerned with making inferences from samples about the populations from which they have been drawn. In other words, if we find a difference between two samples, we would like to know, is this a"real" difference i. Any inferred conclusion from a sample data to the population from which the sample is drawn must be expressed in a probabilistic term. Probability is the language and a measuring tool for uncertainty in our statistical conclusions. Statistical inference refers to extending your knowledge obtained from a random sample from the entire population to the whole population. This is known in mathematics as Inductive Reasoning, that is, knowledge of the whole from a particular. Its main application is in hypotheses testing about a given population. Statistical inference guides the selection of appropriate statistical models. Models and data interact in statistical work. Inference from data can be thought of as the process of selecting a reasonable model, including a statement in probability language of how confident one can be about the selection. The normal or Gaussian distribution is a continuous symmetric distribution that follows the familiar bell-shaped curve. One of its nice features is that, the mean and variance uniquely and independently determines the distribution. It has been noted empirically that many measurement variables have distributions that are at least approximately normal. Even when a distribution is non-normal, the distribution of the mean of many independent observations from the same distribution becomes arbitrarily close to a normal distribution, as the number of observations grows large. Many frequently used statistical tests make the condition that the data come from a normal distribution. Estimation and Hypothesis Testing: Inference in statistics are of two types. The first is estimation, which involves the determination, with a possible error due to sampling, of the unknown value of a population characteristic, such as the proportion having a specific attribute or the average value m of some numerical measurement. To express the accuracy of the estimates of population characteristics, one must also compute the standard errors of the estimates. The second type of inference is hypothesis testing. It involves the definitions of a hypothesis as one set of possible population values and an alternative, a different set. There are many statistical procedures for determining, on the basis of a sample, whether the true population characteristic belongs to the set of values in the hypothesis or the alternative. Qualitative data, such as eye color of a group of individuals, is not computable by arithmetic relations. They are labels that advise in which category or class an individual, object, or process fall. They are called categorical variables. Quantitative data sets consist of measures that take numerical values for which descriptions such as means and standard deviations are meaningful. They can be put into an order and further divided into two groups: Continuous data are collected by measuring and are expressed on a continuous scale. For example, measuring the height of a person. Sampling Methods Following are important methods in sampling: Cluster sampling can be used whenever the population is homogeneous but can be partitioned. In many applications the partitioning is a result of physical distance. For instance, in the insurance industry, there are small"clusters" of employees in field offices scattered about the country. In such a case, a random sampling of employee work habits might not required travel to many of the"clusters" or field offices in order to get the data. Totally sampling each one of a small number of clusters chosen at random can eliminate much of the cost associated with the data

requirements of management. Stratified sampling can be used whenever the population can be partitioned into smaller sub-populations, each of which is homogeneous according to the particular characteristic of interest. If there are k sub-populations and we let Ni denote the size of sub-population i, let N denote the overall population size, and let n denote the sample size, then we select a stratified sample whenever we choose: Population total T is estimated by N. Random sampling is probably the most popular sampling method used in decision making today. Many decisions are made, for instance, by choosing a number out of a hat or a numbered bead from a barrel, and both of these methods are attempts to achieve a random choice from a set of items. But true random sampling must be achieved with the aid of a computer or a random number table whose values are generated by computer random number generators. A random sampling of size n is drawn from a population size N. The unbiased estimate for variance of is: For 0, 1, binary type variables, variation in estimated proportion p is:

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In the period since the first edition was published, I have appreciated the correÂ- spondence from all parts of the world expressing thanks for the presentation of statistics from a user's perspective. It has been particularly pleasing to have been invited to contribute to course restructuring and.

However, there are certain basics which can help to make sense of reams of data. Always start with your research goals When analyzing data whether from questionnaires, interviews, focus groups, or whatever , always start from review of your research goals, i. This will help you organize your data and focus your analysis. For example, if you wanted to improve a program by identifying its strengths and weaknesses, you can organize data into program strengths, weaknesses and suggestions to improve the program. If you wanted to fully understand how your program works, you could organize data in the chronological order in which customers or clients go through your program. If you are conducting a performance improvement study, you can categorize data according to each measure associated with each overall performance result, e. Basic analysis of "quantitative" information for information other than commentary, e. Make copies of your data and store the master copy away. Use the copy for making edits, cutting and pasting, etc. Tabulate the information, i. For ratings and rankings, consider computing a mean, or average, for each question. For example, "For question 1, the average ranking was 2. This is more meaningful than indicating, e. Consider conveying the range of answers, e. Read through all the data. Organize comments into similar categories, e. Label the categories or themes, e. Attempt to identify patterns, or associations and causal relationships in the themes, e. Keep all commentary for several years after completion in case needed for future reference. Interpreting information Attempt to put the information in perspective, e. Consider recommendations to help employees improve the program, product or service; conclusions about program operations or meeting goals, etc. Record conclusions and recommendations in a report, and associate interpretations to justify your conclusions or recommendations. Also see Analyzing Data and Communicating Results Reporting Results The level and scope of content depends on to whom the report is intended, e. Be sure employees have a chance to carefully review and discuss the report. Translate recommendations to action plans, including who is going to do what about the research results and by when. The funder may want the report to be delivered as a presentation, accompanied by an overview of the report. Or, the funder may want to review the report alone. Be sure to record the research plans and activities in a research plan which can be referenced when a similar research effort is needed in the future. Who Should Carry Out the Research? Then a research expert helps the organization to determine what the research methods should be, and how the resulting data will be analyzed and reported back to the organization. If an organization can afford any outside help at all, it should be for identifying the appropriate research methods and how the data can be collected. The organization might find a less expensive resource to apply the methods, e. If no outside help can be obtained, the organization can still learn a great deal by applying the methods and analyzing results themselves. However, there is a strong chance that data about the strengths and weaknesses of a product, service or program will not be interpreted fairly if the data are analyzed by the people responsible for ensuring the product, service or program is a good one. These people will be "policing" themselves. This caution is not to fault these people, but rather to recognize the strong biases inherent in trying to objectively look at and publicly at least within the organization report about their work. Therefore, if at all possible, have someone other than the those responsible for the product, service or program to look at and determine research results. Contents of a Research Report -- An Example Ensure your research plan is documented so that you can regularly and efficiently carry out your research activities. For example, consider the following format: There is no "perfect" research design. Work hard to include some interviews in your research methods. For the Category of Business Research: To round out your knowledge of this Library topic, you may want to review some related topics, available from the link below. Each of the related topics includes free, online resources. Also, scan the Recommended Books listed below. They have been selected for their relevance and highly practical nature.

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This book describes the basis, application, and interpretation of statistics, and presents a wide range of univariate and multivariate statistical methodology. In its first edition it has proved popular across all science and technology based disciplines, including the social sciences, and in areas of commerce.

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