# DICTIONARY OF STATISTICS METHODOLOGY pdf

## 1: Statistics - Wikipedia

*Written in a clear, readable style with a wide range of explanations and examples, The SAGE Dictionary of Statistics & Methodology, Fifth Edition by W. Paul Vogt and R. Burke Johnson is a must-have dictionary that reflects recent changes in the fields of statistics and methodology.*

Overview[ edit ] In applying statistics to a problem, it is common practice to start with a population or process to be studied. Populations can be diverse topics such as "all persons living in a country" or "every atom composing a crystal". Ideally, statisticians compile data about the entire population an operation called census. This may be organized by governmental statistical institutes. Descriptive statistics can be used to summarize the population data. Numerical descriptors include mean and standard deviation for continuous data types like income , while frequency and percentage are more useful in terms of describing categorical data like race. When a census is not feasible, a chosen subset of the population called a sample is studied. Once a sample that is representative of the population is determined, data is collected for the sample members in an observational or experimental setting. Again, descriptive statistics can be used to summarize the sample data. However, the drawing of the sample has been subject to an element of randomness, hence the established numerical descriptors from the sample are also due to uncertainty. To still draw meaningful conclusions about the entire population, inferential statistics is needed. It uses patterns in the sample data to draw inferences about the population represented, accounting for randomness. These inferences may take the form of: Inference can extend to forecasting , prediction and estimation of unobserved values either in or associated with the population being studied; it can include extrapolation and interpolation of time series or spatial data , and can also include data mining. Sampling[ edit ] When full census data cannot be collected, statisticians collect sample data by developing specific experiment designs and survey samples. Statistics itself also provides tools for prediction and forecasting through statistical models. The idea of making inferences based on sampled data began around the mids in connection with estimating populations and developing precursors of life insurance. Representative sampling assures that inferences and conclusions can safely extend from the sample to the population as a whole. A major problem lies in determining the extent that the sample chosen is actually representative. Statistics offers methods to estimate and correct for any bias within the sample and data collection procedures. There are also methods of experimental design for experiments that can lessen these issues at the outset of a study, strengthening its capability to discern truths about the population. Sampling theory is part of the mathematical discipline of probability theory. Probability is used in mathematical statistics to study the sampling distributions of sample statistics and, more generally, the properties of statistical procedures. The use of any statistical method is valid when the system or population under consideration satisfies the assumptions of the method. The difference in point of view between classic probability theory and sampling theory is, roughly, that probability theory starts from the given parameters of a total population to deduce probabilities that pertain to samples. Statistical inference, however, moves in the opposite directionâ€” inductively inferring from samples to the parameters of a larger or total population. Experimental and observational studies[ edit ] A common goal for a statistical research project is to investigate causality , and in particular to draw a conclusion on the effect of changes in the values of predictors or independent variables on dependent variables. There are two major types of causal statistical studies: In both types of studies, the effect of differences of an independent variable or variables on the behavior of the dependent variable are observed. The difference between the two types lies in how the study is actually conducted. Each can be very effective. An experimental study involves taking measurements of the system under study, manipulating the system, and then taking additional measurements using the same procedure to determine if the manipulation has modified the values of the measurements. In contrast, an observational study does not involve experimental manipulation. Instead, data are gathered and correlations between predictors and response are investigated. While the tools of data analysis work best on data from randomized studies , they are also applied to other kinds of dataâ€”like natural experiments and observational studies [15] â€”for which a statistician would use a modified, more structured estimation method e. Experiments[ edit ] The basic

steps of a statistical experiment are: Planning the research, including finding the number of replicates of the study, using the following information: Consideration of the selection of experimental subjects and the ethics of research is necessary. Statisticians recommend that experiments compare at least one new treatment with a standard treatment or control, to allow an unbiased estimate of the difference in treatment effects. Design of experiments , using blocking to reduce the influence of confounding variables , and randomized assignment of treatments to subjects to allow unbiased estimates of treatment effects and experimental error. At this stage, the experimenters and statisticians write the experimental protocol that will guide the performance of the experiment and which specifies the primary analysis of the experimental data. Performing the experiment following the experimental protocol and analyzing the data following the experimental protocol. Further examining the data set in secondary analyses, to suggest new hypotheses for future study. Documenting and presenting the results of the study. Experiments on human behavior have special concerns. The famous Hawthorne study examined changes to the working environment at the Hawthorne plant of the Western Electric Company. The researchers were interested in determining whether increased illumination would increase the productivity of the assembly line workers. The researchers first measured the productivity in the plant, then modified the illumination in an area of the plant and checked if the changes in illumination affected productivity. It turned out that productivity indeed improved under the experimental conditions. However, the study is heavily criticized today for errors in experimental procedures, specifically for the lack of a control group and blindness. The Hawthorne effect refers to finding that an outcome in this case, worker productivity changed due to observation itself. Those in the Hawthorne study became more productive not because the lighting was changed but because they were being observed. This type of study typically uses a survey to collect observations about the area of interest and then performs statistical analysis. In this case, the researchers would collect observations of both smokers and non-smokers, perhaps through a cohort study , and then look for the number of cases of lung cancer in each group. Types of data[ edit ] Main articles: Statistical data type and Levels of measurement Various attempts have been made to produce a taxonomy of levels of measurement. The psychophysicist Stanley Smith Stevens defined nominal, ordinal, interval, and ratio scales. Nominal measurements do not have meaningful rank order among values, and permit any one-to-one transformation. Ordinal measurements have imprecise differences between consecutive values, but have a meaningful order to those values, and permit any order-preserving transformation. Interval measurements have meaningful distances between measurements defined, but the zero value is arbitrary as in the case with longitude and temperature measurements in Celsius or Fahrenheit , and permit any linear transformation. Ratio measurements have both a meaningful zero value and the distances between different measurements defined, and permit any rescaling transformation. Because variables conforming only to nominal or ordinal measurements cannot be reasonably measured numerically, sometimes they are grouped together as categorical variables , whereas ratio and interval measurements are grouped together as quantitative variables , which can be either discrete or continuous , due to their numerical nature. Such distinctions can often be loosely correlated with data type in computer science, in that dichotomous categorical variables may be represented with the Boolean data type , polytomous categorical variables with arbitrarily assigned integers in the integral data type , and continuous variables with the real data type involving floating point computation. But the mapping of computer science data types to statistical data types depends on which categorization of the latter is being implemented. Other categorizations have been proposed. For example, Mosteller and Tukey [18] distinguished grades, ranks, counted fractions, counts, amounts, and balances. Nelder [19] described continuous counts, continuous ratios, count ratios, and categorical modes of data. See also Chrisman , [20] van den Berg  Whether or not a transformation is sensible to contemplate depends on the question one is trying to answer" Hand, , p. A statistic is a random variable that is a function of the random sample, but not a function of unknown parameters. The probability distribution of the statistic, though, may have unknown parameters. Consider now a function of the unknown parameter: Commonly used estimators include sample mean , unbiased sample variance and sample covariance. A random variable that is a function of the random sample and of the unknown parameter, but whose probability distribution does not depend on the unknown parameter is called a pivotal quantity or pivot. Between two estimators of a given parameter, the one with lower mean

squared error is said to be more efficient. Furthermore, an estimator is said to be unbiased if its expected value is equal to the true value of the unknown parameter being estimated, and asymptotically unbiased if its expected value converges at the limit to the true value of such parameter. Other desirable properties for estimators include: UMVUE estimators that have the lowest variance for all possible values of the parameter to be estimated this is usually an easier property to verify than efficiency and consistent estimators which converges in probability to the true value of such parameter. This still leaves the question of how to obtain estimators in a given situation and carry the computation, several methods have been proposed: Null hypothesis and alternative hypothesis[ edit ] Interpretation of statistical information can often involve the development of a null hypothesis which is usually but not necessarily that no relationship exists among variables or that no change occurred over time. The null hypothesis, H0, asserts that the defendant is innocent, whereas the alternative hypothesis, H1, asserts that the defendant is guilty. The indictment comes because of suspicion of the guilt. The H0 status quo stands in opposition to H1 and is maintained unless H1 is supported by evidence "beyond a reasonable doubt". However, "failure to reject H0" in this case does not imply innocence, but merely that the evidence was insufficient to convict. So the jury does not necessarily accept H0 but fails to reject H0. While one can not "prove" a null hypothesis, one can test how close it is to being true with a power test , which tests for type II errors.

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## 2: W. Paul Vogt (Author of Dictionary of Statistics & Methodology)

*Explore the research methods terrain, read definitions of key terminology, and discover content relevant to your research methods journey. Reading Lists Find lists of key research methods and statistics resources created by users.*

Research is completed through various methods, which are similar to those of case studies, but since the researcher is immersed within the group for an extended period of time more detailed information is usually collected during the research. A form of ethnography that studies activities of group members to see how they make sense of their surroundings Existence or Frequency This is a key question in the coding process. For example, "damn" could be counted once, even though it appears 50 times, or it could be counted all 50 times. The latter measurement may be interested in how many times it occurs and what that indicates, whereas the former may simply looking for existence, period. Experiment Experimental Research A researcher working within this methodology creates an environment in which to observe and interpret the results of a research question. In an attempt to create a causal model i. Factor Analysis A statistical test that explores relationships among data. The test explores which variables in a data set are most related to each other. In a carefully constructed survey, for example, factor analysis can yield information on patterns of responses, not simply data on a single response. Larger tendencies may then be interpreted, indicating behavior trends rather than simply responses to specific questions. Generalizability The extent to which research findings and conclusions from a study conducted on a sample population can be applied to the population at large. Grounded theory Practice of developing other theories that emerge from observing a group. Independent Variable A variable that is part of the situation that exist from which originates the stimulus given to a dependent variable. Includes treatment, state of variable, such as age, size, weight, etc. Inductive A form of reasoning in which a generalized conclusion is formulated from particular instances Inductive analysis A form of analysis based on inductive reasoning; a researcher using inductive analysis starts with answers, but forms questions throughout the research process. Internal Consistency The extent to which all questions or items assess the same characteristic, skill, or quality. Internal Validity 1 The rigor with which the study was conducted e. In studies that do not explore causal relationships, only the first of these definitions should be considered when assessing internal validity. Interrater Reliability The extent to which two or more individuals agree. It addresses the consistency of the implementation of a rating system. A variable in which both order of data points and distance between data points can be determined, e. Irrelevant Information One must decide what to do with the information in the text that is not coded. Kinesics Kinesic analysis examines what is communicated through body movement Level of Analysis Chosen by determining which word, set of words, or phrases will constitute a concept. According to Carley, concepts is generally sufficient when coding for a specific topic, but this number of course varies on a case by case basis. Level of Generalization A researcher must decide whether concepts are to be coded exactly as they appear, or if they can be recorded in some altered or collapsed form. Using Horton as an example again, she could code profanity individually and code "damn" and "dammit" as two separate concepts. Or, by generalizing their meaning, i. For example, consider a hypothetical piece of text about skiing, written by an expert. The expert might refer several times to "??? One must decide whether to code "??? A matched pairs T-test can be used to determine if the scores of the same participants in a study differ under different conditions. For instance, this sort of t-test could be used to determine if people write better essays after taking a writing class than they did before taking the writing class.

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## 3: Dictionary of Statistics & Methodology : W. Paul Vogt :

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## 4: Nomological Net - SAGE Research Methods

*The Third Edition of the Dictionary of Statistics & Methodology: A Nontechnical Guide for the Social Sciences is THE sourcebook of simple definitions and explanations of statistical and statistics-related concepts.*

Definition - Methodology simply refers to the methods we use to conduct an investigation. Systematic Research - Research in psychology is not haphazard. Following the basic principles of science there is some systematic way all research is conducted. Usually this means the psychologists approaches a problem from a theoretical perspective, they arrive at some question they want to answer which is called a hypothesis, and then perform a study to answer the question. Naturalistic Observations - This is the simplest way we study behavior. You simply observe the behavior in its natural environment. This is frequently informal is usually the first step to allow you to get a better understanding of the behavior which allows further, more in-depth investigation. Case Study - This is the gathering of detailed information on a specific individual. It is the technique used by Freud. It is difficult; however, to generalize past the person you are studying. They are only accurate, however, if the people surveys are representative of the population as a whole. Correlations - This investigates the degree of relatedness between two variables. A positive correlation indicates that a high score on one variable is associated with a high score on the other variable. For example, height and weight are positively correlated. As you get taller you tend to weigh more. A negative correlation means that a high score on one variable is associated with a low score on the other. For example, amount of brain damage and short-term memory. The more brain damage you have the poorer your short-term memory. Correlation does not imply causality. For example, there is a high correlation between umbrellas being open and the number of puddles on the ground. That does not mean the umbrellas cause puddles. Causation - If you want to determine if one variable causes another to happen you have to conduct an experiment. An experiment systematically alters one variable to see its effect on another variable. Independent Variable - The variable that we alter systematically is referred to as the independent variable. Dependent Variable - This is the outcome variable, the one we measure to see how it is affected by the independent variable. Example - You are interested in seeing the immediate effects of watching TV violence on aggression. You then put each in a play situation and see how much pushing the child engages in. The IV is the film and the DV is the amount of pushing. How Some Experiments Go Wrong There are a number of events that can occur before, during and after an experiment that can have a negative impact on the psychological research study. Poorly planned studies will yield results that are useless, misleading or worse. Here are some of them. Instead he or she will try to guess what the experimenter is trying to do or study and either "help" or "hinder" the researcher. For example, if a study is titled: The researcher can have his or her own perception of each participant. The participants who decide to drop out of the study may be doing so because they possess certain characteristics that are not suited to the study. When just the participant or just the experimenter does not know the purpose, it is called a "single-blind" study. If both experimenter and participants do not know it is called "double-blind. Utility - We use statistics to determine the probability of differences in the DV are large enough so we are confident they are not due to chance. Descriptive Statistics - These do not tell us anything about probability but only allow us to take a large amount of data and put it in some understandable form. These are grouped in two major forms: Measures of Central Tendency tell us about the center of our scores and Measures of Dispersion tell us how spread out our scores are. Measures of Central Tendency - Mean is simple the average score. This is calculated by adding up all the scores and dividing by the total number of scores. The mode is the most frequently occurring score. The median is the middle most score. Example - Scores on an exam. Ten people in the class.

## 5: Guide: Glossary of Key Terms

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