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| MHST 603:  Tutorials  [Tutorial 1](http://charon.athabascau.ca/cnhsgrad/mhst603/tutorials.htm#Tutorial_1) | [Tutorial 2](http://charon.athabascau.ca/cnhsgrad/mhst603/tutorials.htm#Tutorial_2) | [Tutorial 3](http://charon.athabascau.ca/cnhsgrad/mhst603/tutorials.htm#Tutorial_3) | [References](http://charon.athabascau.ca/cnhsgrad/mhst603/tutorials.htm#References)Tutorial 1: The Nature of Statistics Welcome to the first of three tutorials on statistics.  As a student in the MHS/NURS 603 course, we want you to be a sophisticated consumer of research. To accomplish this, you need to be familiar with statistics, what statistics tell us, and how to interpret statistics in a research report. These tutorials are designed as a **review** of statistics.  Statistics allow you to take a large (or small) amount of data and, using selected statistical techniques, provide answers to your research questions.  There are three general levels of research questions:  **Level 1** questions are usually answered by qualitative means of data collection, e.g., interviews, observation, and qualitative method of analysis, e.g., identification of themes, etc.  The **"what is**" question.   * What is it like to be an online student at Athabasca University? * What is the extent of loneliness in young and middle adults in a long-term rehabilitation center?   **Level 2** questions are "relationship" questions where you look at the relationship between two or more variables (attributes that take on different values and are measurable).   * What is the relationship between the dependency level of renal transplant patients and their rate of recovery? * Is there a relationship between entering averages of baccalaureate nursing students and success in the program?   **Level 3** questions look at "cause and effect": how can I, as a researcher, cause something to happen. Examples:   * First-time mothers who have attended prenatal classes report lower levels of anxiety than first-time mothers who have not attended classes. * Patients who have had preoperative teaching will have better postoperative outcomes.   Level 2 and Level 3 questions are answered by quantitative means, e.g., statistics! Statistics There are two **general classifications of statistics**: descriptive (which allows you to describe and summarize your data), and inferential statistics (which allows you to infer—reach an opinion—that the relationships you observed in a sample are likely to be found in a larger population). We will revisit descriptive and inferential statistics in Tutorial 2.  **Levels of Measurement**  After the researcher has refined the research questions (s), determined a design, decided on a sample, the next questions is what data are needed to answer the research questions (s) and how are these data collected?  Data in quantitative studies tend to be collected from larger samples than in qualitative studies, tend to be numerical data and tend to be collected through the use of standardized instruments (e.g., questionnaires).  In the design state, i.e., when the researcher is developing the research plan, a question that needs to be answered is:  What are the appropriate statistical tests for me to perform to answer my research questions?  A determining factor in the decision on the types of statistics to be used in the analysis is the level of measurement of the data. Thus, the levels of measurement are an important concept to understand.  **There are the four 'levels of measurement':**   * Nominal: classifying objects into mutually exclusive categories, e.g., gender, marital status, blood type. Nominal measurement provides information about the category only, i.e., how many objects are in each category. * Ordinal: sorting of objects on the basis of their standing, relative to each other. For example, rank ordering the subjects in a weight control study from heaviest to lightest. Many variables can be rank ordered, with measurement instruments designed to capture this level of measurement. For example, if we wanted to measure the concept "dependency" at an ordinal level of measurement, it could be measured as follows:   1 = completely dependent on others 2 = needs another's assistance 3 = needs mechanical assistance 4 = completely independent  In ordinal data, we know the rank order of objects relative to each other, but we do not know the distance between them.   * Interval: specifies the rank order and the distance between objects. For example, most educational marks are interval data. The difference between 70 and 75 is the same difference as between 75 and 80. * Ratio: the highest level of measurement; there are equal intervals between objects and an absolute zero starting point. Many physical characteristics are ratio level data (e.g., height, weight, volume).   We will see in Tutorial 2 and 3 why it is important to understand the concept of levels of measurement. Variables One additional concept we need to review is variables. A variable is an attribute that takes on different values and can be measured. Two terms you need to become familiar with are dependent and independent variables.  Dependent variable: the variable that is thought to depend on or be caused by another variable (i.e. the independent variable).  Let's look at the first example under Level 3 questions.  "First-time mothers who have attended prenatal classes report lower levels of anxiety than first-time mothers who have not attended classes"  The dependent variable is "anxiety"; the independent variable is "prenatal classes" as it is the classes that are thought to decrease the level of anxiety. The sample is "first-time mothers."  **Tutorial 2: Descriptive and Inferential Statistics**  In this tutorial we will be looking at descriptive and inferential statistics.  Recall from Tutorial 1, the level of measurement is a main determining factor in deciding on the type of statistic to be used in the analysis. Also mentioned in Tutorial 1,there are two **general classifications of statistics**: descriptive (which allow you to describe and summarize your data), and inferential statistics (which allows you to infer; to reach an opinion about the larger population based on your sample).  Descriptive statistics is further divided into univariate (looking at one variable) and bivariate (looking at two variables). Inferential statistics is divided into parametric and nonparametric statistics. A variable is an attribute of a person or object that varies and can be measured. If we were to look at the relationship between height and weight, then height and weight are the variables; they are what we are measuring.   |  |  |  |  | | --- | --- | --- | --- | | **STATISTICS** | | | | | **Descriptive** | | **Inferential** | | | **Univariate (one variable)** | **Bivariate (two variables)** | **Parametric** | **Nonparametric** |   So, lets look at each of these four categories:  **Univariate statistics** are procedures for analyzing a single variable for the purposes of description. This description is accomplished by measures of central tendency: mode, median, and mean.   * **Mode:** the score or value that occurs most frequently in a distribution of scores. * **Median:** the exact middle value of a score distribution, the value above and below which 50 percent of the scores lie. * **Mean:**  (average) obtained by summing all the scores and dividing by the number of subjects   Lets look at the following set of data and determine the mode, median and mean.  **13  12  8  15  7  10  16  10  6  11**   * **Mode:** most commonly occurring: 10 (it appears twice) * **Median:** (6,7,8,10,10,11,12,13,15,16): The value that divides the cases in half is 10.5 * **Mean:** (average: add the ten numbers and divide by 10): 10.8   Could we have two sets of data with identical means? Yes.  Thus, the three measures of central tendency do not totally summarize a distribution; we need to look at the *variability* of the distribution, that is, how spread out it is. A distribution of data that is symmetric and not too peaked is referred to as a normal distribution (also called a normal curve or bell curve). Many attributes such as height and intelligence approximate a normal distribution.  To determine whether data are normally distributed or not, we need the measures of variability, in addition to the mode, median, and mean. These are range and standard deviation (sd).  **Range:** thedifference between the highest value in a distribution and the lowest value. Thus, in the data set above, the range is 10 (the difference between 6 and 16).  **The standard deviation** is a measure of how spread out a distribution of scores are. In other words, standard deviation is a measure of variability. To understand this concept, it can help to learn about what statisticians call **normal distribution** of data. A normal distribution of data means that most of the examples in a set of data are close to the "average," while relatively few examples tend to one extreme or the other. Some people refer to the normal distribution as the "bell curve."  The standard deviation is a statistic that tells you how tightly all the various scores are clustered around the mean in a set of data. When the examples are pretty tightly bunched together and the bell-shaped curve is steep, the standard deviation is small. When the examples are spread apart and the bell curve is relatively flat, that tells you that you have a relatively large standard deviation.  ***Reminder*: Descriptive statistics are used to "describe" key variables, and to summarize the characteristics of a sample.** So, the first action a researcher takes with a set of data is usually to calculate the descriptive statistics for the variables. We will see the importance of this in our discussions of parametric statistical tests.  ***Inferential statistics***are divided into parametric and nonparametric tests.  Parametric test are the stronger of the two, thus a researcher will always use parametric tests if certain criteria are met. These are (a) able to assume that the distribution of the data is normally distributed; and (b) the data are at an interval or ratio level.  So, the first thing a researcher does with quantitative data is to run a frequency distribution (mode, median, means, range, sd). If the data are "normally distributed," i.e., the mode, median, and mean are similar with little spread (deviation) of the data from the mean,  the researcher has met the first requirement of using parametric statistics.  We discussed the different levels of measurement in Tutorial 1. To use a parametric test, the data must be at least the interval level.  ***Reminder:* To use parametric statistics the researcher must have at least interval data, and the data be normally distributed.**  **Note:** There is more extensive statistical information available, e.g., sample size, levels of significance, additional statistical tests, etc., but these are beyond the purposes of this course and assignment. Consult a research or statistic text for additional information. There are a few references at the end of Tutorial 3. Tutorial 3: Correlations and t-tests Now that we have reviewed levels of measurement and what we mean by descriptive and inferential statistics, let's review some of the more common statistical tests you will encounter in health care research. Correlation Coefficients If you recall in Tutorial 1, we mentioned three levels of research questions. In a level two question, we look at the relationship between two or more variables; such relationships are usually described through a correlation. The question in such a situation is to what extent are two variables related to each other? For example, there tends to be a relationship between the variables of age, weight, and blood pressure.  The correlation coefficient tells us the degree of the relationship, with the possible value ranging from -1.00 to +1.00. If two variables are perfectly related, the correlation coefficient would be +1.00.  Correlations can express a positive or negative (inverse) relationship. For example, if the relationship between weight and blood pressure in a study was found to be + .50, this tells us that as the weight of the sample goes up, so does the blood pressure. In another example, there tend to be a negative relationship between depression and self-esteem. So, if in a study, the researcher found a correlation of -.50, this tells us as the person's self-esteem increased, and his or her depression tended to be less.  A common question researchers ask is what is an acceptable strength of a correlation?  There is no specific answer to this question, what is interpreted as a strong relationship or a weak relationship depends to some extent on the variables being studied. For most psychological variables such as anxiety, stress (frequently used in health research) a correlation of .60 or stronger would be moderate to strong.  ***Reminder*: A correlation tells you there is a relationship, but does not imply cause and effect.**  ***Reminder:*  When you see "relationship" in a research question, think correlations.**  The more commonly used correlation index that you will see in health research is the product-moment correlation coefficient (also called Pearson's *r*), which requires interval or ratio measures (recall our discussion of levels of measurement in Tutorial 1). A correlation index frequently used for ordinal data is Spearman's *rho.*  Correlations coefficients are frequently reported in two-dimensional tables.  In a study by Fulford and Ford-Gilboe (2004), the authors wanted to examine the health promotion in families with preschool children headed by adolescent mothers. Although published in a nursing journal, the health promotion focus, hopefully, will be of interest to all. The variables are: felt stigma; health work; and health promoting lifestyle practices. The last two study instruments had several subscales, but for the purposes of our discussion we don't need to go into them.  Two of their hypotheses (predictions) were:   1. Family participation in health work is positively related to adolescent mothers' use of health promoting lifestyles practices. 2. Adolescent mothers' feeling of stigma is negatively related to family participation in health work.   The researchers performed descriptive statistics and used Pearson's *r* correlation to test the hypotheses. Part of their correlation result is displayed below. Correlation Matrix  |  |  |  |  | | --- | --- | --- | --- | |  | 1 | 2 | 3 | | 1. Family Health Work | 1.00 |  |  | | 2. Mothers' Health promotion lifestyle practices | 0.52 | 1.00 |  | | 3. Stigma | 0.03 | 0.12 | 1.00 |   In the table above, listed on the left are the variables (health work; health promoting practices; and stigma). The numbers along the top are numbers corresponding to the three variables on the left: one is health work, two is health promotion practices, and three is felt stigma. Where health work (side) and health work (top) bisect, we see the value 1.00 because the variable is perfectly correlated with itself.  So, in reviewing the strength of the correlations, we see a moderate positive relationship between family health work and mothers healthy lifestyle (0.52). This is a positive relationship, so, as the family participation in health work increases, the adolescent mothers' health promotion lifestyle practice increases. This offers support for the researcher's first hypothesis.  Felt stigma was not related to either health work (0.03) or mothers' health promotion lifestyle practice (0.12); thus the second hypothesis is not supported.  ***t-*tests** Suppose we want to assess the differences between two groups. Frequently in research, the research "does something" to one group of subjects (called an intervention) and then tests this group with another group who did not receive the intervention. Suppose the researcher wanted to test the effect of a particular breathing exercise on postoperative outcomes. The researcher might select a group of preoperative patients who receive the breathing exercise. The postoperative outcomes are measured and compared to the same postoperative outcomes on a group of patients who did not received the experimental breathing exercise (but, who did, of course, receive normal preoperative care). The researcher wants to compare if there is difference between the two groups.  A t-test will allow the researcher to answer this question. This as an *independent groups t-test* (meaning there are two groups).Data must be at the interval level in order for the researcher to perform a t-test. If the data are at the nominal level, and the researcher wants to test for differences, usually a chi-square is used (a nonparametric test).An additional situation where a researcher might want to check two groups might be with the same group before and after an intervention. Suppose we wanted to assess the amount of information patients retained after an education session on management of epilepsy. The researcher administers a knowledge test, provides the information in one or more sessions, and then administers the same knowledge test. The researcher now tests the differences between the means the two times the test was offered. Let's assume the mean scores for the two test results are 60 and 78, respectively.  The researcher would use a *paired t-test* to compare the scores of a single group before and after an intervention (there is only one group).  A summary of these two types of t-tests (independent group and paired t-test) is presented below.  **Guide to Use of t-tests (Parametric)**   |  |  | | --- | --- | | **Name** | **Purpose** | | t-test for independent groups | To test the difference between two independent (different) group means | | t-test for dependent groups (paired t-test) | To test the difference between two dependent group means (the same group before and after an intervention) |   ***Reminder*:** If your research question is asking about relationships, think correlations; if asking about differences between means, think t-test.  **References for the Tutorials**  Fulford, A., & Ford-Gilboe, M. (2004). 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