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Chapter 1

Statistics? I Thought This Was Psychology!

When we tell our initially fresh-faced and enthusiastic first-year students that statistics is a substantial component of their course, approximately half of them are genuinely shocked. "We came to study psychology, not statistics," they shout. Presumably they thought they would be spending the next three or four years ordering troubled individuals to "lie down on the couch and tell me about your mother." We tell them there is no point running for the exits because statistics is part of all undergraduate psychology courses and, if they plan to undertake post-graduate studies or work in this area, they'll be using these techniques for a long time to come. (Besides, we were expecting this reaction and have locked the exits.)

Then we hear the cry, "But I'm not a mathematician. I'm interested in people and behavior." We don't expect students to be mathematicians. If you have a quick scan through this book, you won't be confronted with pages of scary looking equations. Software packages such as SPSS do all the complex calculations for us.

We tell them that psychology is a scientific discipline. If they want to learn about people, they have to objectively collect information, summarize it, and analyze it.

Summarizing and analyzing allow you to interpret the information and give it meaning in terms of theories and real-world problems. Summarizing and analyzing information is statistics; it is a fundamental and integrated component of psychology.

The aim of this chapter is to give you a roadmap of the main statistical concepts you'll encounter during your undergraduate psychology studies and sign posts to relevant chapters on topics where you can learn how to become a statistics superhero (or at least scrape by).

Knowing Your Variables

All quantitative research in psychology involves collecting information (called *data*) that can be represented by numbers. For example, levels of depression can be represented by depression scores obtained from a questionnaire, and a person's country of birth can be represented by a number (say, 1 for Afghan and 2 for Zambian). The characteristics you're measuring are known as *variables* because they vary! They can vary over time in the same person (depression scores can vary over a person's lifetime) or vary between different individuals.

Variables can be continuous or discrete, have different levels of measurement, and can be independent or dependent. Variables can be classified as *discrete*, where you specify discrete categories (for example, 1 for Afghan and 2 for Zambian), or *continuous*, where scores can lie anywhere along a continuum (for example, depression scores may lie anywhere between 0 and 63 if measured by the Beck Depression Inventory).

Variables also differ in their measurement properties. Four levels of measurement exist:

- In a *nominal* level of measurement, a numerical value is applied arbitrarily. This measurement level contains the least amount of information. Country of birth is an example of a nominal variable because it makes no sense to say one is greater or less than the other.
- In an *ordinal* level of measurement, values are ranked. Rankings on a class test are an example of an ordinal level of measurement because we can order participants from the highest to the lowest score but don't how much better the first person did compared to the second person. (The difference between actual scores could be 1 mark or 20 marks.)

- In an *interval* level of measurement, the difference between each point is equal. IQ scores are measured at the interval level, which means we can order the scores and difference between 95 and 100 is the same as the difference between 115 and 120.
- In a *ratio* level of measurement, the scores can be ordered, the difference between each point on the scale is equal, and the scale also has a true absolute zero. Weight, for example, is measured at the ratio level. Having a true absolute zero means a weight of zero signifies an absence of any weight and also allows you to make proportional statements, such as "10 kg is half the weight of 20 kg."

You also need to classify the variables in your data as independent or dependent, and that classification will depend on the research question you're asking. For example, if you're investigating the difference in depression scores between Afghans and Zambians, country of birth is the *independent variable* (the variable you think is predicting a change) and depression scores is the *dependent variable* (the outcome variable where the scores depend on the independent variable).

These terms, which we cover in more detail in the next chapter, may seem bewildering. But having a good understanding of them is important because they dictate the statistical analyses that are available and appropriate for your data.

What Is SPSS?

SPSS, or Statistical Package for the Social Sciences, is a program for storing, manipulating, and analyzing your data. In this book, we assume that you will be using SPSS to analyze your data. SPSS is probably the most commonly used statistics package in the social sciences, but of course other similar packages exist as well as those designed to conduct more specialized analysis.

The normal format for entering data is that each column represents a variable (for example, country of birth or depression) and each row represents one person. Therefore, if you collected and entered information on the country of birth and depression scores of 10 people, you would have 2 columns and 10 rows in SPSS data view. SPSS allows you to enter numeric data and string data (which is non-numeric data, such as names) and also assign codes (for example, 1 for Afghan and 2 for Zambian).

Once you enter your data, you can run a variety of analyses by using drop-down menus. Hundreds of analyses and options are available, but in this book we explain only the statistical procedures necessary for your course. After you select the analyses you want to conduct, your results appear in the output window; your job then is to read and interpret the relevant information.

TECHNICAL STUFF

In addition to using the pull-down menus, you can also program SPSS by using a simple syntax language. This approach can be useful if you need to repeat the same analyses on many different data sets, but explaining how to do it is beyond the scope of this introductory text.

SPSS was released in 1968 and has been through many versions and upgrades. At the time of writing this chapter, the most recent version was SPSS 30.0, which was released in 2024. In 2010 it was purchased by IBM and now appears in your computer's menu under the name *IBM SPSS statistics.* (And no, we don't know why the last *statistics* is necessary either!)

Descriptive Statistics

When you collect your data, you need to communicate your findings to other people (tutor, boss, or supervisor). Let's imagine you collect data from 100 people on their levels of coulrophobia (fear of clowns). Simply producing a list of 100 scores in SPSS won't be useful or easy to comprehend for your audience. Instead, you need a way to describe your data set in a concise and repeatable format. The standard way to do this is through descriptive statistics. In this section, we introduce the following types of descriptive statistics: central tendency, dispersion, graphs, and standardized scores.

Central tendency

There are several types of central tendency, but they all attempt to give a single number that represents your variable. The most common measure is sometimes known as *average* but is more correctly called the *arithmetic mean,* and you're probably already familiar with it. The common measures of central tendency are covered in Chapter 4.

Dispersion

Several measures of dispersion exist, and each aims to give a single number that represents the spread or variability of your variable. Chapter 5 describes important measures of dispersion, including standard deviation, variance, range, and interquartile range.

Graphs

Another way of displaying your data is to provide a visual representation in the form of a graph. Graphs are important for another reason; the type of statistical analysis you can conduct with variables will depend on the distribution of your variables, which you will need to assess by using graphs. Chapter 6 outlines the common types of graphs used in psychology and how to generate each of them in SPSS.

Standardized scores

Imagine you measured a friend's extraversion level with the Revised NEO Personality Inventory and told them they obtained a score of 164. It's likely they will want to know how this score compares to other people's scores. Is it high or low? They also might want to know how it compares to the psychoticism score of 34 they received last week from the Eysenck Personality Questionnaire. Simply reporting raw scores often isn't informative. You need to be able to compare scores to other people's scores and compare scores measured on different scales. The good news is that converting a raw score into a standardized score to make these comparisons is easy. We cover standardization in more detail in Chapter 10.

Inferential Statistics

Descriptive statistics are useful in summarizing the properties of your *sample* (that is, the participants you've collected data from), but most of the time you'll be more interested in the properties of the *population* (that is, all possible participants of interest). For example, if you're interested in attitudes to sectarianism between children enrolled in schools in Northern Ireland, your population is all Northern Irish schoolchildren. It is unrealistic to recruit all the children in Northern Ireland (in terms of time, money, and consent), so instead you would measure sectarianism in a small subset, or sample, of the children. (You examine the differences between samples and populations in Chapter 7.)

The *inferential statistic* you conduct will tell you about the probability of your result occurring in the population (that is, does the difference in your sample really exist in the population or did you obtain this result by chance), but it doesn't tell you anything about the size of the difference. For instance, you may find that older children are more likely to show sectarian attitudes than younger children, but this isn't interesting if the effect is tiny. *Effect sizes* indicate the strength of the relationship or difference between your variables and should always be reported with any inferential statistic. (We cover effect sizes in Chapter 11.)

Before you commence any study, you should have a hypothesis, or a specific testable statement, that reflects the aim of your study. We outline hypothesis testing in Chapter 8 and explain why we always start with the assumption that the data demonstrates no effect, difference, or relationship.

When you're addressing a hypothesis, you can conduct two main types of statistical analysis: a parametric test or the non-parametric equivalent test. *Parametric statistics* assume that the data approximates a certain distribution, such as the normal distribution (see Chapter 9). This allows us to make inferences, which makes this type of statistics powerful and capable of producing accurate results. (See Chapter 11 for a discussion of power.)

WARNING

However, because parametric statistics are based on certain assumptions, you must check your data to ensure that it adheres to these assumptions. (We explain how to do this for each individual statistic in the book.) If you fail to check the assumptions, you risk performing inappropriate analyses, which means your results, and therefore conclusions, may be incorrect.

By comparison, *non-parametric statistics* make fewer assumptions about the data, which means they can be used to analyze a more diverse range of data. Non-parametric tests tend to be less powerful than their parametric equivalents, so you should always attempt to use the parametric version unless the data violates the assumptions of that test.

Research Designs

The choice of research design is influenced by the question you want answered or your hypothesis. Research designs can be broadly classified as correlational design or experimental design. Experimental design can be further broken down into independent groups design or repeated measures design. To determine the type of statistical analyses you should conduct, you must know your study's design.

Correlational design

In *correlational design*, you're interested in the relationships or associations between two or more variables. Unlike experimental design, in correlation design there is no attempt to manipulate the variables; instead you're investigating existing relationships between the variables.

For example, suppose you're conducting a study to look at the relationship between the use of illegal recreational drugs and visual hallucinations; in this case, you need to recruit participants with varying levels of existing drug use and measure their experience of hallucinations. The ethics panel of your department may have serious misgivings if you try to conduct an experimental study, which would mean manipulating your variables by handing out various amounts of illegal drugs to your participants.

Part 3 deals with inferential statistics, which assess relationships or associations between variables that normally relate to correlational designs. (Please note our use of *normally.* There are always exceptions.)

Experimental design

Experimental design differs from correlational design because it may involve manipulating the independent variable. Correlational design focuses on the relationship between existing variables. In *experimental design*, you change the independent variable (directly or indirectly) and assess whether this change has an effect on the outcome variable. For example, you may hypothesize that ergophobia (fear of work) in psychology students increases throughout their courses. You could use one of two experimental designs to test this hypothesis: independent groups design or repeated measures design.

When you employ an *independent groups design*, you're looking for differences on a variable between separate groups of people, such as differences on ergophobia scores between first-year and second-year psychology students. In this scenario, you can employ either the parametric or non-parametric test. We explain these tests in Chapter 15, 16, and 17.

When you employ a *repeated measures design*, you're looking for differences on a variable in the same group of people at different times. For example, you could measure ergophobia levels when students first start their psychology course, and then 12 months later test the same group to see if the scores have changed. If you test the same participants more than once, you should use the tests outlined in Chapters 18, 19, and 20.

Getting Started

The critical stage of any research study is always the start. Remember the following:

- Specify a hypothesis that is testable and addresses the question you're interested in (see Chapter 8). Your hypothesis must be informed by theory and previous research.
- Consider how you will analyze the data by deciding on the appropriate statistic; this decision will help you decide how to measure your variables. Deciding on the appropriate statistical analysis also allows you to calculate the sample size you will need (see Chapter 11). If you do not recruit enough participants, you're unlikely to discover a significant effect in your data even if one exists in the population, and your efforts will be a waste of time.
- When you're preparing your SPSS file, take time to label your data and assign values that are easy to read and will make sense when you re-visit them months later.
- The best time to consult a statistical advisor is when you're designing your study. Your advisor will be able to offer advice on the type of data to collect, the analyses to conduct, and the required sample size. Asking for help after the data has been collected may be too late!