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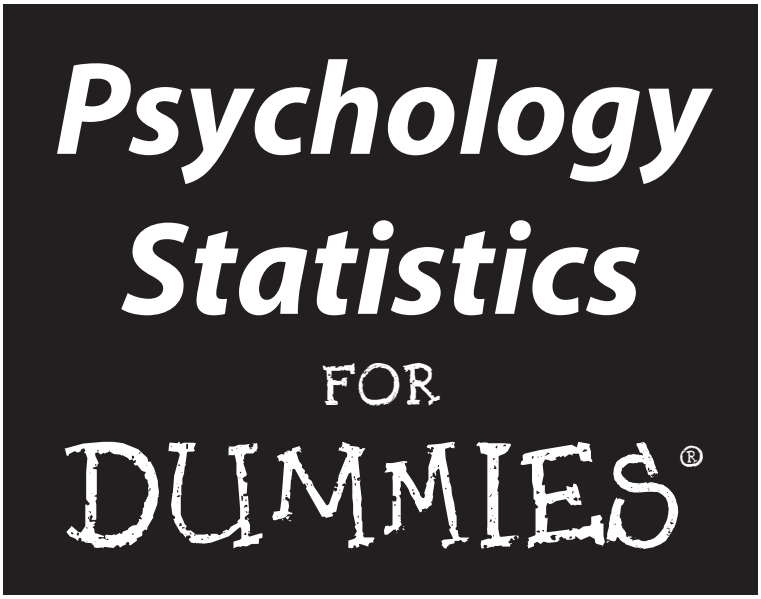

by Donncha Hanna and Martin Dempster

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About the Authors

Donncha Hanna is, among other more interesting things, a lecturer at the School of Psychology, Queen's University Belfast.

He has been teaching statistics to undergraduate students, postgraduate students and real professional people for over 10 years (he is not as old as Martin). His research focuses on mental health and the reasons why students do not like statistics; these topics are not necessarily related. He attempts to teach statistics in an accessible and easy to understand way without dumbing down the content; maybe one day he will succeed.

Donncha lives in Belfast with two fruit bats, a hedgehog and a human named Pamela.

Martin Dempster is a Senior Lecturer in the School of Psychology, Queen's University Belfast. He is a Health Psychologist and Chartered Statistician who has also authored *A Research Guide for Health & Clinical Psychology*.

He has been teaching statistics to undergraduate psychology students for over 20 years. As a psychologist he is interested in the adverse reaction that psychology students often have to learning statistics and endeavours to work out what causes this (hopefully not him) and how it can be alleviated. He tries to teach statistics in an accessible manner (which isn't always easy).

Martin lives in Whitehead, a seaside village in Co. Antrim, Northern Ireland, which isn't very well-known, which is why he lives there.

Dedication

From Donncha: For my mother and father. Thank you for everything.

From Martin: For Tom, who joined the world half way through the development of this book and has been a glorious distraction ever since.

Author's Acknowledgments

From Donncha: I'm very grateful to the team at Dummies Towers for their work and guidance in getting this book to print – particularly our editors Simon Bell and Mike Baker.

I would like to thank all the students, colleagues and teachers who have helped shape my thinking and knowledge about statistics (and apologise if I have stolen any of their ideas!). I must also acknowledge Pamela (who didn't complain when I used the excuse of writing this book to avoid doing the dishes) and my sister, Aideen, who offered practical help as always. Thanks to my friend and colleague Martin Dorahy who put up with me in New Zealand where half of this book was written. And of course to Martin Dempster, without whom there would be no book.

From Martin: This book is the product of at least 20 years of interaction with colleagues and students; picking up their ideas; answering their questions; and being stimulated into thinking about different ways of explaining statistical concepts. Therefore, there are many people to thank – too many too list and certainly too many for me to remember (any more).

However, there are a few people who made contributions to the actual content of this book. My brother, Bob, who has a much better sense of humour than me, helped with some of the examples in the book. Noleen helped me to better formulate my thinking when I was having some difficulty and supported my decision to undertake this project in the first place. My mum and dad spurred me on with their ever-present encouragement. Finally, thanks to my colleague Donncha, who floated the idea of writing this book and asked me to collaborate with him on its development.

Publisher's Acknowledgments

We're proud of this book; please send us your comments at http://dummies.custhelp.com. For other comments, please contact our Customer Care Department within the U.S. at 877-762-2974, outside the U.S. at 317-572-3993, or fax 317-572-4002.

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Introduction

We recently collected data from psychology students across 31 universities regarding their attitudes towards statistics; 51 per cent of the students did not realise statistics would be a substantial component of their course and the majority had negative attitudes or anxiety towards the subject. So if this sounds familiar take comfort in the fact you are not alone!

Let's get one thing out of the way right now. The statistics component you have to complete for your degree is not impossible and it shouldn't be gruelling. If you can cope with cognitive psychology theories and understand psycho-biological models you should have no difficulty. Remember this isn't mathematics; the computer will run all the complex number crunching for you. This book has been written in a clear and concise manner that will help you through the course. We don't assume any previous knowledge of statistics and in return we ask you relinquish any negative attitudes you may have!

The second point we need to address is why, when you have enrolled for psychology, are you being forced to study statistics? You need to know that statistics is an important and necessary part of all psychology courses. Psychology is an empirical discipline, which means we use evidence to decide between competing theories and approaches. Collecting quantitative information allows us to represent this data in an objective and easily comparable format. This information must be summarised and analysed (after all, pages of numbers aren't that meaningful) and this allows us to infer conclusions and make decisions. Understanding statistics not only allows you to conduct and analyse your own research, but importantly it allows you to read and critically evaluate previous research.

Also, statistics are important in psychology because psychologists use their statistical knowledge in their day-to-day work. Consider a psychologist who is working with clients exhibiting depression, anxiety and self-harm. They must decide which therapy is most useful for particular conditions, whether anxiety is related to (or can predict) self harm, or whether clients who self harm differ in their levels of depression. Statistical knowledge is a crucial tool in any psychologist's job.

About This Book

The aim of this book is to provide an easily accessible reference guide, written in plain English, that will allow students to readily understand, carry out, interpret and report all types of statistical procedures required for their course. While we have targeted this book at psychology undergraduate students we hope it will be useful to all social science and health science students.

The book is structured in a relatively linear way; starting with the more basic concepts and progressing through to more complex techniques. This is the order in which the statistics component of the psychology degree is normally taught. Note, though, that this doesn't mean you are expected to start from page one and read the book from cover to cover. Instead each chapter (and each statistical technique) is designed to be self-contained and does not necessarily require any previous knowledge. For example, if you were to look up the technique 'partial correlation' you will find a clear, jargon-free explanation of the technique followed by an example (with step-by-step instructions demonstrating how to perform the technique on SPSS, how to interpret the output and, importantly, how to report the results appropriately). Each statistical procedure in the book follows this same framework enabling you to quickly find the technique of interest, run the required analysis and write it up in an appropriate way.

As we know (both from research we have conducted and subjective experience of teaching courses) statistics tends to be a psychology student's least favourite subject and causes anxiety in the majority of psychology students. We therefore deliberately steer clear of complex mathematical formulae as well as superfluous and rarely-used techniques. Instead we have concentrated on producing a clear and concise guide illustrated with visual aids and practical examples.

What You're Not to Read

We have deliberately tried to keep our explanations concise but there is still a lot of information contained in this book. Occasionally you will see the technical stuff icon; this, as the icon suggests, contains more technical information which we regard as valuable in understanding the technique but not crucial to conducting the analysis. You can skip these sections and still understand the topic in question.

Likewise you may come across sidebars where we have elaborated on a topic. We think they are interesting, but we are biased! If you are in a hurry you can skip these sections.

Foolish Assumptions

Rightly or wrongly we have made some assumptions when writing this book. We assume that:

- You have SPSS installed and you are familiar with using a computer. We do not outline how to install SPSS and we are assuming that you are familiar with using the mouse (pointing, clicking, etc.) and the keyboard to enter or manipulate information. We do not assume that you have used SPSS before; Chapter 3 gives an introduction to this programme and we provide you with step-by-step instructions for each procedure.
- You are not a mathematical genius but you do have some basic understanding of using numbers. If you know what we mean by squaring a number (multiplying a number by itself; if we square 5 we get 25) or taking a square root – the opposite of squaring a number (the square root of a number is that value when squared gives the original number; the square root of 25 is 5) you will be fine. Remember the computer will be doing the calculations for you.
- You do not need to conduct complex multivariate statistics. This is an introductory book and we limit out discussion to the type of analyses commonly required by undergraduate syllabuses.

How this Book is Organised

This book has been organised into six parts:

- Part I of the book deals with describing and summarising data. It starts by explaining, with examples, the types of variables commonly used and level of measurement. These concepts are key in deciding how to treat your data and which statistics are most appropriate to analyse your data. We deal with the SPSS environment, so if you haven't used SPSS before, or need a refresher, this a good place to start. We also cover the first descriptive statistics: the mean, mode and median. From there we go on to key ideas such as measures of dispersion and interpreting and producing the most commonly used graphs for displaying data.

- Part II of the book focuses on some of the concepts which are fundamental for an understanding of statistics. If you don't know the difference between a null and alternative hypothesis, unsure why you have to report the *p*-value and an effect size or have never really been confident of what statistical inference actually means, then this part of the book is for you!
- Part III of the book deals with inferential statistics, the ones that examine relationships or associations between variables, including correlations, regression and tests for categorical data. We explain each technique clearly – what it is used for and when you should use it, followed by instructions on how to perform the analysis in SPSS, how to interpret the subsequent output and how to write up the results in both the correct statistical format and in plain English.
- Part IV of the book deals with the inferential statistics that examine differences between two or more independent groups of data. In particular we address the Independent *t*-test, Mann-Whitney test and Analysis of Variance (ANOVA). For each technique we offer a clear explanation, show you how it works in SPSS, and how to interpret and write up the results.
- Part V of the book deals with the inferential statistics that examine differences between two or more repeated measurements. Here we cover the Paired *t*-test, the Wilcoxon test and Analysis of Variance (ANOVA). We also focus on analysis of research designs that include both independent groups and repeated measurements: the Mixed ANOVA.
- Part VI, the final part of the book, provides you with hints and tips on how to avoid mistakes and write up your results in the most appropriate way. We hope these pointers can save you from the pitfalls often made by inexperienced researchers and can contribute to you producing a better results section. We outline some of the common mistakes and misunderstandings students make when performing statistical analyses and how you can avoid them, and we provide quick and useful tips for writing your results section.

Icons Used in This Book

As with all *For Dummies* books, you will notice icons in the margin that signify there is something special about that piece of information.

This points out a helpful hint designed to save you time or from thinking harder than you have to.

This one is important! It indicates a piece of information that you should bear in mind even after the book has been closed.

This icon highlights a common misunderstanding or error that we don't want you to make.

This contains a more detailed discussion or explanation of a topic; you can skip this material if you are in a rush.

Where to Go from Here

You could read this book cover to cover but we have designed it so you can easily find the topics you are interested in and get the information you want without having to read pages of mathematical formulae or find out what every single option in SPSS does. If you are completely new to this area we suggest you start with Chapter 1. Need some help navigating SPSS for the first time? Turn to Chapter 3. If you are not quite sure what a *p*-value or an effect size is, you'll need to refer to Part II of the book. For any of the other techniques we suggest you use the table of contents or index to guide you to the right place.

Remember you can't make the computer (or your head) explode so, with book in hand, it's time to start analysing that data!

Part I
Describing Data

In this part . . .

We know: you're studying psychology, not statistics. You're not a mathematician and never wanted to be. Never fear, help is near. This part of the book covers the key concepts you need to grasp to describe statistical data accurately and successfully. We talk about the simplest descriptive statistics – mean, mode and median – and important ideas such as measures of dispersion and how to interpret and produce the graphs for displaying data.

We also introduce you to SPSS (Statistical Package for Social Sciences, to give it its full name) and walk you through the basics of using the program to produce straightforward statistics.

Chapter 1

Statistics? I Thought This Was Psychology!

In This Chapter

- Understanding variables
- Introducing SPSS
- Outlining descriptive and inferential statistics
- Differentiating between parametric and non-parametric statistics
- Explaining research designs

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 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 as they will quickly learn that statistics is part of all undergraduate psychology courses, and that if they plan to undertake post-graduate studies or work in this area they will 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 am interested in people and behaviour'. 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. These days we use computer-based software packages such as SPSS to 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, summarise it and analyse it. Summarising and analysing allows you to interpret the information and give it meaning in terms of theories and real world problems. Summarising and analysing 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 will encounter during your undergraduate psychology studies and to signpost you to relevant chapters on topics where you can learn how to become a statistics superhero (or at least scrape by).

Know 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, or a person's gender can be represented by a number (1 for male and 2 for female). The characteristics you are measuring are known as *variables* because they vary! They can vary over time within the same person (depression scores can vary over a person's life time) or vary between different individuals (individuals can be classified as male or female, but once a person is classified this variable doesn't tend to change!).

Several names and properties exist, associated with variables in any data set, which you must become familiar with. Variables can be continuous or discrete, have different levels of measurement and can be independent or dependent. We cover all this information in Chapter 2. Initially these terms may seem a little bamboozling, but it is important you ensure you have a good understanding of them, as they dictate the statistical analyses that are available and appropriate for your data. For example, it helps to report a mean depression score of 32.4 for a particular group of participants, but a mean gender score of 1.6 for the same group doesn't much make sense (we discuss the mean in Chapter 4)!

Variables can be classified as *discrete*, where you specify discrete categories (for example, male and female), 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:

- **Nominal**: This contains the least amount of information of the levels. At the nominal level, a numerical value is applied arbitrarily. Gender is an example of *nominal* level of measurement (for example, 1 for male and 2 for female), and it makes no sense to say one is greater or less than the other.
- **Ordinal**: Rankings on a class test are an example of an *ordinal* level of measurement; we can order participants from the highest to the lowest score but we don't how much better the first person did compared to the second person (it could be 1 mark or it could be 20 marks!).
- **Interval**: IQ scores are measured at the *interval* level, which means we can order the scores but the difference between each point is equal. That is, the difference between 95 and 100 is the same as the difference between 115 and 120.