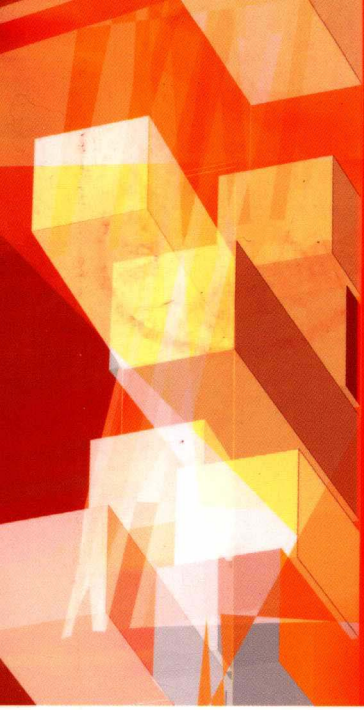

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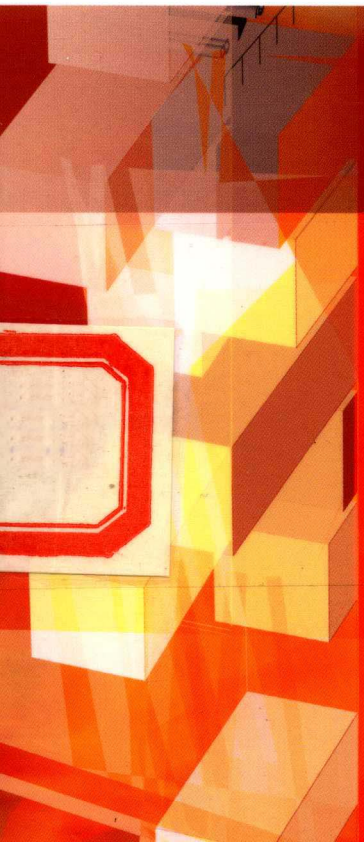

Elizabeth Heavey

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A PRACTICAL APPROACH

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Dedication

This book is dedicated to my daughter Gabrielle, who reminds me every day how much effort, persistence, and determination it takes to try again. You have helped me be a better teacher, mother, and person just by being the brave young woman that you are. You never give up, and because of that I have watched you accomplish so much. So here is my second try at this book, and I hope it is even better than my first. I will keep trying, my beautiful girl—just like you do!

INTRODUCTION

When the first edition of this book came out, I was very happy to hear from many nurses how useful it was in making statistics accessible for those of you just beginning to work with these concepts. You also had some very helpful suggestions, much like my own students, who provided the motivation and feedback that helped create the first edition of the book. I also heard from quite a few of you in DNP programs that the book was helpful to get you started as well, but that you also needed some introductory information about regression techniques before you could understand some of the higher level statistics texts. When I first wrote the book, DNP programs were not common, so the idea that nurses seeking clinical practice doctorates would need an introductory-level statistics text never really crossed my mind. Regression is a complicated statistical technique, so trying to introduce it in a meaningful yet understandable way was a real challenge for me. I hope you find the new chapter covering regression to be helpful.

I have acted upon the request many of you made for even more practice questions at the end of each chapter, giving you more opportunities to practice, practice, practice. I have also provided additional SPSS tutorials and article reviews on the website for the text. A few additional concepts have been added to the original chapters to create a more inclusive approach to the topic; however, I have stayed true to the original premise of the text, which is that all of this is at an introductory level without a lot of ancillary information to confuse you.

If you are teaching from this text at an undergraduate level, it is perfectly appropriate to skip the regression chapter; the rest of the content from the book will still work fine. You can also include it if it is appropriate for your students or course. As with the previous edition, the From the Statistician section examines some of the chapter concepts in greater detail.

These sections are set apart from the rest of the text and are available for students who prefer a more mathematical approach or want to have a better understanding of "why." Students who want to stick with the clinically applied information can skip these sections without experiencing problems in understanding the essential content.

The second edition of the book also includes an expanded test bank for instructors, additional multiple choice practice questions that are accessible for students and instructors alike, and additional recorded PowerPoint lectures, homework review sessions, and computer application updates. In teaching from the first edition of the book, I found that many of my students, particularly those for whom English was not a first language, appreciated and used the short recorded lectures repeatedly. It was rewarding to me to see the impact having access to this material had on their learning. Several earned the top grades in the class! With this in mind, I again opened up conversations with my students about what other tools I might be able to provide to make the material more accessible.

In talking with my students, I discovered that many are auditory learners and some are also struggling readers. Many reported that this was the first college text they read cover to cover, and they found it useful to have the limited content that was frequently repeated and applied. I was glad to hear that, but also began to wonder how I might be able to make this material more accessible so students could focus on learning the material rather than using a great deal of energy to overcome barriers to learning. So for the first time, the second edition of the book also includes an audiobook recording in which I read the essential content from the chapters (not the objectives, From the Statistician, or problems at the end). Unfortunately, the world of educational textbook publishing is not highly lucrative for authors, so I couldn't hire Brad Pitt to read the text, but I hope you find this a useful addition and can tolerate my less than perfect attempt to present the material in another useful way. My students have requested it and I have found that listening to their suggestions is always a good idea, so it is available for all of you as well. It is the same content as the chapters, so if you prefer to read the chapters go right ahead (this works better for me, a visual learner), but if you prefer to hear the chapters that option is available as well. Of course, you are welcome to use both approaches. I would suggest at least having your text with you while you listen because there are references to tables or figures, and obviously I can't read those effectively. And of course, don't forget to check the website for the book frequently for written and video tutorials, review article assignments for practice, extra practice problems and answers, and additional support options which are updated regularly.

I would love to hear from any of you who do use the new content and supports for the second edition of the text. What are your thoughts? Did these new resources help you? Do you have any other ideas for useful learning tools? Send me a quick email and help me make this material even better.

I hope you find the second edition of the book helpful and that you continue on your quest to becoming a nurse who understands statistics! You never know where it may take you someday. I certainly didn't!

All the best,
Beth

ACKNOWLEDGMENTS

This book is the product of the combined effort of many individuals who were gracious enough to contribute their time, knowledge, and effort.

Brendan Heavey is the contributing author for all of the "From the Statistician" boxes in the text. Brendan has a statistical knowledge significantly beyond my own and spent many hours writing, rewriting, and explaining concepts to make sure my simplified explanations were technically correct. I am ever grateful not only for his statistical contributions to the text, but also for his interest in and support of the project from the early proposal days. He is an incredibly gifted human being. I am proud to call him my brother.

Dr. Linda Snell, Dr. Margie Lovett-Scott, and the Department of Nursing at SUNY Brockport recognized the need for a course that explained statistics in a way that nurses could relate to and understand. They supported my efforts in developing the first class we offered and later in formalizing the material so that nurses in other locations could benefit from the curriculum.

Dr. Kathleen Peterson continues to advocate for all of us within the department and profession. She has been an incredible support both personally and professionally, and has believed in my efforts to write this second edition from the start. I consider myself to be incredibly blessed to work with such an outstanding group of individuals who make going to work a rewarding and challenging experience every day.

Jessica Jackson and Chris Passarell, both former students and now professionals working in the field, provided feedback and student perspectives, which helped me determine when I had explained a concept well and also what needed revision. Also, the many students who have

taken my class throughout the years have continued to inspire me to make this edition even better and have given me lots of good ideas and perspectives that help me help you!

Many other undergraduate and graduate students emailed me from afar with feedback and thoughts about the first edition of the book. I always enjoy hearing how this book has impacted your understanding and your career, as well as your suggestions for improvement.

Thank you also to all the instructors who are using the book and letting me know how well it is working in your classrooms. You inspire and encourage me with all of your great ideas and dedication to student learning.

Thank you to the publishing team at Jones & Bartlett Learning, who saw the potential in the first edition before I did and helped make it happen, and then came back for more!

As always, my heartfelt gratitude goes to my family and friends, who loved and supported me throughout this project. I would not be where I am today without all of you. The Monday night meals, the fun family trips and college planning, the hours spent with your niece and nephew while I am away at a conference, the quiet hugs and heartfelt phone calls, the belief in me no matter what crazy plan I come up with next … I will always be grateful for each of you.

And to my children, Gabrielle and Nathaniel, you teach me every day what really matters. As I watch you grow from babies to children I am amazed by the energy, spirit, and determination you each possess. I think of you when I am teaching and remember that all of my students are another parent's pride and joy, doing their best and trying very hard. You help me be more patient, understanding, humble, and forgiving. You are the reason behind it all, my loveys. Being your Mama puts the meaning in everything that I do. I love you to the moon and the stars, to infinity and beyond and back again, forever and ever.

Thank you all.
Beth

CONTENTS

CHAPTER 1

INTRODUCTION TO STATISTICS AND LEVELS OF MEASUREMENT

HOW TO FIGURE THINGS OUT.

OBJECTIVES

By the end of this chapter students will be able to:

- State the question that statistics is always trying to answer.
- Define the empirical method.
- Compare quantitative and qualitative variables.
- Differentiate a population from a sample and a statistic from a parameter, giving an example of each.
- Explain the difference between an independent and a dependent variable, citing examples of each.
- Identify continuous and categorical variables accurately.
- Distinguish the four levels of measurement and describe each.
- Apply several beginning-level statistical techniques to further develop understanding of the concepts discussed in this chapter.

KEY TERMS

Categorical variable
A variable that has a finite number of classification groups or categories, which are usually qualitative in nature.

Continuous variable
A variable that has an infinite number of potential values, with the value being measured falling somewhere on a continuum containing in-between values.

Dependent variable
The outcome variable or final result.

Empirical method
Gathering information through systematic observation and experimentation.

Estimate
A preliminary approximation.

Independent variable
A variable measured or controlled by the experimenter; the variable that is thought to affect the outcome.

Interval data
Data whose categories are exhaustive, exclusive, and rank ordered, with equally spaced intervals.

Nominal data
Data that indicates a difference only, with categories that are exhaustive and exclusive, but not rank ordered.

Ordinal data
Data whose categories are exhaustive, exclusive, and rank ordered.

Parameter
Descriptive result for the whole group.

Population
The whole group.

Probability
How likely it is that an outcome will occur.

Qualitative measure
A measure that describes or characterizes an attribute.

Quantitative measure
A measure that reflects a numeric amount.

Ratio data
Data whose categories are exhaustive, exclusive, and rank ordered with equally spaced intervals and a point at which the variable does not exist.

Sample
A group selected from the population.

Statistic
An estimate derived from a sample.

Variable
The changing characteristic being measured.

INTRODUCTION

So here you are. You've worked hard, you are in nursing school, and are ready to begin your studies. But wait! What do you mean you have to take statistics? Why does a nurse need to understand all those numbers and equations when you just want to help people?

Most nursing students experience a mild sense of panic when they discover they have to take statistics—or any other kind of math for that matter. That reaction is commonplace. Here is a calming thought to remember: You already practice statistics, but you just don't know it.

Statistics boils down to doing two things:

- Looking at data.
- Applying tests to find out either (1) that what you observe is what you expected or (2) that your observation differs enough from what you expected that you need to change your expectations.

You might be convinced that you don't use statistics in your life, so let me give you an example. New York State, where I live, has four seasons. The summer is usually June, July, and August. Fall is September, October, and November. Winter is December, January, and February. And that leaves March, April, and May for the spring. If you walk outside in July and find it to be 80° and humid, you would draw an unspoken conclusion that what you just observed is what you were expecting, and you would put on your sunglasses. However, what if you walk outside in January and find it to be 80° and humid? You would probably be startled, take off your overcoat and boots, and read up on global warming. The difference between the weather you expect in January and what you actually encounter is so different that you might need to change your expectations. You are already practicing statistics without knowing it!

Of course, that day in January might just be a fluke occurrence (a random event), and the temperature could be below freezing again the next day. That is why we need to use the **empirical method**, otherwise known as systematic observation and experimentation. The empirical method allows you to determine whether the temperature observed is *consistently* different from what you expect. To use the empirical method, you need to check the temperature on more than one day. So you might decide to monitor the temperature for the whole month of January to see whether readings are consistently different from what you expect. In this scenario, you would be using the empirical method to practice statistics.

Population versus Sample

To answer questions in research, we need to set up a study of the concepts we're interested in and define multiple **variables**, that is, the changing characteristics being measured. In our example, the temperature is a variable, a measured characteristic. Each variable has an associated **probability** for each of its possible outcomes, that is, how likely it is the outcome will occur. For example, how likely is it that the temperature will be below freezing as opposed to in the eighties? In your study, you recorded the temperature for only the month of January, and those readings make up a **sample** of all the days of the year. The manner in which you collect your sample is dependent on the purpose of your study.

A sample is always a subset of a **population**, or an overall group (sometimes referred to as the reference population). In this case, our population includes all the days of the year, and the subset, or sample, is all the days in January. If you calculate the average temperature based on this sample data, you create what is called a **statistic**, which is an **estimate** generated from a sample.

A measured characteristic of a population is called a **parameter**. In our example, if you measured the temperature for the whole year and then calculated the average temperature, you would be determining a parameter. A really good way to remember the relationships among these four terms is with the following analogy: Statistic is to sample as parameter is to population.

QUANTITATIVE VERSUS QUALITATIVE

While you are collecting the weather data, you may realize that the data can be recorded in several ways. You could write down the actual temperature on that day, which would be a **quantitative measurement**, or you could describe the day as "warm" or "cold," which would be a **qualitative measurement**. A numeric amount or measure is associated with quantitative measurement (such as 80°F), and qualitative measures describe or characterize things (such as, "So darn cold I can't feel my toes").

Be careful with this difference: You can easily get confused. Qualitative variables do not contain quantity information, even if numbers are assigned. The assigned numbers have no quantitative information, rank, or distance. For example, a survey question asks, "What color scrubs are you wearing?" and lists choices numbered 1–3. Even if you selected choice 2, neon orange, you do not necessarily have any more scrubs than someone who chooses 1, lime green (although both respondents may want to purchase new scrubs). Even though these qualitative variables have numbers assigned to them, the numbers simply help with coding. The variables are still qualitative.

INDEPENDENT VERSUS DEPENDENT VARIABLES

Being as inquisitive as you are, you have probably asked yourself a number of times about a relationship you observe in your patients. For example, you notice that many supportive family members visit Sally Smith after her hip replacement recovery and that she is discharged 3 days after her surgery. Joanne Jones, on the other hand, has no visitors during her hip replacement recovery and is not discharged until day 6. As an observant nurse researcher, you have been wondering how variable x (the **independent variable**, which is measured or controlled by the experimenter) affects variable y (the **dependent variable**, or outcome variable). You wonder, does having family support (the independent variable) affect the duration of a hospital stay (the dependent, or outcome, variable)?

To answer this question, you create a study. Obviously, other factors might be involved as well, but in your experiment you are interested in how family support, the independent variable, impacts hospital stay, the dependent variable. If you are correct, then the duration of the hospital stay *depends* on family support. The independent variable can be the suspected causative agent, and the dependent variable is the measured outcome or effect.

Note: Additional criteria must be met to say a variable is causative, so I refer here only to the "suspected" causative agent.

CONTINUOUS VERSUS CATEGORICAL VARIABLES

Some data have an infinite number of potential values, and the value you measure falls somewhere on a continuum containing in-between values. These values are called **continuous variables**. As a nurse, when you measure your patient's temperature, you are measuring a continuous variable. The reading could be 98° or 98.6° or 98.66666°. The infinite possibilities are all quantitative in nature. Actually, the only limit to the measurement is the accuracy of the measuring device. If, for example, you have a thermometer that measures only

FROM THE STATISTICIAN *Brendan Heavey*

What is a Statistic?

As a student of statistics, you will run into questions regarding parameters and statistics all the time. Determining the difference between the two can be difficult. To get a concrete idea of the difference, let's look at an example. According to the Bureau of Labor Statistics, registered nurses constitute the largest healthcare occupation, with 2.7 million jobs nationwide. Because this text is primarily designed for nursing students, let's use this number for our example.

Let's say you are a consultant working for a fledgling company that is planning to make scrubs for nurses. Let's call this company Carol's Nursing Scrubs, Inc. Scrubs at Carol's will come in small, medium, and large. The company will offer all kinds of styles and prints, but the underlying sizes are intended to remain the same. Carol just received her first bit of seed money to mass-produce 20,000 pairs of scrubs. Carol, an overly demanding boss, wants the medium-size scrubs to fit as many nurses nationwide as possible. To make that happen, she needs to know the average height and weight of nurses nationwide, so she has instructed you to conduct a nationwide poll. She thinks you should ask every nurse in the country his or her height and weight and then calculate the average of all the numbers you get.

Now, you are an intelligent, well-grounded employee who's in demand everywhere and working for Carol only because her health plan comes with a sweet gym membership and you get a company car. So you realize it would be pretty difficult to set up a nationwide poll and ask all the nurses in the country for their height and weight. Even if you tried a mass mailing, the data returned to you would be filled with so many incompletes and errors that it wouldn't be trustworthy.

So what are you to do? Your first instinct might be to respond to your boss by saying, "Geez, Carol, that's so absurd and impossible I don't even know where I'd start," and then finish your day on the golf range. However, after this course you'll be not only a nurse, but a nurse with some training in statistics. You'll be able to deal with this situation in a more effective way.

Jenna the Statistical Nursing Guru (you): Carol, I recommend we take a few *samples* of nurses nationwide and *survey* them rather than attempting to contact every nurse in the country. Then we could *estimate* the true average height and weight based on our samples.

Carol: How would that work, Jenna?

Jenna: Well, I'd go down to the University Hospital and poll 30 RNs on their height and weight. Then I'd go to the next state and do the same. My third and final sample would contain 30 RNs from a hospital in Springfield. I'd calculate the average from my total *sample* (90 RNs), which is a *statistic*, and use that to estimate the overall average in the United States, which is a *parameter* of the total *population*.

You see, Carol, any time you calculate an estimate with data from a sample or list the data from the sample itself, you calculate a statistic. If you calculate an estimate from data in an entire population, you're calculating a parameter.