Preface

Do you know what a Family Wise Error Term is? How about when to use the standard deviation and when to use the standard error of the mean? When someone says they have 85% power does that mean they don't need to plug in their digital device for a while? How about the difference between a Dunn's test and a Dunnett's test or the Wilcoxon two-sample test and the Mann–Whitney U statistic? If you don't then this book is for you. All of these terms are found in the neuroscience literature and many of them are used incorrectly.

Let me state up front—I'm not a statistician but I am a renaissance neurobiologist. I have dabbled in many different disciplines within the field of neuroscience and thus have some appreciation for the issues the researcher might encounter. I wrote this book to help graduate students in the field of neuroscience. The student who masters this material should be able to evaluate the statistical results of most papers in the field of neurobiology. A book of this limited size really can't begin to cover the field of statistics and that's not the intent of this work. I like to use the analogy of describing the extrapyramidal system. Where do you begin and what structures do you include? Is it important to mention the rubrospinal tract and the tectospinal tract? How much detail do you go into when talking about the circuitry of the basal ganglia and the nigrostriatal pathway? The purpose of this book is really just to give the neurobiologist fundamental statistical principles, hence the name—a survival guide.

This is not a traditional statistics book—it contains almost no statistical equations or statistical symbols. It only covers some of the most basic situations that the neurobiologist will encounter. It is a book that hopefully will help develop and increase an understanding of statistical theory and practices. Virtually every researcher today has a personal computer that can be loaded with really fantastic statistical software or has access to one in the laboratory. Gone are the days when you had to memorize any statistical equations. I love working with these commercial programs and viewing the various outputs, even though some of these may appear to be uninterpretable. What I quickly realized was that these programs make very few assumptions about the data entered. In fact, they will attempt to process data without regard to its type or origin—which is a problem. These programs will provide the user with a multitude of different choices and simply wait for the researcher to make the choice. Some even provide interesting suggestions. But then that's part of the

problem because most neuroscientists don't know which statistical routine is the most appropriate for a given set of experiments. Should you use the Tukey–Kramer or the Games-Howell multiple comparison procedure? And, of course, the programs can't really interpret the results. Part of the aim of this book is to provide the reader with information to critically choose which statistical test to command the software to use. I've tried to use very plain English and avoid jargon. However, one needs to also understand the language of the biostatistician and thus I've included some of that jargon with an explanation.

Although statistical reasoning/experimental design is crucial to experimentation it often never receives the classroom time it should. Most graduate students learn their statistics from other graduate students or from reading journal articles. Unfortunately many of the published articles, even in top-notch journals, report statistical findings that are either incomplete or incorrect. While many of the top biomedical journals have formal statistical reviewers that flag many of the most basic statistical faux pas, there are simply too many new and lower impact journals that don't scrutinize the data analysis components. Coupled with this is the overall lack of sophistication of the reviewers themselves who are often somewhat clueless of the difference between significance and effect size.

I have never envisioned that this would be the only statistics book that you will need. It is intended to be just a basic survival guide. There are so many great books on statistics and I often recommend several of these such as "Intuitive Biostatistics" by Harvey Motulsky and "Primer of Biostatistics" by Stanton Glantz. For the neurobiologist who wants a more detailed look at statistical theory and practice then I recommend the terrific text "Research Design and Statistical Analysis" by Myers, Well, and Lorch.

Many students are simply "afraid" to ask for help because they would appear as "less enlightened." They shouldn't be, because none of us are experts in the field of statistics. I still ask for advice when I dream up certain experiments. Your friendly neighborhood biostatistician is indeed your friend in science and wants to help you do your best. Although the student may not believe it, the biostatistician is trained to help you. That individual can assist you with both the design of an experiment and the data analysis. This text will help you make the most of your interactions with the biostatistician.

All of the examples that I use in this text are made up by me and as far as I know they don't exist in the literature. None of the experimental results have any foundation in reality. Actually, making up the data was one of the hardest parts of writing this book because I was always manipulating the numbers just to demonstrate a point and to focus on an important idea. I have created all of the graphs and tried to make

them simple. Some of my own biases are shown in these graphs and represent my dislike for so many hard to understand graphs I've had the displeasure to navigate when reading grants for the NIH.

Although it isn't necessary to read the chapters in order, the first three simply present some of the basic concepts that every statistician "assumes" you know. I encourage the reader to carefully read the section on Type I and Type II errors because this is at the very heart of statistical reasoning. In Chapter 6 I tried to make sense of the field of multiple comparisons. This is a very confusing and heavily debated part of statistics but one that is crucial to the interpretation of data. Chapter 8 deals with nonparametric statistics, which are really very important in the field of neuroscience. You may have to read a particular section more than once to have a complete understanding of a point I'm trying to make. That's OK and expected. I've tried to make explanations extremely simple and easy to understand. The book covers a very wide range of statistical topics. Hopefully they will enable the reader to apply some statistical procedures properly so that the data can accurately reflect their meaning.

If after reading this book you have gained a new appreciation for statistics and have a greater insight into which statistical procedure is most appropriate for your data, then I have succeeded in my aim.

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