Review of “Chi-Squared Data Analysis and Model Testing for Beginners”

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The book *Chi-Squared Data Analysis and Model Testing for Beginners* by Witkov and Zengel is a delightful little book with a simple aim – to make chi-squared data analysis accessible to first-year physics students. Not only does the book succeed in this aim, but it does so without resorting to the oft-used “collection of recipes” approach that makes statistical modeling seem more like magic than a coherent system of scientific thinking. To extend the analogy further, I found *Chi-Squared Data Analysis* to be quite like some of my favorite books on cooking, where the author doesn’t give the reader a bunch of recipes, but rather teaches *how* to cook. To this end, Witkov and Zengel will teach the reader *how* to model data and think like a scientist.

The style of the book is very pedagogical. It is most definitely not a reference book, but rather a book that is written in a narrative, conversational style. As such it will be ideal for beginning students, perhaps as a supplementary laboratory manual. It could certainly serve as a primary text, depending on the scope of the intended course.

The chapter on ”Statistical Toolkit” is uniquely exemplarly of the authors’ pedagogical style. It reminds the reader of the most basic statistical concepts (e.g., mean, standard deviation, standard error), but does so in a way that makes these tools seem obvious and necessary if one wants to reason about data that one might collect in a laboratory experiment. In my experience, this is absolutely one of the best approaches to teaching any mathematical and statistical concept – one needs to make it obvious *why* we do something, not just show that we *can* do it.

After being introduced to the toolkit, the reader then learns about using chi-squared analysis to model systems with one variable and with two variables.

Statistical concepts (such as maximum likelihood estimation) are introduced as necessary – this is sort of a "just in time" pedagogical approach that I really like in books. It allows the reader to dive right in to the substantive parts of a topic without getting bogged down initially in a lot of prerequisites. The book continues with two case studies that exemplify the model fitting approach in the context of a first-year physics lab. There is also a brief chapter on advanced topics – this chapter gives details on some things that are mentioned throughout the book (i.e., probability density functions), but are not necessary for all readers to consider. I like to think of this chapter as an appendix, but rather than just being a dumping ground for technical material, it retains the same pedagogical style as the earlier chapters.

This is a very short book! The text comprises only 72 pages, not including appendices. Each chapter includes a short collection exercises of varying difficulty (along with solutions – perfect for self-study!). The book also contains code listings in Matlab and Python. Perhaps surprisingly, each code listing contains a lengthy copyright/license statement in comments. It seems that this could have been expressed once in the appendix without including it in each code listing. This minor quibble aside, the code is nicely commented throughout.

In short, I highly recommend this book for many applied fields – not just physics. For example, a knowledgeable instructor in another field (i.e., psychology) could take the basic concepts from this book and adapt them to case studies relevant to that field. I look forward to doing this myself sometime soon. This book will deserve a place on your shelf.

About the reviewer: Thomas J. (Tom) Faulkenberry, Ph.D., is an Associate Professor in the Department of Psychological Sciences at Tarleton State University. He teaches courses on statistical methods and mathematical modeling in the behavioral sciences, and his primary research areas are mathematical cognition and Bayesian statistics.