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Kline, R. B., & Little, T. D. (2023). Principles and practice of structural equation modeling (5th ed.). The Guilford Press.

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A myriad of information surrounds us every day. As the proverbial look for the needle in the haystack indicates, finding relevant knowledge within an overabundance of information is difficult. The process can be overwhelming. Furthermore, despite considerable efforts, the process may prove to be fruitless, as the acquired knowledge can become obsolete or be erroneous. How can individuals orient themselves in such a flood of information? The wise advice I obtained as a young student was to ask. More precisely, the advice suggested asking somebody well-educated in the field to recommend where to start. How does all this relate to the review of a book with statistics? Based on this question, I asked which book should be recommended to someone who wants to learn structural equation modelling as a student and the answer is the topic of this review. The story is more nuanced, though, so allow me to briefly touch upon it before moving to the review.

I have asked which book should be recommended to someone who wants to learn structural equation modelling several times and various people to triangulate the answer. The answers converged in one direction—a book called *Principles of Structural Equation Modelling* by the author *Rex B. Kline*. I obtained the book; however, I did not finish reading it at that time. Why? Several explanations could be provided. Perhaps more urgent priorities struck as SEM was not the most relevant method for me, considering the theme of my thesis. I found that relying solely on conceptual knowledge left me disconnected from the practical world. A more practically oriented, tutorial-like format that connects the topic to real-world applications in specific software with data relevant to my field of study would resonate with me more. Nevertheless, I sporadically connected to the topic of SEM on several occasions over the years. As time passed, I took some courses, played with data, discovered the free tools called Lavaan and R, read online tutorials, but I still felt that I missed something. Perhaps a deeper understanding and more comprehensive and up-to-date knowledge about the best practices and common pitfalls.

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A few months ago - in late 2023 - I encountered an old shadow from the past – *Principles and Practices of Structural Equation Modeling* by *Rex B. Kline* – but in *the most recent, fifth version* (Kline, 2023). I started to read this version of the book, and I was amazed on several occasions, pondering the "what if" this had been the version I had encountered at the very beginning of my SEM journey.

The book is divided into four main parts:

1. Concepts, Standards, and Tools
2. Specification, Estimation and Testing
3. Multiple-indicator approximation of concepts
4. Advanced techniques

The book's first part focuses on the theoretical background behind SEM. For example, the author describes the SEM family of methods, including covariance-based SEM (CB-SEM), composite SEM (partial least squares path modelling; PLS-PM), and nonparametric SEM (structural causal model). Also, background statistical information with the self-test is provided. The basic steps are covered and briefly discussed (i.e., specification, identification, measures selection, data collection, analysis, and reporting).

The second part is dedicated to specification, estimation, and testing. For example, discussion devoted to methods for estimation and non-normal data is provided, among other topics, such as the analysis of path models with a mean structure and interpretation of various outputs. The chapter dedicated to model testing (as a binary decision) and model fit indexing (as non-binary measures of model-data correspondence) is very intriguing. As stressed by the author, there is a need for global and local fit examination and a more nuanced evaluation of the thresholds, to mention just a few examples of topics covered in this part.

The last two parts are dedicated to the comparison of the models and groups and various topics related to the multiple-indicator approximation of concepts and various advanced issues. In particular, CFA (including CFA with categorical variables), structural regression models, analysis in a small sample, mediation analysis, non-recursive models, measurement invariance, and latent growth curve models are discussed. Additionally, a chapter devoted to composite analysis (PLS-SEM) is covered, providing a welcome discussion on this family of SEM models. The last chapter, dedicated to the best practices in SEM, serves as a valuable wrap-up with excellent practical recommendations.

Several aspects that echoed throughout the book should be appreciated. First and foremost, the book is conceptually oriented and does not require extensive mathematical knowledge. This is important as many people, including myself, struggle with a limited understanding of more advanced mathematics. The book engages the reader with the right amount of technical jargon. As such, it is suitable for various groups, from starting students to more advanced users. Moreover, Kline's profound emphasis on established best practices and prevalent pitfalls is invaluable. I also greatly appreciate the author's healthy perspective on various SEM-related topics. For instance, Kline widely acknowledges that the knowledge of the research area and measures and usage of the best computer in the world – the brain – is more critical than technicality and overpriced and fancy analytic tools. The book also discusses analytic tools, including free ones, such as R and package lavaan (Rosseel, 2012) and related packages (e.g., SEM tools), which are readily available, and is accompanied by a website that offers an R code. Lavaan´s output and various settings are discussed several times throughout the book. While a tutorial to lavaan can be found online, Kline´s

decision helps facilitate an understanding of this tool, as well as its various settings and output, up to the next level.

As such, the book provides a great way to start learning SEM but also improves SEM's conceptual understanding and practical application for more advanced readers. For example, Kline argues that most, if not all, SEM studies are not without problems. This information can be frustrating initially, but it also facilitates the journey to better practices. While reading the book, I was struck several times by how many misconceptions and "folklore" are present in the research literature, in the “arguments” of proverbial “reviewer number 2”[1], but also how my own work could be improved substantially by this book. For example, as shown by Rhemtulla et al. (2020), reflective measurement is the default choice by many, and the conceptual issues are ignored. Model selection is often unjustified, and this practice could lead to potential bias. Kline points out that the type of measurement model should be considered, and specifications should be based on substantive consideration – guiding the reader in addressing this very common issue. As such, the book is precious as it points to widespread errors and misunderstandings, which could be addressed at the most appropriate time – during the initial learning process. Furthermore, every chapter ends with a *learn more* section, where additional resources are recommended, and the reader can dig deeper into selected topics. Alongside this are various appendices and several exercises.

The book is not perfect, though. It has several limitations. In some cases, the problem is foreshadowed, and general information is provided, but this is insufficient for real-world applications. Instead, other resources should be consulted. Relatedly, the main text could include primers (significance testing primer, regression primer, and psychometrics primer). These are downloadable as an extra PDF, but their inclusion in the text could improve the workflow. Also, the strategy of using multiple-indicator measurement is provided only later in the book. This strategy provides some benefits, such as the simplicity needed for the reader in the first chapters. However, I would prefer if latent variables were covered and incorporated into the text much sooner. Furthermore, the book does not cover some important topics. For example, longitudinal SEM and some specific types of power analysis were not covered deeply enough to meet my needs. I would also appreciate it if the philosophy of science behind various types of SEM (e.g., a discussion between realism and constructivism) were covered to prime our thinking about these deeper issues. Other people could miss multi-level SEM, SEM for imaging data, Bayesian SEM, etc. However, is this truly a severe problem considering the book’s goal? I don't think so. More dedicated books are needed for more advanced topics. For instance, Longitudinal SEM (Newsom, 2024) could be consulted if an individual is interested in various ways how to analyse longitudinal data, and specific articles and tutorials could be examined if one needs to conduct a power analysis for various types of SEM (Jak et al., 2021; Mulder, 2023; Wang & Rhemtulla, 2021).

At the beginning of the review, I mentioned that, as a young student, I struggled to complete reading the older version of Principles of Structural Equation Modelling. I must be honest with the reader. At the time of writing, I still had not completed reading the revised version from the beginning to the end. Also, I still needed to go back to some chapters of the book, read them several more times, and engage with the recommended reading list. However, this time, it is different. The lavaan code is provided and commented on; the book is engaging, well-balanced, and offers current state-of-the-art knowledge. Also, the book provides valuable insights into the most common mistakes and best practices in SEM. Thus, if I do not complete the reading this time, I will have to find another excuse and work on my time management skills and persistence.

If anybody asks what I recommend to somebody wanting to learn SEM, it will be this book - in its fifth version. To the best of my knowledge, this could be one of the best candidates for overcoming

the proverbial look for the needle in the haystack and finding SEM-related knowledge that is up-to-date, relevant, and relatively comprehensive. As such, *Principles of Structural Equation Modelling* by the author *Rex B. Kline,* in its fifth version, is highly recommendable for anybody who wants to start to learn SEM but also for people who already started some time ago but want to learn more. We are a few clicks away from learning from the expert in the field, we have access to data and free-to-use software, and we can share questions with the community of people (SEMNET, lavaan discussion group, even local communities such as SKRN[2]). What a great time to be alive as a researcher.

Popular reviews tend to end with an overly optimistic statement about how the book changed lives. Unfortunately, the promise that this book will change your life is too strong. However, I think that this book can change how we approach, understand, conduct, and interpret SEM, which is currently a very important part of research life for many researchers.

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[1]Reviewer number two is used to personify the problems one can encounter during the review process, where reviewers suggest rejecting the paper based on/or argue to revise the paper based on certain practices that are problematic.

[2] SKRN – Slovak Reproducibility network – see https://www.slovakrn.org.

Reference for the reviewed book:

Kline, R. B., & Little, T. D. (2023). *Principles and practice of structural equation modeling* (5th ed.). The Guilford Press.

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