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J. P. Verma · Priyam Verma

Understanding Structural Equation Modeling

A Manual for Researchers

Springer

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A Manual for Researchers

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Prof. Mihir Kanti Chaudhuri,
Who is my Beacon of Constant Encouragement and Inspiration

Preface

This book offers readers a comprehensive understanding of Structural Equation Modeling (SEM) and guides them in utilizing it to address research issues across various disciplines. A key feature of this book is its "simple to complex" approach, where concepts are explained progressively with the support of examples in different chapters. As we extensively utilize IBM SPSS and IBM SPSS Amos software, a dedicated chapter is included to introduce readers to these tools.

One unique selling point (USP) of this book is that readers do not need complex programming skills or an advanced background in statistics and mathematics to grasp its content. To ensure a strong comprehension of SEM's foundational components, the book provides a review of variance, covariance, correlation, multiple regression, mediation, moderation, path analysis, and confirmatory factor analysis. Furthermore, we discuss the initial steps researchers undertake in conducting structural equation modeling, including model specification, identification, estimation, testing, and modification.

Readers will learn how to develop measurement, structural, and SEM models using IBM SPSS Amos. Each chapter is self-explanatory and includes illustrative examples for better understanding. The book emphasizes conceptual clarity in understanding the models and presents a practical approach to solving them. It offers valuable insights to graduate-level researchers, providing them with new ideas to develop research problems using mediation models, path analysis with multiple regression, SEM, and confirmatory factor analysis with SEM. Students and researchers from diverse fields such as psychology, education, sociology, management, business, medicine, political science, biological sciences, sports, and physical education can visualize their research studies through the application of these models. Appendix I of the book lists several research areas where techniques such as multiple regression analysis, mediation analysis, path analysis, confirmatory factor analysis, and structural equation modeling can be applied. Research scholars can refer to these areas to develop research proposals aligned with their interests.

We commence the discussion with mediation and path models, utilizing regression analysis, and address the use of SEM to account for measurement error in regression analysis. We cover the fundamentals of model fit in multiple regression, including the R-squared value, as well as the limitations of such models. Through these models, we delve

into direct and indirect effects and outline the procedure for evaluating indirect effects in mediated and unmediated models. We explain why relying solely on the chi-square statistic is insufficient for testing model fit and highlight the importance of additional fit indices such as the goodness of fit index (GFI), normed fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) to assess model fit. Our goal is to provide readers with the essential concepts, principles, and practical applications needed to test theoretical models. We hope that readers will gain confidence in utilizing structural equation modeling in their research after going through this book.

The chapters have been carefully organized to enhance the flow of knowledge and proficiency in SEM modeling. To grasp SEM analysis and its intricacies, we recommend starting from the first chapter. This book consists of seven chapters:

Chapter 1 introduces the fundamental concepts and terminologies used in SEM, including expectations, variances, covariances, direct and indirect effects, measurement and structural models, parameters, and fit indices. We also discuss the strengths and weaknesses of SEM in this chapter.

Chapter 2 is dedicated to learning the use of IBM SPSS and IBM SPSS Amos software. Step-by-step procedures, accompanied by screenshots, are provided to enhance understanding. Learning to create SEM models with Amos will enable readers to comprehend and develop more complex models as discussed in subsequent chapters.

Chap. 3, reviews various types of parametric and non-parametric correlations, as well as multiple regression. We illustrate the procedures used in developing and testing multiple regression models using SPSS. Additionally, we discuss the assumptions required in multiple regression analysis and provide guidance on testing and reporting these assumptions.

Chapter 4 delves into the mediation model and its real-life applications. We explore concepts such as mediator and moderator variables, direct and indirect effects, and assumptions in the mediation model. The procedures for analyzing the mediation model using SPSS are demonstrated through illustrations. Readers will learn how to investigate the presence and significance of mediation, as well as understand the contribution of indirect effects in examining the relationship between intervention and the variable of interest.

Chap. 5 focuses on path analysis, outlining prerequisites and assumptions for developing the model. We explain the terminologies used in path models and demonstrate the procedure for analyzing path models using multiple regression analysis in SPSS. The chapter emphasizes effective reporting of model analysis results and guides readers on investigating indirect effects, comparing path coefficients in unmediated and mediated models, and assessing the status of mediation in the model.

Chap. 6 covers path analysis using IBM SPSS Amos. We provide a detailed procedure for developing different structural equations in the model. Readers will gain an understanding of the parameters in the model and learn how to test whether the model is

under-identified, just identified, or over-identified. Lastly, an illustration using IBM SPSS Amos guides readers through the process of developing a path model with SEM.

Chapter 7 is dedicated to confirmatory factor analysis (CFA) with SEM. We discuss all the foundational concepts in developing and analyzing SEM models. Topics such as sample size requirements and assumptions for CFA with SEM are explored. The procedure for developing a CFA model with SEM using Amos is illustrated, with a focus on understanding model outputs in terms of fit indices, estimates, and modification indices for testing model fit. Additionally, we discuss how to assess the reliability and convergent and divergent validity of the model using CFA.

To illustrate concepts throughout the book, we have created a fictitious dataset available on the Springer link webpage or the author's website at www.jpverma.org. We highly appreciate any suggestions for further improvement in the book and welcome feedback, which can be sent directly to the author(s).

I am excited to have Priyam Verma as a co-author in this book. Thanks to his initiatives and valuable contributions, the text has become user-friendly. Several strategic sections of the book have been prepared by him, which has shaped the book to its current form.

We hope that this book will inspire researchers who wish to utilize multiple regression models, mediation models, path analysis models with SEM, and CFA with SEM in their research studies.

We encourage readers to share their suggestions and queries with me via email at vermajprakash@gmail.com or with my co-author Priyam Verma at priyamverma.2992@gmail.com, and we will respond as soon as possible.

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J. P. Verma
Vice Chancellor

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