BASIC OF PLS SEM STEP BY STEP USING SMART - PLS SEM

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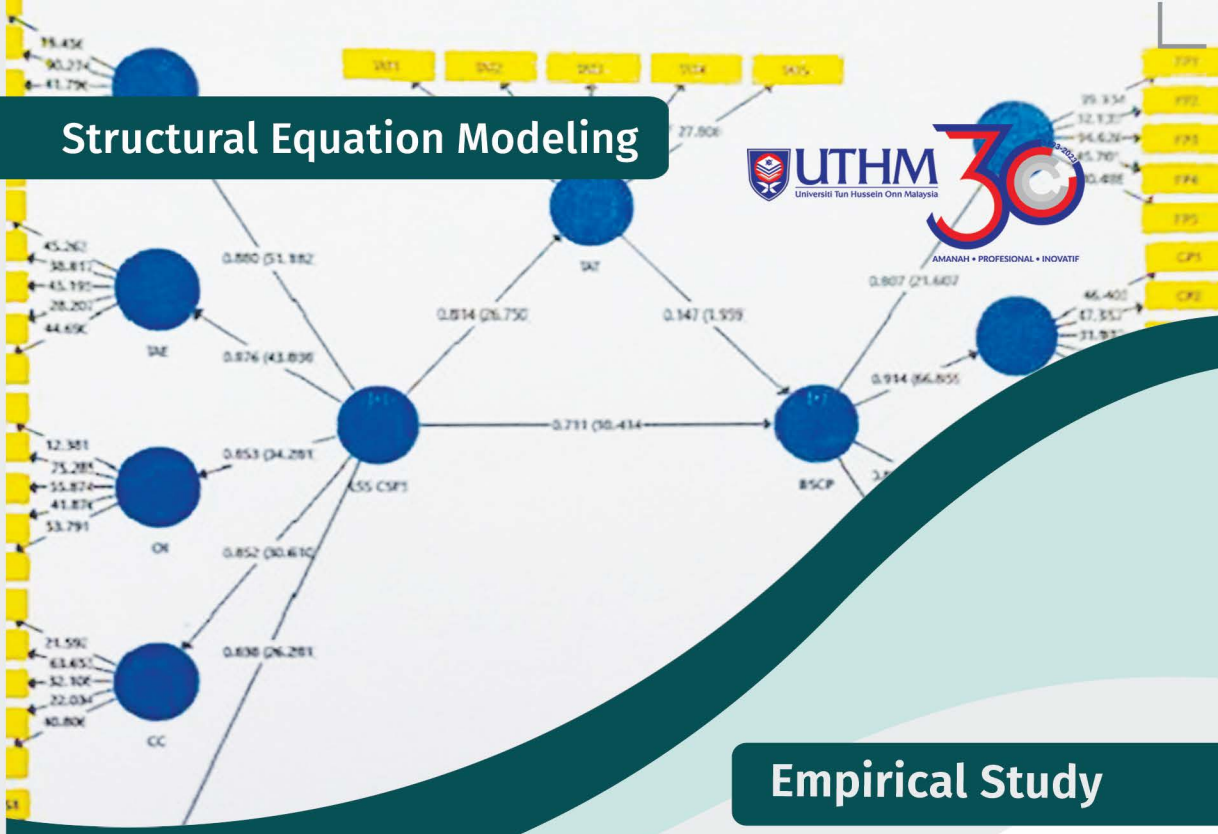
Abstract: Finally, I manage to complete writing this book. Thanks to God for giving me, patience and inspiration. Structural Equation Modeling or SEM is a second-generation statistical analysis technique for analyzing the inter-relationships among multiple variables in a model. SEM is an extension of the general linear model (GLM) that enables a researcher to test a set of regression equations simultaneously, SEM software can examine complex relationships and models, such as confirmatory factor analysis and second-order latent variables which improves the weaknesses of ordinary least square (OLS) method. There are two ways to proceed with the structural equation modelling (SEM technique) Covariance-based SEM and PLS-SEM. The selection of the method is based on the normality of data and the type of research. PLS SEM method is used for non-normal data and exploratory research. This book provides researchers with the application of PLS SEM through empirical data focusing on quality management. Empirical data will provide a better understanding of SEM application. I believe that this book will be able to help who are in the theories of applying this technique in their research. Hopefully. this book will provide a useful reference for a better understanding of SEM which can lead to implementing successful research for students and researchers. My sincere, thanks to UTHM for giving me the opportunity to write this book, particularly to share my experience and knowledge in this small contribution.

Keywords: Empirical, structural, knowledge, equations, technique

Structural Equation Modeling



Empirical Study

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MD. FAUZI AHMAD

Structural Equation Modeling is a second-generation statictical analysis technique for analyzing the inter-relationships among multiple variables in a model.

Research is easy if you can do it in a systematic way

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LIST OF ABBREVIATIONS

GLM	General Linear Model	2
OLS	Ordinary Least Square	4
CR	Composite Reliability	10
AVE	Average variance extracted	10
CFA	Confirmatory factor analysis	9
SEM	Structural Equation Modeling	11
SPSS	Statistical Package for the Social Science	14

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DEDICATION

To my beloved mother and father,
Haji Mohamad and Hajjah Mariah.
My family, Fatan Adib, Faiza Dina
and Faiz Saffin,
My Dearest Sisters and Brothers
Fadzil, Fauziana, Fariza, Fuad and
Fatimah

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PREFACE

Finally, I manage to complete writing this book. Thanks to God for giving me, patience and inspiration. Structural Equation Modeling or SEM is a second-generation statistical analysis technique for analyzing the inter-relationships among multiple variables in a model. SEM is an extension of the general linear model (GLM) that enables a researcher to test a set of regression equations simultaneously. SEM software can examine complex relationships and models, such as confirmatory factor analysis and second-order latent variables which improves the weaknesses of ordinary least square (OLS) method. There are two ways to proceed with the structural equation modelling (SEM technique); Covariance-based SEM and PLS-SEM. The selection of the method is based on the normality of data and the type of research. PLS SEM method is used for non-normal data and exploratory research. This book provides researchers with the application of PLS SEM through empirical data focusing on quality management. Empirical data will provide a better understanding of SEM application. I believe that this book will be able to help who are in the theories of applying this technique in their research. Hopefully, this book will provide a useful reference for a better understanding of SEM which can lead to implementing successful research for students and researchers. My sincere, thanks to UTHM for giving me the opportunity to write this book, particularly to share my experience and knowledge in this small contribution.

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"Research is easy if you can do it in a systematic way"

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Universiti Tun Hussein Onn, Malaysia.

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This book is one of my small contributions to this country and nation based on my experience, observation and research. Hopefully, this book will be useful as a guidance to students and researchers. At last, thanks to UTHM for giving me the opportunity to publish this book.

All The Best !

Gambatte!

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CHAPTER

1

STRUCTURAL EQUATION MODELING (SEM)

Structural Equation Modeling (SEM) Introduction

Structural equation modeling (SEM) is a statistical analysis technique that is used to analyze structural relationships. SEM consists of factor analysis and multiple regression analysis. It is applied to analyze simultaneously the structural relationship amongst many variables. Researchers in social science have used statistical analysis for analysing their research data in a quantitative study. In the beginning stage, researchers often used **univariate and bivariate analysis** to analyse data. **To analyse more complex relationships** in a conceptual model, researchers have started applying a more advanced multivariate analysis method named as **Structural Equation Modeling (SEM)**. The evolution of statistical analysis started from first-generation through the 1980s then, followed by the second-generation in the 1990s (Hair et al. 2014). First-generation analysis such as exploratory factor analysis (EFA), ANOVA and multiple regression has their weaknesses which is unable to involve in sophisticated multivariate data analysis. Structural Equation Modeling Structural Equation Modeling or SEM is a **second generation statistical analysis techniques** and it has been introduced for analyzing the inter-relationships among multiple variables in a model as shown in **Table 1.1**. The Structural Equation

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CHAPTER

2

MEASUREMENT MODEL AND CONFIRMATORY FACTOR ANALYSIS (CFA)

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) has been done to examine the hypothesised factor structure and to assess its fit to the data. CFA is the most comprehensive method for assessing construct validity as it provides statistical evidence. CFA has been performed to test the construct validity of unidimensionality and convergent validity and to support the result of EFA.

Validity and reliability are two criteria for measure of goodness. **Reliability is a test of how consistently a measuring instrument measures** whatever concept it is measuring, whereas **validity is a test of how well an instrument that is developed measures the particular concept it is intended to measure** (Sekaran & Bougie, 2010; Hair, 2010).

Validity

Validity refers to how well an instrument as measures what it is intended to measure. The validity has been tested using first order and second order measurement model. Empirical studies have

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CHAPTER

3

SMART PLS AND MEASUREMENT MODEL: CONFIRMATORY FACTOR ANALYSIS (CFA)

Introduction of Smart Pls and New Project

SmartPLS is a software with a graphical user interface for variance-based structural equation modelling (SEM) using the partial least squares (PLS) method. SmartPLS computes standard results assessment criteria for measurement model and the structural model, including convergent validity, discriminant validity, bootstrap and goodness of fit.

Downloading and Installation

You can download SmartPLS and refer to browse https://www.smartpls.com/ for installation.

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CHAPTER

4

STRUCTURAL MODEL - PLS SEM

Collinearity Statistics (Variance Inflation Factor -VIF)

VIF determines the relationship of the correlation between the independent variables. It is predicted by taking a variable and regressing it against every other variable. **The closer the R^2 value to 1, the higher the value of VIF and the higher the multicollinearity with the particular independent variable**. A high VIF indicates that the associated independent variable is highly collinear with the other variables in the model. Figure 4.1 shows the assessment flow for structural model.

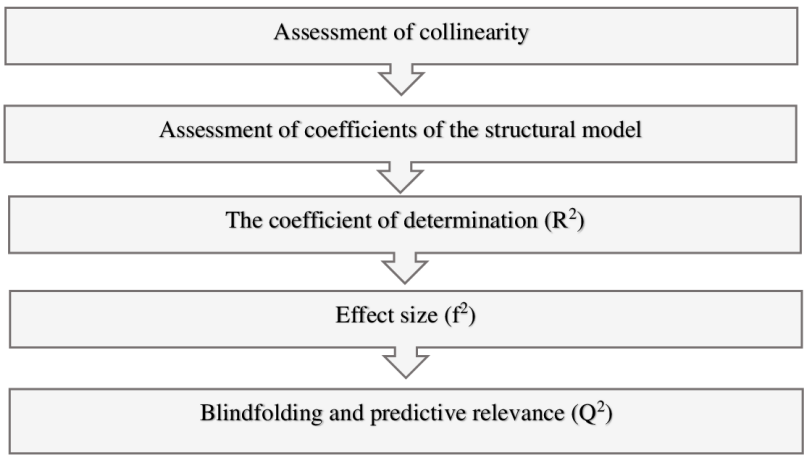

Figure 4.1: Assessment flow for structural model

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Overseas Technical Scholarship (AOTS). He also contributed in establishing company strategy for improving customer satisfaction and other major quality projects. He also received Best Student PHD Award during his study. Based on his experience studying in Japan and working with Japanese companies for more than 20 years, he understands the secret of Japanese management well. Collaborating the knowledge, experience and success for the past 20 years of his life living within this Japanese culture, this book was then initiated for the benefit and survival of industries in the highly competitive age.

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