Course Description

MEDD8904 Introduction to factor analysis and structural equation modeling

Course description

This course is designed to introduce the theory and practice of factor analysis (FA) and structural equation modeling (SEM). Technically, FA and SEM cover a family of multivariate statistical techniques to analyze structural and causal models with observed and latent variables. Methodologically, they offer a quantitative framework for empirical research from the exploratory to confirmatory ends. The course focuses on both theoretical knowledge to understand a variety of topics and practical skills that can be widely applied in social and behavioral sciences. General topics include the exploratory factor analysis, confirmatory factor analysis, path analysis, and general structural equation models. Many special topics and similar variants will be briefly introduced. Prerequisite knowledge of statistics up to regression analysis is required. Throughout, R and Mplus are utilized for all analyses.

Coursework / Examination ratio: 100 % Coursework, 0 % Examination

Course objectives

This course will adopt a more methodological, rather than statistical, approach towards FA and SEM. The main objective is to introduce FA and SEM as a methodological framework from two perspectives. For the fundamental perspective, it focuses on general knowledge and conceptual theories that can aid in understanding; for the design and analysis perspective, it focuses on specific skills and practical techniques that can be illustrated with real-data examples. Thus, the course is bound with conceptual understanding, statistical analysis, and computational exercise. The goals are to help students: 1) understand the concepts, theory and methodological foundations of FA and SEM; 2) understand the appropriate practice and applications of FA and SEM when conducting empirical research; 3) develop skills to conduct FA and SEM with computer software and procedures of implementation; and 4) develop skills in interpreting, communicating, and reporting results of the analysis.

Course learning outcomes	**Aligned programme learning outcomes (PLOs)**
1. Understand the concepts, theory and methodological foundations of FA and SEM	PLOs 1, 2
2. Understand the appropriate practice and applications of FA and SEM when conducting empirical research	PLOs 1, 3
3. Develop skills to conduct FA and SEM with computer software and procedures of implementation	PLOs 1, 2
4. Develop skills in interpreting, communicating, and reporting results of the analysis	PLOs 4, 5

Course assessment methods

Assessment method	**Type of assessment (e.g. description of assignment)**	**Weighting (%)**	**Aligned course learning outcome(s)**
Homework assignments	Individual (Eight assignments)	88	CLOs 1, 2
Class and Online Discussions	Individual	12	CLOs 1, 2

Course content and topics

Session 1: From Latent Variable Models to Factor Analysis
Session 2: Exploratory Factor Analysis
Session 3: Confirmatory Factor Analysis: Fundamentals
Session 4: Confirmatory Factor Analysis: Design and Analysis
Session 5: Path Analysis: Fundamentals
Session 6: Path Analysis: Design and Analysis
Session 7: General Structural Equation Models: Fundamentals
Session 8: General Structural Equation Models: Design and Analysis

Required / recommended readings and online materials

Required readings:

Chen, J. (2023). Factor Analysis and Structural Equation Modeling in Methodology. Handouts.

Key (*) and Useful Reference

*Bollen, K. A. (1989). Structural equations with latent variables. New York, NY: Wiley.

*Hancock, G. R., & Mueller, R. O. (Eds.). (2013). Structural equation modeling: A second course. Information Age Publishing.

*Kline, R. B. (2016). Principles and practice of structural equation modeling (4th ed.). New York: Guilford.

*Thompson, B. (2004). Exploratory and confirmatory factor analysis: Understanding concepts and applications. Washington, DC, 10694(000).

Bartholomew, D. J., Knott, M., & Moustaki, I. (2011). Latent variable models and factor analysis: A unified approach (3rd ed.). Chichester, UK: Wiley.

Brown, T. A. (2015). Confirmatory factor analysis for applied research (2nd ed.). New York: The Guilford Press.

Bowen, N. K., & Guo, S. (2011). Structural equation modeling. Oxford University Press.

Duncan, T. E., Duncan, S. C., & Strycker, L. A. (2006). An introduction to latent variable growth curve modeling (2nd ed.). Mahwah, NJ: Erlbaum.

Fabrigar, L. R., & Wegener, D. T. (2011). Exploratory factor analysis. Oxford University Press.

Glymour, M., Pearl, J., & Jewell, N. P. (2016). Causal inference in statistics: A primer. John Wiley & Sons.

Hancock, G. R., & Mueller, R. O. (2001). Rethinking construct reliability within latent variable systems. Structural equation modeling: Present and future, 195, 216.

Hayes, A. F. (2022). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford Publications.

Hoyle, R. H. (Ed.). (1995). Structural equation modeling: Concepts, issues, and applications. Thousand Oaks, CA: Sage.

Hoyle, R. H. (Ed.). (2012). Handbook of structural equation modeling. Guilford press.

Kaplan, D. (2008). Structural equation modeling: Foundations and extensions (Vol. 10). SAGE publications.

Loehlin, J. C. (2004). Latent variable models: An introduction to factor, path, and structural equation analysis. Psychology Press.

Maruyama, G. (1997). Basics of structural equation modeling. Sage.

Mueller, R. O., & Hancock, G. R. (2018). Structural equation modeling. In The reviewer's guide to quantitative methods in the social sciences (pp. 445-456). Routledge.

Mulaik, S. A. (2009). Linear causal modeling with structural equations. Chapman & Hall/CRC.

Mulaik, S. A. (2010). Foundations of factor analysis (2nd ed.). Boca Raton, FL: Chapman & Hall/CRC.

Muthén, B. (2004). Latent variable analysis. The Sage handbook of quantitative methodology for the social sciences, 345(368), 106-109.

Muthén, L. K., & Muthén, B. O. (1998-2022). Mplus user's guide. Los Angeles, CA: Muthén and Muthén.

Pearl, J. (2000). Models, reasoning, and inference. Cambridge, UK: Cambridge University Press, 19(2).

Raykov, T., & Marcoulides, G. A. (2012). A first course in structural equation modeling. Routledge.

Schumacker, R. E., & Lomax, R. G. (2004). A beginner's guide to structural equation modeling. Psychology Press.

Ullman, J. B., & Bentler, P. M. (2012). Structural equation modeling. Handbook of Psychology, Second Edition, 2.

Wang, J., & Wang, X. (2019). Structural equation modeling: Applications using Mplus. John Wiley & Sons.

Weston, R., & Gore Jr, P. A. (2006). A brief guide to structural equation modeling. The counseling psychologist, 34(5), 719-751.

Other additional course information

Advanced Research Methods (ARM) course

Previous enrolment in MEDD8815 Introduction to Statistical Methods or equivalent (consent with the instructor)