

**COURSE TITLE:** Introduction to Structural Equation Modeling  
(Enrico Perinelli, 15 hours - 3 cfu)

**PERIOD:** January 2024

### **COURSE CONTENTS, OBJECTIVES AND LEARNING OUTCOMES**

#### **Description of activity and topics:**

The purpose of this course is to introduce students to analyses for latent variables, in particular factor analysis and structural equation models.

Structural Equation Modeling (SEM) represents an advancement and an integration of factor analysis and linear regression. SEMs belong to a large class of multivariate statistical analysis, very widespread in the current quantitative research landscape of the social sciences. Initially (late 1960s early 1970s), the main purpose of SEM was to investigate the fit of the model to data by estimating (a) relationships between unobserved (latent) variables and their observed indicators and (b) relationships between several latent variables. To date, SEMs allow a wider range of analyses, such as the study of the development of a construct over time, the analysis of latent sub-populations within a sample, or the study of the enduring, ephemeral, and error components of a variable.

The general purpose of this course will be to provide an overview of SEM through applications with *Mplus* and R. In particular we will deal with:

- An overview of latent variables in psychology
- Factor analysis
- The matrices underlying the SEMs
- The graphical representation of the SEMs
- Degrees of freedom (and relative calculation) in the SEM
- Fit indices (and related calculation)
- The various types of SEM and their practical utility
- An overview of *Mplus* (history, functionality, main advantages, bibliographic, and website sources)
- The *Mplus* syntax
- An introduction to Longitudinal Structural Equation Modeling
- Exercises with *Mplus* (construction of the input and interpretation of the output of CFA and full-SEM; comparison between models; mediation with latent variables)
- SEM in R (*lavaan* and *MplusAutomation*)

#### **Specific learning objectives (i.e. specific knowledge and skills that the participants in the activity will acquire):**

At the end of the teaching activity, the student will be able to interpret the results of an SEM (for example, taken from the results of a study) and will have the basis for being able to implement a SEM in *Mplus* and R.

#### **DUBLIN DESCRIPTORS (Indicate the learning objective(s) that the activity aims to achieve, exercise and/or consolidate)**

- systematic understanding of a field of study and mastery of the skills and methods of research associated with that field;
- ability to conceive, design, implement and adapt a substantial process of research with scholarly integrity;
- ability to make a contribution through original research that extends the frontier of knowledge by developing a substantial body of work, some of which merits national or international refereed publication;
- ability to critically analyse, evaluate and synthesise new and complex ideas;

- ability to communicate with their peers, the larger scholarly community and with society in general about their areas of expertise;
- ability to promote, within academic and professional contexts, technological, social or cultural advancement in a knowledge based society;

**ENTRANCE REQUIREMENTS (Indicate any specific knowledge and/or skills that the student must have in order to participate in the activity)**

none

**TEACHING AND LEARNING METHODS AND ACTIVITIES**

in class. Students are encouraged to bring their own laptop

**ASSESSMENT OF THE ACHIEVEMENT OF LEARNING OBJECTIVES (Possibly an activity carried out independently by the student functional to his/her research activity)**

activities, exercises and group-work in class

**BIBLIOGRAPHY /STUDY MATERIALS (video-lessons, etc.) (Specificare se il materiale va letto, visionato, etc. prima degli incontri)**

Suggested readings, not necessarily to be viewed before the meetings

Intro to SEM

- Barbaranelli, C., & Ingoglia, S. (2013). I Modelli di Equazioni Strutturali: Temi e prospettive. Milano: LED.

- Kline, R. B. (2023). Principles and practice of Structural Equation Modeling (5th ed.). New York, NY: The Guilford Press.

Advanced Introduction to SEM

- Bollen K. A. (1989). Structural equations with latent variables. Wiley.

Basic Intro to Mplus

- Geiser, C. (2013). Data analysis with Mplus. The Guilford Press.

Advanced Introduction to Mplus

- Wang, J., & Wang, X. (2012). Structural equation modeling: Applications using Mplus. Wiley.

SEM in R with lavaan

- <https://lavaan.ugent.be/>

Mplus and lavaan comparison

- Geiser, C. (2023). Structural equation modeling with the Mplus and lavaan programs. In R. Hoyle (Ed.), Handbook of structural equation modeling (2nd ed., 241-258). New York: Guilford Press. Available at:

[https://www.researchgate.net/publication/358103653\\_Structural\\_Equation\\_Modeling\\_with\\_the\\_Mplus\\_and\\_lavaan\\_Programs](https://www.researchgate.net/publication/358103653_Structural_Equation_Modeling_with_the_Mplus_and_lavaan_Programs) [accessed Sep 20 2022].available at

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Introduction to Longitudinal Structural Equation Modeling

- Little, T. D. (2013). Longitudinal structural equation modeling. The Guilford Press.

- Newsom, J. (2015). Longitudinal structural equation modeling: A comprehensive introduction. Taylor & Francis.

To be downloaded before the third lesson, the Mplus User's Guide

- Muthén, L. K., & Muthén, B. O. (1998-2017). Mplus User's Guide (Eighth Edition). Los Angeles, CA:

Muthén & Muthén. Available at [https://www.statmodel.com/download/usersguide/MplusUserGuideVer\\_8.pdf](https://www.statmodel.com/download/usersguide/MplusUserGuideVer_8.pdf)

N.B. Other material will be suggested during the meetings or upon request

