(Online) TUTORIAL STRUCTURAL EQUATION MODELS [SEMinar]

Version 1 (April 20 2020)

- **Instructor**: Harry Ganzeboom (harry.ganzeboom@vu.nl; 06-47877396; HG a2.73).
- **For**: MA students preparing their thesis with quantitative designs with (linear) causal and measurement models; guests
- **Contents**: SEM is a unified approach to quantitative analysis that integrates the analysis of causal relationships with measurement models. As we restrict the models to linear specifications (non-linear forms are NOT covered, but do exist), SEM can be usefully thought of as a integration of linear regression analysis and latent factor analysis, the two main workhorses of quantitative analysis. SEM thus covers in a comprehensive framework causal models with confounding, mediation, and instrumental variables, recoprical and cross-lagged causation, as well as assessment of validity, reliability assessment and measurement equivalence, estimated on single or multiple samples. Through maximum likelihood estimation and constrained estimation the SEM approach brings major benefits when data are missing or have limited statistical power.
- **Form**: The SEMinar will introduce students to the use of Stata's SEM, which is a very elegant and easy to learn stand-alone programme. Not much familiarity with Stata is required. Alternatives to Stata SEM are: Mplus, Lavaan (R), Lisrel and EQS – which all provide more or less the same facilities. Students who have access to either of these programme's should feel free to practice in these other programmes.
- **Schedule:** Four online seminars, in which I will integrate instruction with ready-made exercises. Most of my examples will deal with examples from the stratification literature: the classical status attainment model, extended with multiple indicator measurement models.
- **Evaluation:** For VU-FSW MA students completing the tutorial is credited at one ECTS (28 hours). **Active participation** in the SEMinars is graded with 7.5 and constitutes 40% of the final grade. The remaining 60% is produced by two **lecture reports,** to be written after Lecture 1-2, and Lecture 3-4 respectively.

Seminar 1: Preparation
- What is SEM and what can you do with it?
- Ten good reasons to do SEM for the rest of your life.
- Correlations, covariances and how they are decomposed in causal (path) modeling into spurious, indirect and direct effects.
- The elements of a regression model: B, beta, SE, T, ANOVA
- Getting Stata SEM to run

Seminar 2: The elementary SEM models
- Causal path models in SEM
- Factor analysis (measurement) models in SEM
- Fit statistics
- Standard errors – the full story

Seminar 3: More advanced measurement models
- Parallel, tau-equivalent and congeneric measurement
- The simplex model of measurement reliability
- Multi-trait, multi-method models: how to separate reliability and validity of measurement
- Testing for measurement equivalence in multi-group data

Seminar 4: More advanced causal models
- Cross-lagged and reciprocal causation panel models
- Instrumental variables
- MIMIC models

Readings

Bollen, K. A., & Pearl, J. (2013). Eight Myths about Causality and Structural Equation Models. In S. L. Morgan (Ed.), *Handbook of Causal Analysis for Social Research* (pp. 301–328). Dordrecht: Springer Netherlands.

Ganzeboom, Harry (2017). Lecture notes on SEMinar at Department of Sociology, University of Melbourne, October 2017. Available at: www.harryganzeboom.nl/Teaching/index.htm

STATA Corp. (2011), Structural Equation Modelling Reference Manual. Release 12 (301 pp).

STATA Corp. (2013), Structural Equation Modelling Reference Manual. Release 13 (583 pp).

I recommend reading the Stata12 manual (first), because it avoids the complexities of GSEM modeling. GSEM, which includes a multi-level part, is available as of Stata13 and up.