

Analysis of Causal Effects with EffectLite, LISREL and/or Mplus

Presented by Rolf Steyer, August 5 - 6, 2009
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This course is an introduction to the stochastic theory of causality (Steyer et al. Springer: 2010), which is a generalization of the theory of causal effects in the tradition of J. Neyman and D. B. Rubin. All designs and models for the analysis are developed for the purpose of learning about conditional and/or average causal effects, in some cases also about individual causal effects. Unlike other courses on the analysis of treatment effects, it uses structural equation modeling (with or without latent variables) instead of analysis of variance techniques, the General Linear Model or related techniques. This course is a synthesis of different traditions in methodology: Rubin's approach to causality, the Campbellian tradition of quasi-experimentation and internal validity, and structural equation modeling, especially latent state-trait modeling, latent change modeling and latent growth curve modeling.

Although this workshop does not require experience and knowledge in structural equation modelling (SEM), we do *not* recommend this workshop as a first introduction to SEM, if the motivation is to have an introduction into SEM. For this purpose, I rather suggest our course "**Introduction to latent variable modeling with Structural Equation Models using Mplus**" held in April 2009 at the University of Jena. This and other courses are still available in the internet and on DVDs at: www.metheval.uni-jena.de/courses).

The course, "Introduction to the Analysis of Causal Effects with EffectLite, LISREL and/or Mplus" aims at those students and researchers that are interested in data analysis in experimental and quasi-experimental studies involving covariates such as one or several pretests, a discrete treatment variable, and one or several outcome variables.

EffectLite is a program developed by Rolf Steyer and Ivailo Partchev that will be provided to all participants. It analyzes a generalized multivariate analysis of variance and covariance. It creates LISREL and/or Mplus input files, reads and interprets the results, computes some statistics, and produces an output file containing the results that most important for the analysis of causal effects. In the univariate case, EffectLite does not assume homogeneity of variances of the outcome variable between groups. In the multivariate case with two or more outcome variables it does not assume homogeneity of covariance matrices of the outcome variables between groups. Furthermore, it allows analyzing mean differences and adjusted means differences – aimed at estimating causal effects – between groups with respect to

- (a) several manifest covariates and/or outcome variables
- (b) one or more latent covariates and/or outcome variables, and
- (c) a mixture of the two kinds of variables.

The covariate(s) may also be qualitative (blocking factors). In this case, we estimate and test average effects for non-orthogonal analysis of variance designs, provided that the covariates are specified as qualitative indicator variables. If the covariates fulfil certain assumptions, the program estimates and tests the conditional and average causal effects.

In the course we will

- present the theory of stochastic causality with an emphasis on causal effects
- show how to use EffectLite, LISREL and Mplus for generalized ANCOVA models
- show how to use LISREL and Mplus for individual causal effect models.

Theory

- Motivation: Simpson's paradox, non-orthogonal ANOVA
- The scope of the theory: some single-unit trials
- The mathematical structure of causal models: causality spaces
- True outcome variables, average and conditional causal effects
- The prima facie effect
- Two kinds of biases and unbiasedness
- Sufficient conditions for unbiasedness
- The role of randomization and other design techniques and strategies of data analysis

Applications

- Estimating and testing average and conditional causal effects via structural equation modeling (Applications using EffectLite, LISREL and *Mplus*)
- Models for the analysis of individual causal effects using *Mplus* in simulated and real-data examples.

Prerequisites for participants

It will be useful to be familiar with Probability Theory (including conditional expectations), basic concepts and analysis methods of Statistics (such as ANOVA, ANCOVA, Regression Analysis and Structural Equation Modeling) and their applications in the social and/or behavioral sciences. Course material (including readings, data sets, the updated version of the book "Probability and Causality", the EffectLite program and manual) will be available at www.metheval.uni-jena.de/courses in the first week of July 2009.

Software

EffectLite is a free program. The program and the manual can be downloaded at www.causal-effects.de. It works together with LISREL or *Mplus*, the full versions of which are not free. However, a free "student version" of LISREL can be downloaded at www.ssicentral.com. A free "demo version" of *Mplus* can be downloaded at www.statmodel.com. Both programs allow for the analysis of models with a small number of variables.

Registration

The course is free of charge. If you would like to participate you are requested to send an email to Mrs M Wagenaar of the Royal Netherlands Academy of Arts and Sciences (KNAW). Email Martine.Wagenaar@bureau.knaw.nl Please indicate your name, affiliation and email address. It is possible to make hotel reservations in the NH Doelen Hotel which is located nearby the Academy. For more information please contact Mrs Wagenaar.