Introduction to Structural Equation Modeling

Location: CIQSS, 3535 Queen-Mary, Suite 420, Montréal
Dates: May 14–18, 2018

Trainer

The seminar is under the responsibility of Dr. Rex B. Kline, Professor, Department of Psychology, Concordia University; rex.kline@concordia.ca; 514-848-2424, ext.7556; http://tinyurl.com/rexkline

Eligibility and Registration

The course is open to graduate students and postdoctoral fellows as well as to professors and applied researchers. The seminar is limited to a maximum of 20 participants registered on a first-come, first-served basis. Online registration will take place on the CIQSS web site. Contact and registration information:

CIQSS website, https://www.ciqss.org/en/qicss-summer-school
Luc St-Pierre, luc.st-pierre@ciqss.org

Description

The sessions are in English. This five-day seminar introduces structural equation modeling (SEM). Core SEM techniques, such as path analysis and confirmatory factor analysis (CFA), are covered, and examples of applying SEM to actual research problems are considered. The presentation will be conceptually rather than mathematically oriented. Basic familiarity with multiple regression and exploratory factor analysis (EFA) is assumed. There is also an opportunity for those with no prior experience using a computer tool for SEM to practice on-site with the student version of LISREL. Even if participants eventually use a different SEM computer tool in their own work, principles learned from working with LISREL will generalize to related applications.

Main Source (Optional)

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). New York: Guilford. Book resource site at http://www.guilford.com/kline

Other Readings with Links

Appelbaum, M., Cooper, H., Kline, R. B., Mayo-Wilson, E., Nezu, A. M., & Rao, S. M., (2018). Journal article reporting standards for quantitative research in psychology: The APA Publications and Communications Board Task Force report. *American Psychologist*, *73*, 3–25. http://psychology.concordia.ca/fac/kline/sem/qicss/a18.pdf

Goodboy, A. K., & Kline, R. B. (2017). Statistical and practical concerns with published communication research featuring structural equation modeling. *Communication Research Reports*, *34*, 1–10. http://psychology.concordia.ca/fac/kline/library/gk17.pdf

Kline, R. B. (2012). Assumptions of structural equation modeling. In R. Hoyle (Ed.), *Handbook of structural equation modeling* (pp. 111-125). New York: Guilford. http://psychology.concordia.ca/fac/kline/library/k13a.pdf

Kline, R. B. (2013). Exploratory and confirmatory factor analysis. In Y. Petscher & C. Schatschneider (Eds.), *Applied quantitative analysis in the social sciences* (pp. 171–207). New York: Routledge. http://psychology.concordia.ca/fac/kline/library/k13b.pdf

Kline, R. B. (2015). The mediation myth. *Basic and Applied Social Psychology*, *37*, 202–213. http://psychology.concordia.ca/fac/kline/library/k15.pdf

Schedule

Morning			Afternoon	
9:30–11:0am	Session 1		1:30–3:00pm	Session 3
11:15am–12:15pm	Session 2		3:15–4:45pm	Session 4

Topics

Mon	Background concepts, data preparation, types of models, computer tools
Tues	Path analysis, estimation, local fit testing
Wed	Global fit testing, testing hierarchical or non-hierarchical models
Thurs	CFA vs. EFA, testing measurement models, analyzing ordinal data
Fri	Structural regression (SR) models, two-step modeling, reflective vs. formative measurement, open question time

Computer Tools and Practice

Computer practice sessions use the student version of LISREL 9.2 for Windows platform computers. It can be freely downloaded from

http://www.ssicentral.com/lisrel/student.html

The two LISREL exercises are described in the last section of this outline. Participants have the option to either install LISREL on their own laptop computer or to use one of the laptop computers available at the CIQSS for the two exercises.

The Ωnyx graphical SEM computer program will be demonstrated. It runs under the Java Runtime Environment (version 1.6 or later) on Windows, Macintosh, or Linux platform computers and can be freely downloaded from

http://onyx.brandmaier.de/

The dataset for the Ωnyx demonstration can be downloaded from

http://psychology.concordia.ca/fac/kline/sem/qicss/roth-onyx.cov

Listed next is the schedule for the practice and demonstration sessions, all of which begin at 1:30pm:

Tues   LISREL syntax editor analysis

Wed   LISREL graphical editor analysis

Thur   Ωnyx demonstration

Syntax, Data, and Output Files for Examples with Links

Roth, *N* = 373, path model of illness factors, `lavaan` for R
   http://psychology.concordia.ca/fac/kline/sem/qicss/outputA.pdf

Kaufman, *N* = 200, two-factor CFA model, Mplus
   http://psychology.concordia.ca/fac/kline/sem/qicss/outputB.pdf

Shen, *N* = 983, SR model of depression, LISREL SIMPLIS
   http://psychology.concordia.ca/fac/kline/sem/qicss/outputC.pdf

Roth, D. L., Wiebe, D. J., Fillingim, R. B., & Shay, K. A. (1989). Life events, fitness, hardiness, and health: A simultaneous analysis of proposed stress-resistance effects. *Journal of Personality and Social Psychology*, *57*, 136–142.
Kaufman, A. S., & Kaufman, N. L. (1983). *K-ABC administration and scoring manual*. Circle Pines, MN: American Guidance Service.
Shen, B.-J., & Takeuchi, D. T. (2001). A structural model of acculturation and mental health status among Chinese Americans. *American Journal of Community Psychology*, 29, 387–418.

LISREL Exercises

These exercises are easier if your computer shows file names with extensions. Variable names in LISREL are case sensitive and limited to 8 characters in length. Syntax is executed by clicking on the Run LISREL icon, or . If the analysis is successful, displayed in the Path Diagram window is

Chi-Square=11.11, df=5, P-value=0.04929, RMSEA=0.057

Exercise 1 (Tuesday), LISREL SIMPLIS syntax

1. Create a new SIMPLIS syntax file: select File | New | Syntax Only, and then save the file as

roth.spl

2. Study the SIMPLIS syntax listed next for the example four-variable path model:

```
four-variable example
observed variables
 neg_str cur_prob prob_sol depress
covariance matrix
 76.913
 55.668 249.324
 33.757 115.685 478.297
 21.775  53.614  60.695 37.700
sample size is 205
relationships
 cur_prob = neg_str
 prob_sol = neg_str cur_prob
 depress = neg_str cur_prob prob_sol
LISREL output: ND = 3 SC RS MI
path diagram
end of problem
```
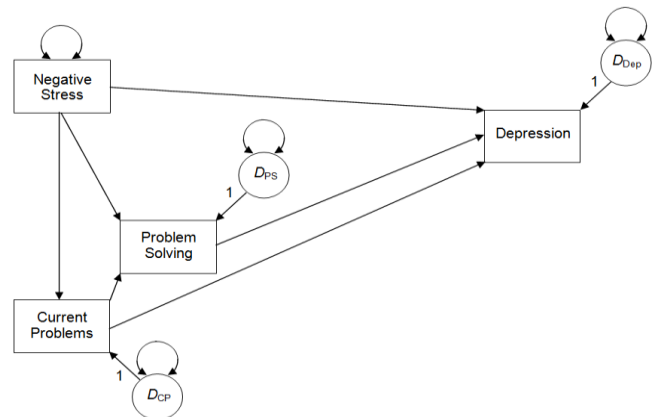

3. Adapt the syntax just shown for the data and model presented next for $N = 373$:

```
exercise, hardy, fitness, stress, illness

4422.250
 -75.810 1444.000
 477.204   48.944  338.560
-111.388 -292.790  -80.132 1122.250
-332.394 -379.878 -333.393  711.647 3903.750
```
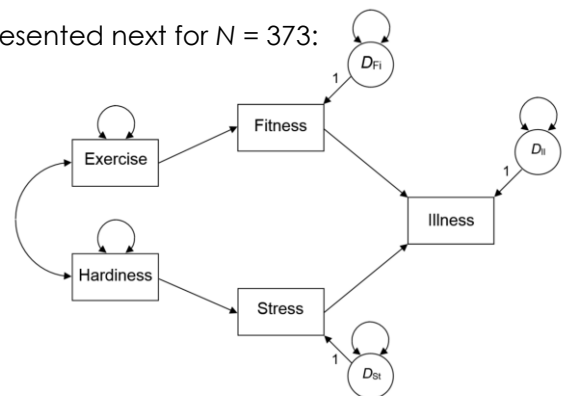

Exercise 2 (Wednesday), LISREL graphical editor

1. Save just the covariances (without labels) in the text file roth.cov

2. Create a new path diagram: select File | New | Path Diagram, and then save the diagram as roth.pth

3. These steps will be demonstrated in class, but you can try them on your own: Use the Setup menu to specify the data file, variable names, and sample size before drawing the model on the screen. Check the boxes for the endogenous variables (Observed Y) before dragging and dropping the observed variables from the list to the drawing palette. Select View | Toolbars | Drawing Bar to display the shape tools, if not already visible.

4. When the diagram is finished, select Setup | Build SIMPLIS syntax, and then run it.