Introduction to Structural Equation Modeling

Location: CIQSS, 3535 Queen-Mary, Suite 420, Montréal
Dates: April 20–24, 2015

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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. A maximum of 20 participants will be selected by the CIQSS on the basis of the relevance of the course to their curriculum, research, or teaching. Online registration will take place on the CIQSS web site. Contact and registration information:

Luc St-Pierre, l.st-pierre@umontreal.ca
CIQSS website, www.ciqss.umontreal.ca

Course Description and Content

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 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.

Seminar Web Page and Computer Tools

From the seminar web page you can download the slides and articles in PDF format and also computer syntax, data, and output files in either text (ASCII) or PDF format for analysis examples. The address is

http://psychology.concordia.ca/fac/kline/sem/qicss.html

Computer practice sessions use the student version of LISREL 9.1 for Windows platform computers. It can be freely downloaded from

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

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/

[1]Université de Montréal, INRS-UCS, McGill University, Concordia University, Université Laval, Université du Québec, Université de Sherbrooke.

Daily Schedule

Morning		Afternoon	
9:15–10:45am	Session 1	1:30–3:00pm	Session 3
10:45–11:00am	Break	3:00–3:15pm	Break
11:00am–12:15pm	Session 2	3:15–4:45pm	Session 4
12:15–1:30pm	Lunch		

Topics and Computer Exercises

Computer exercises with LISREL take place on Tuesday and Wednesday from 1:15–1:45pm, and the demonstration with Ωnyx is for Thursday at the same time.

Day	Topics and exercises
M	Background concepts, data preparation, types of models, computer tools
T	Path analysis, estimation, local fit testing LISREL syntax analysis
W	Global fit testing, comparing hierarchical or non-hierarchical models LISREL graphical editor analysis
Th	CFA vs. EFA, testing measurement hypotheses, analyzing ordinal data Ωnyx demonstration
F	SR models, two-step modeling, reflective vs. formative measurement

Main Source (optional)

Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). New York: Guilford Press. (Book resource site for 3rd edition at http://www.guilford.com/kline)

Other Readings (see seminar web page)

MacCallum, R. C., & Austin, J. T. (2000). Applications of structural equation modeling in psychological research. *Annual Review of Psychology*, *51*, 201–226.

McCoach, D. B., Black, A. C., & O'Connell, A. A. (2007). Errors of inference in structural equation modeling. *Psychology in the Schools*, *44*, 461–470.

Narayanan, A. (2012). A review of eight software packages for structural equation modeling. *American Statistician*, *66*, 129–138.

Shah, R., & Goldstein, S. M. (2006). Use of structural equation modeling in operations management research: Looking back and forward. *Journal of Operations Management*, *24*, 148–169.

Tomarken, A. J., & Waller, N. G. (2005). Structural equation modeling: Strengths, limitations, and misconceptions. *Annual Review of Clinical Psychology*, *1*, 31–65.

LISREL Practice

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

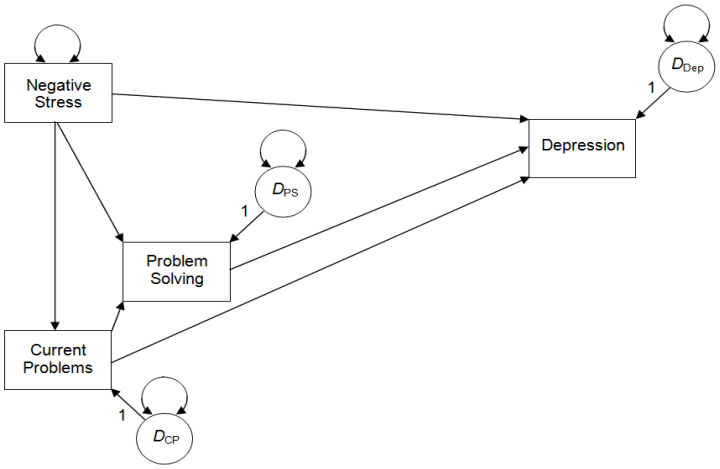
```
Chi-Square=11.11, df=5, P-value=0.04929, RMSEA=0.057
```

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 syntax list next for the example path model:

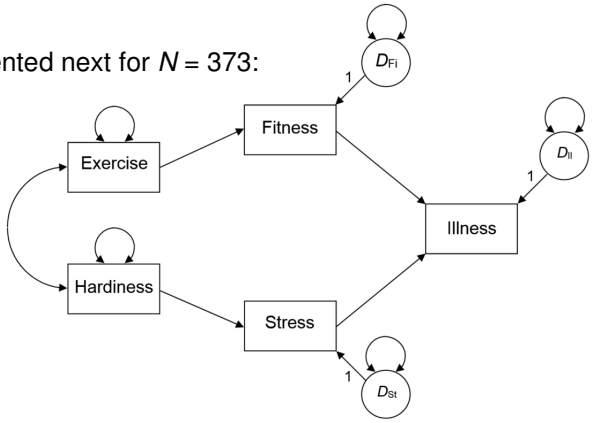
```
four-variable example
observed variables
 neg_str cur_prob prob_sol depress
covariance matrix
 76.913
 55.668 249.324
 33.757 115.685 478.297
 21.775  53.614  60.695 37.700
sample size is 205
relationships
 cur_prob = neg_str
 prob_sol = neg_str cur_prob
 depress = neg_str cur_prob prob_sol
LISREL 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 Path Diagram:

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.