

Introduction to Structural Equation Modeling

Location: CIQSS, 3535 Queen-Mary, Suite 420, Montréal

Dates: May 6–10, 2019



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 25 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/aicss-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

9:30–11:0am	Session 1
11:15am–12:15pm	Session 2

Afternoon

1:30–3:00pm	Session 3
3:15–4:45pm	Session 4



Topics

Mon	Best practices, data, computer tools
Tues	Path analysis, estimation, local fit testing
Wed	Global fit testing, testing hierarchical or non-hierarchical models
Thurs	CFA measurement models, testing strategies
Fri	Structural regression (SR) models, two-step modeling, reflective vs. formative measurement



Computer Tools and Practice

Computer practice sessions use the student version of LISREL 10.1 for Windows platform computers. It can be freely downloaded from

<https://www.ssicentral.biz/upload/lisrelstudent.pdf>

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.

Ωnyx 1.0-1021, a 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

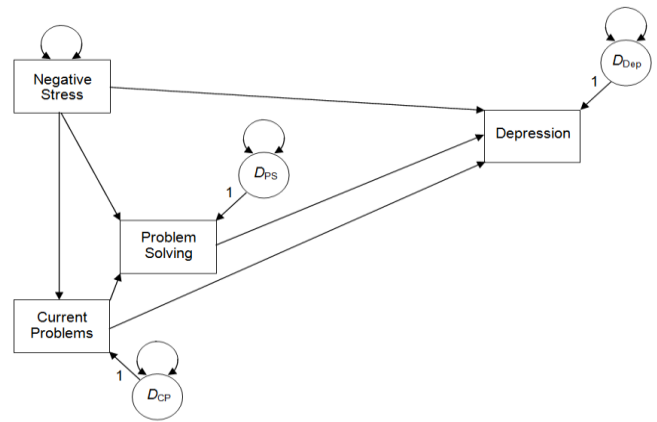
Exercise 1 (Tuesday), LISREL SIMPLIS syntax

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

```



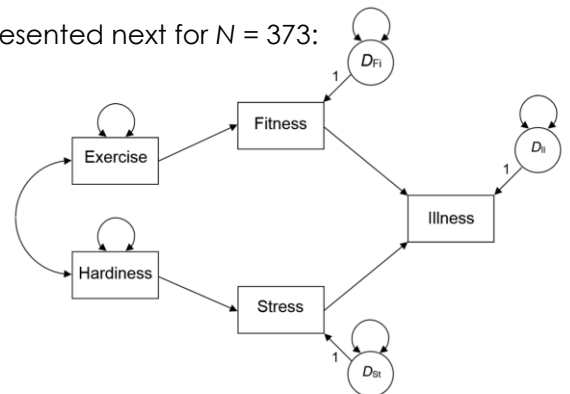
3. Adapt the syntax just shown for the data and model presented next for $N = 373$:

```

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.