Structural Equation Modeling & Other Statistical Methods
Spring 2018

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Individual Session with Instructor: tbd
Seminar Day & Times: Fri 12-15:45
Classroom: 3rd Floor, Carnegie

Check the instructor’s website to make sure that the version of the syllabus you are using is the most recent version available: http://homepages.rpi.edu/~grayw/courses/syllabi/j%20Fa2017/

This is a graduate level course. Junior or Senior undergraduates may sign up with consent of the instructor.

Description The course will focus on SEM and will be structured around the Kline textbook (below). It will emphasize (a) conceptual understanding and (b) ability to communicate results analyzed by these techniques to a wide-range of cognitive scientists using journal papers and professional talks as the main media. A significant part of the seminar will entail reading, presenting, and discussing published work that used these techniques. In addition to SEM, we may dwell on other advanced techniques such as Judea Pearl’s “Graph Theory and the Structural Causal Model” (Pearl won the 2011 Rumelhart Prize, awarded at the annual meeting of the Cognitive Science Society, for his work on these techniques) as covered by Chapter 8 of Kline’s textbook.

Pre-requisites include a solid foundation in Regression and ANOVA at the level of an undergraduate Psychology Major as well as knowledge of “R” and the ability to use the applicable R packages to perform the exercises in the textbook.

The overall goal of this course is to understand how to use these techniques to investigate cognitive science problems – what doors do they open for us that our current techniques do not?

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Week 1  [JAN 19] ORIENTATION AND THE NEW STATISTICS

- All read and be prepared to discuss:
  - Kline (2016), Introduction, pp 1-4 and Ch1 – Coming of Age
- In class, we will watch and discuss:
  - Judea Pearl – 2011 Rumelhart Prize talk
  - Yves Rosseel (creator of lavaan) – 2017 Keynote Address at useR! International R User 2017 Conference

Week 2  [JAN 26] R AND SEM

- All read and respond to:
- Exercises:
  - Read Rosseel and work through some of his examples using the datasets he provides
- KLINE READINGS:
  - Kline, Ch02: Regression Fundamentals
- IN CLASS:
  - Response paper to the Miyake paper due Thursday 17:00 (the day before class)
  - Questions, comments, and/or exercises covered in Rosseel paper . . . to be brought to and discussed in class.

Week 3  [FEB 02] semPlot

- All read and respond to:
- KLINE READINGS:
IN CLASS:
- Response paper to the Epskamp paper due Thursday 17:00 (the day before class)
- Questions, comments, and/or exercises covered in Kline chapter . . . to be brought to and discussed in class.

Week 4  [WEEK 04 – FEB09] CAUSAL FOUNDATIONS OF SEM

- All read and respond to:

KLINE READINGS:
- Kline, Ch04: Data Preparation and Psychometrics Review

IN CLASS:
- Response paper to the Pearl paper due Thursday 17:00 (the day before class)
- Questions, comments, and/or exercises covered in Kline chapter . . . to be brought to and discussed in class.

Week 5  [WEEK 05 – FEB16] WM, STM, AND FLUID INTELLIGENCE + Path Models

- Presentation:
  - Can Serif Mekik will present:

- No response paper this week.

KLINE READINGS:
- skip — glance through this on your own
  - Kline, Ch05: Computer Tools
  - KLINE PART II. SPECIFICATION AND IDENTIFICATION
    * Kline, Ch06: Specification of Observed-Variable (Path) Models (pp. 117-144)

IN CLASS:
- Questions, comments, and/or exercises covered in Kline chapter . . . to be brought to and discussed in class.
Week 6  [WEEK 06 – FEB23] PATH MODELS + Causal Models

- Presentation:
  - Roussel Rahman will present

- **KLINE PART II. SPECIFICATION AND IDENTIFICATION**
  - Kline, Ch07: Identification of Observed-Variable (Path) Models (pp. 145-160)
  - Kline, Ch08: Graph Theory and the Structural Causal Model (pp. 164-187)

- **IN CLASS:**
  - Questions, comments, and/or exercises covered in Kline chapter . . . to be brought to and discussed in class.

Week 7  [WEEK 07 – MAR02] EXTREME GROUP ANALYSIS

- Ropa Denga will present

- **KLINE PART II. SPECIFICATION AND IDENTIFICATION**
  - Kline, Ch09: Specification and Identification of Confirmatory Factor Analysis Models

- **IN CLASS:**
  - Questions, comments, and/or exercises covered in Kline chapter . . . to be brought to and discussed in class.

Week 8  [WEEK 08 – MAR09] SKILL DECAY IN THE SWEDISH AIR FORCE

- Josh Eaton will present

- **KLINE PART II. SPECIFICATION AND IDENTIFICATION**
  - Kline, Ch10: Specification and Identification of Structural Regression Models
• IN CLASS:
  – Questions, comments, and/or exercises covered in Kline chapter . . . to be brought to and discussed in class.

MARCH 16th — SPRING BREAK – NO CLASS – MARCH 16 – SPRING BREAK – NO CLASS

Week 9  [WEEK 09 – MAR23] COGNITIVE PREDICTORS OF MULTITASKING ABILITY

• Ropa will present

• KLINE PART III. ANALYSIS
  – Kline, Ch11: Estimation and Local Fit Testing

• IN CLASS:
  – Questions, comments, and/or exercises covered in Kline chapter . . . to be brought to and discussed in class.

Week 10  [WEEK 10 – APR06] THE LATENT STRUCTURE OF SPACE AND MATHEMATICS

• Nate Powell will present

• LATENT VARIABLE MODELING w/ R: Finch & French
  – LVMwR, Ch04: FOUNDATIONS OF STRUCTURAL EQUATION MODELING, pp. 59-82

• IN CLASS:
Questions, comments, and/or exercises covered in LVMwR chapter . . . to be brought to and discussed in class.

**Week 11  [WEEK 11 – APR13] SEM FOR MULTIPLE GROUPS, THE MIMIC MODEL, AND LATENT MEANS COMPARISONS**

- Jackie Berry will present

- LATENT VARIABLE MODELING w/ R: Finch & French
  - LVMwR, Ch05: SEM FOR MULTIPLE GROUPS, THE MIMIC MODEL, AND LATENT MEANS COMPARISONS

- IN CLASS:
  - Questions, comments, and/or exercises covered in LVMwR chapter . . . to be brought to and discussed in class.

**Week 12  [WEEK 12 – APR20] FURTHER TOPICS IN SEM**

- Roussel will present either:
  - or

- LATENT VARIABLE MODELING w/ R: Finch & French
  - LVMwR, Ch06: FURTHER TOPICS IN SEM, pp 112-133

- IN CLASS:
  - Questions, comments, and/or exercises covered in the LVMwR chapter . . . to be brought to and discussed in class.

APRIL 27th — NO CLASS – NO CLASS – APRIL 27 – NO CLASS
Week 13  [WEEK 13 – MAY04] GROWTH CURVE MODELING

- Matt Sangster will present

- LATENT VARIABLE MODELING w/ R: Finch & French
  - LVMwR, Ch07: GROWTH CURVE MODELING, pp. 134–150

- IN CLASS:
  - Questions, comments, and/or exercises covered in the LVMwR chapter . . . to be brought to and discussed in class.

1 RESOURCES

Five types of resource readings are included here:

- “How to” report SEM models.

- **Statistical Issues**: Research papers focusing on the assumptions or extensions or alternatives to SEM-type models.

- **Research Applications**: Examples of SEM-type models applied to cognitive science studies

- Resources available on the “Kline Materials” website

- Human Cognitive Abilities (HCA) Data Set Archive

1.1 How to Report


• Basic APA Reporting of Methods and Results: https://www.apa.org/pubs/authors/jars.pdf Table 1 is pretty fantastic. [wdg – FYI – these aren’t my words, I am quoting another source here]

• Hoyle, R. H. & Isherwood, J. C. (2013). Reporting results from structural equation modeling analyses in Archives of Scientific Psychology. Archives of Scientific Psychology, 1(1), 14–22 For SEM reporting: “It is as close to paint by number as possible. Again, Table 1 is fantastic.” [wdg – FYI – these aren’t my words, I am quoting another source here]


1.2 Statistical Issues


• On Making Causal Claims

• Orthogonalizing

• Sensitivity Analyses
  – Ashley, R. (2009). Assessing the credibility of instrumental variables inference with


- Measurement Invariance


1.3 Research Applications

- SEM and friends on Skilled Performance


- Miyake and friends


- Friedman, N. P., Miyake, A., Young, S. E., DeFries, J. C., Corley, R. P., & Hewitt,

- Updating Miyake

- Cognitive SEM, EFA, etc

- Pre-Miyake


– Corrections to keep Type 1 errors of the chi-square at a decent level


1.4 Resources on the “kline materials” website

1.4.1 Materials and Resources for each Chapter


1.4.2 Materials for Kline chapters 11, 13, 14, 15, 16, 17

http://www.guilford.com/kline-materials

1.5 Human Cognitive Abilities (HCA) Data Set Archive

http://www.iapsych.com/wmfhcaarchive/wmfhcaindex.html

90 REQUIREMENTS

90.1 PreRequisites

Permission of the instructor. This is a graduate research seminar in the Cognitive Science Department. However, all interested undergraduates and interested graduate students from other departments are encouraged to contact the instructor to discuss their participation in the seminar. Responsibilities and assignments for undergraduates will be discussed and agreed on, in writing, by the student and the instructor.

90.2 About the Instructor

Professor Gray has been a member of the Cognitive Science Department at RPI since the Fall of 2002. For details on his research interests and activities see his homepage.
90.3 Activities
Reading, Writing, Presenting, Discussing

- Group discussion.
  - The most important contribution each person can make is to our discussions of the readings. I believe a seminar course in which everyone actively participates can be the most productive and educational forum in grad school (often for the instructor as well). Bringing together the various backgrounds and training of everyone in the room generally leads to a much richer perspective than would otherwise be possible. There is a lot of individual variability in tendency to speak up in this type of environment, but it is critical to an academic career to be comfortable doing so. You cannot succeed in this field without a willingness (and desire) to share your ideas in the face of criticism, and this is perhaps the best context to practice. If you are someone who has no qualms about dominating a debate, this is also a good place to practice restraint and listening.
  - Students (graduate and undergraduate) will take a turn leading a discussion of each week’s core assigned readings. Advanced preparation for this includes the Response Paper for that week’s readings.

- Response Papers
  - For each week students will be asked to write short, one-page, “response papers”. Each response paper will be on one of that week’s assigned readings.
  - Unless explicitly told otherwise, response papers will always be due by 5pm the day before class meets. This will enable me sufficient time to read your papers, to integrate the various themes that different students identify, and to gage the difficulties (if any) the class had understanding the paper.

- Discussion, presentations, and so on.
  - The focus will be on the statistics. Most week we will have group discussions of the Kline readings and do a variety of exercises in class to work through various parts of each chapter.

91 Grading Policy

- Examinations – none
- Group Discussion
  - 35% Grad Students; 45% Undergrads
  - For active participation in all discussions on all weeks in which the seminar is held. Exceptions due to professional travel or other activities need to be discussed with the instructor ahead of time.
- Response Papers
  - 35% Grad Students; 45% Undergrads
Prior to each week’s meeting, one or more readings will be assign and, for each reading, all students are expected to write a short, one-page Response Paper. The Response Paper should not merely summarize or outline the assigned reading but should reflect your thoughts on the author’s arguments, the strength of evidence, alternative hypotheses, implications, and so on.

Response papers are due to the Instructor by 5:00 pm the day before the seminar.

- In Class Discussions
  - 35% Grad Students; 15% Undergrads
  - There are no corners in the classroom. No place to hide. All class members are expected to come prepared and to participate in active discussions. Showing up to class is key, contributing to the ongoing discussion is vital.

- Yes. I expect 105% out of you!

92 Honors Policy

- My expectation is that all of the work you do for me in this class will be the work of one individual. Exceptions to this rule will be broadcast to the class by email.

- As you will all find out, I explicitly encourage you to engage in public (using email and other media to broadcast a message to the entire) or private (one-to-one) discourse regarding the readings and topics raised in this class. Study groups are encouraged.

- If any of you have any questions regarding current situations or future situations, remember that I am your first contact on this. Please come and see me.
93 References


Lövdén, M., Li, S.-C., Shing, Y. L., & Lindenberger, U. (2007). Within-person trial-to-trial variability precedes and predicts cognitive decline in old and very old age: Longitudinal data from the Berlin Aging Study. *Neuropsychologia, 45*(12), 2827–2838. doi:10.1016/j.neuropsychologia.2007.05.005


Unsworth, N. & McMillan, B. D. (2013). Mind Wandering and Reading Comprehension: Examining the Roles of Working Memory Capacity, Interest, Motivation, and Topic Experi-


This document contains 43 references.