

# ANLY 580: Structural Equation Modeling

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Class Hours: Wednesdays 08:30-10:00PM

Class Room: Adobe Connect

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## Course Description

This course will cover an in-depth exploration of structural equation modeling. You will learn the basic concepts of SEM and how to model different types of research questions, as well as how to report these models in APA style. Path analysis, confirmatory factor analysis, and multi-group models will be several types of techniques covered.

## Learning Objectives

At the end of this course, students will be able to perform multivariate statistic techniques on a variety of data. These learning outcomes will be assessed in the following ways:

1. Increase your understanding of statistics. This outcome will be implemented through reading and discussion of course material. This outcome will be assessed through classroom assignments.
2. Increase your skill in writing technical reports. You will run and report your statistical models. This outcome will be assessed through writing assignments.

## Program Goals Assessed

Program Goal 1. Identify and assess the objectives, scope, and methodological limitations for domain-specific problems.

- a. Translate between a domain problem and an analytical framework (Weekly Assignments and Final Project).

Program Goal 2. Design and execute insightful analyses.

- a. Form a testable hypothesis (Weekly Assignments and Final Project).
- b. Select the appropriate analytical technique (Final Project).

Program Goal 5. Recognize and analyze ethical issues related to intellectual property, data security, integrity, and privacy.

- a. Identify plagiarism / Document ideas from source to execution (Academic Integrity Quiz).

Program Goal 6. Communicate effectively to a variety of audiences.

- c. Articulate through written report comprehensive, but concise, relevant information (Final Project).
- d. Able to develop and use persuasive arguments about technical topics to non-technical audiences (Final Project).

## Required Texts and Programs

1. R + RStudio: <https://www.r-project.org/>, <https://rstudio.com/products/rstudio/download/>
2. Rstudio Virtual Machine - You should use this virtual machine to complete your homework to avoid errors with installation of packages. Because we have provided these virtual machines, any installation issues with your personal computer must be handled on your own.
3. Recommended Books: Most readings will be provided on Canvas, but these are good books for the topics we are discussing. Some are expensive, so I mainly recommend the first if you are going to buy something.
  - Beaujean's *Latent Variable Modeling in R* (the whole class)
  - Tabachnick and Fidell's *Using Multivariate Statistics* (data screening, basic SEM)
  - Byrne's *Structural Equation Modeling with AMOS* (some basic terminology, we are not using this software)
  - Brown's *Confirmatory Factor Analysis for Applied Research* (advanced CFA)
  - Kline's *Principles and Practice of Structural Equation Modeling* (just a general excellent technical book on SEM)
  - Navarro *Learning Statistics with R* (excellent R resource)
  - Field's *Discovering Statistics Using R* (excellent statistics resource)

## Course Policies

1. Canvas: We will use Canvas for all course activities.
2. Attendance: Each week we will have a live session for course lecture. You are expected to attend these sessions.
3. Assignments: There are assignments for each section of the course. They will be due a week after we finish the course material on that topic. Please note these important policies:
  - All assignments must be submitted compiled into a report. I do not grade uncompiled assignments (I'll ask you to resubmit!).
  - I grade the assignment you submitted, and I do not regrade assignments.
  - Every day an assignment is late is 5% off the final score achieved.
  - All assignments must be your own work. Answers copied from online sources will be given a zero. Students who turn in the same assignments will all be given a zero. Your work should be properly referenced and adhere to standards of both academic integrity and proper form. APA style is preferred (see <http://www.apa.org/>).

- You should make sure your code/computer is working properly during class or earlier in the week to ensure these deadlines are met. This semester we are using a Rstudio virtual machine for you to complete your work. I will only troubleshoot errors involved with working on those machines. You may use your own computer, but be aware you are on your own for any technical errors arising from installation issues.
  - If you are having a difficult semester due to work and/or family issues, I suggest contacting the dean of students for your options. These rules are in place to treat every student fairly and equally.
4. Materials: You are responsible for all the readings, even if the material is not explicitly covered in class. You should read the class materials prior to class and be prepared to discuss and ask questions about the readings and assignments. You should also re-read the material after class as not every topic will be covered during class time. Many passages in the text may need to be read several times to gain clarity. Also, taking notes on the material you are reading and reflecting on the reading and these notes will help you better understand the issues, concepts and techniques that are being presented. I will provide readings that are necessary, as I wish to keep the cost down by using selected chapters from multiple books.
  5. Email: All class credit-related electronic mail must be done using Harrisburg's electronic mail service and the student's assigned Harrisburg University ID. By 'credit-related' I mean all work to be evaluated for credit. Any work submitted through a different mail system will NOT be accepted.

## **HU Core Competencies**

At the conclusion of this course a student will have met the following core competencies that reflect HU's mission:

1. Critical Thinking and Problem Solving skills are demonstrated by the student's ability to: Identify and clarify the problem, Gather information, Evaluate the evidence, Consider alternative solutions, and Choose and implement the best alternative.
2. Communication - The core communication skills are demonstrated by the student's ability to: Express ideas and facts to others effectively in a variety of formats, particularly written, oral, and visual formats, and Communicate effectively by making use of information resources and technology.
3. Teamwork and Collaboration - The students will be working with others to increase involvement in learning and by sharing one's own ideas and responding to others' reactions to sharpen thinking and deepen understanding.
4. Information Technology - The students will be making effective use of the .NET information resources and technology.

## **Statement of Academic Integrity**

According to the University's Student Handbook: Academic integrity is the pursuit of scholarly activity free from fraud and deception, and is the educational objective of this institution. Academic dishonesty includes, but is not limited to cheating, plagiarism, fabrication of information or

citations, facilitating acts of academic dishonesty by others, unauthorized possession of examinations, submitting work of another person, or work previously used without informing the instructor, or tampering with the academic work of other students. Any violation of academic integrity will be thoroughly investigated, and where warranted, punitive action will be taken. Students should be aware that standards for documentation and intellectual contribution may depend on the course content and method of teaching, and should consult the instructor for guidance in this area.

*Honor Code* - We as members of Harrisburg University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work. As a Community of Learners, we honor and uphold the *HU Honor Code*.

## Grading

Your grade will be determined by the following breakdown:

1. Attendance (15%)
  - Attendance is measured by checking against AdobeConnect rosters for class periods.
2. Assignments (70%)
  - Practice Assignments (15%): Each topic will include one or more practice assignments. These assignments will be scored complete/incomplete. You can find videos on my YouTube channel of me talking through each of these assignments. I will provide links to those videos. These assignments are simply to give you practice outside the classroom on the code and skills. The academic integrity assignment also fits into this category.
  - Homework Assignments (55%): These assignments will allow you to practice your R skills and SEM techniques. You will be given data to build a special type of model and write up a results style section. EFA/Data screening practice, Path models, Confirmatory Factor Analysis, Multigroup Models, and IRT will be covered in these projects.
3. Final Project (15%)
  - Final Project: This project gives you a chance to apply the techniques and methods you will learn in this class to a problem that interests you. For this project, you will need to pick a dataset and develop a research question you can answer with that dataset. At the end of the semester, you will turn in a short research report (or white paper) that explains what your research question is, why it matters, what data you used, how you analyzed it, and what the results mean. You don't have to do this alone. You can work in groups of 2 or 3 and near the middle of the semester a discussion board will be opened to help you find others who may share similar research interests.

The course breakdown is:

1. A 90.00%+
2. B 80.00% - 89.99%
3. C 70.00% - 79.99%
4. F < 70.00%

## Class Schedule

Here's a best guess at the course schedule - the exams and holidays will not change, but lecture material may be moved around depending on course speed. The exercises will be posted on Canvas, along with all notes and scripts created for you to use to work from.

### Week 01, 10/26 - 10/30

- Class Overview
- Introduction to R
- *Readings*: Beaujean Chapter 1, 7; Navarro Chapter 2, 3
- **Small Assignment**: Introduction to R
- **Small Assignment**: Academic Integrity Module and Quiz

### Week 02, 11/02 - 11/06

- Data Screening in R
- *Readings*: Field Chapter 5
- **Small Assignment**: Data Screening in R

### Week 03, 11/09 - 11/13

- Exploratory Factor Analysis
- *Readings*: Field Chapter 17
- **Small Assignment**: Exploratory Factor Analysis
- **Big Assignment**: Data Screening and Exploratory Factor Analysis

### Week 04, 11/16 - 11/20

- Terms and Concepts in SEM
- *Readings*: Brown Chapter 2, Byrne Chapter 1, Tabachnick SEM pg 681-689
- **Small Assignment**: Basics

### Week 05, 11/23 - 11/27

- No class (Thanksgiving Holiday)

### Week 06, 11/30 - 12/04

- Path Analysis, Estimation, Fit Indices
- *Readings*: Kline Chapters 5, 6; Beaujean Chapter 2
- **Small Assignment**: Path 1, Path 2
- **Big Assignment**: Path Analysis

**Week 07, 12/07 - 12/11**

- Path Analysis, Estimation, Fit Indices
- *Readings*: Kline Chapters 5, 6; Beaujean Chapter 2
- **Small Assignment**: Path Analysis
- **Big Assignment**: Path Analysis

**Week 08, 12/14 - 12/18**

- Confirmatory Factor Analysis: Basics
- *Readings*: Beaujean Chapter 3, Kline Chapter 9
- **Small Assignment**: CFA Basics

**Week 09, 12/21 - 12/25**

- No class (Winter Holiday)

**Week 10, 12/28 - 01/01**

- No class (Winter Holiday)

**Week 11, 01/04 - 01/08**

- Confirmatory Factor Analysis: Second Order
- *Readings*: Beaujean Chapter 9
- **Small Assignment**: Second Order CFA
- **Big Assignment**: CFA Models

**Week 12, 01/11 - 01/15**

- Full Structural Models
- *Readings*: Kline Chapter 10; Brown Chapter 5 (157-211)
- **Small Assignment**: Full SEM

**Week 13, 01/18 - 01/22**

- Multi-Trait Multi-Method
- *Readings*: Brown Chapter 6
- **Small Assignment**: MTMM

**Week 14, 01/25 - 01/29**

- Multigroup CFA
- *Readings*: Beaujean Chapter 4; Brown Chapter 7
- **Small Assignment**: MGCFA
- **Big Assignment**: MGCFA

### **Week 15, 02/01 - 02/05**

- Latent Growth Models
- *Readings*: Beaujean Chapter 5
- **Small Assignment**: LCM

### **Week 16, 02/08 - 02/12**

- Item Response Theory
- *Readings*: Kline Chapter 11, Beaujean Chapter 6
- **Small Assignment**: DIRT, MIRT
- **Big Assignment**: Item Response Theory

### **Week 17, 02/15 - 02/19**

- Final Projects

### **University Resources**

Student Services: [link](#) (contact, [JNoel@harrisburgu.edu](mailto:JNoel@harrisburgu.edu))

Library: [link](#)

International Student Office: [link](#)

IT Help: [link](#)

LinkedInLearning: [link](#)

COVID Resources: [link](#)