Doctoral Seminar in School of Management and Labor Relations
Multivariate Analysis for Industrial Relations and Human Resources
Rutgers University – Fall 2022
16:545:614:01
Monday, 3:30pm-6:00pm

Professor: Lawrence Houston III	**Classroom:** JLB-106
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Office Hours: By appointment	**Phone:** (848) 445-1051

TEXT: Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). Boston: Pearson. **ISBN-13:** 978-0134790541.

There are no required textbooks for this course. Instead, journal articles and book chapters will be assigned throughout this semester. Students are required to read various chapters and articles PRIOR to the class for which they are assigned. Lectures and class discussions will assume that students have read all assigned material prior to class – it is your responsibility to keep up with the readings.

COURSE DESCRIPTION: This course examines the application of data analytic methods for multivariate statistics. Topics to be covered include: matrix algebra, general (and generalized) linear model, principal component analysis and factor analysis, multivariate analysis of variance, path analysis with manifest and latent variables, and latent profile analysis. Some time will also be spent on issues in data screening and visualization. This is an advanced doctoral-level statistics course. As such, emphasis is placed on the theoretical assumptions, mathematics, application, and interpretation of multivariate statistics, within the context of organizational research.

CLASS OBJECTIVES: This course has three goals:

1. To provide students with a broad **theoretical understanding** of multivariate statistics.
2. To provide students with the **applied skills** necessary to appropriately choose and implement multivariate methods for a given research question and correctly interpret the output.
3. To provide students with **hands-on experience** of using multivariate methods and a "toolbox" to incorporate multivariate analytic techniques into their future research activities.

CLASS PHILOSOPHY: This class is my opportunity to introduce you to the interesting and complex world of multivariate statistics. It is my personal mission to make sure that all of you walk away from this class capable of discussing in great depth the topics we cover. I expect everyone to be ***proactively*** involved in this educational and professional development opportunity.

I expect all of us to work together to create a learning community that reinforces constructive criticism and feedback and that facilitates knowledge acquisition. To this end, I will actively support and encourage an environment characterized as open and collaborative; and I will actively discourage an environment that is characterized as aggressive or destructive. I encourage all of you to think outside the box—try to frame and address research questions in innovative and

creative ways. Finally, ***always be thinking about how the topics we discuss relate back to the research in each of your specialty areas***. I would be more than happy to meet with you individually to discuss or clarify how the ideas and methods presented in class are relevant to your research.

OVERVIEW OF COURSE FORMAT: This course is scheduled to meet for 2.5 hours every week in the Janice Levin Building, Room 106. It is expected that students show up on time and prepared for class, which implies that at a minimum: 1) they have read the assigned readings (*at least once*), 2) they have installed necessary statistical packages for a given class, and 3) they have reviewed and practiced the methods covered previously to have a solid foundation for understanding more advanced topics.

COURSE PORTAL: The Canvas learning management system will be the primary home for this course (https://rutgers.instructure.com/courses/195324), so you must be familiar with this mode of interaction as it will house the syllabus, PowerPoint slides for the lecture notes, assignments, and contact information. To access Canvas, you must use your net ID and password. All course announcements are posted to Canvas, and sent to your Rutgers email address. You are responsible for regularly checking your Rutgers email address, or forwarding your Rutgers email to an address that you do check on a regular basis.

EVALUATION CRITERIA AND POLICY:

1. *Homework assignments* (30%).
2. *Group project* (30%).
3. *Final take-home exam* (30%).
4. *Participation* (10%).

Homework: Students will be assigned **3 exercises** throughout the semester, which are designed to help master the multivariate methods covered in the course. The exercises will require students to perform various data management and analyses of actual organizational data using SPSS and *M*plus (You can use your software of choice to perform the same analysis). In addition, and equally important, students will be asked to critically *interpret* results from the analyses they conduct. Each exercise will be worth **10 percentage points**, for a total of **30% of the total course grade**.

Group project: Students will be asked to form two or three-person groups in charge of introducing an often-used multivariate method to the class (see a list of example topics below). There are four parts to this project:

a. a 20-minute group presentation on the topic
b. a 10-minute illustration of specific research examples (e.g., 2-3 journal articles)
c. an exercise for students to perform the analysis
d. an answer key to the exercise.

Two to three suggested readings on the topic, as well as the dataset and instructions for the exercise, should be uploaded to *Canvas* by 2 pm on **December 5th**. Presentation slides and the

answer key should be uploaded to *Canvas* by 10 pm on **December 11th**. The group project will be worth **30% of the total course grade**.

Example topics:

1. Parallel analysis
2. Dyadic analysis (e.g., Actor-Partner Interdependence Model)
3. Testing moderation using structural equation modeling
4. Survival analysis
5. Relative importance analysis

Final Examinations: Students will be administered a take-home final examination during the semester. The exam will require you to answer a series of questions based upon the results. In answering exam questions, you will be expected to attend to all issues relevant to ensuring that sound inferences can be made from the data-analytic results. As such, the instructor will penalize answers that lack proper consideration of key issues of relevance to the results of analyses provided (e.g., violations of the normality assumption, multicollinearity, etc.). The final examination will be worth **30 percentage points**.

Due Dates: Homework problems assigned throughout the semester are due by 12 pm on the day of the next class. The take-home final exam is due on **Monday, December 19th** by 11:59 pm.

Lateness: It is expected that students will turn in all homework assignments and exams on or before the due dates. **NO late homework or exam will be accepted** unless you receive prior approval by the instructor AND have an official document that excuses you from meeting the deadline (e.g., a note from the ODOS or a doctor treating your illness/injury). In rare circumstances where an alternative arrangement for a missing homework assignment or exam is necessary, it needs to be discussed with the instructor prior to the due date.

Academic Integrity: Each student's homework and examinations must be done independently. You are allowed to discuss orally with each other the assignments and their relation to materials covered in class, but you are to complete your own work. Looking at or copying other's work is strictly forbidden, and if found, all students involved will receive a 0 on that assignment. ***All incidents of academic dishonesty are reported to the HRM Undergraduate Program, the SMLR Academic Integrity Facilitator, as well as the Rutgers University Office of Student Conduct.*** All academic integrity violations are retained in a student's records for 10 years and will be disclosed to any employer or graduate school that requests that information. Consult the official Rutgers University document entitled "Academic Integrity at Rutgers University" regarding your responsibilities for maintaining academic integrity: http://academicintegrity.rutgers.edu/.

Computing: The primary computing software taught in this course is **Mplus** Version 8.8. You will also learn to master basic **R** syntax for multivariate statistics by the conclusion of this course (https://www.r-project.org/); however, you are expected to complete your assignments and exams using Mplus.

Participation: The quality of a doctoral seminar is highly dependent on the quality of class discussion. The exchanging of ideas between scholars is a great source of learning and insights, which potentially, can spawn provocative research projects and publications. Thus, students should come to class ready to share their thoughts (and questions) relevant to the assigned readings. **Participation will be evaluated on the following three dimensions—attendance**, **contribution to in-class discussions**, and **contribution to resources directly related to class**.

> ***Article examples:*** Throughout the semester, students will be asked to submit copies of 3 published papers on substantive topics that utilize statistical techniques covered in the course. Articles must be recent (i.e., 2017 or later), and from a top-tier journal in your discipline. **Students should sign up for three article examples for three different weeks by September 18th**. Students also need to upload (by no later than 10:00 pm, the day before the class meeting) a copy of the article to Canvas and be prepared to present how the article used the focal analytical strategy to examine a hypothesis (or address a research question). The same article may not be used for more than one course topic.

Grading System: Grades will be assigned using the following scale. No curve or score adjustments will be given.

Letter Grade	Percentage of Points	Letter Grade	Percentage of Points
A	100 % to 92%	**C**	77.9% to 72%
A-	91.9% to 90%	**C-**	71.9% to 70%
B+	89.9% to 88%	**D+**	69.9% to 68%
B	87.9% to 82%	**D**	67.9% to 62%
B-	81.9% to 80%	**D-**	61.9% to 60%
C+	81.9% to 80%	**F**	59.9% to 0 %

ACCOMMODATIONS: I am committed to providing a welcoming and accessible classroom for all students. Students who are in need of accommodations due to a disability should provide me with the appropriate documentation from the Office of Disability Services for Students as early in the semester as possible, and definitely before the first exam.

University Statement on Accommodations: Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation:https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodation. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS website at: https://ods.rutgers.edu/students/registration-form.

COURSE QUESTIONS: Should you have any administrative questions about homework, exams, due dates, etc., please take the following steps: 1) first check the syllabus; 2) next, you can check the CanvasChat to see whether others may have had the same question. 3) If your question has not been asked or answered, then you can pose your question in the CanvasChat. 4) If you do not receive a response to your question within 24 hours, then you should email the instructor via Canvas.

ONLINE COURSE ASSESSMENT: Your constructive assessment of this course plays an indispensable role in shaping education at Rutgers. Upon completing the course, please take the time to fill out the online course evaluation.

INTELLECTUAL PROPERTY OF COURSE MATERIAL: All materials generated for this class, including but not limited to the syllabus, in-class materials, and exercises, may not be copied, sold or made available to third parties (including note-taking services), published, broadcasted, reprinted, included in your blog, posted on any websites or sent via text messaging from your phone without the explicit written permission of the instructor. Any material that is distributed without such consent will be seen as a direct violation of academic integrity.

TENTATIVE COURSE SCHEDULE

Week	Date	Topic	Reading	Assignment Due
1	9/12	Introduction & Overview	T & F: Chapter 1, 2 Journal articles	
2	9/19	Inspecting and Understanding Multivariate Data	T & F: Chapter 4 Journal articles	Article Signup
3	9/26	Matrix Algebra and Eigensystems	T & F: Appendix A Journal articles	Practice Quiz: Matrix Algebra/Eigensystems
4	10/3	Multiple Regression: Moderation	T & F: Chapter 5 Journal articles	Article #1
5	10/10	Multiple Regression: Mediation	Journal articles	Article #2
6	10/17	**Software Tutorial #1** (Manifest Variable Path Analysis in Mplus)	Analytics w\Mplus; Chapters 1, 2, 3.2 Journal articles	
7	10/24	Multivariate Analysis of Variance (MANOVA) and Covariance (MANCOVA)	T & F: Chapter 7	Article #3 HW Exercise #1: Regression (OLS, logistic, polynomial)
8	10/31	Latent Profile Analysis	T & F: Chapter 8 Journal articles	Article #4
9	11/7	**Software Tutorial #2:** MANOVA/MANCOVA/ Latent Profile Analysis	Data Analytics w\Mplus: Chapter 6	
10	11/14	Principal Component and Exploratory Factor Analysis	T & F: Chapter 13 Journal articles	Article #5 HW Exercise #2: MANOVA/LPA
11	11/21	Structural equation modeling (SEM) - Confirmatory factor analysis	T & F: Chapter 14 Journal articles	Article #6
12	11/28	Structural equation modeling (SEM) – Testing structural equation models	T & F: Chapter 14 Journal articles	Article #7
13	12/5	**Software Tutorial #3** (Latent Variable Path Analysis in Mplus)	Data Analytics w\Mplus: Chapter 3 Journal articles	
14	12/12	Additional Useful Methods Using Mplus - ***Group Presentations***	Other readings will be assigned	HW Exercise #3: SEM Group Project: Presentation slides and answer key to exercise
Final	12/19			FINAL EXAM

COURSE SCHEDULE & ASSIGNMENTS

Course materials can be downloaded from Canvas

1. September 12: Introduction and Overview

Assigned readings:

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Chapters 1 & 2*

Zhang, Y., & Shaw, J. D. (2012). Publishing in AMJ – Part 5: Crafting the methods and results. *Academy of Management Journal, 55*, 8-12.

2. September 19: Inspecting and Understanding Multivariate Data

Assigned readings:

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Chapter 4*

Smith, P. C., Budzeika, K. A., Edwards, N. A., Johnson, S. M., & Bearse, L. N. (1986). Guidelines for clean data: Detection of common mistakes. *Journal of Applied Psychology, 71*, 457-460.

Newman, D. A. (2014). Missing data: Five practical guidelines. *Organizational Research Methods*, *17*, 372-411.

3. September 26: Matrix Algebra and Eigensystem

Assigned readings:

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Appendix A*

Stevens, J. P. (2012). Applied multivariate statistics for the social sciences (6th ed.). New York: Routledge. *Chapter 2*

4. October 3: Multiple Regression: Moderation

Assigned readings:

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Chapter 5*

Preacher, K. J. (2003). A primer on interaction effects in multiple linear regression. http://quantpsy.org/interact/interactions.htm

Dawson, J. F. (2014). Moderation in management research: What, why, when and how. *Journal of Business and Psychology, 29, 1-19.*

Russell, C. J., & Dean, M. A. (2000). To log or not to log: Bootstrap as an alternative to the parametric estimation of moderation effects in the presence of skewed dependent variables. *Organizational Research Methods*, *3*, 166-185.

5. October 10: Multiple Regression: Mediation

Assigned readings:

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7*, 83-104.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods, 7*, 422-445

Edwards, J. R., & Lambert, L. S. (2007). Methods for integrating moderation and mediation: A general analytical framework using moderated path analysis. *Psychological Methods*, 12, 1-22.

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research, 42*, 185-227.

6. October 17: Software Tutorial #1 (Manifest Variable Path Analysis in Mplus)

Assigned readings:

Geiser, C. (2012). Data analysis with Mplus. New York: Guildford Press. *Chapters 1, 2, 3 (section 3.2)*

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Chapter 10*

Shanock, L. R., Baran, B. E., Gentry, W. A., Pattison, S. C., & Heggestad, E. D. (2010). Polynomial Regression with Response Surface Analysis: A Powerful Approach for Examining Moderation and Overcoming Limitations of Difference Scores. Journal of Business and Psychology, 25(4), 543–554.

7. October 24: Multivariate Analysis of Variance (MANOVA) and Covariance (MANCOVA)

Assigned readings:

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Chapter 7*

8. October 31: Latent Profile Analysis

Assigned readings:

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Chapter 8*

Lubke, G. H., & Muthén, B. (2005). Investigating population heterogeneity with factor mixture models. Psychological Methods, 10(1), 21–39.

Muthén, B. O. 2001. "Latent variable mixture modeling". In New developments and techniques in structural equation modeling, Edited by: Marcoulides, G. and Schumacker, R. 1–33. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Vermunt, J. K. (2010). Latent Class Modeling with Covariates: Two Improved Three-Step Approaches. Political Analysis, 18(4), 450–469.

9. November 7: Software Tutorial #2 (Latent Profile and Class Analysis, MANOVA, AND MANCOVA in Mplus)

Assigned readings:

Geiser, C. (2012). Data analysis with Mplus. New York: Guildford Press. *Chapters 6*

10. November 14: Principal Component and Exploratory Factor Analysis

Assigned readings:

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Chapter 13*

Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis: An integrated approach*. Hillsdale, NJ: Lawrence Erlbaum – Chapter 22.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods, 4*, 84-99.

11. November 21: Structural equation modeling (SEM) - Confirmatory factor analysis

Assigned readings:

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson. *Chapter 14*

Pedhazur, E. J., & Schmelkin, L. P. (1991). Measurement, design, and analysis: An integrated approach. Hillsdale, NJ: Lawrence Erlbaum – Chapter 23.Lance, C. E., & Vandenberg, R. J. (2002). Confirmatory factor analysis. In F. Drasgow and N. Schmitt (Eds), Measuring and analyzing behavior in organizations: Advances in measurement and data analysis (pp. 221-254). San Francisco, CA: Jossey-Bass.

Jackson, D. L., Gillaspy, J. A., & Purc-Stephenson, R. (2009). Reporting practices in confirmatory factor analysis: An overview and some recommendations. Psychological Methods, 14, 6-23.

12. November 28: Structural equation modeling (SEM) – Testing structural equation models

Assigned readings:

Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis: An integrated approach*. Hillsdale, NJ: Lawrence Erlbaum – Chapter 24.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychology Bulletin, 103*, 411-423.

Williams, L. J., Vandenberg, R. J., & Edwards, J. R. (2009). Structural equation modeling in management research: A guide for improved analysis. *The Academy of Management Annals, 3*, 543-604.

Cortina, J. M., Green, J. P., Keeler, K. R., & Vandenberg, R. J. (2017). Degrees of freedom in SEM: Are we testing the models that we claim to test? *Organizational Research Methods*, 20, 350-378.

13. December 5: Software Tutorial #3 (Latent Variable Path and Growth Curve Analysis in Mplus)

Assigned readings:

Geiser, C. (2012). Data analysis with Mplus. New York: Guildford Press. *Chapters 3 and 4 (section 4.5)*

Mehta, P., & West, S. G. (2000). Putting the individual back into individual growth curves. *Psychological Methods, 5*, 23-43.

14. December 12: Group Presentations

This course syllabus provides a general plan for the course; deviations are unlikely but may be necessary.