

# PSY 5246C: Fall 2022 Syllabus

## Multivariate Analysis in Applied Psychological Research

### Instructor Information

- **Dr. Stefany Coxé**
  - I have a Ph.D. in Quantitative Psychology from [Arizona State University](#)
  - In my free time, I enjoy knitting, playing video games, and spending time with my husband and almost 2 year old son
  - I love statistics and want you to love them too!
- **Email:** [stefany.coxe@fiu.edu](mailto:stefany.coxe@fiu.edu)
  - This is always the best way to contact me!
  - I usually respond pretty quickly, but if you haven't heard back from me in a couple days, send me another email
- **Office Hours:** By appointment via [Zoom](#) (link is also on Canvas)
  - Send me an email to schedule a time

### Course Information

#### Format and Meetings

This is a hybrid course. We will meet in person each Wednesday from 10:30am to 11:45am in PC 419; you will be responsible for completing course assignments such as readings, videos, and quizzes prior to class in order to be prepared to participate in the in-person meeting. See Assessments and Schedule below.

## Learning Goals

This course covers topics related to **multivariate statistical analysis**, focusing on methods used in the social sciences and health research. You will learn about *matrix algebra*, *linear regression*, *logistic regression*, *Poisson regression*, *factor analysis*, *principal components analysis*, *mixed models*, and *mediation*. You will be able to **analyze, interpret, and write up results** using these methods. This course will provide you with the background and confidence for *further study in applied statistics*.

## Learning Objectives

- **Compare** and **contrast** possible analysis options based on the research question
- **Select** the appropriate analysis approach for the research question
- **Analyze** data with statistical methods appropriate to the research question
- **Create** a written report of your findings
- **Make conclusions** about your research question(s) based on those results
- **Discover** a love of statistics!

## Prerequisites

Graduate coursework in analysis of variance and linear regression, such as PSY 5939: Quant 1 and PSY 5939: Quant 2. We will cover a variety of topics in this course, but all of them build on a basic ANOVA and regression (general linear model) framework.

## Software and Technology

Course materials will be posted on Canvas.

Assignments will be submitted via Canvas.

We will use **SPSS** and **R** for this course. I expect you to be able to use **at least one of these software packages** to do things like open datasets, transform variables, conduct simple analyses, etc. I will provide information about the specific procedures you will need to know for this course.

We will briefly use *Mplus* later in the course. I do not expect you to know anything about *Mplus*; I will provide input and output files for you for this portion of the course.

Lecture videos will be posted on **Playposit**, with links in Canvas.

## Course Structure

**This course takes place in a hybrid format.** We will meet in person for 1 hour 15 minutes each week. You will be responsible for completing course assignments such as readings, videos, and quizzes prior to class in order to be prepared to participate in the in-person meeting. You will also have assignments to complete outside of class.

Each week will follow a similar structure:

- **Monday:** Lecture videos posted early in the day
- **Tuesday:** Watch lecture and complete embedded questions by 8pm
- **Wednesday:** In-person meeting to review material and work on applications
- **Thursday:** Reflection due by 8pm
- **Sunday:** Homework assignment due by 8pm

## Assessments

Your work in this course will be assessed using a variety of methods.

- **Lecture Questions (10%)**

Questions will be embedded within the lecture video. These questions will assess *whether you understand some key points* in the lecture. You will have *unlimited* attempts to answer each question.

- **Homework (50%)**

There will be twelve (12) homework assignments covering each of the topics we will cover. The assignments involve running analyses in SPSS and/or R, making some decisions based on the analyses, interpreting output, and presenting the results.

- **Reflection (10%)**

There will be twelve (12) short reflections about the week's work, including responses to in-class questions, connections between the material and your own research, and similar.

- **End-of-module Quizzes (30%)**

There will be three (3) in-class quizzes, one at the end of each module. See the Tentative Schedule for dates. I will give you output or other information and you will need to interpret or annotate the results or otherwise comment on the material. You may have to do some mathematical calculations, but they will be minimal. You will NOT need to run analyses in SPSS or R. **These quizzes are open book and open notes, but you must work alone and complete each quiz within 1 hour.**

## Tentative Schedule

Week	Date (Wednesday)	Topic	Assignment
1	August 24	Intro, matrix algebra	Homework 1
2	August 31	Linear regression	Homework 2
3	September 7	Linear regression	Homework 3
4	September 14	Logistic regression	Homework 4
5	September 21	Poisson regression	Homework 5
6	September 28		<b>Quiz 1</b>
7	October 5	Matrix algebra	Homework 6
8	October 12	Principal components analysis	Homework 7
9	October 19	Factor analysis	Homework 8
10	October 26	Latent class analysis	Homework 9
11	November 2		<b>Quiz 2</b>
12	November 9	MANOVA / RM ANOVA	Homework 10
13	November 16	Mixed models	Homework 11
14	November 23	HOLIDAY	
15	November 30	Mediation	Homework 12
16	December 7		<b>Quiz 3</b>

**Due dates subject to change** due to hurricane, emergency, scheduling changes, etc.

**Lecture quizzes are due by Tuesday at 8pm.**

**Quizzes take place in class on Wednesday morning.**

**Reflections are due by Thursday at 8pm.**

**Homework assignments are due by the end of Sunday (midnight).**

## Grades

Grade	Percentage
A	$\geq 93$
A-	90 - 92.99
B+	87 - 89.99
B	83 - 86.99
B-	80 - 82.99
C+	77 - 79.99
C	70 - 76.99
F	$\leq 69.99$

## Course and University Policies

### Academic Misconduct

Students at Florida International University are expected to adhere to the highest standards of integrity in every aspect of their lives. Honesty in academic matters is part of this obligation. Academic integrity is the adherence to those special values regarding life and work in an academic community. Any act or omission by a student which violates this concept of academic integrity shall be defined as academic misconduct and shall be subject to the procedures and penalties set forth herein. All students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.

<https://dasa.fiu.edu/all-departments/student-conduct-and-academic-integrity/>

### Academic Dishonesty

Please refer to your student handbook for a description of what constitutes academic dishonesty. While you may work with other students on your homework assignments, I expect all students to complete and turn in their own work.

### Accessibility / Accommodation

Any student with a disability or other need that may require special accommodations for this course should make this known to the instructor during the first week of class. You can contact the Disability Resource Center at

- <http://drc.fiu.edu>
- [drcupgl@fiu.edu](mailto:drcupgl@fiu.edu)
- 305-348-3532
- Graham Center 190

### Attendance

Attendance is not explicitly part of your grade in this course, but activities completed during the in-person portion of the course will be **extremely** helpful.

If you need to miss class (such as for illness, religious event, professional activity, or university-sanctioned event), please contact me as soon as possible to make any necessary arrangements, particularly if you will miss a Quiz day.

## References

### General Multivariate Statistics

- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis*. Upper Saddle River, NJ: Pearson Prentice Hall.
- Harlow, L. L. (2014). *The essence of multivariate thinking: Basic themes and methods*. Routledge.
- Tabachnick, B. G., & Fidell, L. S. (2012). *Using Multivariate Statistics*, 6th Edition. Pearson.

### Matrix Algebra

- Basilevsky, A. (2013). *Applied matrix algebra in the statistical sciences*. Courier Corporation.
- Fieller, N. (2015). *Basics of Matrix Algebra for Statistics with R*. CRC Press.
- Searle, S. R., & Khuri, A. I. (2017). *Matrix algebra useful for statistics*. John Wiley & Sons.

### Linear Regression / General(ized) Linear Model

- Ai, C. & Norton, E. C. (2003). Interaction terms in logit and probit models. *Economics Letters*, 80 (1), 123–129. doi:10.1016/S0165-1765(03)00032-6
- Agresti, A. (2003). *Categorical data analysis* (Vol. 482). John Wiley & Sons.
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- Cohen, J., Cohen, P., West, S.G. & Aiken, L.S. (2003). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. L. Erlbaum Associates, Mahwah, N.J.
- Fox, J. (2015). *Applied regression analysis and generalized linear models*. Sage Publications.
- Gelman, A., & Hill, J. (2006). *Data analysis using regression and multilevel/hierarchical models*. Cambridge University Press.
- Long, J. S. (1997). *Regression models for categorical and limited dependent variables* (Vol. 7). *Advanced quantitative techniques in the social sciences*, 219.
- McCabe, C., Halvorson, M. A., King, K. M., Cao, X., & Kim, D. S. (2020, April 8). Estimating and interpreting interaction effects in generalized linear models of binary and count data. <https://doi.org/10.31234/osf.io/th94c>

Norton, E. C., Wang, H., & Ai, C. (2004). Computing interaction effects and standard errors in logit and probit models. *The Stata Journal*, 4 (2), 154–167.

## **Logistic Regression**

Allison, P. D. (2012). *Logistic regression using SAS: Theory and application*. SAS Institute.

Bürkner, P. C., & Vuorre, M. (2019). Ordinal regression models in psychology: A tutorial. *Advances in Methods and Practices in Psychological Science*, 2(1), 77-101.

Chen, K., Cheng, Y., Berkout, O., & Lindhiem, O. (2016). Analyzing Proportion Scores as Outcomes for Prevention Trials: A Statistical Primer. *Prevention Science*, 1-10.

DeMaris, A. (2002). Explained variance in logistic regression: A Monte Carlo study of proposed measures. *Sociological Methods & Research*, 31(1), 27-74.

Hayes, A. F., & Matthes, J. (2009). Computational procedures for probing interactions in OLS and logistic regression: SPSS and SAS implementations. *Behavior research methods*, 41(3), 924-936.

Hosmer Jr, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied logistic regression* (Vol. 398). John Wiley & Sons.

Menard, S. (2002). *Applied logistic regression analysis* (No. 106). Sage.

## **Poisson Regression**

Atkins, D. C., & Gallop, R. J. (2007). Rethinking how family researchers model infrequent outcomes: a tutorial on count regression and zero-inflated models. *Journal of Family Psychology*, 21(4), 726.

Blevins, D. P., Tsang, E. W., & Spain, S. M. (2015). Count-Based Research in Management Suggestions for Improvement. *Organizational Research Methods*, 18(1), 47-69.

Cameron, A. C., & Trivedi, P. K. (2013). *Regression analysis of count data* (Vol. 53). Cambridge university press.

Coxe, S., West, S. G., & Aiken, L. S. (2009). The analysis of count data: A gentle introduction to Poisson regression and its alternatives. *Journal of personality assessment*, 91(2), 121-136.

Gardner, W., Mulvey, E. P., & Shaw, E. C. (1995). Regression analyses of counts and rates: Poisson, overdispersed Poisson, and negative binomial models. *Psychological bulletin*, 118(3), 392.

Green, J. (2020). A tutorial on modelling health behaviour as count data with Poisson and negative binomial regression.

Land, K. C., McCall, P. L., & Nagin, D. S. (1996). A comparison of Poisson, negative binomial, and semiparametric mixed Poisson regression models with empirical applications to criminal careers data. *Sociological Methods & Research*, 24(4), 387-442.

## **Principal Components Analysis (PCA) and Factor Analysis (FA)**

Hayton, J. C., Allen, D. G., & Scarpello, V. (2004). Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. *Organizational research methods*, 7(2), 191-205.

Jolliffe, I. T., & Morgan, B. J. T. (1992). Principal component analysis and exploratory factor analysis. *Statistical methods in medical research*, 1(1), 69 - 95.

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior research methods, instruments, & computers*, 32(3), 396 - 402.

Suhr, D. D. (2005). Principal component analysis vs. exploratory factor analysis. *SUGI 30 proceedings*, 203, 230.

Velicer, W. F., & Jackson, D. N. (1990). Component analysis versus common factor analysis: Some issues in selecting an appropriate procedure. *Multivariate behavioral research*, 25(1), 1 - 28.

## **Latent Class / Profile Analysis**

Bray, B. C., Lanza, S. T., & Tan, X. (2015). Eliminating bias in classify-analyze approaches for latent class analysis. *Structural equation modeling: a multidisciplinary journal*, 22(1), 1-11.

Collins, L. M., & Lanza, S. T. (2010). *Latent Class and Latent Transition Analysis*. Hoboken, NJ: John Wiley & Sons.

Lanza, S. T., & Cooper, B. R. (2016). Latent class analysis for developmental research. *Child Development Perspectives*, 10(1), 59-64.

Lanza, S. T., Tan, X., & Bray, B. C. (2013). Latent class analysis with distal outcomes: A flexible model-based approach. *Structural equation modeling: a multidisciplinary journal*, 20(1), 1-26.

Magidson, J., Vermunt, J. K., & Madura, J. P. (2020). *Latent class analysis*. Thousand Oaks, CA, USA:: SAGE Publications Limited.

Masyn, K. E. (2013). Latent class analysis and finite mixture modeling. *The Oxford handbook of quantitative methods*, 2, 551.



Nylund-Gibson, K., & Choi, A. Y. (2018). Ten frequently asked questions about latent class analysis. *Translational Issues in Psychological Science*, 4(4), 440.

## **MANOVA**

Hummel, T. J., & Sligo, J. R. (1971). Empirical comparison of univariate and multivariate analysis of variance procedures. *Psychological Bulletin*, 76(1), 49 - 57.

Keppel, G., & Wickens, T. D. (2004). *Design and Analysis: A Researchers Handbook*, 4th ed. Upper Saddle River: Prentice Hall, 2-11.

Olson, C. L. (1976). On choosing a test statistic in multivariate analysis of variance. *Psychological Bulletin*, 83(4), 579 - 586.

Stevens, J. P. (1980). Power of the multivariate analysis of variance tests. *Psychological Bulletin*, 88(3), 728 - 737.

## **Repeated Measures ANOVA**

Gueorguieva, R., & Krystal, J. H. (2004). Move over anova: progress in analyzing repeated-measures data and its reflection in papers published in the archives of general psychiatry. *Archives of general psychiatry*, 61(3), 310-317.

Huck, S. W., & McLean, R. A. (1975). Using a repeated measures ANOVA to analyze the data from a pretest-posttest design: a potentially confusing task. *Psychological bulletin*, 82(4), 511.

McCulloch, C. E. (2005). Repeated Measures Anova, RIP?. *Chance*, 18(3), 29-33.

Misangyi, V. F., LePine, J. A., Algina, J., & Goeddeke Jr, F. (2006). The adequacy of repeated-measures regression for multilevel research: Comparisons with repeated-measures ANOVA, multivariate repeated-measures ANOVA, and multilevel modeling across various multilevel research designs. *Organizational Research Methods*, 9(1), 5-28.

Muller, K. E., & Barton, C. N. (1989). Approximate power for repeated-measures ANOVA lacking sphericity. *Journal of the American Statistical Association*, 84(406), 549 - 555.

## Mixed / Multilevel Models

Baldwin, S. A., Imel, Z. E., Braithwaite, S. R., & Atkins, D. C. (2014). Analyzing multiple outcomes in clinical research using multivariate multilevel models. *Journal of consulting and clinical psychology*, 82(5), 920 - 930.

Bates D, Mächler M, Bolker B, Walker S (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software*, 67(1), 1–48. doi: 10.18637/jss.v067.i01.

Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. *Journal of Cognition and Development*, 11 (2), 121 - 136.

Ferron, J. M., Hogarty, K. Y., Dedrick, R. F., Hess, M. R., Niles, J. D., & Kromrey, J. D. (2008). Reporting results from multilevel analyses. *Multilevel modeling of educational data*, 391-426.

Kwok, O. M., Underhill, A. T., Berry, J. W., Luo, W., Elliott, T. R., & Yoon, M. (2008). Analyzing longitudinal data with multilevel models: An example with individuals living with lower extremity intra-articular fractures. *Rehabilitation Psychology*, 53(3), 370 - 386.

McCoach, D. B., & Kaniskan, B. (2010). Using time-varying covariates in multilevel growth models. *Frontiers in psychology*, 1, 1 - 12.

McCoach, D. B., Rifkenbark, G. G., Newton, S. D., Li, X., Kookan, J., Yomtov, J., Yomtov, D., Gambino, A., J., & Bellara, A. (2018). Does the package matter? A comparison of five common multilevel modeling software packages. *Journal of Educational and Behavioral Statistics*, 43(5), 594-627.

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Stroup, W. W. (2012). *Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

## Mediation

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, 51(6), 1173 - 1182.

- Cheong, J., MacKinnon, D. P., & Khoo, S. T. (2003). Investigation of mediational processes using parallel process latent growth curve modeling. *Structural Equation Modeling*, 10(2), 238-262.
- Geldhof, G. J., Anthony, K. P., Selig, J. P., & Mendez-Luck, C. A. (2018). Accommodating binary and count variables in mediation: A case for conditional indirect effects. *International Journal of Behavioral Development*, 42(2), 300-308.
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- Hayes, A. F., & Preacher, K. J. (2010). Quantifying and testing indirect effects in simple mediation models when the constituent paths are nonlinear. *Multivariate behavioral research*, 45(4), 627-660.
- Imai, K., Keele, L., & Tingley, D. (2010). A general approach to causal mediation analysis. *Psychological methods*, 15(4), 309.
- Judd, C. M., & Kenny, D. A. (1981). Process analysis estimating mediation in treatment evaluations. *Evaluation Review*, 5(5), 602 - 619.
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- Maxwell, S. E., & Cole, D. A. (2007). Bias in cross-sectional analyses of longitudinal mediation. *Psychological Methods*, 12(1), 23 - 44.
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