Multivariate Analysis in Applied Psychological Research

Primera Casa (PC) 416

Wednesday 9am – 11:45am

	Instructor	Teaching Assistant
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Office:	DM 275	AHC5 5th floor, Cubicle 7
Office hours:	by appointment	Tuesday 12noon - 2pm
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This course will cover basic techniques of multivariate analysis, emphasizing the rationale and applications to psychological research. Includes matrix algebra, multiple regression, principal component analysis, factor analysis, MANOVA, and mixed models. Topics in this course build on the general linear model (GLM, which includes ANOVA and regression), so I expect you to have had graduate-level coursework on ANOVA and regression. I do not expect you to have taken SEM or other advances courses.

Goals of the Course:

- Familiarize you with classic multivariate statistics
- Make sure that you understand how to perform these analyses using statistical software
- Give you background to understand current applied statistics research in Psychology
- Prepare you for further study in applied statistics in Psychology

Course Materials

Blackboard

Course materials (lecture notes, computer code, and assignments) will be posted on the Blackboard site for the course. You should bring lecture notes and other materials to class. Please note that the lecture notes are not complete – you will also need to take notes in class and even consult readings.

Software

Every software package has strengths and weaknesses, so it's good to learn several packages. We will use both SPSS and SAS in this course. I will provide you with information to get started in SPSS and SAS, as well as information about specific procedures / analyses we will cover in this class. You will need to access SPSS and SAS outside of class to complete homework assignments.

Textbook

Not required, but a good additional perspective on the topics. Also easy to read and inexpensive.
The Essence of Multivariate Thinking, 2nd edition, by Lisa L. Harlow. ISBN: 978-0415873727
Other readings: I will post relevant articles to Blackboard on an as-needed basis.

Assignments

Homework

- Homework assignments due on Blackboard by midnight on Tuesday
- Almost weekly (12 assignments)
- You will need to access SPSS and SAS to complete most homework assignments
- You may also need to do some mathematical calculations by hand

Quizzes

- In-class quizzes approximately every three weeks (see Course Outline, 5 quizzes)
- 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 SAS
- You will have 1 hour to complete each quiz before lecture, so it is in your interest to be punctual!

Grading

Final Grade

Your final grade is the weighted average of all your assignments
Homework: 60% of total grade
Quizzes: 40% of total grade

Letter grade	Percentage
A	>= 93
A-	90 - 92.99
B+	87 - 89.99
B	83 - 86.99
B-	80 - 82.99
C+	77 - 79.99
C	73 - 76.99

There are no plans for any make-up or extra credit assignments or activities.

Course and University Policies

Attendance and Late Policy

- I shouldn't have to tell you to attend every class. This is graduate school.
- Assignments are late if they are turned in after the due date and time. A 5 point late penalty will be deducted for each 24 hour period late — maximum score of 95/100 if 1 day late, maximum score of 90/100 if 2 days late, etc.
- Legitimate, verifiable cases of illness and emergencies, religious holy days, and conference travel can be accommodated. You need to contact me as soon as possible to make arrangements.

Drop Dates

Monday, August 28: Last day to drop courses or withdraw from the University without incurring financial liability for tuition and fees
Monday, October 30: Deadline to drop a course with a DR grade

Special Needs

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

Disability Resource Center

Graham Center (GC) 190
(305) 348-3532
drcupgl@fiu.edu
drc.fiu.edu

Academic Misconduct

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and to honestly demonstrate the quality of their learning. Therefore, 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.

Academic Dishonesty

Please refer to your student handbook for a description of what constitutes academic dishonesty.

- While it's acceptable to collaborate with your colleagues in class and while completing homework assignments, I expect each student to ALWAYS turn in their own work.

NOTE: Anything on this syllabus is subject to change at the Instructors discretion.

Tentative Course Outline

Week	Date	Topics	HW due	Quiz	Readings
1	Aug 23	Introduction, Matrix algebra 1			1, 2, S1
2	Aug 30	Software, linear regression	1		3
3	Sept 06	Linear regression (matrix)	2	1	3
4	Sept 13	Linear regression (matrix)			3
5	Sept 20	Analysis of covariance (ANCOVA)	3		4
6	Sept 27	Maximum likelihood	4	2	S2
7	Oct 04	Missing data			S3
8	Oct 11	Matrix algebra 2	5		S1
9	Oct 18	Principal components analyis (PCA)	6	3	9
10	Oct 25	Factor analysis (FA)	7		9
11	Nov 01	MANOVA	8	4	5
12	Nov 08	Repeated measures ANOVA	9		5
13	Nov 15	Mixed models	10		8
14	Nov 22	NO CLASS	11		
15	Nov 29	TBD		5	
16	Dec 06	FINALS WEEK	12		

Readings are chapters from the Harlow textbook, unless otherwise indicated
S1 = Supplement 1: Tabachnick & Fidell, Appendix 1
S2 = Supplement 2: Enders (2005)
S3 = Supplement 3: Baraldi & Enders (2010)

Extended Reading list

Do not try to read all of these articles and books. These are additional resources if you want to learn more about a specific topic. I used many of these resources when developing the course.

General multivariate statistics and linear regression textbooks

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.

Gelman, A., & Hill, J. (2006). Data analysis using regression and multilevel/hierarchical models. Cambridge University Press.

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.

Analysis of covariance

Brown, J. D. (2014). Analysis of Covariance. In Linear Models in Matrix Form (pp. 443-467). Springer International Publishing.

Delaney, H. D., & Maxwell, S. E. (1981). On using analysis of covariance in repeated measures designs. Multivariate Behavioral Research, 16(1), 105-123.

Kisbu-Sakarya, Y., MacKinnon, D. P., & Aiken, L. S. (2013). A Monte Carlo comparison study of the power of the analysis of covariance, simple difference, and residual change scores in testing two-wave data. Educational and Psychological Measurement, 73(1), 47 - 62.

Lord, F. (1967). A paradox in the interpretation of group comparisons. Psychological Bulletin, 68(5), 304 - 305.

Miller, G. A., & Chapman, J. P. (2001). Misunderstanding analysis of covariance. Journal of abnormal psychology, 110(1), 40 - 48.

Westfall, J., & Yarkoni, T. (2016). Statistically controlling for confounding constructs is harder than you think. PloS one, 11(3), e0152719.

Maximum likelihood

Enders, C. K. (2005). Maximum likelihood estimation. Encyclopedia of statistics in behavioral science.

Missing data

Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. Journal of School Psychology, 48(1), 5 - 37.

Collins, L. M., Schafer, J. L., & Kam, C. M. (2001). A comparison of inclusive and restrictive strategies in modern missing data procedures. Psychological methods, 6(4), 330 - 351.

Enders, C. K. (2010). Applied missing data analysis. Guilford Press.

Little, R. J., & Rubin, D. B. (2014). Statistical analysis with missing data. John Wiley & Sons.

Little, T. D., & Rhemtulla, M. (2013). Planned missing data designs for developmental researchers. Child Development Perspectives, 7(4), 199 - 204.

Rubin, D. B. (1976). Inference and missing data. Biometrika, 63(3), 581 - 592.

Schafer, J. L., & Graham, J. W. (2002). Missing data: our view of the state of the art. Psychological methods, 7(2), 147 - 177.

Principal components analysis (PCA) and factor analysis (FA)

Joliffe, 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 Velicers 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.

Multivariate analysis of variance (MANOVA)

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

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

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

Repeated measures ANOVA

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

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.

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.

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.

Peugh, J. L. (2010). A practical guide to multilevel modeling. Journal of School Psychology, 48(1), 85 - 112.

Snijders, T. A. B., & Bosker, R. (2012). Multilevel analysis: An introduction to basic and advanced multilevel modeling (2nd ed.). Sage Publications, Ltd.