Multivariate Statistics

PSYX 522 – Autumn 2017

Course Location and Time

Skaggs Building 303
Thursday 12:30 – 3:20pm

Instructor Information

Instructor: Daniel J. Denis, Ph.D.
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Phone: N/A
Email: daniel.denis@umontana.edu
Office hours: W, 1-3; F, 11-12.

Course Overview & Expectations

It is assumed that students entering this course have taken previous graduate statistics courses (e.g., Stat I and Stat II here at U of M or equivalent elsewhere), and have a basic understanding of statistics and statistical inference from early concepts through to linear models such as ANOVA and multiple regression.

Credits

3.0

Learning Outcomes

1. To provide you with the opportunity to obtain a working knowledge of various multivariate statistical procedures and a **foundation** for further learning.

2. To provide you with the ability to critically evaluate various multivariate analyses found in modern social and natural science literature.

3. To provide you with the opportunity to successfully present and defend statistical/methodological material to an audience (such as your thesis or dissertation committee, or anyone else in the future, e.g., "job talks" etc.).

Course Description

We will survey the more common multivariate procedures used in psychology and related sciences. We will not be surveying *every* multivariate methodology. Such will include topics as multivariate analysis of variance, factor analysis/SEM models, principal components analysis, cluster analysis, and others. In addition to surveying these methods, their application using software will occasionally be demonstrated. The key to understanding and using statistics is to be able to rely on your knowledge of **fundamental**

concepts so that you may learn a variety of statistical procedures that you may need (or read) in your career. The key is to **understand** what you are doing, and not simply run statistical procedures blindly. Theoretical details will be drawn from Johnson & Wichern, while data analysis examples will be surveyed in the two software books. A fundamental goal of the course is to teach you how to think statistically (almost synonymous with "scientifically") from the ground up so that you may become a wise interpreter and producer of scientific knowledge.

Course Depth vs. Breadth

This course is necessarily a "breadth" course, as it is impossible to cover *all of multivariate statistics* in depth in the amount of time allotted for this course. For instance, for each of the multivariate procedures that exist, there are many BOOKS written on these individual topics, and countless peer-reviewed journal articles. It is unreasonable to think that this course alone will make you an "expert" on any of the various multivariate procedures. Rather, the course will provide you with reasonable knowledge of which multivariate procedure might be suitable for a given research problem, and how to begin to implement the procedure. Even if you complete a given data analysis as an exercise in this course, every time you do a new data analysis in the future, you are always "starting anew." Each data analysis is different (design issues are usually extremely difficult to figure out), and "cookbook" approaches to statistical analysis, even if somewhat helpful and having their place as a learning tool, can be dangerous if they are not used with caution. The course will also to some extent introduce you to the underlying technical details of these procedures, so that you have some background on the "anatomy" of multivariate analysis before attempting to apply it to problems in research. Successful completion of this course will provide you with a solid theoretical, applied, and **philosophical foundation** for virtually all of traditional statistical modeling that you may encounter. Most, if not all, of any statistical methods you will likely encounter in your career are based on the same fundamentals studied in this course. If you master the fundamentals and grasp the "big picture," your ability to learn new things in the future will be unstoppable.

Required Texts

Johnson, R. A. & Wichern, D. W. (2007). *Applied multivariate statistical analysis*. New Jersey: Prentice Hall.

Applications in Software (R and SPSS)

Everitt, B. & Hothorn, T. (2011). *An introduction to applied multivariate analysis in R*. New York: Springer.

Leech, N. L., Barrett, K. C. & Morgan, G. A. (2015). *IBM SPSS for intermediate statistics: Use and interpretation (5th ed)*. Routledge.

Class notes and handouts (to be distributed and/or posted on-line).

Optional Texts & Resources

Rencher, A. C. & Christensen, W. F. (2012). *Methods of Multivariate Analysis*. New York: Wiley.

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Meyers, L. S., Gamst, G., & Guarino, A. J. (2006). *Applied multivariate research*. Sage publications: London.

Hays, W. L. (1994). *Statistics*, 5th ed. Wadsworth Publishing Company, Belmont CA.

Kirk, R. E. (2008). *Statistics: An introduction*. Thomson/Wadsworth: Belmont, CA.

Denis, D. (2007). *Study guide for Kirk, R. E. (2008). Statistics: An introduction*. Thomson/Wadsworth: Belmont, CA.

Field, A. (2009). *Discovering statistics using SPSS*. Sage Publications: California.

Upton, G., & Cook, I. (2006). *Oxford Dictionary of Statistics*. Oxford University Press. New York.

Morgan, G.A., Leech, N. L., Gloeckner, G. W. & Barrett, K. C. (2011). IBM SPSS for Introductory Statistics: Use and Interpretation, 4th ed. Routledge: New York.

Leech, N. L., Barrett, K. C. & Morgan, G. A. (2011). IBM SPSS for Intermediate Statistics: Use and Interpretation, 4th ed. Routledge: New York.

Office Hours

Office hours are held weekly. You are also strongly encouraged to e-mail questions to the instructor and/or TA, as they arise. Writing your question out in an e-mail, as clearly as you can (even if very long) is an **excellent** way to clarify what you do not understand, and often, you achieve a deeper understanding of the topic itself. Please be as detailed and specific as you can in your e-mail so I know how to frame my response to best suit your needs.

Evaluation

Your final grade will be based on the following:
1. Student Seminar (30%)
2. Mid-Term Test (10%) 1/2 Theory / 1/2 Application
3. Final Exam (50%) 1/2 Theory / 1/2 Application
4. Assigned Questions (10%) – ungraded but verified.

Student Seminar

Each seminar will be approximately 45 minutes in length, with about 10 minutes for questions. Seminars will be evaluated on the following:

- Topic Knowledge & Expertise (30%)
- Level of Difficulty, Complexity and Depth (30%)
- Presence and Clarity of Exposition (20%)
- Organization, Delivery, and Thought Process (20%)

Percentage	Grade	Percentage	Grade	Percentage	Grade
100	A	79	B +	59	D +
99	A	78	B +	58	D +
98	A	77	B +	57	D +
97	A	76	B	56	D
96	A	75	B	55	D
95	A	74	B	54	D
94	A	73	B	53	D
93	A	72	B -	52	D -
92	A	71	B -	51	D -
91	A	70	B -	50	D -
90	A	69	C +	< 50	F
89	A -	68	C +		
88	A -	67	C +		
87	A -	66	C		
86	A -	65	C		
85	A -	64	C		
84	A -	63	C		
83	A -	62	C -		
82	A -	61	C -		
81	A -	60	C -		
80	A -				

Course Guidelines & Policies

Disability Modifications

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406-243-2243. I will work with you and Disability Services to provide an appropriate modification.

Academic Misconduct

You are expected to adhere to the university's Student Conduct Code with regard to academic integrity. Academic misconduct in this course will not be tolerated and will result in an academic penalty. **If you are suspected of cheating on a test or exam, you will receive zero on that test or exam and be asked to leave the class permanently**. In short, even if you do not know the answer to a question, you're much better off guessing than risking the chance of getting caught cheating.

Incompletes

Departmental and university policies regarding incompletes do not allow one to change "incomplete" grades after 1 year has passed since the "I" was granted.

A Note on the Use of Statistical Software

SPSS (and R) will be occasionally demonstrated in this course. It is of extreme importance that you do not equate "software knowledge" with statistical knowledge. The emphasis in this course will be on **first understanding statistics**, then applying them on the computer. Learning how to use SPSS effectively and efficiently is relatively easy IF YOU FIRST UNDERSTAND THE STATISTICAL PROCEDURES which it offers.

Tentative Course Schedule (Subject to Change)

Date	Topic	Primary Readings	Problems TBA
31 Aug.	Introductions, Syllabus, Course Preview & Big Picture	-	
7 Sept.	Univariate Statistics & Motivating Multivariate	Instructor Handouts / Class Notes	
14 Sept.	Univariate Statistics & Motivating Multivariate	Instructor Handouts / Class Notes	
21 Sept.	Vectors & Matrices (select topics)	Johnson & Wichern Chap. 2 (and 2A)	
28 Sept.	Multivariate Samples & Distributions (select topics)	Johnson & Wichern Chap. 3 and 4	
05 Oct.	MANOVA & DISCRIM	Johnson & Wichern Chap. 6	
12 Oct.	Principal Components Analysis (PCA)	Johnson & Wichern Chap. 8 / Everitt & Hothorn Chap. 3	
19 Oct.	Exploratory Factor Analysis (EFA)	Johnson & Wichern Chap. 9 / Everitt & Hothorn Chap. 5	
26 Oct.	Exploratory Factor Analysis (EFA)	Johnson & Wichern Chap. 9 / Everitt & Hothorn Chap. 5	
02 Nov.	**Mid-Term Exam (10%)** and Cluster Analysis	Johnson & Wichern Chap. 12 / Everitt & Hothorn Chap. 6	
09 Nov.	Cluster Analysis	Johnson & Wichern Chap. 12 / Everitt & Hothorn Chap. 6	
16 Nov.	Confirmatory Factor Analysis & Structural Equation Modeling	Everitt & Hothorn Chap. 7 & Class Notes	
23 Nov.	**THANKSGIVING – NO CLASS**		
30 Nov.	TBA	Student Seminars	
07 Dec.	TBA	Student Seminars	
19 Dec.	**FINAL EXAM (50%)** **10:10 – 12:10pm**	All material covered in class is testable.	