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Fall 9-1-2018

## PSYX 522.01: Multivariate Statistics

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## Multivariate Statistics

### PSYX 522 – Autumn 2018

#### Course Location and Time

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

#### Instructor Information

Instructor: Daniel J. Denis, Ph.D.  
Office: Skaggs Building 369  
Phone: N/A  
Email: [daniel.denis@umontana.edu](mailto: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 applied 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 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.

### **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**

Schumacker, R. E. (2016). *Using R with multivariate statistics*. New York: Sage Publications.

### **Applications in Software (R and SPSS)**

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

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

### **Optional Texts & Resources**

Johnson, R. A. & Wichern, D. W. (2007). *Applied multivariate statistical analysis*. New Jersey: Prentice Hall. [we will select elements of this text as the basis for our theoretical results]

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

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.

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*, 4<sup>th</sup> ed. Routledge: New York.

Leech, N. L., Barrett, K. C. & Morgan, G. A. (2011). *IBM SPSS for Intermediate Statistics: Use and Interpretation*, 4<sup>th</sup> 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%) \*\*\* Major Course Component
2. Mid-Term Test: Take-Home (10%) 1/2 Theory / 1/2 Application
3. Final Exam (50%) 1/2 Theory / 1/2 Application
4. Assigned Questions (10%) – ungraded but verified (*come to class prepared to share and discuss your solutions*)

### Student Seminar

Each seminar will be approximately 30 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 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)**

<b>Date</b>	<b>Topic</b>	<b>Primary Readings</b>	<b>Problems TBA</b>
<b>30 Aug.</b>	Introductions, Syllabus, Course Preview & Big Picture		
<b>6 Sept.</b>	Univariate Statistics & Motivating Multivariate Vectors & Matrices	Lecture notes / Meehl, Lehmann	
<b>13 Sept.</b>	Vectors & Matrices (con't)	Lecture notes Chapters 1, 2	
<b>20 Sept.</b>	Hotelling's $T^2$	Chapter 3	
<b>27 Sept.</b>	MANOVA	Chapter 4	
<b>04 Oct.</b>	MANCOVA & Multivariate Repeated Measures	Chapters 5, 6	
<b>11 Oct.</b>	Discriminant Analysis	Chapter 7	
<b>18 Oct.</b>	Canonical Correlation	Chapter 8	
<b>25 Oct.</b>	Principal Components	Chapter 10	
<b>01 Nov.</b>	<b>Mid-Term Exam (10%) – Take Home (1/2 theory, 1/2 app)</b>	TBA	
<b>08 Nov.</b>	Exploratory Factor Analysis	Chapter 9	
<b>15 Nov.</b>	Structural Equation Modeling	Chapter 12	
<b>22 Nov.</b>	<b>THANKSGIVING – NO CLASS</b>		
<b>29 Nov.</b>	TBA	Student Seminars (30%)	
<b>06 Dec.</b>	TBA	Student Seminars (30%)	
<b>10 Dec.</b>	<b>FINAL EXAM (50%) 10:10 – 12:10pm</b>	All material covered in class is testable.	