UNIVERSITY OF VICTORIA
DEPARTMENT OF PSYCHOLOGY

PSYC 533 (A01)
General Linear Model -- Multivariate
Spring 2018

Time: Tuesdays and Fridays 12:30-1:50 p.m.
Room: HSD A150 (Computer Lab)
Instructor: Stuart MacDonald, PhD
Office Hours: Tues/Fri following class, or by appointment
Office: Cornett A261
Phone: (250) 472-5297
E-mail: smacd@uvic.ca

COURSE DESCRIPTION

This graduate course is designed to introduce you to the concepts and practical application of select techniques that are special cases of the general linear model (GLM) including both multivariable (e.g., logistic regression) and multivariate (e.g., multivariate analysis of variance, multivariate multiple regression) procedures. In brief, multivariable procedures involve a single outcome measure with two or more predictors (e.g., multiple regression), whereas true multivariate procedures incorporate two or more dependent measures with a set of predictors (e.g., multivariate multiple regression, factor analysis). The variety of multivariate techniques introduced in this class will cover a number of key themes including data reduction and structure (principal components analysis, exploratory factor analysis, structural equation modeling), time-based analyses (repeated measures ANOVA, multilevel modeling), prediction of group membership (logistic regression), as well as the testing of group differences (MANOVA) and degree of association (multivariate multiple regression).

To facilitate learning, the course emphasizes conceptual understanding and practical application (assignments). Our discussions will teach you how to ask intelligent questions of your data, and in particular how you decide upon the most appropriate analytic technique for addressing your question(s). In many respects, this course represents an extension of the material covered in PSYC 532 to the situation in which there are multiple dependent and independent variables, with varying distributions (both continuous and categorical variables). Another central objective will be to hone your practical skills through various assignments by computing analyses, navigating the output, and interpreting your results.

COURSE PREREQUISITES

The official prerequisite for this course is PSYC 532 (GLM: Univariate). If you have not completed this introductory course (or a comparable course such as PSYC 400A), please contact me to discuss your background. I would be happy to provide suggestions for supplementary reading material.

COURSE FORMAT AND LEARNING GOALS

This graduate course on select multivariate applications of the GLM (factor analysis, structural equation modeling, repeated measures and multilevel modeling) is specifically designed to promote learning through
lecture, practical application, and discussion. Our regular meetings will integrate conceptual learning with practical application.

In my capacity as a guide to your learning, I am committed to you achieving the following learning outcomes upon completion of the course:

1. Augment your basic understanding of the general linear model with coverage of various multivariable (single dependent measure with two or more independent measures) and multivariate (two or more dependent measures with a set of predictors) techniques, with specific emphasis on approaches that explore data structure (factor analysis, structural equation modeling), prediction of group membership (logistic regression), the analysis of time (repeated measures ANOVA, multilevel modeling), group differences (MANOVA), and degree of association (multivariate multiple regression).

2. Develop practical skills in data management and analysis for topics in Objective 1.

3. Learn which statistical approach(es) to adopt in a given context, and how to adapt the analytic techniques learned to your own data (e.g., master’s thesis, manuscript).

4. Appreciate that your research questions are of foremost importance, and that the choice of analytic technique will naturally follow.

**ACADEMIC EXPECTATIONS**

To achieve the learning outcomes, it is necessary for you to attend class, to contribute to discussions, and to complete each laboratory assignment. Should circumstances prevent your attendance, please inform me (in advance if possible). If you are unable to submit the final written assignment (or write the final exam) on the specified date due to illness or family affliction, you should apply at Records Services for a "Request for Academic Concession", normally within 10 working days of the exam date.

You are expected to abide by the University’s policy on plagiarism and cheating (see last 2 pages of syllabus).

**COURSE REGISTRATION**

You are personally responsible for checking your registration status before the end of the course-add period (Friday, January 19, 2018). Please verify and confirm your registration status with me as, according to University policy, I am unable to facilitate a course addition after this date even if you have been attending class. Also note that Wednesday, February 28, 2018 is the last day for officially withdrawing from PSYC 533 without academic penalty. University policy states that failing to attend lectures does not constitute official withdrawal.
Evaluation of your progress toward the course objectives will be based upon several graded requirements including: (a) in-class and take-home practical assignments using various software packages and (b) two written take-home examinations.

(a) Practical Assignments
The number of assignments and their associated due dates will be determined according to weekly progress in covering the conceptual material. Approximately 4-5 assignments will be distributed across the entire term. Each brief assignment will be due ONE WEEK after it has been distributed in class. The purpose of each assignment is to have you gain experience in computing analyses and interpreting results for a given multivariate technique. Assignment questions are worded so as to emulate the thought processes you will often face in your own research pursuits. Performance will be evaluated on (a) fitting of appropriate statistical models (e.g., submit copy of model syntax), and (b) identification and succinct explanation of key findings in response to the questions. For example, in select assignments, you may be asked to draft a statistical procedures subsection that summarizes the statistical procedure (as you would draft in the method section of a manuscript), as well as a corresponding summary of the results. The practical exercises will be advantageous for your retention of the concepts covered during lectures.

(b) Exams
The first take-home exam will cover techniques related to the theme of data structure, with the second take-home exam due one week following our final class meeting (on Friday, April 13, 2018). The second take-home exam will focus largely on new material covered following the first take-home exam. The two exams will be very intuitive, and are intended to assess your conceptual understanding of the GLM techniques covered, as well as your ability to interpret the analytic output. The exams will be completed during a limited 48-hour time window, and accordingly will evaluate conceptual understanding and ability to interpret output (as opposed to emphasis on practical application which will be primarily evaluated on the assignments).

Take-home exam #1 is due on THURSDAY, MARCH 1, with take-home exam #2 due on FRIDAY, APRIL 13. These dates are tentative; exams will be made available electronically 48 hours prior to the scheduled due date/time.

Grading
I have purposely employed several forms of evaluation in recognition that each of you has an individual learning style. Your grade for the course will be based upon the practical assignments as well as the two take-home exams, providing you the best opportunity to demonstrate your many abilities. Further, to minimize anxiety associated with individual projects/exams that count toward a large percentage of your grade, I have specifically chosen to parse evaluation into smaller components. Your workload should not increase, but rather be more evenly dispersed across the term.

1. Assignments = 50%
2. Take-home exam #1 = 25%
3. Take-home exam #2 = 25%

Graded course requirements will be weighted and aggregated to yield a percentage score. The final letter grade in the course will be based on total percent score rounded up at values of .5 or greater (e.g., 89.5 will be
rounded up to 90, but 89.4 will not). Final grades will be assigned according to the following scale: 90-100% = A+; 85-89 = A; 80-84 = A-; 77-79 = B+; 73-76 = B; 70-72 = B-; 65-69 = C+; 60-64 = C; 50-59 = D; 0-49 = F.

**WEEKLY TOPICS AND RECOMMENDED READINGS**

Please note that the following weekly schedule is tentative, and will likely change pending student responses to the questionnaire that I administer in the first class. My objective will be for you to learn the basics of each multivariate technique, with any remaining time devoted to coverage of other special multivariate topics (e.g., set correlation, survival analysis).

**Overview of Dates and Topics**

05 January Course Overview and Objectives; Some Brief Review

**Data Structure**

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>9/12 January</td>
<td>Principal Components Analysis (PCA)</td>
</tr>
<tr>
<td>16/19 January</td>
<td>Exploratory Factor Analysis (EFA)</td>
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<tr>
<td>23/26 January</td>
<td>EFA/PCA Practical Examples</td>
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<tr>
<td>30 January</td>
<td>Structural Equation Modeling: Confirmatory Factor Analysis</td>
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<td></td>
<td><strong>Assignment 1: tentative due date (January 30)</strong></td>
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<tr>
<td>02 February</td>
<td>No Class (I will be away on February 2 due to research travel)</td>
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<tr>
<td>06/09 February</td>
<td>Structural Equation Modeling: Path Analysis</td>
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<tr>
<td>13/16 February</td>
<td>No Class (Reading Break)</td>
</tr>
<tr>
<td>20/23 February</td>
<td>Structural Equation Modeling: Structural Models</td>
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<td><strong>Assignment 2: tentative due date (February 23)</strong></td>
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**Time-Based Analyses**

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<tr>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>27 February</td>
<td>Repeated Measures ANOVA and Multilevel Models</td>
</tr>
<tr>
<td>1 March</td>
<td>Take-Home Exam #1 Due</td>
</tr>
<tr>
<td>2 March</td>
<td>Repeated Measures ANOVA and Multilevel Models</td>
</tr>
<tr>
<td>06/09 March</td>
<td>Repeated Measures ANOVA and Multilevel Models</td>
</tr>
<tr>
<td>13/16 March</td>
<td>Repeated Measures ANOVA and Multilevel Models</td>
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<td><strong>Assignment 3: tentative due date (March 16)</strong></td>
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**Prediction of Group Membership**

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<th>Date</th>
<th>Topic</th>
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<tr>
<td>20/23 March</td>
<td>Logistic Regression</td>
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<tr>
<td>27 March</td>
<td>Logistic Regression</td>
</tr>
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**Testing Group Differences and Degree of Association**

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<th>Topic</th>
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<tr>
<td>30 March</td>
<td>Multivariate Multiple Regression/Multivariate Analysis of Variance</td>
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Weekly Readings
There is no required textbook for this class. In part, this decision reflects the diversity of analytic topics that we will cover and the fact that no single multivariate text provides sufficient coverage of these techniques. In lieu, I have carefully identified select chapters and articles that overview a given week’s theme and that provide the foundation for group discussions, practical demonstrations, assignments, and take-home exams. Each article identified below represents a core reading for a given week’s theme that I may supplement with additional suggested readings. Please note that this is a tentative reading list that will most likely evolve.

JANUARY 5
Introduction and GLM Overview
Getting to know you, previous experiences questionnaire, discussion of syllabus and course objectives, and brief review of the general linear model (GLM)

Analytic Theme 1: Data Structure
JANUARY 9/12
Principal Components Analysis (PCA)

Suggested Readings:

JANUARY 16/19 and 23/26
Exploratory Factor Analysis (EFA)
Basics of factor analysis
Exploratory factor vs. principal components analysis
Data analysis: some basic examples

Suggested Readings:

Secondary Readings:

JANUARY 30

Structural Equation Modeling: Confirmatory Factor Analysis

Gentle introduction to SEM
Why use it? (aka advantages of SEM models)
Types of SEM models (measurement/confirmatory factor models, structural models)
Exploratory factor analysis (EFA) vs principal components analysis (PCA) vs SEM (confirmatory factor analysis)
SEM equations; underpinnings of SEM; measurement error and its implications

Suggested Readings:


University of Texas AMOS Tutorial

FEBRUARY 2

**No class scheduled on FRIDAY, February 2 due to research travel**

FEBRUARY 06/09

Structural Equation Modeling: Path Analysis

Path Analysis (a special case of SEM for observed indicators)
Key terms and concepts (latent vs. manifest variables, uniqueness, loading, covariance vs. correlation, model identification, convergence, maximum likelihood, SEM equations, etc.)
Basic steps in fitting SEMs
Model specification and identification
Evaluation of model fit
Model modification and interpretation
Practical examples

Suggested Readings:

FEBRUARY 13/16
Reading Break
No scheduled classes from Feb 12-16

FEBRUARY 20/23
Structural Equation Modeling: Structural Models
Basic steps in fitting SEMs (continued)
Practical examples

Suggested Readings:


Analytic Theme 2: Time-Based Analyses
FEBRUARY 27; MARCH 2
Repeated Measures Analysis of Variance
Assumptions of the ANOVA-based approach for measuring change.

Suggested Readings:

MARCH 1
Take-Home Exam #1 is Due (25%)
MARCH 06/09 and 13/16
Multilevel Models

Advantages of multilevel models relative to repeated measures ANOVA
Basic multilevel equations and terminology (fixed and random effects, etc.)
Model assumptions
Maximum likelihood, missing data, and borrowing strength
Fully unconditioned models and intraclass correlation coefficient
Using HLM: Illustration and practice with longitudinal data

Suggested Readings:


Analytic Theme 3: Prediction of Group Membership
MARCH 20/23/27
Logistic Regression
Predicting group membership by computing the log of the odds of being in a given group (e.g., group in early stages of dementia vs. control group).

Suggested Readings:


Analytic Theme 4: Testing Group Differences and Degree of Association
MARCH 30
Good Friday
No scheduled class on Friday March 30.

APRIL 3/6
Multivariate Multiple Regression
Extension of univariate regression to the case where a linear combination of dependent measures is maximally correlated with a linear combination of predictors.

Suggested Readings:
**Multivariate Analysis of Variance**

Extension of univariate ANOVA; examination of a linear combination of dependent measures to maximize mean group differences.

**Suggested Readings:**


**Please note that FRIDAY, APRIL 6 is the last day of classes for the Spring 2018 term.**

**APRIL 13, 2018**
Take-Home Exam #2 is Due (25%)

**The above schedule, course policies, and assignments are subject to change**
Commitment to Inclusivity and Diversity

The University of Victoria is committed to promoting, providing and protecting a positive and supportive and safe learning and working environment for all its members.

Policy on Academic Integrity including Plagiarism and Cheating
The Department of Psychology fully endorses and intends to enforce rigorously the Senate Policy on Academic integrity https://web.uvic.ca/calendar2018-01/grad/academic-regulations/academic-integrity.html, p.37–40 UVic Calendar January 2018). It is of utmost importance that students who do their work honestly be protected from those who do not. Because this policy is in place to ensure that students carry out and benefit from the learning activities assigned in each course, it is expected that students will cooperate in its implementation.

The offenses defined by the policy can be summarized briefly as follows:

1. **Plagiarism.** You must make sure that the work you submit is your work and not someone else’s. There are proper procedures for citing the works of others. The student is responsible for being aware of and using these procedures.

2. **Unauthorized Use of an Editor.** The use of an editor is prohibited unless the instructor grants explicit written authorization.

3. **Multiple Submission.** Only under exceptional circumstances may a work submitted to fulfill an academic requirement be used to satisfy another similar requirement. The student is responsible for clarifying this with the instructor(s) involved.

4. **Falsifying Materials Subject to Academic Evaluation.** This includes falsification of data, use of commercially prepared essays, using information from the Internet without proper citation, citing sources from which material is not actually obtained, etc.

5. **Cheating on Assignments, Tests, and Examinations.** You may not copy the work of others in or out of class; you may not give your work to others for the purpose of copying; you may not use unauthorized material or equipment during examinations or tests; and you may not impersonate or allow yourself to be impersonated by another at an examination. The Department of Psychology has a policy of not making old examinations available for study purposes. Therefore, use of old exams without the express written permission of the instructor constitutes cheating by the user, and abetting of cheating by the person who provided the exam.

6. **Being an Accessory to Offences.** This means that helping another student to cheat (for instance, by showing or communicating to them answers to an assignment, or by allowing them to view answers on an exam) is an academic offence.

Instructors are expected to make every effort to prevent cheating and plagiarism. This may include the assignment of seating for examinations, asking students to move during examinations, requests to see student identification cards, and other measures as appropriate. Instructors also have available to them
a variety of tools and procedures to check for Internet and electronic media-based cheating. In instances of suspected or actual plagiarism or cheating, instructors, following prescribed procedures, are authorized to take steps consistent with the degree of the offence. These measures will range from a zero on the test or assignment or a failing grade for the course, probation within a program to temporary or even permanent suspension from the University.

Rights of Appeal are described in the Policy on Academic Integrity in the University calendar (on p. 38 in January 2018).

**The definitive source** for information on Academic Integrity is the University Calendar (p. 37-40 in January 2018) ([https://web.uvic.ca/calendar2018-01/grad/academic-regulations/academic-integrity.html](https://web.uvic.ca/calendar2018-01/grad/academic-regulations/academic-integrity.html))

**Other useful resources on Plagiarism and Cheating include:**
1. The Study Solutions Office: [https://www.uvic.ca/services/counselling/success/study/index.php](https://www.uvic.ca/services/counselling/success/study/index.php)
2. The Ombudsperson’s office: [http://www.uvss.uvic.ca/ombudsperson/pubsguides/plagiarism.pdf](http://www.uvss.uvic.ca/ombudsperson/pubsguides/plagiarism.pdf)