PSYC*6380, Course Outline: Winter 2020

General Information

Course Title: Psychological Applications of Multivariate Analysis

Course Description:
The purpose of this course is to give students the conceptual and practical tools they need to answer a wide variety of research questions in Psychology using a variety of both parametric and non-parametric data analytic techniques. We will be building on concepts and techniques taught in PSYC*6060; and will cover the fundamentals of inferential statistics, data exploration, parameter estimation, and model testing and comparison. In addition, we will explore ways to become informed, thoughtful, ethical, and skilled users of multivariate statistical techniques. In order to do this, emphasis throughout the course will be placed on openness and transparency in research, how to avoid questionable research practices, and the crucial distinction between exploration and confirmation in data analysis.

Credit Weighting: 0.5 credit(s)

Academic Department (or campus): Psychology

Semester Offering: W20

Class Schedule and Location:
Tuesdays @ 11:30am-2:20pm, Crop Science (CRSC), Room 403

Instructor Information

Instructor name: Scott A. Cassidy, Ph.D.
Instructor email: cassidys@uoguelph.ca
Office hours and location: Available by appointment

GTA Information

GTA Name: Gillian Maurice, M.A.
GTA Email: gmaurice@uoguelph.ca
Office hours and location: TBA

Course Content

Specific Learning Outcomes:
By the end of this course, students should be able to:

1. Understand and apply advanced concepts in statistics to data analysis in psychology.
2. Recognize and describe various multivariate data analytic techniques, and apply them appropriately to a range of research questions in psychology.
3. Analyze and interpret statistical data to test a claim or investigate a research question.
4. Effectively utilize statistical software (i.e., *R*) to aid in data analysis.
5. Apply critical thinking and troubleshooting skills to the analysis of quantitative data.
6. Apply analytic approaches and concepts learned in class to novel research questions.
7. Explain and apply ethical considerations to the conduct of research in quantitative psychological science.
8. Demonstrate written communication skills - the ability to express ideas in a clear, concise, and professional manner.
9. Manage time effectively, and ensure personal organization.
10. Demonstrate academic and intellectual integrity.

Class Content:
The topics I'll be covering at our class will often build off of one another; so to get the most out of the course, you should try to attend every class if possible. My role as an instructor at our classes is twofold: First, my role is provide background information and some context around the statistical concepts and techniques assigned for the class. Following this, my second role is to facilitate the application of the concepts we cover in class to applied activities and examples. We will use the class sessions to facilitate interactive learning in which we discuss and apply the concepts covered in class, and learn how to apply them to novel situations and research questions. As we do this, I expect you to participate in the active learning activities, ask about anything you do not understand, and comment on anything that you are interested in.

Note on Assigned Readings(s) and Resources:
I will make a number of different readings and other resources available for each of the topics that we will cover this semester. However, I do not consider all of these to be necessary for you to complete in order to succeed in the class. In many cases, I consider these resources to be better used as potential sources or reference material that I think you may find useful, either while you're completing your assignments (see below), or in your future research or applied work. To that end, I have divvied the readings and resources for each week into three sections:

Read before class: Readings listed here provide fundamental concepts or other important information on the topic we'll be covering. I will be teaching the class at a level that assumes all students have covered this information. To make sure that everyone in the class begins with what I feel to be essential information, I would ask you to read this before our class. I have kept

these readings to a minimum where possible, to respect what I understand to be your busy schedules as graduate students.

Technical help: Readings and resources listed here provide technical information on the concepts or techniques that we'll be covering in class. I do not expect you to read or watch these ahead of our class, and do not feel that doing so will provide you with any substantive benefit. Instead, I encourage you to use the resources listed here on an as-needed basis for reference when you are completing assignments or other work based on the topic covered that week. These resources are meant to cover multivariate analytic techniques in more detail than I can realistically provide during our class time; and I may refer you back to these if there is something that you are struggling with that I feel is best addressed there.

Further reading: Readings listed here go beyond the concepts I expect you to master coming out of this class. You will not be assessed on material covered here (assuming it is not also covered elsewhere). Instead, these readings provide useful ancillary information on the topic being covered that week. I encourage you to download these articles if they correspond to a concept or technique that you feel you may need to use in your future analytic work, and refer back to it when and if that need arises.

Topics and Class Schedule:

Week	Date	Topic(s) Covered	Assigned Reading(s)/Resource(s)
1	January 7	1. Course Overview 2. Guidelines for Statistically-Sound Research Practices 3. It's Pronounced "*Arggh*!": A Gentle Re-Introduction to Using *R*	**Read before class:** N/A **Technical help:** N/A **Further reading:** Cumming & Calin-Jageman, Chapter 10
2	January 14*	1. Correlation and Regression Redux: A New Look at an Old Topic 2. A Guide to Running Simple Correlation and Regression Designs in *R*	**Read before class:** University of Guelph Statistical Methods in Theses: Guidelines and Explanations **Technical help:** *DataCamp* Course on Linear Regression **Further reading:** Maxwell & Delaney (1993) Motulsky & Ransas (1987)

3	January 21*	1. More Fun with Regression: Adding Mediation, Moderation, and Suppression Effects to Your Model 2. A Guide to Analyzing and Interpreting Mediated and Moderated Regression Effects in *R*	**Read before class:** N/A **Technical help:** *Statistics of Doom Tutorial* on Regression with Mediation *Statistics of Doom Tutorial* on Regression with Moderation **Further reading:** Stone-Romero & Rosopa (2008) Aquinis & Gottfredson (2010) Pandey & Elliot (2010)
4	January 28*	1. Dealing with Categorical Predictors: t-tests/ANOVAs 2. A Guide to Running Independent Groups t-test and Oneway ANOVA Designs in *R* 3. A Guide to Running Multiple ANOVA Designs in *R*	**Read before class:** N/A **Technical help:** *Statistics of Doom* Tutorial on Oneway Between-Subjects ANOVA *Statistics of Doom* Tutorial on Oneway Within-Subjects ANOVA *Statistics of Doom* Tutorial on Multiple Between-Subjects ANOVA *Statistics of Doom* Tutorial on Multiple Within-Subjects ANOVA **Further reading:** Lix, Keselman, & Keselman (1996) Charness, Gneezy, & Kuhn (2002)
5	February 4*	1. The Weird Things We Assume About Our Data 2. A Guide to Testing Parametric Data Assumptions in *R* 3. A Guide to Running Non-Parametric Analyses in *R* when Some of Your Assumptions Fail You	**Read before class:** N/A **Technical help:** *Statistics of Doom* Tutorial on Data Screening for Assumptions **Further reading:** Hunter & May (1993) May & Hunter (2003) *PsychBrief* (2019) Blog Post on Analyzing Ordinal Data
6	February 11*	1. Categorical Outcomes: A Game of Probabilities 2. A Guide to Assessing Categorical Outcomes using Chi-Square and Logistic Regression Designs in *R*	**Read before class:** N/A **Technical help:** *DataCamp* Course on Multiple and Logistic Regression **Further reading:** McHugh (2013) Lewis & Burke (1949) Hsieh, Bloch, & Larsen (1998) Peng, Lee, & Ingersoll (2002) Jamieson (2004)

--	February 18	Reading Week (No classes scheduled)	**Read before class:** N/A **Technical help:** N/A **Further reading:** N/A
7	February 25*	1. Factor Models I: Exploratory Factor Analysis 2. A Guide to Running Exploratory Factor Analyses in *R*	**Read before class:** N/A **Technical help:** *DataCamp* Course on Dimensionality Reduction **Further reading:** Fabrigar et al. (1999) Costello & Osborne (2005) Hayton, Allen, & Scarpello (2004) Bollen & Lennox (1991) Hinkin (1991)
8	March 3*	1. Factor Models II: Confirmatory Factor Analysis 2. A Guide to Running Confirmatory Factor Analyses in *R*	**Read before class:** N/A **Technical help:** *DataCamp* Course on Factor Analysis Roseel's (2017) documentation on the *lavaan* package in *R* **Further reading:** Jackson et al. (2009)
9	March 10*	1. Structural Equation Models: Blending Regression with Factor Analysis for More Nuanced Models 2. A Guide to Building Structural Equation Models in *R* using the *lavaan* package	**Read before class:** Iacobucci (2009) **Technical help:** *DataCamp* Course on Structural Equation Modelling using *lavaan* Roseel's (2017) documentation on the *lavaan* package in *R* **Further reading:** Barrett (2007) Hooper, Coughlan, & Mullen (2008)
10	March 17*	1. The Dreaded Multilevel Statistics: A Primer on Random Effects Models and How to Handle Them 2. A Light (and only Minimally-Painful) Introduction to Running Multilevel Regression Designs in *R*	**Read before class:** Peugh (2010) **Technical help:** *DataCamp* Course on Mixed Effect Modelling **Further reading:** Scherbaum & Ferreter (2009) Green & MacLeod (2016)

11	March 24*	1. Latent Growth Models: Tackling Longitudinal Research by Combining SEM with Multilevel Analyses 2. A Guide to Running Latent Growth Models in *R*	**Read before class:** N/A **Technical help:** Statistics of Doom Tutorial on Latent Growth Modelling **Further reading:** McArdle (2009) Fan (2003)
12	March 31	1. Special Topics I: A Survivor's Guide to Multilevel Mediation 2. A Guide to Adding Indirect Effects to Your Multilevel Regression Designs in *R* 3. Final Thoughts: Inference, Ethical Data Stewardship, and the New Statistics OR 1. Special Topics II: A Brave New World of Bayesian Data Analysis 2. A Beginner's Guide to Breaking into (and not Buggering up) Bayesian Inference in *R* 3. Final Thoughts: Inference, Ethical Data Stewardship, and the New Statistics	**Read before class:** N/A **Technical help:** *Statistics of Doom* Tutorial on Multilevel Mediation Analyses **Further reading:** Bauer, Preacher, & Gil (2006) Zhang, Zyphur, & Preacher (2009) Preacher, Zyphur, & Zhang (2010) **Read before class:** N/A **Technical help:** *DataCamp* Course on Bayesian Analysis Fundamentals **Further reading:** Mulder & Wagenmakers (2016) Bayarri et al. (2016)

* Indicates a week where there is a minor assignment.

Methods of Assessment:

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Weekly Minor Assignments (70% of final grade)

One of the main goals for this course is to practice and build mastery over various data analytic techniques in *R*. To help meet this goal, you will be asked to use the techniques we cover during the lecture portion of our class to analyze a novel data set. Most weeks, there will be a minor assignment where we do this. Each minor assignment will primarily cover material that was taught during the corresponding lecture (although any given assignment may also cover fundamental *R* skills or concepts that we covered earlier in the semester; for example, loading data files).

These weekly activities will be structured in the following way: During class, we will work together to apply the analyses we covered at a conceptual level to a sample data set using *R*. During this time, the teaching assistant and I will be there to help answer questions about the

data and provide you with the scaffolding you need to complete the analysis. After class, you will then be asked to independently complete the same type of analyses on a new data set, and write up a short report on the research question, data, and conceptual interpretation of the results you obtained (this may involve revisiting the lecture slides, textbook readings, or external sources to help cement your understanding of the topic).

Once completed, the minor assignment should be submitted using the *CourseLink* Dropbox. 70% of each minor assignment grade will be based on your analysis of the data; the remaining 30% will be based on your conceptual interpretation of the results. Please include your full *R* script, the answer form for the results, and your conceptual write-up for all submissions. Unless otherwise stated, all submissions will be due by 11:59pm the night before our following class.

Independent Data Analysis Project (30% of final grade)

A second goal for this course is to help you think about research questions in terms of their logistics (data set-up, complexity and appropriateness of analyses, etc.), so that you're in a better position to plan out your methodology and analyze your data when running your thesis project (or other research work). To help meet this goal, the other major assessment for this course will involve you selecting an analysis method for a given data set; and running and interpreting your findings in an analysis report.

I will upload a simulated data file on our *CourseLink* page early in the semester. You will be asked to select a subset of variables from this data set that you would be interested in analyzing (instead of this simulated data set, you may also use actual data from other sources; such as archival data from your lab or open source data, pending my approval). You will then incorporate these variables into an analysis plan that you run and report on in an APA-style report. To get the most out of the project, I would encourage you to select your data and variables strategically; consider choosing something that fits well with a type of analysis you may need to master for your own research work.

Your final report should detail your research question(s); the operational variables and their proposed relations; what analysis or analyses you chose and why (i.e., what are you conceptually testing?); how you handled power, missing values, data cleaning, etc.; the results of the analyses; and, conclusions about the research question(s) you sought to test.

This paper should not exceed eight double-spaced pages (excluding a cover page, any references you feel are applicable, and any tables, figures, or appendices), and should be written in full-sentence APA style (i.e., 1" margins, 12-point Times New Roman Font). Once completed, your report should be submitted using the *CourseLink* Dropbox, along with your complete *R* script. Your report will be assessed in terms of its numerical accuracy, its replicability (i.e., whether your *R* script runs and is commented appropriately); the appropriateness of the analyses you ran; the thoroughness of your analyses (e.g., did you consider assumptions, missing data, etc.?); your adherence to APA formatting guidelines; and,

the extent to which your report demonstrates your understanding of the concepts we covered in class – and how those concepts pertain to the research question that you have selected.

Course Assignments and Tests:

Assignment or Test	Due Date	Contribution to Final Grade (%)	Learning Outcome(s) Assessed
Minor Assignments	Assessed throughout the semester	70% (8.75% x 8 weeks)	1, 3, 4, 5, 6, 8, 9, & 10
Final Data Analysis Project	April 3, 2020	30%	1, 2, 3, 4, 5, 6, 7, 8, 9, & 10

Additional Notes (if Required):

Given time restrictions, marks of the final analysis project may not be released until the final grade submission at the end of the semester.

Final Examination Date and Time:

There is no final exam for this course.

Course Resources

Required Texts:

There is no required text for this course; all assigned readings will be posted on *CourseLink* prior to the start of class**.**

Recommended Texts:

Cumming, G., & Calin-Jageman, R. (2017). *Introducing the New Statistics: Estimation, Open Science, & Beyond*. Routledge.

Other Resources:

***R* Statistical Software:**
We will be using *R* and *R Studio* to complete exercises in class. Both are free software. You can download and install them with the links below. I encourage you to do so before the first class, as these downloads may be too large to effectively download over the university's wifi network.

You should download the version of *R* that corresponds to your computer's operating system (see headings below). The pieces of software that I've listed here build off of one another; so for best results, please install them in the order that I've presented them in below:

For Windows users:
1) First, install *R*: here
2) Then, install *R Studio*: here

For MAC OSX users:
1) First, install *R* compatibility software (*XQuartz*): here
2) Then, install *R*: here
3) Then, install *R Studio*: here

CourseLink:

Assignments will be submitted via the *CourseLink* Dropbox. It is your responsibility to ensure that your assignments are submitted correctly. Please double check that you have done this correctly. Late submission penalties will apply in the case on incorrectly-submitted assignments.

DataCamp:

An active subscription to *DataCamp*, though not strictly required for success in this course, is recommended. There are a number of courses and technical resources offered there that may be helpful for practicing and understanding the analyses we'll be covering in class.

Course Policies

Grading Policies

Please be sure to submit all assignments by 11:59pm on the assigned date using the *CourseLink* Dropbox. Assignments submitted in any other way (e.g., email submissions to the instructor or teaching assistant) cannot be accepted. Marks will be docked for all late submissions (10% per day, including weekends).

Although there are 10 minor assignments in total this semester, only the best 8 of these will be counted towards your final grades (at a rate of 8.75% for each of the 10 assignments); your two lowest-marked minor assignments will be discounted.

Please note that these policies are binding unless academic consideration is given to an individual student.

Course Policy on Group Work:

All assignments must be completed on an individual basis. Collaborations among students for the purposes of writing assignments are prohibited. Any student(s) suspected of unauthorized

collaboration will be reported to the dean's office for an academic misconduct investigation (see the university's policy on academic misconduct below).

Course Policy on the Use of Electronic Devices and Recording of Lectures:

As with many classes at the University of Guelph, electronic recording of my classes is not allowed without prior consent. If I do permit recordings of our sessions, they are solely for the use of the authorized student, and may not be reproduced or transmitted to others without my express written consent.

Course Policy on Email Communication:

Where possible, I prefer that you come to my office hours to ask questions (especially as more substantive questions are often better handled in person, where I can help look through your data with you). To help with this, I am happy to hold office hours on an as-needed basis by appointment when it fits both of our schedules. Due to my current work and travel schedule, these office hours may be a combination of in-person and live online meetings.

That said, I am happy to answer emails about course policies, assignment expectations, or general inquiries, as long as I feel your question can be adequately answered in a single email (i.e., not a back-and-forth discussion). I reserve the right to ask students to come to either my in-person or online office hours to discuss any question if I feel it would be better addressed in a follow-up conversation (e.g., *R* help); or if it requires more substantive discussion than I can realistically provide in a single email. I will do my best to answer any email I receive within 24 hours.

University Policies

Academic Consideration

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor in writing, with your name, ID#, and e-mail contact. See the academic calendar for information on regulations and procedures for Academic Consideration:
Academic Consideration, Appeals, and Petitions

Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community, faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring.

University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor. The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
Academic Misconduct Policy

Accessibility

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 54335 or email accessiblity@uoguelph.ca or the Student Accessibility Services Website

Course Evaluation Information

Please refer to the Course and Instructor Evaluation Website**.**

Drop Date

The last date to drop one-semester courses, without academic penalty, is Friday, April 3rd, 2020. For regulations and procedures for Dropping Courses, see the Academic Calendar:
Current Graduate Calendar