Western University
Psychology
PSY 9551A
Experimental Design, Data Analysis, and Sample Size Calculation
Fall 2023
SSC 5220, Mon 1:30-4:30pm

Enrollment Restrictions
Enrollment in this course is restricted to graduate students in Psychology as well as any student in another program (pending class size) who has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student’s home program.

Instructor and Teaching Assistant Information
Instructor: Paul F. Tremblay
Office: SSC 6336
Office Phone: (519) 661-2111 x85644
Office Hours: by appointment
Email: ptrembla@uwo.ca

Teaching Assistant        TBD
Email                     TBD

Course Description
This course covers advanced experimental design, analysis of variance, and the general linear model. We begin with principles of descriptive and inferential statistics including sample size calculations for precision of estimates and statistical power using simulation procedures and software applications. The course includes methods of data inspection, visualization, and methods for handling missing data and non-normal outcomes such as robust statistics and bootstrapping. We then cover the main research designs and their associated ANOVA models for one-way, factorial, within-subjects, mixed between-within designs, and hierarchical designs. Also covered in these topics is the distinction between fixed and random factors, effect size estimates for meta-analysis, and power calculations. The course work consists entirely of lab assignments that provide hands-on training in generating hypotheses and designs, conducting power analyses and analyzing data, interpreting and reporting results. Demonstrations are provided using various software (e.g., R, Jamovi, SPSS).

Course Format
Lectures in person
Course Learning Outcomes/Objectives
Upon completion of this course, students should be able to:

1. Design studies with interactions and a mix of between- and within-subjects factors.
2. Conduct a sample size calculation for statistical power of an effect in any design or for precision of confidence intervals.
3. Conduct analyses and report results including tests, diagnostics, effect size, and visuals.
4. Make sound decisions about how to proceed with missing data and violations of assumptions using options such as robust statistics, bootstrapping, and improving measurement scale of outcome variable.

Course Materials
The following textbooks are optional and can serve as secondary resources. The first will be available online through our Western library and both can be accessed through the OWL course page. You will be able to download sections in pdf.


A list of supplementary articles and book chapters (available online through the library system or in the OWL course website) are listed below by lecture topics. These are additional resources that are discussed in the course and may serve you beyond this course in your own research.

Methods of Evaluation
The course work consists entirely of 6 equally weighted (~16.5% each) lab assignments provided every two weeks starting Sep 18. You will have two weeks to complete each assignment. These assignments provide hands-on training by having you generate hypotheses, analyze data, interpret and report results, conduct simulations, write mini research proposals, or evaluate published research. My lectures and demonstrations include presentations in R (and the related Jamovi software) and SPSS. Students are allowed to work in any software package or programming language of their choice including any not mentioned above (e.g., SAS, Stata, Python or MATLAB).

Assignment reports will typically consist of a two double-spaced page write-up including a short method section, results section including tables and/or figures, interpretation and discussion of results, answers to specific questions, and an appendix with analysis output.

Late assignments will receive a 5% deduction per 24 hours. Assignments that are more than one week late will not be accepted for partial marks unless you have contacted me to request an extension.
**Rules about working in groups.** I am supportive of students working in pairs or groups to conduct the analyses and discuss the assignments. However, you are required to write your own report with no duplication from your colleagues' work. The assignments will often require you to choose a subset of variables, to make decisions about plausible strategies, or to describe research ideas from your own area of interest. Also, some questions will ask you to design your own hypothetical research designs. As a result, it is unlikely that two students will work with the exact same material.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Due date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>Lab1</td>
<td>Oct 2</td>
<td>Data inspection, visualization, scales of measurement</td>
</tr>
<tr>
<td>Lab2</td>
<td>Oct 16</td>
<td>Simulation to understand Type I error rate and power</td>
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<tr>
<td>Lab3</td>
<td>Nov 6</td>
<td>Sample size calculation for power and precision</td>
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<tr>
<td>Lab4</td>
<td>Nov 20</td>
<td>Factorial ANOVA, interactions and power analysis</td>
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<td>Lab5</td>
<td>Dec 4</td>
<td>Split plot (mixed factor) ANOVA</td>
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<tr>
<td>Lab6</td>
<td>Dec 18</td>
<td>Running a small meta analysis in Jamovi or R</td>
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Each of these assignments will be provided to you, two weeks prior to the due date.

**Course Timeline**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Book chapters*</th>
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<tbody>
<tr>
<td>1</td>
<td>Sep 11</td>
<td>Overview, causality, scales of measurement</td>
<td>HV&amp;L 1</td>
</tr>
<tr>
<td>2</td>
<td>Sep 18</td>
<td>Data inspection, visualization, missing data analysis</td>
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<tr>
<td>3</td>
<td>Sep 25</td>
<td>Sampling distributions, confidence intervals</td>
<td>HV&amp;L 2, 3, 4; L 7</td>
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<tr>
<td>4</td>
<td>Oct 2</td>
<td>Inferential statistics (NHST), error rates, power</td>
<td>HV&amp;L 5, 6; L 1, 2</td>
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<tr>
<td>5</td>
<td>Oct 9</td>
<td>t-tests, effect size estimation, robust stats, bootstrap</td>
<td>HV&amp;L 7; L 6</td>
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<tr>
<td>6</td>
<td>Oct 16</td>
<td>Sample size calculation for power and precision</td>
<td>L 8, 9</td>
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<tr>
<td>7</td>
<td>Oct 23</td>
<td>Experimental design and one-way ANOVA</td>
<td>HV&amp;L 9, 11, 12</td>
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<tr>
<td>8</td>
<td>Read wk</td>
<td></td>
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<tr>
<td>9</td>
<td>Nov 6</td>
<td>Factorial ANOVA and interactions</td>
<td>HV&amp;L 13</td>
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<tr>
<td>10</td>
<td>Nov 13</td>
<td>Repeated measures and analysis of change</td>
<td>HV&amp;L 15</td>
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<tr>
<td>11</td>
<td>Nov 20</td>
<td>Split plot (mixed factor) ANOVA and hierarchical designs</td>
<td>HV&amp;L 15</td>
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<tr>
<td>12</td>
<td>Nov 27</td>
<td>Adding continuous covariates to your designs</td>
<td>HV&amp;L 14</td>
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<tr>
<td>13</td>
<td>Dec 4</td>
<td>Introduction to meta-analysis</td>
<td>L 11</td>
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*HV&L: Hahs-Vaughn & Lomax (2020); L: Lakens (2022)

Additional resources for lecture topics (list may be slightly updated before start of course)

**Sep 11.**

**Sep 18.**

**Sep 25.**

**Oct 2.**

**Oct 9.**

**Oct 16.**

**Oct 23.**

**Nov 6.**

**Nov 13.**
Nov 20.

Nov 27.

Dec 4.

Statement on Academic Offences
Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

Health/Wellness Services
Students who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.
Accessible Education Western (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program.

Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW), a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.