

82:251 – FUNDAMENTALS OF PSYCHOLOGICAL RESEARCH II – A01

Winter Semester: January 7th – April 4th 2025
Lectures: Mon, Wed, and Fri: 1:40pm – 2:30pm Room: BB – 1-53
Labs: Thursdays: 1:40pm – 4:30pm Room: G-20 C

Instructor: Nicholas Watier, PhD
E-mail: WatierN@BrandonU.ca
Course Resources: Moodle for grades, lab quizzes, lecture slides and recordings, lab manuals and instructional videos (moodle.brandonu.ca; key: 82251)

Office hours: I am available by appointment usually before or after class

Course Description (from the course calendar): Prerequisite: 82:250. This course will deal in detail with several types of research designs that are widely employed in Psychology. These designs will be examined in terms of the underlying rationale, the advantages and disadvantages, the empirical and statistical procedures, and the interpretation of the data obtained from the designs. Topics to be dealt with include randomized and matched two- group designs, one-way designs, two-factor factorial designs, within subject designs, Solomon 4-group design, quasi-experimental designs, and small-n designs. (Required for all Psychology majors and normally to be taken during the second year of the student's program). 3 lecture hours per week, 3 laboratory hours per week, one term.

Course Description (from the perspective of the instructor): Now the fun begins. We will be incorporating everything that you have learned in *Fundamentals to Psychological Research I* to discover new tools and techniques that describe, visualize, analyze, and generalize data from psychological research. We will spend a considerable amount of time focusing on how to determine if the results from an experiment are due to the manipulation or simply due to chance. More poetically, we will be learning why calculating the mean of means, the mean of variances, the variance of means, and sometimes the variance of variances results in something meaningful. **Wild speculation and conjecture are encouraged.** Emphasis will still be placed on conceptual rather than computational understanding.

At the end of the course, if you gave an honest effort and asked a lot of questions, then you should be able to:

- ❖ Determine which statistic is appropriate for different research scenarios
- ❖ Correctly interpret the outcome of a particular statistical test
- ❖ Understand how the conceptual meaning of a statistic relates to its formal (i.e. mathematical) meaning
- ❖ Conduct statistical analyses using specialized computer software

Textbook: While a textbook is not required for this course, the following textbook is recommended: Gravetter, F.J., Wallnau, L.B., Forzano, L.B., & Witnauer, J.E. (2020). *Essentials of Statistics for the Behavioral Sciences (10th Ed)*. Belmont, CA: Wadsworth. If you have access to an earlier edition, feel free to use it. If you have another statistics textbook that suits your learning style and overlaps with the content of this textbook, you can use it. Past students have done well in the course without the textbook, whereas others have indicated that the textbook was critical in obtaining an 'A' grade. I personally think that the practice questions in the textbook, even in earlier editions, are alone worth the cost.

Content: The course is structured into three parts. The first, which will last until the end of January, will largely focus on a review of descriptive statistics and on applying the Null Hypothesis Framework to single-sample designs. The second, which will last until the end of February, will focus on single factor designs with only two levels. Attention will then shift to single factor designs with multiple levels and two-factor designs, which will last until the end of March. If time permits, the course will end with correlational analyses.

Course Outline (approximate temporal sequences of Lectures and Labs)

1. Review of Descriptive Statistics, Statistical Inference, and Null Hypothesis Testing (NHT)
 - a. Mean and Standard Deviation
 - b. Z-Scores and the Normal Curve
 - c. Treatment vs. Chance
 - d. Test Statistics
 - e. $P(D|H_0)$ & Sampling Distributions
 - f. Statistical Significance
 - g. Steps in NHT
 - h. Alpha, Critical Region, p-values
 - i. One vs. Two-Tailed Tests
2. Errors, Power, and Effect Size
 - a. Type I & Type II Errors
 - b. Power
 - c. Factors affecting Power
 - d. Measures of Effect Size
3. Single-Sample T-Test
 - a. Single-Group Post-Test Designs
 - b. t -Distribution
 - c. Calculation of test statistic
4. Independent-Measures T-Test
 - a. Single Factor Between-Subject Designs with 2 levels
 - b. Calculation of test statistic
 - c. Distribution of Difference between Sample Means
 - d. Homogeneity of Variance
 - e. r^2
5. Limitations of NHT and Confidence Intervals
 - a. Logic of NHT Revisited
 - b. Criticisms of NHT
 - c. Confidence Intervals
6. Repeated-Measures T-Test
 - a. Single Factor Within-Subject Designs with 2 levels
 - b. Difference Scores
 - c. Calculation of test statistic
 - d. Distribution of Mean Difference Scores
7. One-Way ANOVA
 - a. Experimentwise vs. Testwise Alpha
 - b. Between vs. Within Variability
 - c. Test Statistic and F-Distribution
 - d. Post-Hoc Tests
8. Repeated-Measures ANOVA
 - a. Individual Differences
 - b. Between Subject Variability
 - c. Test Statistic
 - d. Post-Hoc Tests
 - e. Sphericity
9. Factorial ANOVAs
 - a. Describing Factorial Designs
 - b. Main Effects and Interactions
 - c. Mean Plots
 - d. Partitioning Variance
 - e. Calculation of Test Statistics
10. Correlational Designs (if Time Permits)
 - a. Analyses in Correlational Designs
 - b. Correlational Coefficients
 - c. Factors affecting Correlation

Lab Title	Lab Date
Fundamentals of R	Jan 9 th
Review of NHT, Descriptive Statistics in R	Jan 16 th
Identifying and Filtering Outliers	Jan 23 rd
Single Sample T-Test	Jan 30 th
Independent Measures T-Test	Feb 6 th
Data Analysis Assignment #1 Help Period	Feb 13 th
Repeated Measures T-Test	Feb 27 th
One-way ANOVA	March 13 th
Repeated-Measures ANOVA	March 20 th
Data Analysis Assignment #2 Help Period	March 27 th

Evaluation: Eight laboratory quizzes, two data analysis assignments, and one final exam. Each lab quiz is worth 2% of your final grade. The assignments are each worth 22%, and the final exam is worth 40%.

Evaluation Item	Course Material that the Item will Cover	Due Date	Proportion of Final Grade
Data Analysis Assignment # 1	Topics: 1 to 4	February 14 th	22%
Data Analysis Assignment # 2	Topics: 5 to 8	March 28 th	22%
Lab Quizzes	Topics: 1 to 8	Thursdays by Midnight	16%
Final Exam	Everything	TBD	40%

Labs: The labs largely involve learning how to use a statistical programming language called R, which is required for the Data Analysis Assignments. R is one of the most popular programming languages for data scientists. It is free and available on Mac, Windows, and Linux. R is installed on all of the computers in G20-C, and Lab #1 will show you how to download and install it on your personal computer.

I have written a lab manual and created instructional videos for this course. The lab manual and videos contain step-by-steps instructions for conducting analyses in R. Each lab has a corresponding video and entry in the lab manual, and all of the entries and videos are posted on Moodle. It is expected that you will rely on these entries and/or videos to complete the lab quizzes. You should watch the video and/or read the entry before starting the lab quiz. Trying to do both simultaneously usually leads to disaster. While watching the video and/or reading the manual, repeat the same steps that I perform, and pay attention to how I interpret the output. Afterwards, you can then work on the Lab Quiz for that week.

Each weekly lab manual and video will be released on Moodle on Mondays, whereas the lab quizzes will be released on Thursday mornings and are due that same day by midnight, with the exception of the first lab quiz, which is due on Jan 12th. I will be available on Thursdays during the lab period in G-20C for help. You are encouraged to work on the lab during the lab period and ask questions when needed.

Data Analysis Assignments: The data analysis assignments are take-home. Each student will be randomly assigned to a particular research scenario, and then answer questions and analyze data pertaining to the scenario. The questions in the assignments will be similar to those presented in the labs and during the lectures. The instructions, questions, and data sets will be emailed to students five days prior to the due date, and students are to email their answers to me by midnight of the due date. Answers to the questions on the assignment must use the same R code and steps as those presented in the labs. Alternative approaches to the code or to the sequence of steps will not be accepted.

Final Exam: The final exam is in person and will involve a series of short-answer questions that cover all of the content in the course, including the labs. Two review classes will be held before the final exam. Plan accordingly. **I encourage you to ask any questions you want during the review.**

Extensions: If you are unable to submit an evaluation item, please notify me prior to the due date. In general, if you require an extension, I will grant one. Unless otherwise requested, I do not need supporting documentation. I understand that moments occasionally arise where it seems that factors beyond worldly comprehension have manifested and conspired to solely undermine your ability to perform and focus on your studies (e.g. death, illness, family responsibilities). These moments, while distressing, should not ultimately impede your progress, as long as you have been taking your studies seriously up to that point. As such, an extension is reasonable accommodation to grant. That said, if I obtain the impression that students are taking advantage of me or are simply trying to avoid responsibility, no extension will be granted, and you will receive a late penalty whose magnitude is determined by individual circumstances, including a grade of zero.

How to Succeed: Think, speculate, discuss, attend class, read a textbook, complete the practice questions at the end of a textbook, practice, practice, practice, practice, ask questions, give yourself plenty of time to complete the lab quizzes and assignments, and most of all, **practice and ask questions**. Statistics is a hierarchically organized and cumulative discipline. If you don't grasp the basics (i.e. mean, variability, standardization, inference using a normal curve), then the more complex topics will seem herculean. Constantly working on practice problems and reflecting on your understanding is crucial. If I do a poor job of explaining something, tell me. If you don't quite fully understand something, ask a question. If I can't answer the question in class, arrange to meet with me to go through it in more detail. This is especially important at the beginning of the course. Most statistical concepts build on antecedent statistical concepts; consequently, it is critical that you pay attention and consistently reflect on your understanding.

Calculator: A scientific calculator would be helpful for this course. Some questions on the test require calculations that would be tedious and time consuming to do by hand. Some of the lectures will require calculations to be completed during class.

Mathematics: Appendix A of the textbook contains an excellent mathematics review. You will be expected to know the order of operations and how to use fractions, decimals, proportions, exponents, roots, and algebra to solve linear equations with one unknown (e.g. $2x = 6$, what is x ?).

Attendance: All of you are autonomous, independent, and capable of making your own decisions as to how you should spend your time and money, but remember this: You paid approximately 500\$ for this course, and not only will you learn something, but you might actually enjoy it as well, so I encourage you to attend class.

Accessibility Services: Brandon University values diversity and inclusion, recognizing disability as an aspect of diversity. Our shared goal is to create learning environments that are accessible, equitable, and inclusive for all students. The Student Accessibility Services (SAS) office works with students who have permanent, chronic, or temporary disabilities. SAS will provide and/or arrange reasonable accommodations. If you have, or think you may have, a disability (e.g. mental health, attentional, learning, vision, hearing, physical, medical, or temporary), you are invited to contact Student Accessibility Services to arrange confidential discussion at (204) 727-9759. If you are registered with SAS and have a letter requesting accommodations, you are encouraged to contact the instructor early in the term to discuss the accommodations outline in your letter. Additional information is available at the Student Accessibility Services website.

Psychology Department Statements Regarding Rewrites & Waiving Pre-Requisites:

The Psychology Department does not permit individual student rewrites of any exams (or any other alternate form of assessment).

The Psychology Department will not waive prerequisites unless the student can display sufficient background knowledge and/or experience. The student must provide the request to the department in writing for approval with appended documentation.

Letter Grade Equivalents:

A+ 90-100%	B+ 75-79%	C+ 61-64%	D 50-53%
A 85-89%	B 70-74%	C 57-60%	F Below 50%
A- 80-84%	B- 65-69%	C- 54-56%	

Academic Integrity: Academic fraud will not be tolerated. Academic fraud includes, but is not limited to: plagiarism, cheating, submitting assignments from other courses, misuse of AI, and falsifying research data.

As stated in the Senate Policy on Academic Integrity (<https://www.brandonu.ca/senate-office/senate-policies/>) students that are suspected of departing from academic integrity will have a hold placed on their course withdrawal eligibility, meet with the professor to determine student's responsibility for departure, and if the student was deemed responsible, face sanctions from the Dean, including: a grade of zero on the assignment, a grade of F-AD in the course, or expulsion from the university.

Most of the evaluations for this course are take-home. The reason being is that I want you to spend time **THINKING** about statistics, and not memorizing the material so you can regurgitate it on an in-class test. You will rarely ever be in a position where you only have 50 minutes to analyze a data set and answer questions about statistics without access to any resources. Consequently, I opted to give you the opportunity to work at your own pace, think about the questions carefully, and provide an answer that reflects your understanding rather than a verbatim output of a textbook.

Unfortunately, this method of evaluation opens the possibility of plagiarism, misrepresentation, and other methods of cheating. **Students that are suspected of copying off each other or using AI to obtain answers will risk failure in the course and dismissal from the university.** Every year - E-V-E-R-Y Y-E-A-R! – at least one student tries to cheat on the evaluation items. Do not be seduced into thinking that you will not face any consequences. I monitor purported “homework help” websites (chegg, coursehero) and other on-line communities for students posting questions from the assignments and labs. I purposely feed ChatGPT and other large language models wrong answers to the questions. I would rather that you come see me and we work something out together rather than having the questions posted in a public forum and risk failing the course.