NSCI 202 – Spring 2026

Experimental Design and Data Analysis

Thursday 2:00-4:40pm

Meliora 178

Instructor: Renee M. Miller, Ph.D.

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TA: Caleb Mahlen

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Content: This course will use existing data sets to teach students about proper experimental design in the context of different kinds of questions in neuroscience. We will consider the strengths and weaknesses of different techniques and methods in neuroscience and how the choice of experiment design depends upon the hypothesis of the researcher. Students will be given raw data from actual experiments. Together, we will analyze the data using various statistical methods like t-test, ANOVA and MANOVA. Finally, students will learn to effectively graph the results and present them in both written and poster format. There will be two main research projects: one on ligand-receptor interactions and one on a Parkinson's disease model.

Credit hours: This four credit hour course meets in person once per week. To make up the additional hour required for accreditation, students will meet in small groups outside of class to engage in a journal club discussion of a recent research paper. Attendance at both sessions is mandatory. Journal article summaries will be due the Wednesday before class each week (except as noted).

Evaluation: Students will be graded on weekly journal club article summaries, participation in class, successful completion of assignments and a final written and poster presentation.

Journal Summaries: 15%

Assignments and Quizzes: 50%

Final Poster: 25%

Participation: 10%

Letter grades are assigned as follows:

A 90-100

A- 88-89

B+ 87

B 80-86

B- 78-79
C+ 77

C 70-76

C- 68-69
D+ 67

D 60-66

E <60

<u>Policies:</u>

- *Academic Honesty:* All assignments and activities associated with this course must be performed in accordance with the University of Rochester's Academic Honesty Policy. You are encouraged to discuss course readings and assignments with your fellow students. However, all written work must be done independently and not in collaboration with another. In order to make appropriate help available for your written assignments, I encourage you to consult with me and/or with the College Writing, Speaking and Argument Program. The final research paper will require citations and "Works Cited" following standard PubMed format.

- *Plagiarism:* Please refer to the Honesty Policy (www.rochester.edu/college/honesty) for a definition of plagiarism. In scientific writing, plagiarism includes improper citation of primary sources. PubMed has a handy "Cite" function that I encourage you to use. Sources must be given regardless of whether the idea, phrase or other material is quoted directly, paraphrased or summarized in the student-writer's own words. Direct quotes must always be placed in quotation marks in addition to the other citation information that is required, but **quotes should be used almost never in scientific writing.**

If you use an AI like ChatGPT for the purpose of "cleaning up" or "professionalizing" your written work, I require that you hand in the before and after versions of the assignment. There will be no penalty for using ChatGPT or similar for this purpose as long as it is declared but this is the only allowable use of the technology. The unsanctioned use of such technologies or failure to cite them will be considered a violation of the policy for this course.

- *Attendance:* Excused absences include illness with Doctor's note, documented family emergencies, University related travel (sports, debate, etc.), and interviews. It is always better to come to class late or leave early if necessary, rather than missing an entire lecture. I am not a physician and cannot excuse you due to your reports of mental illness (e.g. anxiety, depression), nor am I authorized to make accommodations for reason of mental illness. Please be proactive in meeting with Disability Services if you anticipate any difficulty in attending class or completing work this semester.

Course Schedule

Jan 22: Introduction to the course and participants

       Overview and Anatomy

       Human vs. Animal studies

       Ethical Considerations

Jan 29: Methods in Neuroscience

       Invasive vs. non-invasive methods

       Imaging, EEG, Stimulation, Measuring protein & mRNA, Behavior +

Feb 5: Statistics in Neuroscience

       Statistical Tools: JASP, Python, R

       Journal Club meets (summary due Feb 11)

           JC1: REMSD and NE

       Quiz: methods in neuroscience

Feb 12: Experimental Design

       How to answer your neuroscience research questions

       Journal Club meets (summary due Feb 18)

           JC 2: Glia regulate photoreceptor development

Assignment: Write up the justification for your experimental design in the given scenarios (1 page, due Feb 16)

Feb 19: Caleb's fMRI project – Initial Analysis

Introduction to fMRI data analysis, Python, and Jupyter Notebook

Analyze fMRI connectivity data to find correlations with other biological information

Assignment: Write up the results for oral presentations on Feb 26.

Feb 26: Caleb's fMRI project - Replication

Give brief presentations on findings from Week 1

Attempt to replicate your results using additional new fMRI data

Assignment: Write up the results for oral presentations March 5.

Journal Club meets (summary due Mar 3)

JC 3:

Mar 5: Oral presentations of fMRI analysis and discussion of lessons learned

How common is failure to replicate? (ASD data)

Mar 12: SPRING BREAK

Mar 19: Sniffy Operant Conditioning

Journal Club (summary due March 25)

JC 4: Food and Cocaine Reinforcment

Assignment: Write up the results and discussion of your Sniffy experiments (due March 23)

Mar 26: RNAseq and other OMICS data: Validation, hypothesis generating vs. testing

    Journal Club (summary due April 1)

        JC 5: mtDNA omics in Aging

Apr 2: Behavioral Genetics- Ryan et al paper

    Quiz: Omics

    Journal Club (summary due April 8)

        JC 6: NP receptor underlies sex difference in experience learning in c. elegans

Apr 9: Behavioral Genetics- Ryan et al paper con't

    Assignment: Write an outline of a full-length research paper (due April 15)

Apr 16: PD behavior and 6-OHDA lesion data/paper and poster FINAL PROJECT

    Assignment: Write introduction and methods sections for poster (due April 20)

Apr 23: PD behavior and 6-OHDA lesion data/paper and poster FINAL PROJECT

    Assignment: Make the final poster and practice for presentation

Apr 30: FINAL POSTER PRESENTATIONS