

85311 MODERN RESEARCH METHODS: CUMULATIVE SCIENCE, BIG DATA, AND META-ANALYSIS

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This site contains the syllabus, schedule, and resources for PSYCH 85311 (Spring 2020).

The scientific process is inherently **cumulative**: Scientific understanding moves forward by building on the theories, methods, and findings of individual scientists. The broad aim of this course is to teach you a set of practical, modern tools for conducting psychological research that facilitate cumulative scientific progress.



INSTRUCTOR

👤 [Dr. Molly Lewis](#)
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🏠 Porter 223A
🕒 Office Hours: W 3:00-5:00pm

TA

👤 [Jaeah Kim](#)
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🏠 Baker 455E
🕒 Office Hours: M 1:00-3:00pm

COURSE

📅 MW (lecture); F (lab)
🕒 10:30-11:50am
🏠 Lecture: Baker 336B
🏠 Lab: Baker 332P

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SYLLABUS

COURSE OBJECTIVES

The course has two related goals: (1) Provide a theoretical understanding of the scientific process and the role of cumulative science, and (2) introduce you to a set of modern tools for conducting science in this framework. Specifically, you'll be able to:

- Understand the basic principles of experimental design and the cumulative scientific process

- Use R/RStudio and the tidyverse framework (Wickham, 2017) for conducting basic data analysis

- Present visualizations of data using Grammar of Graphics principles (Wickham, 2010)

- Implement reproducible workflows

- Conduct a basic meta-analysis

In addition, the course will introduce you to a range of other tools ([Github](#), [Rpubs](#), [Open Science Framework](#), web experimental frameworks, metafor) that are useful in psychological research.

COURSE OVERVIEW

The course is organized into four units. The **first unit** will introduce the philosophy of cumulative science and the main themes of the course. The **second unit** will focus on tools for conducting a single experiment. In this unit, we'll learn tools for analyzing and visualizing data within the tidyverse (Wickham, 2017) framework. We'll also learn tools for creating a reproducible workflow in experimental research. In the **third unit**, we'll introduce the Null Hypothesis Testing framework and the concept of replication. As a class, we'll conduct an online replication of a single experiment. Finally, the **fourth unit** will focus on a quantitative approach to synthesizing the results of many experiments: meta-analysis. The basic principles of meta-analysis will be introduced, and students will conduct an original meta-analysis as a final project.

COURSE MATERIALS

The readings in this class are free and will be provided on the course website. There is no book for the course.

The course will make heavy use of [R](#) and [RStudio](#). Course assignments will be completed using [Rstudio Cloud](#). You do not need to download anything for the course – the only thing you'll need is an internet connection with a web browser.

REQUIREMENTS

This course assumes no prior programming experience, but does require a willingness to learn and be challenged. Prior familiarity with any programming language (e.g. R, Python, Matlab), however, will be helpful in the course.

POLICIES

Participation

Learning a new “language” (in this case, R) and the other skills in this course require hands-on involvement, and you will get the most out of this class if you actively engage in the material. Students are therefore expected to complete readings and participate in class. Lecture slides will be posted after class each day, but reading these slides is only a partial substitute for class attendance.

Late Work

Late work policy for the assignments and midterm:

next day: lose 25% of total possible points

later than next day: lose all points

Late work policy for the final project: 10% off for each day late.

Take care of yourself

Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress. All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at <http://www.cmu.edu/counseling>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone at CaPS immediately, day or night: You can also call the Re:solve Crisis Network (888-796-8226). If the situation is life threatening, call the CMU police (412-268-2323), or call 911.

Accommodations for Students with Disabilities

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Respect in the Classroom

It is my intent to present materials and activities that are respectful to the diverse

backgrounds and perspectives of students in the classroom. You may feel free to let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. If you feel uncomfortable discussing this with me or your TA, you may voice your concerns to the Chair of the Department of Psychology Diversity and Inclusion Committee, Timothy Verstynen (timothyv@andrew.cmu.edu). Dr. Verstynen is available to hear your concerns related to respect for diversity for any psychology class you are taking.

Cheating and Plagiarism

Cheating and plagiarism are defined in the CMU Student Handbook, and include (1) submitting work that is not your own for assignments or exams; (2) copying ideas, words, or graphics from a published or unpublished source without appropriate citation; (3) submitting or using falsified data; and (4) submitting the same work for credit in two courses without prior consent of both instructors. Any student who is found cheating or plagiarizing on any work for this course will receive a failing grade for that work. Further action may be taken if necessary, including a report to the dean.

ASSIGNMENTS AND GRADES

Attendance and Participation

Attendance and participation in lecture and lab is expected. If you miss 4 scheduled class sessions (lectures/labs), your grade will drop by a letter grade. For every four classes you miss past that, your final grade will drop by another letter grade. I expect you to participate in discussions (e.g., asking and answering questions) and activities. Your active participation in lecture and lab can earn you up to 16 points in your final grade.

Lab Assignments

There will be 8 Lab Assignments throughout the semester. The goal of these assignments is to give you hands-on experience with the skills that are introduced in lecture and in lab. You are welcomed, and encouraged, to work with each other on the problems. But, you must turn in your own work.

Submission instructions: Always submit the .Rmd and .HTML files via XX.

Midterm Exam

There will be a take-home midterm exam that will assess your conceptual understanding of the topics covered in the first part of the semester through short answer responses.

Final project

The final project will be an original meta-analysis on a topic in cognitive or developmental psychology. You are encouraged to work on the project in groups of 1-3; however, each student must complete their own final write-up. Scope and topics of the meta-analysis will be decided in consultation with me.

There is no final exam. This project is your final exam.

Assignment Grades

Assignment	Percent	Points
Participation	5.0%	16
Lab Assignments (8 × 20)	50.0%	160
Midterm	15.0%	48

Final Meta-analysis Assignment [Proposal = 16; Presentation = 30; Writeup = 50]	30-38%	96 Points
Total		320

Grade	Range
A	90–100%
B	80–89%
C	70-79%
D	60-69%

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SCHEDULE

Here's the roadmap for the semester.

-  Readings should be completed *before* each class session
-  Slides and other class materials will be added on the day of class
-  Assignments are due at noon on the day they are due

PHILOSOPHY OF CUMULATIVE SCIENCE		READING	SLIDES	NOTES
Week 1 [M, 1/13]	Introduction to the course			Welcome!
[W]	The scientific process as cumulative			
[F]	<i>Lab: Getting started with R</i>			We're in Baker 332P. Skills: Rstudio cloud, basic operations in R, loading packages, anatomy of a help file
THE SINGLE EXPERIMENT		READING	SLIDES	NOTES
Week 2 [M, 1/20]	No Class (MLK)			
[W]	Experimental data and design			Skills: quantitative/qualitative variables, tidy data
[F]	<i>Lab: Intro to dplyr</i>			Skills: pipe operator, reading/writing data, filter, select;  A1 posted
Week 3 [M, 1/27]	Summarizing data			Skills: mutate, group_by, summarize
[W]	Visualization: Intro to grammar of graphics			
[TH]	 A1 Due			
[F]	<i>Lab: Working with ggplot</i>			Skills: ggplot and histograms;  A2 posted
Week 4 [M, 2/3]	Visualization: Principles of data visualization			
[W]	The rest of the tidyverse			Skills: joining, wrangling; writing a function
[TH]	 A2 Due			

	[F] <i>Lab: More tidyverse</i>			📅 A3 posted
Week 5 [M, 2/10]	More tidyverse	📖	💻	
	[W] Reproducibility (and the failures)	📖	💻	
	[TH] 📅 A3 Due			
	[F] <i>Lab: Reproducible workflows (OSF/Github)</i>	📖		📅 A4 posted

REPEATING AN EXPERIMENT












		READING	SLIDES	NOTES
Week 6 [M, 2/17]	Statistical Foundations: Distributions	📖	💻	Skills: sampling, distributions, variance
	[W] Statistical Foundations: Null Hypothesis Testing	📖	💻	Skills: two-sample t-test, ES, and CIs
	[TH] 📅 A4 Due			
	[F] <i>Lab: Statistical Foundations: Effect Sizes/Confidence Intervals</i>			📅 A5 posted
Week 7 [M, 2/24]	Statistical Foundations: Power Analysis	📖	💻	Skills: review + basic power analysis in R
	[W] Replication (and the failures)	📖	💻	
	[TH] 📅 A5 Due			
	[F] <i>Lab: Midterm Review</i>			📅 Midterm posted
Week 8 [M, 3/2]	Research practices affecting replication	📖	💻	
	[W] Pre-registration and other replication solutions	📖	💻	
	[F] MIDTERM DUE			

— SPRING BREAK —

Week 9 [M, 3/16]	Research on the Web	📖	💻	
	[W] Research on the Web	📖	💻	
	[F] <i>Lab: Analyzing replication data</i>			📅 A6 posted

AGGREGATING MANY EXPERIMENTS

		READING	SLIDES	NOTES
Week 10 [M, 3/23]	Intro to meta-analysis			

	[W]	Identifying a sampling frame		
	[TH]	 A6 Due		
	[F]	<i>Lab: Conducting a MA</i>		 A7 posted
Week 11 [M, 3/30]		Coding meta-analytic data		
	[W]	Effect sizes for meta-analysis		
	[TH]	 A7 Due		
	[F]	<i>Lab: Intro to metafor</i>		 A8 posted
Week 12 [M, 4/6]		Analyzing MA data		
	[W]	Plotting meta-analytic data		
	[TH]	 A8 Due		
	[F]	<i>Lab: Plotting in metafor</i>		 Final Project posted
Week 13 [M, 4/13]		Big data beyond the lab: Large scale web experiments		
	[W]	Big data beyond the lab: Found data		
		 MA Proposals Due		
	[F]	<i>No Lab (Spring Carnival)</i>		
Week 14 [M, 4/20]		Group meetings		
	[W]	Group meetings		
	[F]	<i>Lab: Work on Projects</i>		
Week 15 [M, 4/27]		Project Presentations		
	[W]	Project Presentations		
	[F]	<i>No Lab</i>		
	[F, 5/8]	FINAL PROJECT DUE (noon)		

This is a tentative schedule, and details may change as the semester progresses.