PSYCH 490.002 Spring 2023

Class Number 18701

Rick O. Gilmore, Ph.D.

2023-04-25

Contents

Part I

Syllabus

About the course

The reproducibility crisis in science
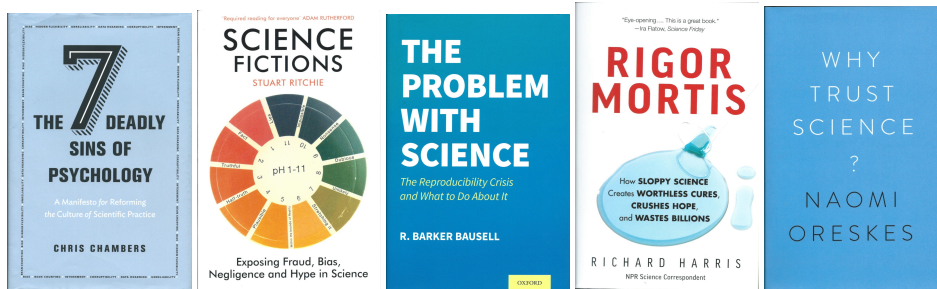
Much attention has focused on the reproducibility of research in psychology, but the challenges of producing robust and reliable knowledge extend to all scientific disciplines. In this seminar, we will discuss whether there is or is not a reproducibility crisis in psychology and in science more broadly. We will discuss how initiatives to make scientific research more open and transparent can also make it more reproducible and robust.

Instructor

Rick O. Gilmore, Ph.D. Professor of Psychology rog1 AT-SIGN psu PERIOD edu

Schedule an appointment: https://psu.zoom.us/my/rogilmore Lab web site: https://gilmore-lab.github.io

Teaching Assistant

Garrett Thomas. M.S. gat84 AT-SIGN psu PERIOD edu

Meeting time & location

Tuesday and Thursday 10:35 AM - 11:50 AM ET Nursing Sciences Building 323

Schedule

January 9 - 13

Tuesday, January 10

- Introduction to the course
- Read

  - Feynman (1974).
  - (Harris 2017), Chapter 1, Begley's Bombshell. PDF on Canvas.
  - Optional Begley and Ellis (2012)

- Class notes

Thursday, January 12

- How science works (or should)
- Read

  - (Ritchie 2020), Chapter 1. Alternate link to PDF on Canvas.
  - Brian A. Nosek and Bar-Anan (2012). Alternate link to PDF on Canvas.
  - Optional (Sagan 1996), Chapter 12, The Fine Art of Baloney Detection. PDF on Canvas

- Class notes

January 16 - 20

Tuesday, January 17

- Scientific norms and counter-norms
- Read
  - (Merton 1973). PDF on Canvas.
  - Mitroff (1974). PDF on Canvas.
- Assignment
  - Complete (anonymous) survey on scientific norms and counter-norms. **No write-up**.
- Class notes

Thursday, January 19

- Adherence to norms and counter-norms
- Read
  - Kardash and Edwards (2012).
  - Macfarlane and Cheng (2008).
- Skim
  - Anderson et al. (2010).
  - Kim and Kim (2018).
- Assignment
  - Exercise 01: Norms and counter-norms write-up
- Class notes

January 23 - 27

Tuesday, January 24

- A replication crisis (or not)
- Read
  - (Ritchie 2020), Chapter 2. PDF on Canvas.
  - Begley and Ellis (2012)
  - (Optional) (Oreskes 2019), Chapter 7, pp. 228-244.
- Class notes

Thursday, January 26

- Replication failure: The "Lady Macbeth Effect"
- Read

    – Zhong and Liljenquist (2006)
    – Earp et al. (2014)

- Due

    – Exercise 01: Norms and counter-norms write-up

- Class notes

January 30 - February 3

Tuesday, January 31

- Replication failure: Priming effect
- Read

    – Bargh, Chen, and Burrows (1996); PDF on Canvas
    – Doyen et al. (2012)

- Class notes

Thursday, February 2

- Replication in cancer biology
- Read

    – Errington, Mathur, et al. (2021)
    – Errington, Denis, et al. (2021)

- Class notes

February 6 - 10

Tuesday, February 7

- The 4 (5?) Rs

- Read

    - Brian A. Nosek et al. (2022)
    - Goodman, Fanelli, and Ioannidis (2016)

- Skim

    - Fidler and Wilcox (2021)

- Class notes

Thursday, February 9

- Fraud & misconduct
- Read

    - (Ritchie 2020), Chapter 3
    - Bhattacharjee (2013)
    - (Skim) Levelt, Drenth, and Noort (2012)
    - (Skim) Carpenter (2012)

- Class notes

February 13 - 17

Tuesday, February 14

- Retraction and scientific integrity
- Read

    - Brainerd and You (2018)

- Explore

    - https://retractionwatch.com/
    - https://ori.hhs.gov/

- Assignment

    - Exercise 02: P-hack your way to scientific glory

- Class notes

Thursday, February 16

- Questionable research practices
- Read

  – Simmons, Nelson, and Simonsohn (2011)
  – (Skim) John, Loewenstein, and Prelec (2012)

- Watch

  – Ngiam (2020)

- Class notes

February 20 - 24

Tuesday, February 21

- Bias
- Read

  – (Ritchie 2020), Chapter 4

- Due

  – Exercise 02: P-hack your way to scientific glory write-up.

- Class notes

Thursday, February 23

- File drawer effect
- Read

  – Rosenthal (1979)
  – Franco, Malhotra, and Simonovits (2014)

- Work session on final project proposals, due Thursday, March 2.
- Class notes

February 27 - March 3

Tuesday, February 28

- Negligence
- Read

  - (Ritchie 2020), Chapter 5
  - Nuijten et al. (2015)
  - Szucs and Ioannidis (2017)

- Work session

  - proposals, due Thursday, March 2.

- Assignment

  - Exercise 03: Alpha, Power, Effect Sizes, & Sample Size

- Class notes

Thursday, March 2

- Hype
- Read

  - (Ritchie 2020), Chapter 6
  - Carney, Cuddy, and Yap (2010)
  - (Optional) Ranehill et al. (2015)

- Watch

  - Cuddy (2012)

- Due

  - Final project proposal

- Class notes

March 6-10 (Spring Break)

NO CLASS

March 13 - 17

Tuesday, March 14

- Solutions
- Read

    - Munafò et al. (2017)
    - Begley (2013)

- Class notes

Thursday, March 16

- Changing journal policies
- Read

    - B. A. Nosek et al. (2015)
    - Gilmore et al. (2020)
    - SRCD (2019)

- Class notes
- Due

    - Exercise 03: Alpha, Power, Effect Sizes, & Sample Size write-up

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March 20 - 24

Tuesday, March 21

- Large-scale replication studies
- Read

    - Collaboration (2015)
    - (Optional) Camerer et al. (2018)
        * For 5 extra credit points, write a paragraph that summarizes the main findings of this paper. Due Tuesday, March 28.

- Class notes
- Assignment

    - Exercise 04: Replication

Thursday, March 23

- Meta-analysis & many analysts
- Read
    - Wilson (2014)
    - Silberzahn et al. (2018)
- Class notes

March 27 - 31

Tuesday, March 28

- Project work day

Thursday, March 30

- Preregistration
- Read
    - Brian A. Nosek et al. (2018)
    - Ledgerwood (2018) or Goldin-Meadow (2016)
    - (Optional) Claesen et al. (2021)
- Explore
    - clinicaltrials.gov
- Due
    - Exercise 04: Replication
- Class notes

April 3 - 7

Tuesday, April 4

- Project work day
- Data sharing
- Read

Thursday, April 6

- Data sharing
- Read

    - Houtkoop et al. (2018)
    - Tenopir et al. (2020)
    - (Optional) Gilmore and Adolph (2017)
    - (Optional) Meyer (2018)
    - (Optional) National Institutes of Health (n.d.)

- Class notes
- Assignment distributed

    - Exercise 05: Data and materials sharing

- Final project survey

    - Please complete the final project survey.

April 10 - 14

Tuesday, April 11

- Materials, code, & protocol sharing
- Read

    - Soska et al. (2021)
    - Gilroy and Kaplan (2019)

- Explore

    - protocols.io
    - Journal of Visualized Experiments (JOVE)

- Class notes

Thursday, April 13

- Open science tools
- Read

    - Kathawalla, Silverstein, and Syed (2021)
    - Crüwell et al. (2019)

- Assignment Due

- – Exercise 05: Data and materials sharing
- Class notes

April 17 - 21

Tuesday, April 18

- In-class final project work day

Thursday, April 20

- Project work day (on your own)

April 24 - 28

Tuesday, April 25

- Project presentations
- Schedule

Thursday, April 27

- Project presentations
- Schedule

May 1-5

Wednesday, May 3

- Due
  - – Final project write-ups due 5:00 PM.

Resources

Most of the readings for the course will come from the published scientific literature.

Required Text

We will make extensive use of the following book:

Ritchie, S. (2021). *Science Fictions: Exposing Fraud, Bias, Negligence, and Hype in Science.* Penguin Random House.

This book is **required** for the course.

Other readings

Scanned copies of other readings are available as PDFs on Canvas.

Web-based resources

- Glossary of open science terms by the Framework for Open and Reproducible Research Training (FORT). (Parsons et al. 2022).
- (Nordmann et al., n.d.) site and its set of web-books on data analysis, visualization, and reproducible research.
- (The Turing Way, n.d.), a web book about open research practices
- (Ball et al. 2015), a collection of course syllabi for open and reproducible methods.

Evaluation

Elements

Component	Description	Points
Attendance	You will receive one (1) point for each class you attend.	30
Exercises	There will be five (5) exercises that you must complete and write up. Each exercise is worth 10 points. The top four (4) count toward your final grade. If you complete all five, half of your lowest assignment score will count as extra credit.	40
Final project	You will complete a final project, either on your own, or with a small group of 3 or less. Your final project is worth 30 points.	30
	TOTAL POINTS POSSIBLE	100
Extra Credit	There may be extra credit opportunities provided at random and unannounced times during the semester. You must come to class in order to benefit from them.	

Grading Scheme

Points	Grade
94+	A
90-93	A-
87-89	B+
84-86	B
80-83	B-
77-79	C+
70-76	C

Points	Grade
60-69	D
<59	F

Deadlines

Date	What's due/happening
2023-01-17	Exercise
2023-01-25	Exercise 01
2023-02-21	Exercise 02
2023-03-02	Final project proposal
2023-03-16	Exercise 03
2023-03-30	Exercise 04
2023-04-13	Exercise 05
2023-05-03	Final project writeup

Policies

Academic Integrity

Students with questions about academic integrity should visit http://www.la.psu.edu/current-students/undergraduate-students/education/academic-integrity.

Penn State defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect others dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (Faculty Senate Policy 49-20). Sanctions for academic misconduct can include a grade of F for the course as well as other penalties.

Students are responsible for maintaining academic integrity. Violations include cheating on exams, talking to others during exams, looking at another student's test materials or answers during an exam, removing exams from the classroom without consent from the instructor, plagiarizing (do not copy from someone else!), and dishonesty in any aspect of course participation.

When you complete assignments, remember the **ABC**s to avoid plagiarism: **A**lways place copied information within quotation marks, include information about the quoted or paraphrased source in a **B**ibliography, and **C**ite the source in the body (in the text) of your paper immediately after the quoted or paraphrased information. When in doubt, cite in the text and include the source in a bibliography.

Absences or late assignments

0.0.1   Absence from class

Your absence from class may be excused under unusual circumstances such as (a) an interview for graduate school or a job, (b) illness, (c) religious observance,

(d) the death of a family member, or (e) any other event recognized by the university as a valid excuse for absence from class.

If you must miss class, you must contact the instructor and the TA **in advance**.

Up to three (3) excused absences will be permitted.

Late exercises

Exercises submitted after the published deadlines will not be eligible for full credit unless the instructor has given specific permission.

Late final projects

Final projects submitted after the published deadline will not be eligible for full credit unless the instructor has given specific permission.

Accommodation for persons with disabilities

Penn State welcomes students with disabilities into the University's educational programs. Please refer to the information provided by Student Disability Resources (SDR) at http://equity.psu.edu/student-disability-resources/ for information about the procedures required to obtain reasonable accommodations in this course. Students should discussSDR-approved accommodations with their instructor as early in the semester as possible, even if they have taken another course with the instructor. Please note: students are not required to provide their instructor with information about the nature of their condition.

Penn State students are also welcome to contact other units for assistance with personal concerns that interfere with academic progress, including: Counseling and Psychological Services (CAPS; http://studentaffairs.psu.edu/counseling/), the Office of Student Affairs (http://studentaffairs.psu.edu/), Career Services (http://studentaffairs.psu.edu/career/), the Center for Women Students (http://studentaffairs.psu.edu/womenscenter/), the LGBTQA Student Resource Center (http://studentaffairs.psu.edu/lgbtqa/), the Office of Sexual Misconduct Prevention and Response (http://titleix.psu.edu/), Penn State Educational Equity (http://equity.psu.edu/), the Multicultural Resource Center (http://equity.psu.edu/mrc), and University Health Services (http://studentaffairs.psu.edu/health/).

Nondiscrimination Statement

The Pennsylvania State University is committed to equal access to programs, facilities, admission and employment for all persons. It is the policy of the

University to maintain an environment free of harassment and free of discrimination against any person because of age, race, color, ancestry, national origin, religion, creed, service in the uniformed services (as defined in state and federal law), veteran status, sex, sexual orientation, marital or family status, pregnancy, pregnancy-related conditions, physical or mental disability, gender, perceived gender, gender identity, genetic information or political ideas. Discriminatory conduct and harassment, as well as sexual misconduct and relationship violence, violates the dignity of individuals, impedes the realization of the University's educational mission, and will not be tolerated.

Direct all inquiries regarding the nondiscrimination policy to:

Dr. Kenneth Lehrman III Vice Provost for Affirmative Action Affirmative Action Office The Pennsylvania State University 328 Boucke Building University Park, PA 16802-5901 Email: kfl2@psu.edu Tel (814) 863-0471

Diversity Statement

This classroom is a place where you will be treated with respect. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.
Penn State is committed to creating an educational environment which is free from intolerance directed toward individuals or groups and strives to create and maintain an environment that fosters respect for others as stated in Policy AD29 Statement on Intolerance.

Mandated Reporting Statement

Penn State's policies require me, as a faculty member, to share information about incidents of sex-based discrimination and harassment (discrimination, harassment, sexual harassment, sexual misconduct, dating violence, domestic violence, stalking, and retaliation) with Penn State's Title IX coordinator or deputy coordinators, regardless of whether the incidents are stated to me in person or shared by students as part of their coursework. For more information regarding the University's policies and procedures for responding to reports of sexual or gender-based harassment or misconduct, please visit http://titleix. psu.edu.

Additionally, I am required to make a report on any reasonable suspicion of child abuse in accordance with the Pennsylvania Child Protective Services Law.

COVID safety information (last updated 2021-08-12)

Please consult the Penn State Covid-19 Dashboard for updates on masking policies, instructional-mode changes, etc. https://virusinfo.psu.edu/covid-19-dashboard/.

This class will meet in-person unless there is a change in University policy.

Penn State University requires everyone to wear a face mask in all university buildings, including classrooms, regardless of vaccination status. **ALL STUDENTS MUST** wear a mask appropriately (i.e., covering both your mouth and nose) while you are indoors on campus. This is to protect your health and safety as well as the health and safety of your classmates, instructor, and the university community. Anyone attending class without a mask will be asked to put one on or leave. Instructors may end class if anyone present refuses to appropriately wear a mask for the duration of class. Students who refuse to wear masks appropriately may face disciplinary action for Code of Conduct violations. If you feel you cannot wear a mask during class, please speak with your adviser immediately about your options for altering your schedule.

Zoom

At some point in the semester, I may decide to use Zoom to allow students who are unable to attend class in person to participate.

While you are on Zoom, keep in mind that this is a classroom environment and others should be treated with respect. Please keep your microphone muted unless you want to ask a question or interact with someone. If your microphone is not muted, the entire class will be able to hear what is going on in your environment. As an instructor, I personally like to see people's faces. As a participant, I am more involved when I have my camera on. I realize, however, that there are many reasons why you might not want to turn on your camera such as poor internet connection, joining via phone, or other privacy concerns. It is your choice as to whether you would like to have the camera on or not.

Principles & Values

Penn State Principles

The Pennsylvania State University is a community dedicated to personal and academic excellence. The Penn State Principles were developed to embody the values that we hope our students, faculty, staff, administration, and alumni possess. At the same time, the University is strongly committed to freedom of expression. Consequently, these Principles do not constitute University policy and are not intended to interfere in any way with an individual's academic or personal freedoms. We hope, however, that individuals will voluntarily endorse these common principles, thereby contributing to the traditions and scholarly heritage left by those who preceded them, and will thus leave Penn State a better place for those who follow.

I will respect the dignity of all individuals within the Penn State community. The University is committed to creating and maintaining an educational environment that respects the right of all individuals to participate fully in the community. Actions motivated by hate, prejudice, or intolerance violate this principle. I will not engage in any behaviors that compromise or demean the dignity of individuals or groups, including intimidation, stalking, harassment, discrimination, taunting, ridiculing, insulting, or acts of violence. I will demonstrate respect for others by striving to learn from differences between people, ideas, and opinions and by avoiding behaviors that inhibit the ability of other community members to feel safe or welcome as they pursue their academic goals.

I will practice academic integrity. Academic integrity is a basic guiding principle for all academic activity at Penn State University, allowing the pursuit of scholarly activity in an open, honest, and responsible manner. In accordance with the University Code of Conduct, I will practice integrity in regard to all academic assignments. I will not engage in or tolerate acts of falsification, misrepresentation or deception because such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

I will demonstrate social and personal responsibility. The University

is a community that promotes learning; any behaviors that are inconsistent with that goal are unacceptable. Irresponsible behaviors, including alcohol or drug abuse and the use of violence against people or property, undermine the educational climate by threatening the physical and mental health of members of the community. I will exercise personal responsibility for my actions and I will make sure that my actions do not interfere with the academic and social environment of the University. I will maintain a high standard of behavior by adhering to the Code of Conduct and respecting the rights of others.

I will be responsible for my own academic progress and agree to comply with all University policies. The University allows students to identify and achieve their academic goals by providing the information needed to plan the chosen program of study and the necessary educational opportunities, but students assume final responsibility for course scheduling, program planning, and the successful completion of graduation requirements. I will be responsible for seeking the academic and career information needed to meet my educational goals by becoming knowledgeable about the relevant policies, procedures, and rules of the University and academic program, by consulting and meeting with my adviser, and by successfully completing all of the requirements for graduation.

Penn State Values

Integrity: We act with integrity and honesty in accordance with the highest academic, professional, and ethical standards.

Respect: We respect and honor the dignity of each person, embrace civil discourse, and foster a diverse and inclusive community.

Responsibility: We act responsibly, and we are accountable for our decisions, actions, and their consequences.

Discovery: We seek and create new knowledge and understanding, and foster creativity and innovation, for the benefit of our communities, society, and the environment.

Excellence: We strive for excellence in all our endeavors as individuals, an institution, and a leader in higher education.

Community: We work together for the betterment of our University, the communities we serve, and the world.

Part II

Exercises

Exercise 01: Exercise: Norms and Counter-norms

Dates

Due: Thursday, January 26, 2023.

Goals

This exercise gives you an opportunity to consider how the norms (and counter-norms) that appear common in scientific research compare with other human activities.

Assignment

Choose a realm of human activity that you are familiar with and preferable engage in yourself that is *not* scientific research–e.g., a sport or game, religious activity, club or social activity, political activity, or something else. Choose two norms or counter-norms in your chosen activity and in a short essay (2-3 double-spaced pages in length) describe the norms or counter-norms in your chosen activity and discuss how they compare with the norms and counter-norms common in scientific research.

Submit

A 2-3 page paper in Microsoft Word format using the following file-naming convention:

`<lastname>`-`<firstname>`-PSYCH490.002-ex01.docx, where you substitute your last name for and your first name for . If Dr. Gilmore was submitting a paper, it would look like this: `gilmore-rick-PSYCH490.002-ex01.docx`.

Exercise 02: The road to scientific glory

Dates

Due: Tuesday, February 21, 2023.

Acknowledgment

This exercise builds heavily on (Pownall et al. 2021).

Goals

This exercise aims to build your understanding about *p-hacking*, what it is, how it can occur, and its impact on research.

Materials

- a computer, tablet, or smartphone with access to the internet.
- a means of keeping brief notes (notebook or text/word processing document).

Background

You are a policy analyst with a not-for-profit, or as our resource says, "You're a social scientist with a hunch: The U.S. economy is affected by whether Republicans or Democrats are in office." Your task is to publish a short report about

whether the U.S. economy does better under Republican control or Democratic control. You probably have prior ideas about this question, but your goal is to provide *data* that answer it.

You will make use of a dataset with information about how well the U.S. economy performs and about the degree of Republican or Democratic political power. The dataset goes back to 1948.

Your analysis

1. Choose a party as the focus of your report (Republican or Democratic).
2. Write down your prior hypothesis about whether the economy does better or worse under Republican or Democratic control. Do this before you visit the web site[1].

[ ] Republican [ ] Democratic

[ ] Economy does better [ ] Economy does worse

3. Visit the dataset site.
4. Select the party you have chosen to focus on by pressing the button in panel 1. of the site.
5. Write down the variables that are selected in "2. Define Terms" on the site.

   - Politicians included
     - ☐ Presidents
     - ☐ Governors
     - ☐ Senators
     - ☐ Representatives
   - Measure(s) of economic performance
     - ☐ Employment
     - ☐ Inflation
     - ☐ GDP
     - ☐ Stock prices
   - Other options
     - ☐ Factor in power
     - ☐ Exclude recessions

6. If you know how, take a screenshot of the plot in "3. Is there a relationship" Include the screenshot in your report. In a sentence or two, describe what the plot shows.

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[1]Think about why we want you to write down your prediction before you look at the dataset.

7. Report the result indicated in "4. Is your result significant?". What is the p-value? What does that p-value mean in practical terms–what question was tested[2]? Is your result "publishable"?
8. You may stop here and report your findings, or you may choose to explore the question further by selecting other variables (politicians included, measures of economic performance, or other options).
9. If you explore further, for each set of variables you select, write down the variables you selected and the p-value you found:

Politicians Included	Economic Measures	Other factors	p-value

10. Create a report that captures the information you collected during the exercise and summarize your finding(s) in a sentence or two. You may use the simple report template as a guide.

Submit

Please save a copy of your report as a docx using the preferred file naming convention for this class: `<lastname>-<firstname>-PSYCH490.002-ex02.docx`, where you substitute your last name for and your first name for .

Submit your report on Canvas in the dropbox for this assignment.

Please also bring a copy to class with you on **February 21, 2023**.

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[2]**Hint**: The question tested has to do with the slope of the plot in 3.

Expercise 03: Alpha, Power, Effect Sizes, & Sample Size

Dates

Due: Thursday, March 16, 2023.

Goals

This exercise aims to to build your understanding about the relationship between alpha α and its close cousin statistical significance, statistical power $(1-\beta)$, effect size (d), and sample sizes (n).

Materials

- a computer, tablet, or smartphone with access to the internet.
- a means of keeping brief notes (notebook or text/word processing document).

Shiny app

Visit the app at https://rogilmore.shinyapps.io/PSYCH490-2023-APES/.

Background

In the ideal world, we want large samples so that we can be confident that when we find differences between groups A and B (Americans and Europeans; males and females; soccer players and badminton players, etc.) that the differences we find are *not* due to chance. In the real world, there are always trade-offs between the size of the samples we can collect and our ability to avoid making mistakes about what's true and what's not.

One way to think about those trade-offs is to think about our situation this way:

Some "fact" about the world can either be true or false, and our *data analysis* should inform us about whether the fact is either true or false. We want to be right as often as possible. That means having a way of deciding something's true when it actually *is* true and deciding when something's false when it actually *is* false. Both are important ways for our analysis to be correct.

We also want to avoid being wrong. We don't want to decide something's true when it's not. That's a *false positive.* We also don't want to decide something's false when actually it's true. That's called a *false negative.* We want to minimize both.

To avoid false positives, we decide how often we are willing to be wrong in that way and set a criterion accordingly. The alpha (α) value or criterion reflects that choice. It's a probability, so it's between 0 and 1. Since we want the fraction of the time we make false negative decisions to be small, α is also usually small; $\alpha = 0.05$ is conventional, but it is not in any way sacred.

To avoid false negatives, we set another probability value, called beta (β). Beta is the proportion of times we're willing to conclude a true fact is actually false; $\beta = 0.20$ or 1 time out of five is conventional. But what data folks usually focus on is $1 - \beta^3$ or *statistical power.* This number tells us the proportion of times we expect to *detect* a true effect when it's actually there. Detecting the truth is sort of a scientific superpower, don't you think? At least when things go right. Maybe that's why it's called *power.*

Analysts who are planning a study have two other decisions to make: How big a sample should they collect, and how sensitive should their test be? The answer to how big a sample should always be large, but how large? The answer is, of course, called *n.* How sensitive is the test can be asked this way: What's the smallest difference I want to be able to detect–assuming I'm interested in the difference between condition A and condition B? That difference between conditions is called the *effect size* because it might represent the *effect* of some intervention. If we think effect sizes with respect to the standard normal (bell-curve-shaped) distribution with mean (μ) 0 and standard deviation (σ) 1, we can specify it in terms of the number of standard deviations. Specified this way,

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[3]Remember that probabilities are always between 0 and 1 and always sum to 1.

the effect size is usually called d. There are other ways to talk about effect sizes, but we won't go further here.

Your goals in this assignment are to see how choices about sample size (n), effect size (d), alpha ($/alpha$) and power ($1 - \beta$) relate to one another. You'll explore the effects of different values for these parameters, report on the parameters you chose, and what the results turned out to be. There are no right or wrong answers.

Your analysis

1. When you first open the app, note that it simulates an analysis of groups A (red) and B, and that we get to control a number of parameters, including n, d, and α. Note the statistics in the first gray box. It reports on the results of a t test, comparing the difference between the means of the two groups.

    - Interpret the results of the t-test. What does it mean? What is the number in the brackets? What does it mean?
    - "CI" means confidence interval. The CI has a minimum (leftmost) and maximum (rightmost) value. The actual difference in the *observed* means of A and B should fall inside the interval. In your own words, explain what the confidence interval means.

2. Let's see what happens when we generate different samples of A and B with the **same** underlying statistics–the same n, same mean (μ), same standard deviation (σ), same effect size (d), and same criterion (α) or false positive rate.

    - Press the *Regenerate* button. What happens to the histogram? Look in the grey `t-test` box. What happens to the t-test, and the mean values for A, B, the difference between A and B (B-A), and the CI?
    - Press the *Regenerate* button a couple of times until `Sig?` changes from FALSE to TRUE or TRUE to FALSE? This is a form of p-hacking? Explain how. Remember the specific data we're analyzing are being regenerated each time we press the button; what's not changing is the sample size, standard deviation, and the effect size (difference between B and A).

3. Having $n = 75$ is a pretty large sample for many types of research in psychology, so let's see what having smaller samples does to our t-test and to our power.

    - But before we do that, write down your prediction about what will happen to the t-test when we reduce the n for both groups A and B to 50.

- Change the n for A to 50 and the n for B to 50. Interpret the t-test and CI.
- What happened to power (see the box on the right side)? Does this mean we are more likely or less likely to detect a difference between A and B than before? Why?

4. We're simulating what happens if there is an effect size of $d = 0.5$, or half a standard deviation between the means of A and B.

   - Change d to 1.5 or larger. What happens to the histogram? What happens to our t-test and power?
   - Change d to 0.25. What happens to the histogram? What happens to our t-test and power?

5. Let's see if we can find out what size of samples we'd need to have power $1 - \beta = 0.80$ to detect an effect of ($d = 0.25$). Increase the sample sizes of A and B until you exceed the desired level for power. What sample size did you need? Explain your finding.

6. (Optional) Bonus Points (up to 5)

   - Explore the effect of changing some other parameter on the results, for example, criterion/alpha (α), the standard deviation for A or B (σ), or even the 'baseline' mean for B (μ).
   - Report on what you changed, what you observed, and what you conclude.

Submit

Bring your *draft* report to class with you on Tuesday, March 14, 2023. We'll discuss the assignment. The final submission is due Tuesday, March 14, 2023 at midnight.

Exercise 04: Replication

Dates

Due: Thursday, March 30, 2023.

Goals

Replication is one standard among many that can be used to evaluate scientific findings. In this exercise, you will evaluate a published scientific finding on the basis of whether it 1) replicates prior work and 2) could be replicated by someone else.

Assignment

Choose a published scientific paper on a topic you find interesting and important.

Does the paper:

- Report on whether data reported replicate a prior finding?
- Does the paper embrace any of the recommendations by Begley (2013) (e.g., blinding, replication or repetition of key effects, etc.).
- Does the paper implement any of the recommendations from the Munafò et al. (2017) paper?
- Does the paper report effect sizes, sample sizes, and statistical power?
- Was the paper pre-registered?
- What is the TOP Factor for the journal? If none, report 0.
- Does the paper share data? If so, where? Could you get access to the data?
- Does the paper share any statistical or computer code used to analyze the data or make figures? If so, where? Could you access the code?

- Does the paper share sufficient information about the measures used (e.g., a protocol, computer code to generate computer tasks, specific survey questions, or other information needed to replicate the tasks or measures) so that an independent third party like yourself could replicate the study?

If you had to give the author(s) of your paper a grade for *replicability* (A, B, C, D, F), what grade would you give it and why?

Submit

In a short (2-3 pp double-spaced report) discuss the paper's finding and why you think it is interesting and important. Then, evaluate the paper from the perspective of "replicability" by answering the questions in the previous section.

Exercise 05: Data & materials sharing

Dates

Due: Thursday, April 13, 2023

Assignment

Choose a data or code repository from among the following:

- Dryad
- Databrary
- Penn State Data Commons
- Dataverse
- figshare
- GitHub
- GitLab
- Inter-university Consortium for Political and Social Research (ICPSR)
- NIMH Data Archive
- OpenNeuro
- Open Science Framework (OSF)
- Qualitatitive Data Repository (QDR)
- Penn State ScholarSphere
- Zenodo

Provide some basic summary information about the repository:

- Who sponsors the data or code repository?
- What sort of data or code are stored and shared there?
- Who is the target audience for the repository?

Find a dataset or code base within the repository and report on the following:

- What kind of data or code are stored and shared?
- How hard or easy would it be for you to use the data or code yourself?

Submit

A 2-3 pp double-spaced report on your findings. Make sure to include your name and a title for your report in the header of your document.

Report template

Title

Put a title for your report here. Delete these instructions before you submit your report.

Author(s)

List the author(s) of your report. Delete these instructions before you submit your report.

Date

Add the date for your report. The following R code will add the date automatically: 2023-04-25. If you are not using R, then enter the date manually. Delete these instructions before you submit your report.

Purpose

Describe the purpose or aims of this report. Delete these instructions before you submit your report.

Methods

Describe the methods or steps used to address the aims of the report. Delete these instructions before you submit your report.

Results

Describe the findings or results. Delete these instructions before you submit your report.

Conclusions

Summarize your conclusions. Delete these instructions before you submit your report.

Resources/References

List any references you cited or resources you used. Delete these instructions before you submit your report.

It's a good idea to save your report using a structured file name, e.g., `psych-490-gilmore-rick-exercise-2022-11-14.pdf`.

Final project

Background

Your final project is an opportunity for you to produce a product that shows-off some of what you have learned in the course.

You may work alone or with up to two other students in the class. If you work with others, you will need to complete a statement about who did what, and all of the members of your team will get the same grade.

Topics

You may choose any of a wide range of topics for your final project:

- A tool or resource you find especially useful.
- A paper or papers that do or do not replicate.
- Independent research on some topic related to open science.

Formats

There are multiple formats for your final project.

- Short (5-10 min) in-class talk
- Poster
- Lesson plan/exercise
- Tutorial
- Research project (& write-up)
- Opinion piece

Components

- Project proposal

  - Every student or team must submit a one-page project proposal. If the proposal is submitted on-time (by Thu March 2), the student or team gets 5 extra credit points. If the proposal is submitted late, there is no penalty, but also no extra points. If a student or team does not submit a proposal, there will be a five point penalty.

- Project presentation (optional, but strongly recommended)

  - Every student or team may make an optional presentation to the class about their project. Please indicate whether you are willing to make a presentation when you complete the survey below.
  - The presentations will occur during class on April 25 and April 27.
  - If you wish to have your presentation made available publicly on the course website, please let me know. This is also completely optional.

- Project write-up

  - Every student or team must submit a write-up, due on May 3, 2023.
  - Depending on the format of the project (talk, poster, paper), different written materials may be submitted (slides, poster, etc.).
  - For an in-class talk, submit your talk text or your slides with presenter notes.
  - For a poster, submit a PowerPoint or PDF of your poster.

Survey

- Please provide us information about your project via this Google Form:

https://forms.gle/XWFYHcnb3MAV1u4H8

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