

Replication and Reproducibility (EDUC 545-020)

Spring 2022

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Office Hours: By appointment (Virtual)

Course Logistics: This class will meet once per week on Tuesdays from 12:00 - 2:30 PM in GSE Room 322.

Course Description: For over a decade, social science research has been plagued by a phenomenon known as the replication crisis. The concept of replication and replication analyses is associated with the process of confirming the results or hypotheses of a study to demonstrate that the same findings can be obtained in other settings. However, while replication is a central issue in empirical science, replication studies are infrequent in practice, calling into question the validity of estimates and parameters from analyses based on a single study. The purpose of this course is to provide students with an understanding of the history of replication science, the implications for current studies, and the types of statistical methods that have been proposed to address this crisis. The course topics will be divided among three categories: (i) differences between definition and analysis of replication, (ii) frameworks for replication studies and (iii) statistical approaches based on meta-analysis for designing replication studies.

Course Objectives:

At the completion of this course, students should be able to:

- Understand the difference between the definition of replication and an analysis for replication
- Identify challenges to replication and discuss the implications for research
- Discuss methods to design and implement replication studies

Academic Prerequisites

EDUC 667 or equivalent graduate level introductory statistics course. Knowledge of applied regression is preferred. Familiarity with the statistical software program R is preferred, but not required.

Textbooks and Other Course Material: Most of our class sessions will focus on methodological articles posted on Canvas. For some meetings, I will refer to chapters in the following books, physical copies of which can be found in the bookstore:

- Collins, H. (1992). *Changing order: Replication and induction in scientific practice*. University of Chicago Press.
- Fleck, L. (2012). *Genesis and development of a scientific fact*. University of Chicago Press.

Software

For the course meetings in which we will discuss methods of statistical meta-analysis, I will provide demonstrations in R and R Studio, which are free and available for download at <https://www.r-project.org/>.

r-project.org/ and <https://www.rstudio.com/>, respectively. You are welcome to use other programs such as Stata, SAS, or SPSS, but please be aware that I will not be able to troubleshoot issues related to any other software program other than R. However, many software programs, including R, have useful help forums online. If you run into computing issues, I encourage you to try searching for solutions online first as another person may have already solved it.

Course Evaluation:

Response to Readings (40%)

Prior to class each week, you will be asked to submit 1 - 2 questions or short comments in response to the readings. All submissions will be uploaded to the “Discussions” forum on the Canvas page for the course. These responses serve two purposes. One, they allow students to raise questions related to the concepts in each study. Two, they will be used to stimulate discussion of the readings during class.

Replication Project and Presentation (60%)

For the final course project, each student will conduct a direct replication study. For this, I ask that you find a study for which the data are publicly available and replicate the main analysis. The study and the data can be on any topic. Write a short paper (max 10 pages) discussing the original study and the steps you took to replicate the original findings. If your replicated results do not fully mirror the original findings, discuss potential sources of the discrepancy and the implications for replication in evaluation research. During the last day of class, each student will lead a 15 - 20 minute presentation on the results of their replication study.

The following is a list of websites where students may access various types of data sets.

1. National Center for Education Statistics (<https://nces.ed.gov/>)
2. Institute for Social Science Research at the University of Michigan (<https://www.icpsr.umich.edu/icpsrweb/index.jsp>)
3. New York City Clearinghouse (<https://opendata.cityofnewyork.us/>)
4. Chicago Data Portal (<https://data.cityofchicago.org/>)
5. Harvard Dataverse (<https://dataverse.harvard.edu/dataverse/socialsciencerccts>)
6. Kaggle (<https://www.kaggle.com>)
7. Austin Data Clearinghouse (<https://data.austintexas.gov/>)
8. San Francisco Data Clearinghouse (<https://datasf.org/opendata/>)
9. Open Baltimore (<https://data.baltimorecity.gov>)

Other Information:

Attendance: Students are responsible for all of the readings covered during class meetings. If you miss a class, you are responsible for obtaining any notes or summaries of the material that you missed from a classmate.

Academic Honesty: Please consult the GSE Student Handbook on the following webpage for details on expected student conduct: <http://www.gse.upenn.edu/policies/academicintegrity>. Please be sure to read the material in this document. Plagiarism or cheating of any kind will be dealt with according to University policy, which can be found at: <http://www.upenn.edu/academicintegrity>.

Communicating with me: Email is the best way to reach me. If I do not respond within 48 hours, feel free to send a follow up email.

Topic Schedule (Spring 2022)

Week	Date	Readings and Topics
1	01/18	<p>Readings</p> <p>Collins, H. (1992). Chapter 2</p> <p>Fleck, L. (2012). Chapter 3</p> <p>Topics</p> <ul style="list-style-type: none">• Course Introduction• History of Replication
2	01/25	<p>Readings</p> <p>Schmidt, S. (2009). Shall we really do it again? The powerful concept of replication is neglected in the social sciences. <i>Review of General Psychology</i>, 13(2), 90 - 100.</p> <p>Anderson, S.F. & Maxwell, S.E. (2016). There's more than one way to conduct a replication study: Beyond Statistical Significance. <i>Psychological Methods</i>, 21(1), 1 - 12.</p> <p>Topics</p> <ul style="list-style-type: none">• Replication and the social sciences
3	02/01	<p>Readings</p> <p>Bollen, K. et al. (2015). Social, Behavioral, and Economic Sciences Perspectives on Robust and Reliable Science. Report of the Subcommittee on Replicability in Science, National Science Foundation.</p> <p>Topics</p> <ul style="list-style-type: none">• Defining replication
4	02/08	<p>Readings</p> <p>Ioannidis, J.P. (2005). Why most published research findings are false. <i>PLoS Medicine</i>, 2(8), e124.</p> <p>Hedges, L.V. (2017). Challenges in building usable knowledge in education. <i>Journal of Research on Educational Effectiveness</i>, 1 - 21.</p> <p>Topics</p> <ul style="list-style-type: none">• Validity of research findings
5	02/15	<p>Readings</p> <p>Popper, K. (2002). The Logic of Scientific Discovery (2nd edition). Chapter 4. Routledge.</p> <p>Topics</p> <ul style="list-style-type: none">• Falsification

Week	Date	Readings and Topics
		<p>Readings</p> <p>Valentine, J. et al. (2011). Replication in prevention science. <i>Prevention Science</i>, 12, 103 – 117.</p>
6	02/22	<p>Farrington, D.P. et al. (2019). Advancing knowledge about replication in criminology. <i>Journal of Experimental Criminology</i>, 15, 373 – 396.</p> <p>Topics</p> <ul style="list-style-type: none"> • Replication and meta-analysis
		<p>Readings</p> <p>Hedges, L.V. & Schauer, J.M. (2019). Statistical analyses for studying replication: Meta-analytic perspectives. <i>Psychological Methods</i>, 24(5), 557 – 570.</p>
7	03/01	<p>Topics</p> <ul style="list-style-type: none"> • Introduction to statistical meta-analysis • Statistical meta-analysis for replication
		<p>Readings</p> <p>Steiner, P.M., Wong, V.C., Anglin, K. (2019). A Causal Replication Framework for Designing and Assessing Replication Efforts. <i>Zeitschrift fur Psychologie</i>, 227(4), 280 – 292.</p>
8	03/15	<p>Topics</p> <ul style="list-style-type: none"> • Continuation of statistical meta-analysis • Causal replication framework
		<p>Readings</p> <p>Wong, V.C., Anglin, K., & Steiner, P.M. (2021). Design-based approaches to causal replication studies. <i>Prevention Science</i>, 1 – 16.</p>
9	03/22	<p>Topics</p> <ul style="list-style-type: none"> • Causal replication studies
		<p>Readings</p> <p>Schauer, J.M. & Hedges, L.V. (2021). Reconsidering statistical methods for assessing replication. <i>Psychological Methods</i>, 26(1), 127 - 139.</p>
10	03/29	<p>Topics</p> <ul style="list-style-type: none"> • Statistical methods for assessing replication

Week	Date	Readings and Topics
11	04/05	<p>Readings</p> <p>Hedges, L.V. & Schauer, J.M. (2019). More than one replication study is needed for unambiguous tests of replication. <i>Journal of Educational and Behavioral Statistics</i>, 44(5), 543 - 570.</p> <p>Topics</p> <ul style="list-style-type: none"> • Statistical power and replication
12	04/12	<p>Readings</p> <p>Maxwell, S.E., Lau, M.Y., & Howard, G.S. (2015). Is psychology suffering from a replication crisis? <i>American Psychologist</i>, 70(6), 487 – 498.</p> <p>Topics</p> <ul style="list-style-type: none"> • Equivalence Testing
13	04/19	<p>Readings</p> <p>Simonsohn, U. (2015). Small Telescopes: Detectability and the Evaluation of Replication Results. <i>Psychological Science</i>, 26(5), 559 – 569.</p> <p>Topics</p> <ul style="list-style-type: none"> • Hypothesis testing and replication
14	04/26	<p>Readings</p> <p>Held, L. (2020). A new standard for the analysis and design of replication studies. <i>Journal of the Royal Statistical Society, Series A</i>, 183(2), 431 – 448.</p> <p>Hedges, L.V. & Schauer, J.M. (2021). The design of replication studies. <i>Journal of the Royal Statistical Society, Series A</i>, 184(3), 868 – 886.</p> <p>Topics</p> <ul style="list-style-type: none"> • Skeptical p • Designing replication studies
15	05/03	<ul style="list-style-type: none"> • Student presentations