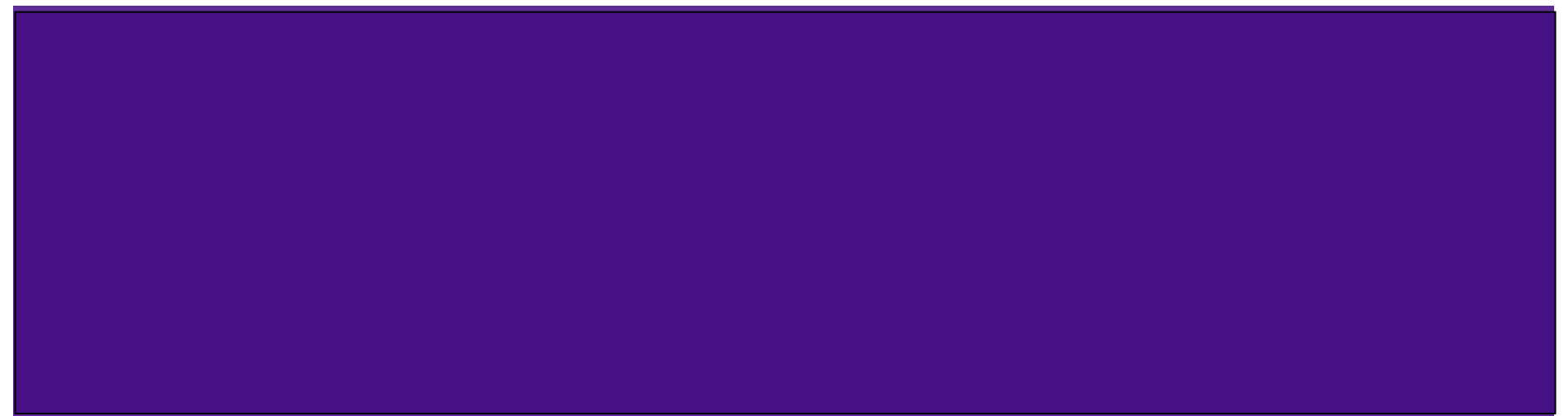# CSDE 502
Reproducibility, Replicability, & Statistical Tests

May 19, 2023

Reproducibility vs. Replicability

- **Reproducibility** is obtaining consistent results to **a specific study** using the same input data; computational steps, methods, and code; and conditions of analysis
- **Replicability** is obtaining consistent results **across studies** aimed at answering the same scientific question, each of which has obtained its own data

Reproducibility vs. Replicability

What are some components of a research study that affect the ability for someone else to reproduce or replicate it?

<u>Reproducibility</u>

Input data
Study design
Computational environment

<u>Replicability</u>

Uncertainty
Complexity
Study design

A manifesto for reproducible science (Munafò et al. 2017)

Methods

- Protect against cognitive biases with **blinding**
- Require **rigorous and continued training** in statistics and research methods
- Increase use of **independent** methodological support or oversight
- Use **collaborative & team science** to pool resources and increase power

A manifesto for reproducible science (Munafò et al. 2017)

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Reporting and dissemination

- Increase use of **study pre-registration** via platforms like the Open Science Framework and Registered Reports
- Improve quality of **methodological reporting** with discipline-specific **checklists**
- Require disclosure of **conflicts of interest** or even exclusion of research where they exist

Replication in Social Science (Freese and Peterson, 2017)

- **Verifiability**– Do the findings presented in a study follow from the data? Aka reproducibility
- **Robustness**– Do further and different analyses of the same data provide similar results?
- **Repeatability**– Can a study's findings be observed by collecting and analyzing new data?
- **Generalizability**– Are a study's findings generalizable beyond the sample or population analyzed?

The Replication Crisis & Bad Statistics

- **P-values aren't bad, just misunderstood!!!!!!!!!**
- Statistical tests can only answer certain types of research questions based on certain types of data.
- Statistical evidence is just that, EVIDENCE. It is not proof.