

# Accelerating Computational Reproducibility with the Social Science Reproduction Platform

Metascience Conference

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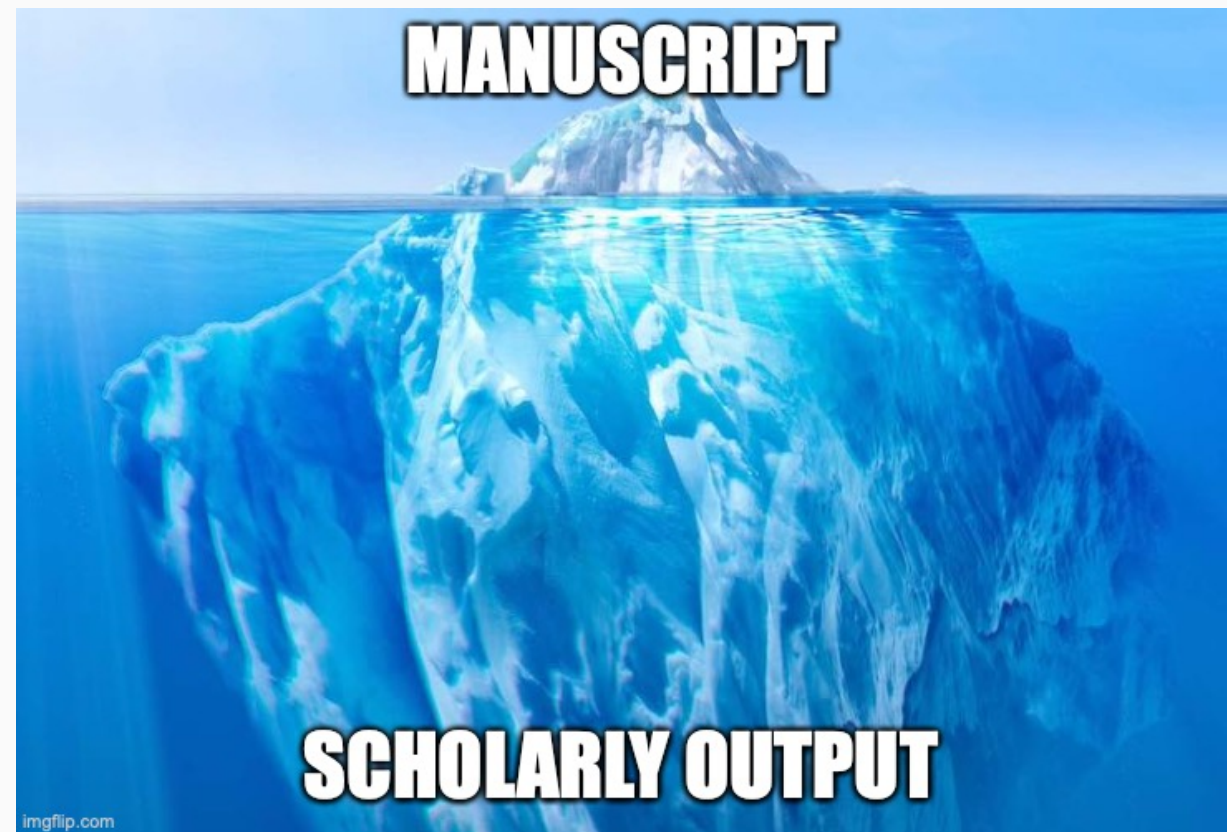
September 2021 | [slides](#)

# Motivation: Computational Reproducibility

Every semester, graduate students around **the world** take an Empirical/Applied [ ... ] course. A typical assignment consists of reproducing the results of a paper and, possibly, testing the robustness of its results.

Stage	New Knowledge
Scope (select and verify)	Data and code exist?
Assess	Degree of reproducibility for specific part of the paper
Improve	E.g. fixed paths, libraries, added missing files, etc.

"Clarebout Principle":



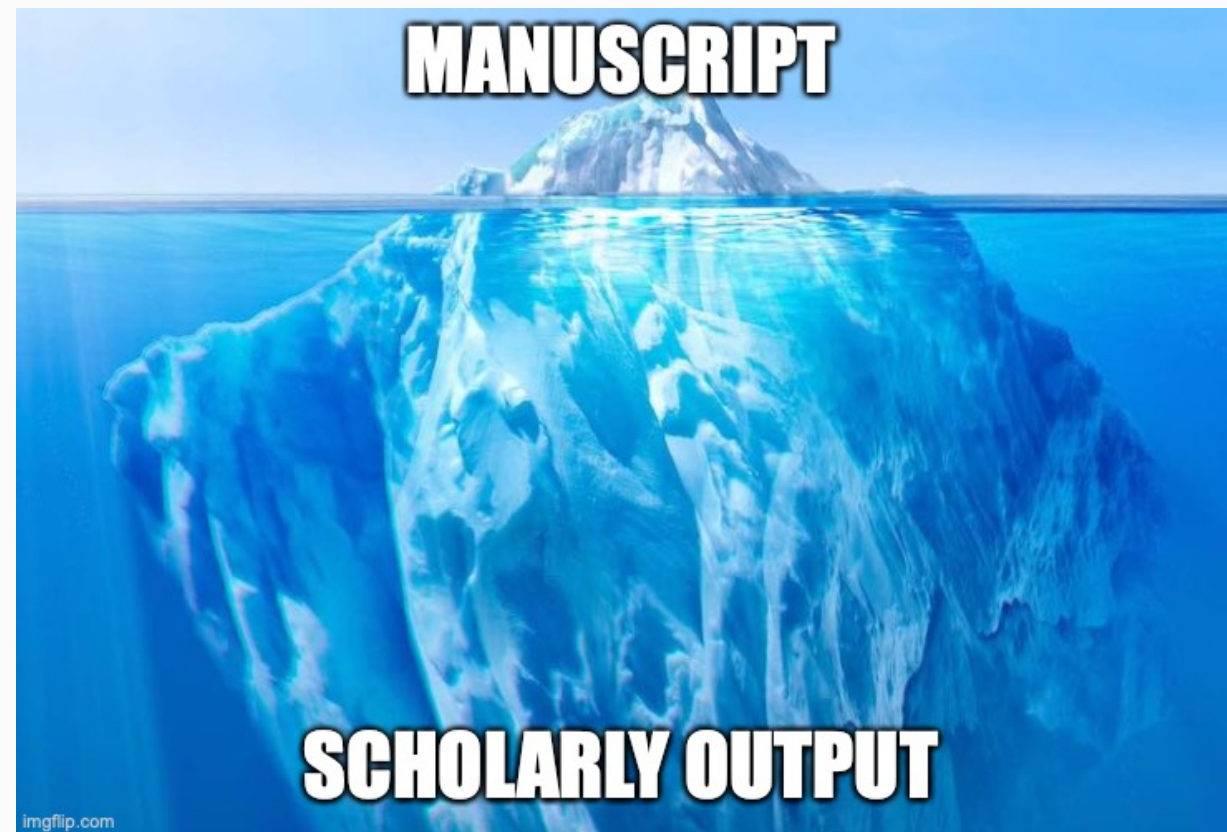
Buckheit and D.L. Donoho (1995, 2009)

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Improve	E.g. fixed paths, libraries, added missing files, etc.
Test robustness	Results are robust to additional specifications

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# Accelerating Computational Reproducibility: Framework

## Beyond Binary Judgments

Reproductions can easily gravitate towards adversarial exchanges.

- Early career researchers (ECR) have incentives to emphasize unsuccessful reproductions
- Original authors have a more senior position and can use it to deter in-depth reproductions from ECRs.
- The media also focuses on eye-catching headlines

## Our approach:

We do not want to say

"Paper X is (ir)reproducible"

We do want to say

"Result Y in paper X has a high/low **level** of reproducibility according to **several** reproduction attempts. Moreover, **improvements** have been made to the original reproduction package, **increasing** its reproducibility to a higher level"

# ACRe Framework

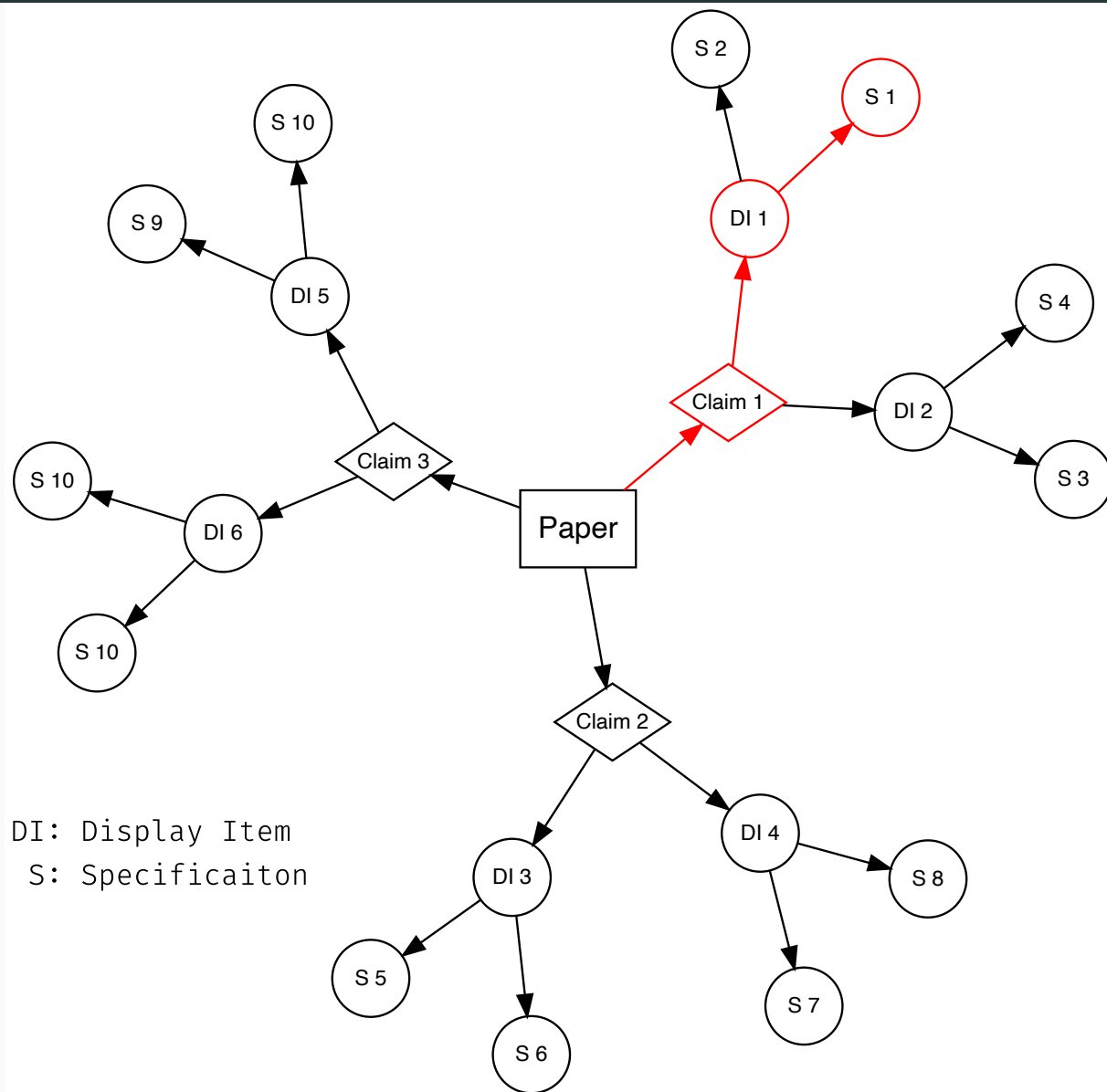
Each **reproduction attempt** is centered around scientific **claims** (following **SCORE**).

One paper can contain several claims.

Each claim may be supported by various **display items**: tables, figures & inline results.

A reproduction attempt is at the claim level, and reproducers must record their **specifications** of interest.

Key challenge: **standardization** of concepts and formats.



# Demo: socialsciencereproduction.org

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# Social Science Reproduction Platform

Accelerating computational  
reproducibility in the social sciences

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Search reproductions by paper title, DOI, or author name



# Select a paper

## Article Information

### Abstract

How large are the benefits of transportation infrastructure projects, and what explains these benefits? This paper uses archival data from colonial India to investigate the impact of India's vast railroad network. Guided by four results from a general equilibrium trade model, I find that railroads: (1) decreased trade costs and interregional price gaps; (2) increased interregional and international trade; (3) increased real income levels; and (4) that a sufficient statistic for the effect of railroads on welfare in the model accounts well for the observed reduced-form impact of railroads on real income in the data.

### Citation

Donaldson, Dave. 2018. "Railroads of the Raj: Estimating the Impact of Transportation Infrastructure." *American Economic Review*. 108 (4-5): 899-934.

DOI: 10.1257/aer.20101199

Choose Format:

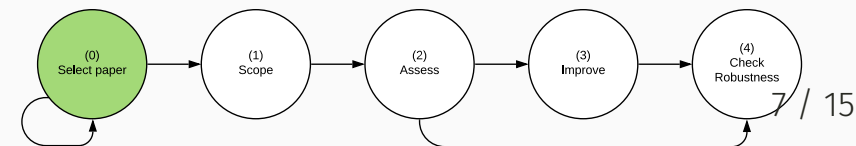


### Additional Materials

Data Set (17.80 MB)

Online Appendix (247.97 KB)

Author Disclosure Statement(s) (63.46 KB)





C. Results

Table 2 presents ordinary least squares (OLS) estimates of equation (12). In column 1 I estimate the effect of the lowest-cost route effective distance on trade when the relative costs of each mode ( $\alpha$ ) are set to observed historical relative freight rate estimates. I use the relative per unit distance freight rates described in Section IB (at their midpoints):  $\alpha^{road} = 4.5$ ,  $\alpha^{river} = 3.0$ , and  $\alpha^{coast} = 2.25$  relative to the freight rate of railroad transport, normalized to 1). Column 1 demonstrates that the elasticity of trade costs with respect to the lowest-cost route effective distance, calculated at observed freight rates, is 0.088, and this is statistically significant at the 5 percent level.

However, as argued in Section IB, it is possible that these observed relative freight rates do not capture the full benefits (such as increased certainty or savings) of railroad transport relative to alternative modes of transportation. For this reason the NLS specification in column 2 estimates the relative freight elasticity (i.e., the parameters  $\alpha$ ) that minimize the sum of squared residuals in equation (12).

Column 2 is my preferred specification. When the mode-wise distance costs (i.e.,  $\alpha$ ) are not restricted to be equal to the observed freight rates, the estimated elasticity of trade costs with respect to effective distance (i.e.,  $\delta$ ) rises to 0.169. Even when controlling for all unobserved, time-constant determinants of trade costs between all salt sources and destinations, as well as unrestricted shocks to the source price of each salt type, reductions in trade costs along lowest-cost routes (estimated from railroad-driven time variation in these routes alone) have a large effect on reducing salt price gaps over space.

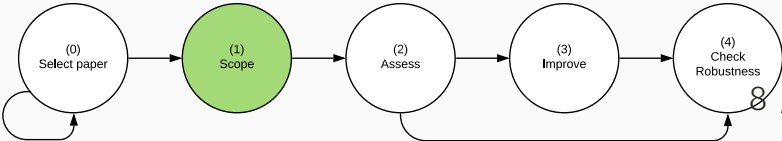
TABLE 2—RAILROADS AND TRADE COSTS: STEP 1

Dependent variable: log salt price at destination	(1)	(2)
log effective distance to source, along lowest-cost route (at historical freight rates)	0.088 (0.028)	
log effective distance to source, along lowest-cost route (at estimated mode costs)		0.169 [0.062, 0.296]
Estimated mode costs per unit distance:		
Railroad (normalized to 1)		1 N/A
Road		2.375 [1.750, 10.000]
River		2.250 [1.500, 6.250]
Coast		6.188 [5.875, 10.000]
Observations	7,345	7,345
R <sup>2</sup>	0.946	0.946

Notes: Regressions estimating equation (12) using data on 6 types of salt (listed in online Appendix A), from 133 districts in Northern India, annually from 1861 to 1930. Column 1 and column 2 estimated by OLS and NLS respectively; both include salt type  $\times$  year and salt type  $\times$  destination fixed effects. “Effective distance to source.”

Col 1: OLS with alpha at historical rates. 1% inc in effc dist (in km) -> 0.088% inc in trade costs

Col 2: NLS with alpha chosen to minimize SSR of col1. effc dist (in km) -> 0.169% inc in trade costs





# Assess

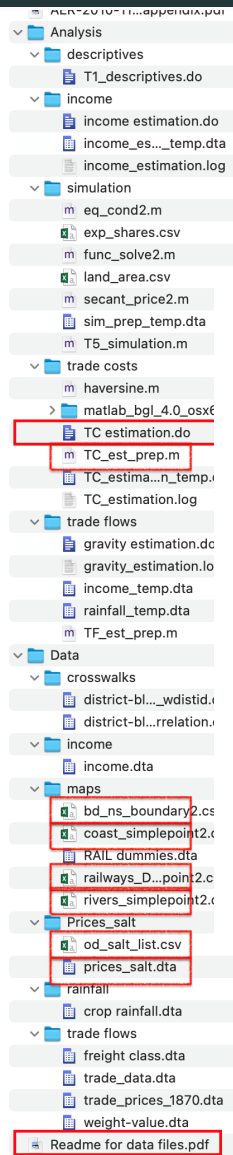
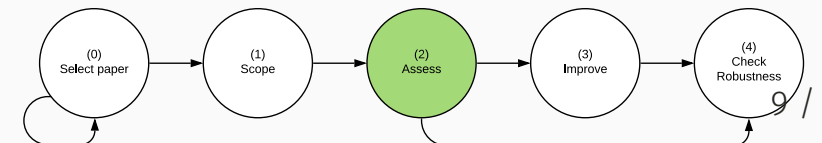


Table 2

TC estimation.do	
LCRED_RoX_CoY_RiZ.csv	
TC_est_prep.m	
railways_Dissolve_Simplify2_point2.csv	
bd_ns_boundary2.csv	
rivers_simplepoint2.csv	
rivers_simplepoint2.csv	
coast_simplepoint2.csv	
od_salt_list.csv	
prices_salt.dta	
railways_Dissolve_Simplify2_point2.csv	
bd_ns_boundary2.csv	
rivers_simplepoint2.csv	
coast_simplepoint2.csv	
od_salt_list.csv	



# Assess

Analysis

descriptives

T1\_descriptives.do

income

income estimation.do

income\_es...\_temp.dta

income\_estimation.log

simulation

eq\_cond2.m

exp\_shares.csv

func\_solve2.m

land\_area.csv

secant\_price2.m

sim\_prep\_temp.dta

T5\_simulation.m

trade costs

haversine.m

matlab\_bg1\_4.0\_osxf

TC estimation.do

TC\_est\_prep.m

TC\_estima...n\_temp.dta

TC\_estimation.log

trade flows

gravity estimation.do

gravity\_estimation.lo

income\_temp.dta

rainfall\_temp.dta

TF\_est\_prep.m

Data

crosswalks

district-bl...wdistid.dta

district-bl...relation.dta

income

income.dta

maps

bd\_ns\_boundary2.csv

coast\_simplepoint2.csv

RAIL\_dummies.dta

railways\_D...point2.csv

rivers\_simplepoint2.csv

Prices\_salt

od\_salt\_list.csv

prices\_salt.dta

rainfall

crop rainfall.dta

trade flows

freight class.dta

trade\_data.dta

trade\_prices\_1870.dta

weight-value.dta

Readme for data files.pdf

Table 2

TC estimation.do

LCRED\_RoX\_CoY\_RiZ.csv

TC\_est\_prep.m

railways\_Dissolve\_Simplify2\_point2.csv

bd\_ns\_boundary2.csv

rivers\_simplepoint2.csv

rivers\_simplepoint2.csv

coast\_simplepoint2.csv

od\_salt\_list.csv

prices\_salt.dta

railways\_Dissolve\_Simplify2\_point2.csv

bd\_ns\_boundary2.csv

rivers\_simplepoint2.csv

coast\_simplepoint2.csv

od\_salt\_list.csv

Table 3.5: Levels of Computational Reproducibility  
(P denotes “partial,” C denotes “complete”)

	Availability of materials, and reproducibility									
	Analysis Code		Analysis Data		CRA	Cleaning Code		Raw Data		CRR
	P	C	P	C		P	C	P	C	
L1: No materials	–	–	–	–	–	–	–	–	–	–
L2: Only code	✓	✓	–	–	–	–	–	–	–	–
L3: Partial analysis data & code	✓	✓	✓	–	–	–	–	–	–	–
L4: All analysis data & code	✓	✓	✓	✓	–	–	–	–	–	–
L5: Reproducible from analysis	✓	✓	✓	✓	✓	–	–	–	–	–
L6: All cleaning code	✓	✓	✓	✓	–	✓	✓	–	–	–
L7: Some raw data	✓	✓	✓	✓	–	✓	✓	✓	–	–
L8: All raw data	✓	✓	✓	✓	–	✓	✓	✓	✓	–
L9: All raw data + CRA	✓	✓	✓	✓	✓	✓	✓	✓	✓	–
L10: Reproducible from raw data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

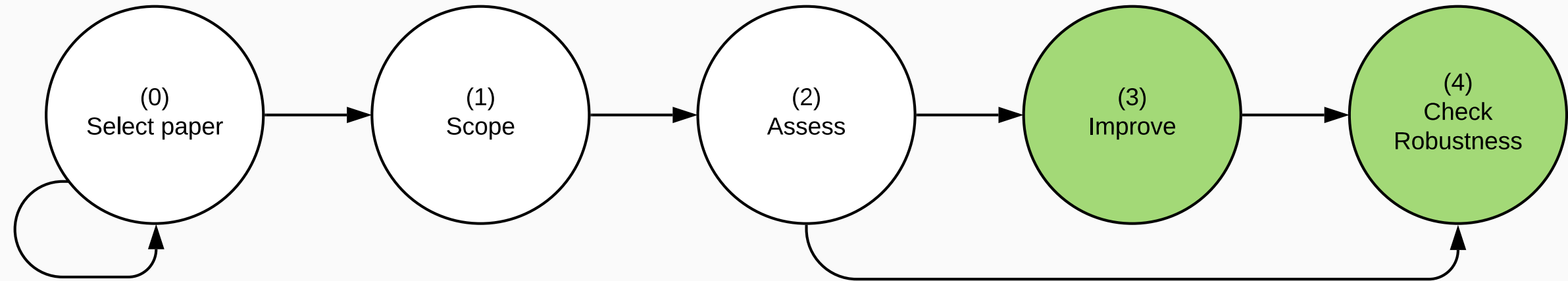
<sup>a</sup> **Computationally Reproducible from Analytic data (CRA):** The output can be reproduced with minimal effort starting from the *analytic* datasets.

<sup>b</sup> **Computationally Reproducible from Raw data (CRR):** The output can be reproduced with minimal effort from the *raw* datasets.

# Improvements & Robustness

## Three types of improvements:

1. Improvements at the paper level
2. Improvements at the display-item level
3. Specific future improvements



## Two main parts for robustness:

1. Increase the number of robustness checks
2. Justify the appropriateness of a specific test

# Completed Reproduction

**Reproduction of: Railroads of the Raj: Estimating the Value of Transportation Infrastructure in American Colonial India**  
<https://doi.org/10.1257/aer.20101199>

Reproducer: Emma Ng

Date created: November 19 2020

Date submitted: August 03 2021

Claims assessed: 1

Display Items (DI) assessed: 1

Improvements: 3

Robustness tests:

- Feasible choices added: 0
- Specifications justified: 0

Claims identified by reproducer:

1. "The paper estimated the value of the extent to which the costs of different modes of transportation are estimated using the reduction of LCRED (lowest-cost route effective distance) trading cost. This estimate has a 95% confidence interval."

Reproducibility of Display Items:

1. Table 2 - Table 2 -- Railroads and Trade Costs: Step 1. ...

Original reproduction package: <https://www.aeaweb.org/articles?id=10.1257/aer.20101199>

Revised reproduction package: <https://github.com/em-ng21/railroads-of-the-raj>

Original authors' availability for further inquiries: Not sure

## 0 Select a paper

Declare the paper that you will analyze in the remainder of the exercise and other "candidate" papers for which you were unable to obtain access to the full text.

[VIEW THIS SECTION](#)

## 1 Scoping

## 2 Assessment

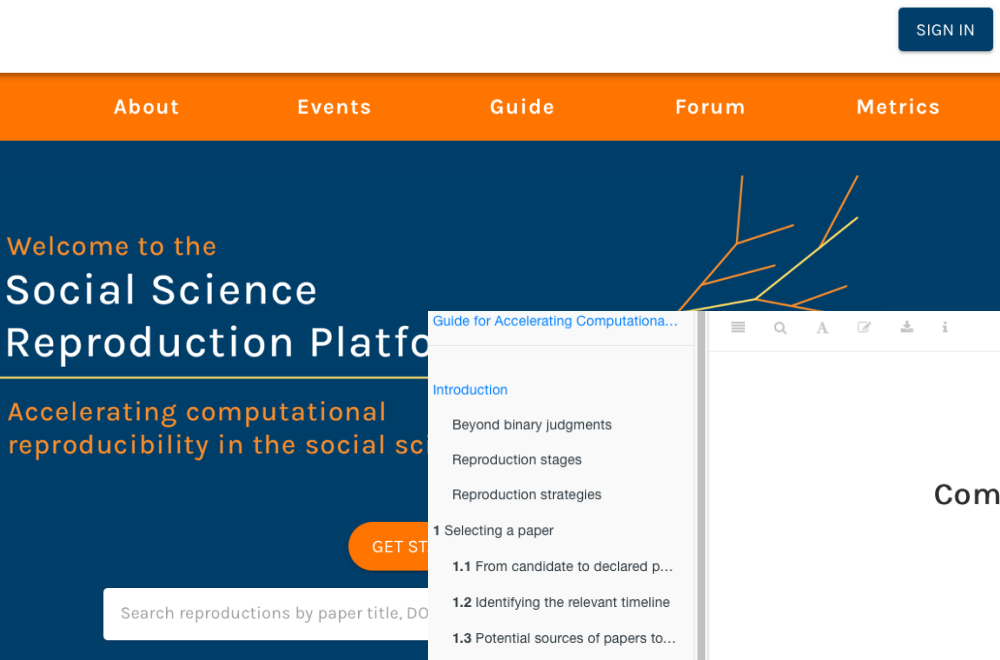
## 3 Improvement

## 4 Robustness

## 0 Select a paper

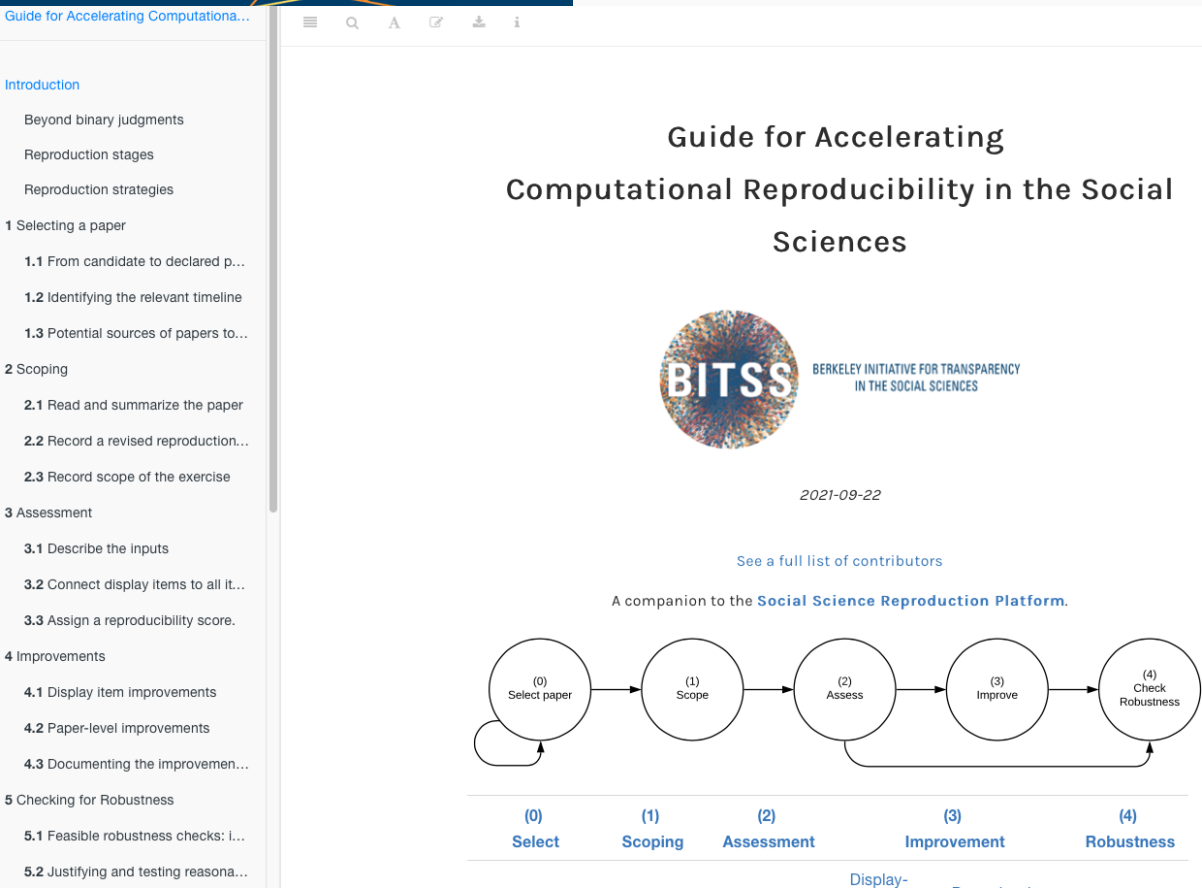
Declare the paper that you will analyze in the remainder of the exercise and other "candidate" papers for which you were unable to obtain access to the full text.

# How Do I Get Started?



Use it for your class  
or independent project

Consult the  
supporting  
guides



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ACCELERATING COMPUTATIONAL

REPRODUCIBILITY IN THE SOCIAL SCIENCES

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Guide for Accelerating Computational Reproducibility in the Social Sciences

Introduction

Beyond binary judgments

Reproduction stages

Reproduction strategies

1 Selecting a paper

1.1 From candidate to declared p...

1.2 Identifying the relevant timeline

1.3 Potential sources of papers to...

2 Scoping

2.1 Read and summarize the paper

2.2 Record a revised reproduction...

2.3 Record scope of the exercise

3 Assessment

3.1 Describe the inputs

3.2 Connect display items to all it...

3.3 Assign a reproducibility score.

4 Improvements

4.1 Display item improvements

4.2 Paper-level improvements

4.3 Documenting the improvemen...

5 Checking for Robustness

5.1 Feasible robustness checks: l...

5.2 Justifying and testing reasona...

Use it for your class  
or independent project

## Guide for Accelerating Computational Reproducibility in the Social Sciences

BERKELEY INITIATIVE FOR TRANSPARENCY  
IN THE SOCIAL SCIENCES

2021-09-22

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A companion to the [Social Science Reproduction Platform](#).

```
graph LR; A((0) Select paper) --> B((1) Scope); B --> C((2) Assess); C --> D((3) Improve); D --> E((4) Check Robustness); E --> A;
```

(0) Select (1) Scoping (2) Assessment (3) Improvement (4) Robustness

all categories ▾

all tags ▾

Categories

Latest New (3) Unread (1) Top

+ New Topic

Category

Topics

Latest

Getting Started

0

Version 1.0, developed in April 2021

Reproductions

5

1 unread

Discuss and share resources about ongoing or completed reproductions sorted by papers reproduced. To join the discussion about a particular paper, look up the paper's DOI, replacing "." with "-".

Tips for Reproducibility

1

Find and share tips and resources for reproducible workflows that aren't linked to a particular reproduction.

Help

3

3 new

Ask questions on how to use the SSRP.

For instructors

0

Connect with a community of

Welcome to Discourse

0

Nov '20

Restricted-use data

0

23h

Help

Catalog of reproductions

0

23h

Help

No replication package

1

23h

Help

Feedback for my reproduction of Twenty-year economic impacts of deworming

1

Aug 11

Reproductions

10-1073-pnas-2023185118

How to use the SSRP

2

Jul 22

Consult the  
supporting  
guides

Ask questions

14 / 15

# Thank You

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[acre@berkeley.edu](mailto:acre@berkeley.edu)