Research Transparency and Reproducibility Workshop
NHH, Bergen, Norway
August 18-19, 2017

Welcome to the BITSS community! In collaboration with The Choice Lab, we are pleased to host the Research Transparency and Reproducibility Workshop, in Bergen, Norway August 18-19, 2017. To ensure you get the most out of this two-day event, BITSS has prepared this **Participant Manual** with a Reading List and instructions for preparing for the hands-on sessions, including required software downloads.

Participants of the Research Transparency and Reproducibility Workshop will learn about a range of innovative practices and tools, including:

- *Meta-analysis.* Innovations in the design of meta-analyses—dealing with issues of bias, study sample size, and model selection—can improve the quality of inferences made from the analyses of pooled studies;
- *Meta-research.* Meta-research is an evolving scientific discipline that aims to evaluate and improve research practices. It includes thematic areas of methods, reporting, reproducibility, evaluation, and incentives – how to conduct, report, verify, correct, and reward good practices in science;
- *Pre-registration.* The registration of study designs in public repositories prior to data collection allows for better tracking of the universe of studies in a given domain, including studies with null results that are rarely published. This begins to tackle the "file-drawer problem" whereby only statistically significant findings are reported;
- *Pre-analysis Plans.* The design and use of a pre-analysis plan (PAP)—a step-by-step plan, written before data are accessed, describing hypotheses and strategies for analyzing data—can help protect against data mining and reduce researcher "degrees of freedom" in confirmatory research;
- *Data de-identification.* To facilitate open science, researchers must work toward public posting of the data and code needed to replicate findings of published studies. However, this requires understanding of and training on how to balance maximizing data's usability with protection of human subjects and data confidentiality by using methods for data de-identification; and
- *Tools for transparent workflows.* There are a plethora of software and online tools to facilitate transparent and reproducible workflows, such as the Open Science Framework (OSF), Git, R, and dynamic documents.

With this training, BITSS aims to *directly impact researchers' practices in favor of transparency and reproducibility*. We focus on topics such as pre-registration, pre-analysis plans, and version control so that you can apply these tools to your own work. BITSS hopes that these types of events will have long-term, sustainable impacts on scientific norms and practices as learners and faculty like you continue to incorporate innovative tools and methods into curricula and coursework at your own institutions.

If you are interested in joining our community, please visit our website to learn more about the **BITSS Catalyst Program**.

Pre-Training Suggested Reading List

*This is a list of foundational literature related to social science research transparency and reproducibility challenges, as well as potential solutions and best practices. We suggest reading the papers preceded by ** before the workshop.*

Foundational literature

**Ioannidis JPA. 2005. "Why Most Published Research Findings Are False." PLoS Med 2(8): e124. doi:10.1371/journal.pmed.0020124. PMCID PMC1182327. Link.

Leamer, Edward. 1983. "Let's Take the Con Out of Econometrics." American Economic Review, 73(1): 31–43. Link.

Merton, Robert K. 1973 [1942]. "The Normative Structure of Science." in Merton, Robert K., The Sociology of Science: Theoretical and Empirical Investigations. Chicago: University of Chicago Press. ISBN 978-0-226-52091-9, OCLC 755754. Link.

**Miguel, E., C. Camerer, K. Casey, J. Cohen, K. M. Esterling, A. Gerber, R. Glennerster, et al. 2014. "Promoting Transparency in Social Science Research." Science 343 (6166): 30–31. doi:10.1126/science.1245317. Link.

Nosek, B. A., et al. 2015. "Promoting an open research culture: Author guidelines for journals could help to promote transparency, openness, and reproducibility." Science (New York, NY) 348.6242: 1422. PMCID PMC4550299. Link.

Open Science Collaboration. 2015. "Estimating the reproducibility of psychological science." Science 349, no. 6251: aac4716. PMID: 26315443. Link.

Rosenthal, Robert. 1979. "The file drawer problem and tolerance for null results." Psychological bulletin 86.3: 638. Link.

Christensen, Garret, and Edward Miguel. 2017. "Transparency, Reproducibility, and the Credibility of Economics Research". BITSS. http://osf.io/preprints/bitss/9a3rw. Link.

P-curve

**Simonsohn, Uri, Leif D. Nelson, and Joseph P. Simmons. 2014: "P-curve: a key to the file-drawer." Journal of Experimental Psychology: General 143, no. 2: 534. Link.

Simmons, Joseph P., Leif D. Nelson, and Uri Simonsohn. 2011. "False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant." Psychological science 22, no. 11: 1359-1366. Link.

Research Reproducibility

Begley, C. Glenn, and Lee M. Ellis. 2012. "Drug development: Raise standards for preclinical cancer research." Nature 483, no. 7391: 531-533. Link.

**Goodman, S. N., Fanelli, D., & Ioannidis, J. P. 2016. “What does research reproducibility mean?” Science Translational Medicine, Vol. 8. Ch. 341. Link.

Replication

Dafoe, Allan. 2014. “Science Deserves Better: The Imperative to Share Complete Replication Files.” PS: Political Science & Politics 47 (1): 60–66. doi:10.1017/S104909651300173X. Link.

Hamermesh, Daniel S. 2007. “Viewpoint: Replication in Economics.” Canadian Journal of Economics/Revue Canadienne D’économique 40 (3): 715–33. doi:10.1111/j.1365-2966.2007.00428.x. Link.

**Klein, Richard A., Kate A. Ratliff, Michelangelo Vianello, Reginald B. Adams Jr, Štěpán Bahník, Michael J. Bernstein, Konrad Bocian et al. 2014. "Investigating variation in replicability: A ‘Many Labs’ Project" Social Psychology. Link.

Meta-analysis

**Borenstein, M., Hedges, L. V., Higgins, J. P. T. and Rothstein, H. R. 2007. "Fixed vs Random effects", in Introduction to Meta-Analysis, John Wiley & Sons, Ltd, Chichester, UK. Link.

Ioannidis JPA, Fanelli D, Dunne DD, Goodman SN (2015) Meta-research: Evaluation and Improvement of Research Methods and Practices. PLoS Biol 13(10): e1002264. doi:10.1371/journal.pbio.1002264. PMCID PMC4592065. Link.

Hsiang, Solomon M., Marshall Burke, and Edward Miguel. 2013. “Quantifying the Influence of Climate on Human Conflict.” Science 341 (6151): 1235367. doi:10.1126/science.1235367. Link.

**Russo, Mark. 2007. "How to Review a Meta-Analysis." Gastroenterol Hepatol 3(8): 637–642. Link.

Pre-registration and Pre-Analysis Plans

Casey, Katherine, Rachel Glennerster, and Edward Miguel. 2012. “Reshaping Institutions: Evidence on Aid Impacts Using a Preanalysis Plan.” The Quarterly Journal of Economics 127 (4): 1755–1812. Link.

Data De-Identification

Goodman, Alyssa, et al. 2014. “Ten Simple Rules for the Care and Feeding of Scientific Data”, PLoS Computational Biology, 10(4), e1003542. Link.

Sturdy, Jennifer, Stephanie Burch, Heather Hanson, and Jack Molyneaux. 2017. “Opening up Evaluation Microdata: Balancing Risks and Benefits of Research Transparency”. BITSS. Link.

Transparency Reporting and Disclosure

Simera, et al. 2010. “Commentary: Transparent and accurate reporting increases reliability, utility, and impact of your research: reporting guidelines and the EQUATOR Network.” BMC Medicine 2010, Vol 8, Ch. 24. Link.

Power and Power Calculations

**Benjamin, Daniel J, James Berger, Magnus Johannesson, Brian A Nosek, Eric-Jan Wagenmakers, Richard Berk, Kenneth Bollen, et al. 2017. “Redefine Statistical Significance”. PsyArXiv. July 22. osf.io/preprints/psyarxiv/mky9j. Link.

Burlig, Fiona, Louis Preonas, and Matt Woerman. 2017. "Panel data and experimental design." *Energy Institute at Haas Working Paper #277*. Link. For a lighter read, please reference the blog post that tries to be less technical.

Button, Katherine S., J.P.A. Ioannidis, C. Mokrysz, B. Nosek, J. Flint, E.S.J. Robinson, M. Munafo. "Power failure: why small sample size undermines the reliability of neuroscience." Nature Reviews Neuroscience14.5 (2013): 365-376. Doi 10.1038/nrn3475 PMID: 23571845. Link.

General Best Practices

Christensen, Garret, and Courtney Soderberg. 2016. "Manual of best practices in transparent social science research." Berkeley, CA: University of California. Link.

Duflo, Esther, Rachel Glennerster, and Michael Kremer. 2007. "Using Randomization in Development Economics Research: A Toolkit." *Handbook of Development Economics*, Vol 4, Ch. 61, pp 3895-3962. Link. Please focus on Section 4.

McKenzie, David. 2012. "Beyond baseline and follow-up: The case for more T in experiments." *Journal of Development Economics,* 99(2): pp 210--221. Link.

Pre-Workshop Actions

All participants should take the following actions before August 18.

Some of the workshop will be hands-on. Participants with their own research projects can work on them during these components. Participants without a research project will be offered the opportunity to do the hands-on component using an example data set (and participate in a "many analyses" project en route), or else they can pair up with other participants during the hands-on sessions to observe the process.

Please reference the Software section of our Resources page on the BITSS website for more information on this software.

1. Establish OSF Account

The Open Science Framework (OSF) allows you to store your research files and link together all your research across several platforms, such as Dropbox, Harvard's Dataverse, and GitHub. It version controls any files you upload and you can register a project to create a frozen time-stamped version with a persistent URL. So by writing a pre-analysis plan, you could prove to the world that your significant results aren't just a successful fishing expedition. Sign up for a free account here.

2. Review + prepare for study pre-registration

In the Pre-Registration hands-on session, participants will be able to walk through registration of their study on the OSF. Please see **Appendix 1** for the information that should be prepared for pre-registration on the OSF.

3. Install Git and Create Github.com Account

The date-and-initial version of keeping track of changes to your files doesn't really cut it when you're doing something complicated or you've got a lot of co-authors. If you want your work to be reproducible, use version control. It has a learning curve even for xkcd-type people, but it's worth it! (Read Gentzkow and Shapiro chapter 3 on why.) Software Carpentry and GitHub have great tutorials.

To get started, download the GitHub Desktop GUI app. If you are comfortable using the command line, we also recommend Windows users install Git Bash. Note that this is only available for Windows and Mac users. Linux users can use the command line or pick one of the other GUIs listed here.

Next, create an account with GitHub.com. GitHub is a popular online storage platform for your repositories (folders/projects) that are version-controlled with Git.

4. Install software for Dynamic Documents

You can write your code and your paper in one place. This means you won't mess anything up copying and pasting, and you'll never have to wonder what code it was that produced which figure, where on earth you saved it, or whether the paper has the updated version.

In R, this can be done with R Markdown, which is built into R Studio - please download and install R and R Studio. When you open a new R Markdown file in R Studio, it starts with a really simple example, or you can learn more here.

In Stata, this can be done with the user-written command MarkDoc with the following commands:

```
ssc install markdoc
ssc install weaver
ssc install statax
```

The package may have been updated recently, so you might want to run "adoupdate" if you installed it a while ago. The syntax is explained in the built-in help file. For MarkDoc to work you also need to install Pandoc, a pretty cool Swiss-army knife that converts almost any markup file to almost any other, as well as wkhtmltopdf. If you install as above, these may be installed automatically, but you may have to click on a link that will show up inside Stata.

5: Install LaTeX

Microsoft Word is nice and easy for writing short papers, but when you start writing longer papers, or you want to include any equations or formatting it quickly becomes cumbersome. LaTeX is better for reproducibility since when you include your figures, you just refer to files, so there's no question of whether you remembered to update or not. LaTeX (download here) is also used by R Markdown when you make pdf's, so you have to at least have it installed in the background. *This is a large file, and you have to install the full version, so don't leave this until the last minute.* If you don't install this, you won't be able to make PDF's with the above dynamic documents software.

6: Install a Decent Text Editor

You need a good way to edit plain text. On a Mac, the simplest thing to do is use the built-in TextEdit, but you will need to change the default so plain text, not rich text (rtf) is the output format. On Windows, you can use Notepad if you like, but we suggest something a little more powerful, like Atom, or Notepad++, or Sublime Text. These have syntax highlighting, and add-on packages that can render markdown, and things like that.

Research Transparency and Reproducibility Workshop Agenda
August 18-19 | NHH | Bergen, Norway

All workshop materials, including software installation instructions, can be found on Github: https://github.com/vivalt/Bergen2017

August 18

09:00	**Introductions and Preparation for Hands-on Component**
09:30	**Overview of Research Transparency and Reproducibility**
10:45	Tea Break
11:00	**Registration and Pre-Analysis Plans: Introduction, Hands-on with AEA registry and OSF**
12:30	Lunch
13:30	**Coding Reproducibility: Lessons Learned**
14:45	**Data De-Identification and Sharing**
15:45	Tea Break
16:00	**Replication and Data Sharing Activity**

August 19

09:00	**Dynamic Documents using Stata and R (parallel sessions)**
10:30	Tea Break
10:45	**OSF, Version Control with Git + Github I**
12:30	Lunch
13:15	**Version Control with Git + Github II**

The Workshop will end by 14:45 on August 19 to facilitate student departure times.

Appendix I: OSF Pre-Registration

Prepared by Erica Baranski (UC Riverside)

Study Information

1. Title
    1.1. Provide the working title of your study. It may be the same title that you submit for publication of your final manuscript, but it is not a requirement.

2. Authorship

3. Research Questions
    3.1. Please list each research question included in this study.

4. Hypotheses
    4.1. For each of the research questions listed in the previous section, provide one or multiple specific and testable hypotheses. Please state if the hypotheses are directional or non-directional. If directional, state the direction. A predicted effect is also appropriate here.

Sampling Plan

In this section we will ask you to describe how you plan to collect samples, as well as the number of samples you plan to collect and your rationale for this decision. Please keep in mind that the data described in this section should be the actual data used for analysis, so if you are using a subset of a larger dataset, please describe the subset that will actually be used in your study.

5. Existing data
    5.1. Preregistration is designed to make clear the distinction between confirmatory tests, specified prior to seeing the data, and exploratory analyses conducted after observing the data. Therefore, creating a research plan in which existing data will be used presents unique challenges. Please select the description that best describes your situation. Please do not hesitate to contact us if you have questions about how to answer this question (prereg@cos.io).
        5.1.1. Registration prior to creation of data: As of the date of submission of this research plan for preregistration, the data have not yet been collected, created, or realized.
        5.1.2. Registration prior to any human observation of the data: As of the date of submission, the data exist but have not yet been quantified, constructed, observed, or reported by anyone - including individuals that are not associated with the proposed study. Examples include museum specimens that have not been measured and data that have been collected by non-human collectors and are inaccessible.
        5.1.3. Registration prior to accessing the data: As of the date of submission, the data exist, but have not been accessed by you or your collaborators. Commonly, this includes data that has been collected by another researcher or institution.

5.1.4. Registration prior to analysis of the data: As of the date of submission, the data exist and you have accessed it, though no analysis has been conducted related to the research plan (including calculation of summary statistics). A common situation for this scenario when a large dataset exists that is used for many different studies over time, or when a data set is randomly split into a sample for exploratory analyses, and the other section of data is reserved for later confirmatory data analysis.

5.1.5. Registration following analysis of the data: As of the date of submission, you have accessed and analyzed some of the data relevant to the research plan. This includes preliminary analysis of variables, calculation of descriptive statistics, and observation of data distributions. Studies that fall into this category are ineligible for the Pre-Reg Challenge. Please contact us (prereg@cos.io) and we will be happy to help you.

6. Explanation of existing data

6.1. If you indicate that you will be using some data that already exist in this study, please describe the steps you have taken to assure that you are unaware of any patterns or summary statistics in the data. This may include an explanation of how access to the data has been limited, who has observed the data, or how you have avoided observing any analysis of the specific data you will use in your study. The purpose of this question is to assure that the line between confirmatory and exploratory analysis is clear.

7. Data collection procedures.

7.1. Please describe the process by which you will collect your data. If you are using human subjects, this should include the population from which you obtain subjects, recruitment efforts, payment for participation, how subjects will be selected for eligibility from the initial pool (e.g. inclusion and exclusion rules), and your study timeline. For studies that don't include human subjects, include information about how you will collect samples, duration of data gathering efforts, source or location of samples, or batch numbers you will use.

8. Sample size

8.1. Describe the sample size of your study. How many units will be analyzed in the study? This could be the number of people, birds, classrooms, plots, interactions, or countries included. If the units are not individuals, then describe the size requirements for each unit. If you are using a clustered or multilevel design, how many units are you collecting at each level of the analysis?

9. Sample size rationale

9.1. This could include a power analysis or an arbitrary constraint such as time, money, or personnel.

10. Stopping rule

10.1. If your data collection procedures do not give you full control over your exact sample size, specify how you will decide when to terminate your data collection.

Variables

In this section you can describe all variables (both manipulated and measured variables) that will later be used in your confirmatory analysis plan. In your analysis plan, you will have the opportunity to describe how each variable will be used. If you have variables that you are measuring for exploratory analyses, you are not required to list them, though you are permitted to do so.

11. Manipulated variables
    - 11.1. Describe all variables you plan to manipulate and the levels or treatment arms of each variable. For observational studies and meta-analyses, simply state that this is not applicable.

12. Measured variables
    - 12.1. Describe each variable that you will measure. This will include outcome measures, as well as any predictors or covariates that you will measure. You do not need to include any variables that you plan on collecting if they are not going to be included in the confirmatory analyses of this study.

13. Indices
    - 13.1. If any measurements are going to be combined into an index (or even a mean), what measures will you use and how will they be combined? Include either a formula or a precise description of your method. If you are using a more complicated statistical method to combine measures (e.g. a factor analysis), you can note that here but describe the exact method in the analysis plan section.

Design Plan

In this section, you will be asked to describe the overall design of your study. Remember that this research plan is designed to register a single study, so if you have multiple experimental designs, please complete a separate preregistration.

14. Study type
    - 14.1. Experiment - A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.
    - 14.2. Observational Study - Data is collected from study subjects that are not randomly assigned to a treatment. This includes surveys, natural experiments, and regression discontinuity designs.
    - 14.3. Meta-Analysis - A systematic review of published studies.
    - 14.4. Other - please explain.

15. Blinding
    - 15.1. Blinding describes who is aware of the experimental manipulations within a study. Mark all that apply.
        - 15.1.1. No blinding is involved in this study.
        - 15.1.2. For studies that involve human subjects, they will not know the treatment group to which they have been assigned.

15.1.3. Personnel who interact directly with the study subjects (either human or non-human subjects) will not be aware of the assigned treatments.

15.1.4. Personnel who analyze the data collected from the study are not aware of the treatment applied to any given group.

16. Study design

16.1. Describe your study design. Examples include two-group, factorial, randomized block, and repeated measures. Is it a between (unpaired), within-subject (paired), or mixed design? Describe any counterbalancing required. Typical study designs for observation studies include cohort, cross sectional, and case-control studies.

17. Randomization

17.1. If you are doing a randomized study, how will you randomize, and at what level?

Analysis Plan

You may describe one or more confirmatory analysis in this preregistration. Please remember that all analyses specified below must be reported in the final article, and any additional analyses must be noted as exploratory or hypothesis generating.

A confirmatory analysis plan must state up front which variables are predictors (independent) and which are the outcomes (dependent), otherwise it is an exploratory analysis. You are allowed to describe any exploratory work here, but a clear confirmatory analysis is required.

18. Statistical models

18.1. What statistical model will you use to test each hypothesis? Please include the type of model (e.g. ANOVA, multiple regression, SEM, etc) and the specification of the model (this includes each variable that will be included as predictors, outcomes, or covariates). Please specify any interactions that will be tested and remember that any test not included here must be noted as an exploratory test in your final article.

19. Transformations

19.1. If you plan on transforming, centering, recoding the data, or will require a coding scheme for categorical variables, please describe that process.

20. Follow-up analyses

20.1. If not specified previously, will you be conducting any confirmatory analyses to follow up on effects in your statistical model, such as subgroup analyses, pairwise or complex contrasts, or follow-up tests from interactions. Remember that any analyses not specified in this research plan must be noted as exploratory.

21. Inference criteria

21.1. What criteria will you use to make inferences? Please describe the information you will use (e.g. p-values, Bayes factors, specific model fit indices), as well as cut-off criterion, where appropriate. Will you be using one or two tailed tests for

each of your analyses? If you are comparing multiple conditions or testing multiple hypotheses, will you account for this?

22. Data exclusion
    22.1. How will you determine what data or samples, if any, to exclude from your analyses? How will outliers be handled?

23. Missing data
    23.1. How will you deal with incomplete or missing data?

24. Exploratory analysis (optional)
    24.1. If you plan to explore your data set to look for unexpected differences or relationships, you may describe those tests here. An exploratory test is any test where a prediction is not made up front, or there are multiple possible tests that you are going to use. A statistically significant finding in an exploratory test is a great way to form a new confirmatory hypothesis, which could be registered at a later time.

Script (Optional)

The purpose of a fully commented analysis script is to unambiguously provide the responses to all of the questions raised in the analysis section. This step is not common, but we encourage you to try to create an analysis script, refine it using a modeled dataset, and use it in place of your written analysis plan.

25. Analysis scripts (Optional)
    25.1. (Optional) Upload an analysis script with clear comments. This optional step is helpful in order to create a process that is completely transparent and increase the likelihood that your analysis can be replicated. We recommend that you run the code on a simulated dataset in order to check that it will run without errors.

Other

26. Other
    26.1. If there is any additional information that you feel needs to be included in your preregistration, please enter it here.