ONLINE APPENDIX

to

"Bringing the Gold Standard into the Class Room: Replication in University Teaching"

Nicole Janz, University of Cambridge

Table 1: Checklist for a 'Gold Standard' Replication

	Goal	Checklist for the replicator	Challenges
Duplication	Verify research results by attempting to produce the exact same results as the original author based on the ***exact same data*** set with ***exactly the same methods***. This will uncover if the procedures described by the original author can produce the findings reported in the original article.	• Obtain the replication data to use exactly the same variables and measurements as the original study. • Conduct all variable transformations (e.g. logs) as specified in the original study if variables are provided in raw form. • Re-run all models as specified in the article; re-produce all figures and tables. • During all these steps, work reproducibly yourself and keep a log of all procedures. • Compare your results with the original study. If the duplication was not successful, discuss possible errors in the data, variable transformation and coding procedures, or in the model specifications and software commands by the original author or by yourself.	• Data set, detailed codebook and commands for the software must be available from the original author. • The original paper must describe theory, data and methods clearly. • Duplication is a great learning tool; but a pure duplication has low chances of publication.
Replication	Test the robustness of the original research results by employing ***newly collected data****, and/or* ***new variables,*** *and/or* ***new model specifications***. An ideal 'gold standard' replication study would do most of this while ensuring that it is transparent and reproducible itself.	Avenues to add value to a duplication: • Collect new data from the same and different sources. Data from the same sources can often be updated e.g. to cover the most recent years. Data from new sources can provide improved measurements or new variables such as potential confounders. Re-run all models as specified in the original article but now using the new variables. Note how a change in the variables affects the results compared to the original study. • Improve the statistical models. Change the model specifications to fit the data and/or theory better (e.g. time lags, dealing with causality issues, handling missing data; see "How to add value" handout in this appendix). • Discuss implications of the new data collection, new variable transformation, or new model specifications which might be responsible for the (very likely) change in results.	• Using different variables or models will almost always yield different results. • The original paper must describe methods and model specifications in detail so that a replication study can show how it improves the previous work. • A replication study may be publishable, but it is much more time consuming than a duplication.

2 Excerpts from syllabi assigning replication

PCS 531: Intermediate Statistics for the Social Sciences, taught by Carlisle Rainey, University at Buffalo

The most important thing we do in this class is a replication paper. Every assignment is designed to directly or indirectly improve your paper. I consider a wide range of ideas about what your paper will look like. I feel strongly, however, that your paper should be co-authored (with one or two other students), except in unusual circumstances. I expect this paper to be high-quality (think about it being ready for a conference at the very worst). Near the end of the semester, you will turn in to me the following:

1. A high-quality manuscript. It should a contribution to a political science literature. This paper should make a contribution to a political science literature, look fantastic, be well written, and have few (ideally no) typos. It should be shorter, rather than longer (think 10-15 pages; Bell and Miller is a good example). If I do not feel comfortable suggesting that you submit the paper to a conference, then you will not get a very good grade. However, I have structured the course so that you should do a good job if you put in the time.

2. A replication data set. Near the end of the semester, I will assign another student the task of replicating your tables and figures starting with the raw data set. If they cannot, you will not get a very good grade.

3. A conference-style presentation. It is part of my job to prepare you for a conference - you are training to be political scientists. Toward the end of the semester, I will give you the opportunity to make a conference-style presentation. I will fill in the details later, but for now, you should be thinking ten minutes, making every minute count.[1]

PLS 501: Methods of Political Analysis (Research Design), taught by Christopher Fariss, Penn State University

Group Replication Project: In groups of 2-4 students, obtain the materials necessary to replicate a political science research paper published in the last 5 years. Describe the initial study and the ease with which the results replicate. Then identify any design flaws in the research and propose a new or improved design. Again, the write-up should be no more than 5 pages.[2]

Political Science 582: Quantitative Analysis in Political Science II, Fall 2013, taught by Jeff Gill, Washington University in St Louis

Course Grade: The final grade will be based on three components: problem sets (40%), a replication assignment (30%), and an exam (30%) on MLE theory and basic models. The exam covers material from the first 7 weeks of the course plus the assigned readings. Consequently, we will discuss the readings in as much detail as the class desires. The problem

[1] Full syllabus at http://www.carlislerainey.com/teaching/linear-models/ (accessed March 15, 2014).

[2] Full syllabus at http://cfariss.com/ (accessed March 15, 2014).

sets will be a combination of analytical and computational assignments and will be given in each meeting. See Alicia Uribe's tips on success with the problem sets. For the replication assignment, find a published work in your field of interest, obtain the data, and exactly replicate the author's model results. It is usually easier to find an article that uses the readily available datasets in the discipline (COW, ANES, GSS, etc.), but some authors are forthcoming about distributing their data if asked. The relevant model should be one of the nonlinear forms studied in this course.[3]

POLI 784 - Intermediate Statistics, Spring 2014, Thomas M. Carsey, University of North Carolina at Chapel Hill

The paper should be a piece of original quantitative analysis. For this class, you should pursue a paper that is a replication and extension of an existing published paper (or book chapter). This will make it easier for you to present the literature review and theory sections for your paper since they will be closely tied to the paper you replicate. Your emphasis for the paper will be on properly analyzing data to test your hypotheses. You should plan to use an OLS model for your paper, but I can work with you if you need to employ some other method. If you have concerns about the appropriateness of OLS for your paper, or if you need assistance in developing a paper topic, you should consult with me early and often in the semester. There is no formal page length, but for most of you I expect the paper will constitute 14-20 pages of text. You should model your paper after the quantitative papers you have seen in journals like APSR, AJPS or JOP, with the caveat that the front-end of your paper (everything up to the Data/Methods section) will be shorter than the typical journal article (because you are doing a replication), and that you will be asked to provide a bit more detail in the back half of your paper regarding the analyses, tests, etc. that you performed.

By "replication," I mean that your first task will be to reproduce the findings exactly as shown in the published paper or chapter you are looking at. This DOES NOT mean simply contacting the author or using a so-called replication data set in which all of the coding, modeling, and estimation decisions/commands are already done for you. Rather, it means going back to the primary (electronic) data source if possible and proceeding from there. For example, suppose you are replicating a study by Bill Smith that uses survey data from the American National Election Studies (ANES) series. Rather than asking Bill Smith to send you any computer files that record all of his coding decisions that you simply have to run, I want you to download the original NES data, locate the proper variables, make any coding changes, and perform the analysis. In other words, your first task is an independent replication/verification of Bill Smith's reported analysis. If that is not possible, we can talk about contacting the original author and other strategies for proceeding.

By "extension," I mean that once you have replicated the results of an existing study, you will then build upon that analysis in some way. This might involve using a different coding of a variable, adding additional variables, considering different (maybe non-linear) model specifications, or adding additional data. Whatever extension you attempt, however, must be derived from a clear theoretical proposition and/or a clear methodological critique. In other words, don't toss in an interaction term, "just to see what happens." Remember, this is not just an exercise in number crunching: you are writing a paper with the goal of answering a

[3] Full syllabus at http://artsci.wustl.edu/~jgill/PS582.2014.html (accessed March 15, 2014).

theoretically motivated research question. However, by going through the process of trying to replicate another scholar's study, I hope you will learn the value of documenting every step of the research process.

All students will read drafts of two other student papers in the course and provide written comments to them. Seeing the work of others and how others react to your work helps you to improve your skills as a researcher. You might be a bit nervous about sharing your work with others, let alone receiving their written comments and providing such comments yourself. It is O.K. to be nervous, but it is also time to start getting used to this. It is better to begin this among friends and colleagues before you have to deal with anonymous reviewers.[4]

PLSC 504: Advanced Quantitative Methods, Fall 2013, Allan Dafoe, Yale University

This course covers a wide range of topics in quantitative methodology. The recurrent theme will be the challenge of drawing reliable causal inferences from quantitative data. The course will involve lectures, sections with the TF, weekly problem sets, a final exam, and a "replication" paper. (...)

The objective for this paper is for you to analyze actual social science data using advanced statistical methods for what could become the basis for a high-quality publishable paper. The best model for this paper is to *replicate* a published work: find a recent and important paper, published in a prominent journal, acquire replication files if they are available, and then, by using the tools you have learned so far and trying other approaches to analyze the problem, examine the inferences of the paper or the subject matter more generally.[5]

Sociology 504: Advanced data analysis for the social sciences, Spring 2015, Matthew Salganik, University of Princeton

In this project, you will work with a partner to reproduce and extend a published research article. The primary goal of this project is to provide the raw materials for a publishable paper, which will be developed and written in the empirical seminar next year. The secondary goals of this project are to 1) give you practice learning new statistical material and computational techniques; 2) give you practice using good software engineering techniques; 3) give you practice doing collaborative research, something you will do throughout your career; 4) show you, in a way that no homework assignment can, the complexity and joy of doing real data analysis. This project not be without pain (…) but it will be worth it. For the project, you must follow the schedule and meet certain technical requirements.

Here are the five steps to the project:

1. Pick a paper
2. Reproduce the results exactly
3. Have your work reproduced by a peer and get feedback
4. Do something new
5. Have your work reproduced by a peer and get feedback[6]

[4] Full syllabus at http://carsey.web.unc.edu/teaching/ (accessed March 15, 2014).

[5] Full syllabus kindly provided by Allan Dafoe.

[6] Full syllabus at http://www.princeton.edu/~mjs3/soc504_s2015/project.shtml (accessed February 19, 2015).

3 Example syllabus for stand-alone replication course

Cambridge Replication Workshop

2013/14

Syllabus

This module will introduce students to the process of reproducing published work. Replicating other scholars' work is an essential tool for becoming familiar with methods, learning to select suitable models, and getting a chance to publish early during their PhD. This replication module will therefore provide students with a deeper understanding of statistical modelling and professionalism in their field. With the right amount of value added, a replication study is publishable after the module.

Duration and format

Each session consists of a short lecture and an extensive practical part. There will be a weekly assignment in which you work on your replication before bringing the results (and problems) to the next session.

Final Project

The main focus of the course is the final project, i.e. a paper in which you have replicated and extend previously published results.

Preparation for first session

Please bring a copy of the article(s) you would like to replicate so we can discuss if it is suitable. A rough guideline:

1) Pick a paper where the data set is available from the Journal's webpage, the author's webpage or a data verse. If you cannot locate its data and code, don't choose it!
2) To increase the probability that your paper will eventually be published, pick an article from a top journal**.**
3) The article should have been published in 2008 or later.
4) Your paper should use methods you can manage or learn over the Christmas break.
5) Bring the paper(s) including the data on your laptop to the first session.

Outline

Week 1 **Nov 28, 2013** **5-7pm**	What is replication? The "reproducibility debate" in statistical research - why replicate? How to pick a suitable paper for replication? Please bring 1-3 papers, including the data, to the first session to pick your project. **Readings:** King, Gary. 1995. Replication, Replication. PS: Political Science and Politics 28: 443–499. http://j.mp/jCyfF1 *Symposium on Replication in International Studies Research*, with articles by Bruce Bueno de Mesquita, Nils Petter Gleditsch, Patrick James, Gary King, Claire Metelits, James Lee Ray, Bruce Russett, Håvard Strand, Brandon Valeriano, in International Studies Perspectives. Volume 4, Issue 1, pages 72–107, March 2003 http://onlinelibrary.wiley.com/doi/10.1111/1528-3577.04105/abstract

Week 2: **Dec 5, 2013** **5-7pm**	How to structure a replication project; Time plan for replication; How to 'read' Rcode, STATA code and SPSS syntax provided by the authors; Preparation of your first replication steps during Christmas vacation **Readings:** King, Gary "How to Write a Publishable Paper as a Class Project ", http://gking.harvard.edu/papers **Each student will be assigned a published replication paper and present its structure and added value components in class**
Week 3+4 **Jan 16, 2014** **4-8pm** **double session**	Presenting first results; Problem solving; Help with Rcode How to add value to a replication; steps to advance knowledge: Robustness checks, Sensitivity analysis, Dummy variables, Interactions, Omitted variables, Adjusted and improved models **No readings for this session; but have all your code and questions ready for the practical part of the session**
Week 5 **Jan 23, 2014** **5-7pm**	Cross-Check: As an assignment for next week, students will exchange replication code and replicate each others' work; guidelines for cross-checking and constructive feedback – including how to make your own work reproducible for others **Readings:** "How to make your work reproducible" https://politicalsciencereplication.wordpress.com/2013/06/04/how-to-make-your-work-reproducible/ Christopher Gandrud, Getting Started with Reproducible Research: A chapter from my new book http://christophergandrud.blogspot.co.uk/2013/07/getting-started-with-reproducible.html Watch this video by Gary King on sharing data: http://tinyurl.com/cpzwbzb
Week 6+7 **Jan 30, 2014** **4-8pm** **double session**	Reports on Cross Check; Problem solving; How to bring a replication into a publishable format for a journal **Readings:** Mark Bell and Nicholas Miller, Guest post: How to persuade journals to accept your replication paper http://tinyurl.com/pqh7b2x "Publishing as a grad student: replication helps" http://tinyurl.com/oksyln3
Week 8 **Feb 6, 2014** **5-7pm**	Publishing the result in our dataverse **No readings for this session; bring your final paper draft, Rcode and data**

4 Handout: How to add value

Cambridge Replication Workshop
2013/14

In what two or three ways will you advance knowledge? Why is this important, and theoretically justified? Will you really improve knowledge, or just play around with data?

Theoretical Contribution	**Statistical Contribution**
Questioning the arguments in the original paper Are links described properly? Making new or better theoretical arguments	**Sample size:** Power calculations (how big should the sample be?) Extended time period More countries (units) New samples (experiments) Different subsets of your data set (e.g. only OECD countries) Multiple Imputation
	Changing measurements: Change of variables: %GDP, log transformation, different ways of dealing with negative values for logging, different measurement for the same variable
	Robustness/Sensitivity checks: Assumptions of regression (e.g. heteroskedasticity; adjusted standard errors) How much do betas and standard errors change when we change model specifications? Are they very 'sensitive' even to small changes?
	Model specification: Standard errors treatment, LDV, lags Interactions Dummy variables Omitted variables Reversed causality Adjusted / improved / advanced models
	Additional exploratory analysis: When replication is not possible (confirmatory analysis failed)
	Avoid "playing around" but take a theoretical approach to data

5 What to do with the manuscript after the class ends

- Keep working on this paper now. If you put it away, it might never leave your drawer again.
- To get additional feedback, consider presenting the paper at a conference before submitting it to a journal.
- Don't forget to concentrate on the argument in the paper, the puzzle, its importance etc., rather than selling this as a replication exercise. The more the paper turns into an original contribution to the literature, the higher its chances of getting published (Carsey 2014; Ishiyama 2014).
- Check if others have published on the same research question after the original study, and cite them.
- If your project could not replicate the original article, show what went wrong and how you improved it. If you did replicate it, stress how you still added value.
- Remain professional in how you express criticism, which should be about the findings not about the original author (King 2006). Journals do not encourage "witch hunts" or efforts to "slay giants" (Ishiyama 2014:79).
- Target the journal that published the original study first, then consider others which publish on the topic. Some journals invite replications, others do not (Carsey 2014; Ishiyama 2014).

References

Carsey, T. M. (2014). Making DA-RT a Reality. *PS: Political Science and Politics*, 47(1):72–77.

Ishiyama, J. (2014). Replication, research transparency, and journal publications: Individualism, community models, and the future of replication studies. *PS: Political Science and Politics*, 47(1):78–83.

King, G. (2006). Publication, publication. *PS: Political Science and Politics*, 39(1):119–125.