

How do you adopt Open and Reproducible Research Practices?

Dr Andrew J. Stewart

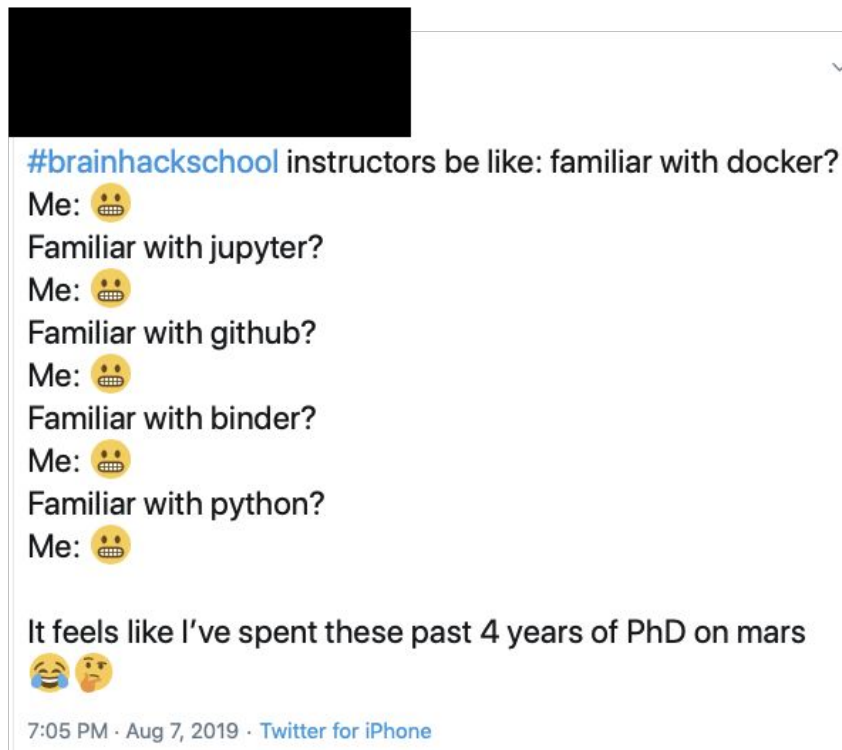
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G: [ajstewartlang](https://github.com/ajstewartlang)



The world of research is rapidly changing...



Open Research is recognised by the G7...

Focus: Incentives and the researcher ecosystem

Ambition: Foster a research environment in which career advancement takes into account Open Science activities, through incentives and rewards for researchers, and valuing the skills and capabilities in the Open Science workforce.

Recommendations:

At national levels: G7 nations should each engage with research stakeholders to identify and implement enhancements to research evaluation and reward systems that take into consideration the Open Science activities carried out by researchers and research institutions. Topics that could be discussed include:

- Recognizing Open Science practices during evaluation of research funding proposals, and research outcomes;
- Recognizing and rewarding research productivity and impact that reflect open science activities by researchers during career advancement reviews;
- Including credit for service activities such as reviewing, evaluating, and curation and management of research data; and,
- Developing metrics of Open Science practices.

...by the REF...

200. The sub-panels welcome research practice that supports reproducible science and the application of best practice. Examples include registered reports, pre-registration, publication of data sets, experimental materials, analytic code, and use of reporting checklists for publication purposes and those relating to the use of animals in research. These contribute to the evaluation of rigour for submitted outputs. Replication studies may be submitted as outputs and will be evaluated on the extent to which they contribute significant new knowledge, improved methods, or advance theory or practice.

346...

Within the context of the institution's strategy, how the submitting unit is progressing towards an open research environment, including where this goes above and beyond the REF open access policy requirements, and wider activity to encourage the effective sharing and management of research data, as appropriate to the discipline. Consideration of reproducibility should also be included where relevant to the discipline.

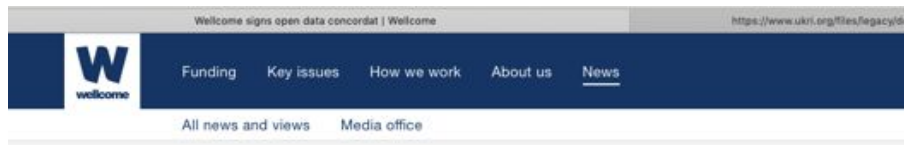
...is forming part of University's teaching manifestos...

Teaching with Open Science commitment:

To teach the practices and skills of open research and science in our undergraduate and postgraduate degree programmes

- a. Promote open science in our teaching.
- b. Design a Research Methods curriculum that teaches skills for open science and uses open science to enhance teaching (for example: teach R and use open data to practice analysis skills).
- c. Learn about and adopt open educational practices in our teaching.
- d. Produce and promote tools for helping student researchers adopt open practices, including training and guidance suitable to their level of study.
- e. Author, share and use open educational resources to promote teaching with open science beyond our School and Institution.
- f. Support our colleagues to learn the skills of teaching Open Science.

...and is required by many funders.



News | 28 July 2016

Wellcome signs open data concordat

Wellcome has signed a concordat to ensure that research data gathered and generated by members of the UK research community is made openly available wherever possible. [HEFCE](#), [Research Councils UK](#) and [Universities](#), signatories.

The [Concordat on Open Research Data](#) [PDF 178K] through consultation with the research community. It covers for sharing research data, including the:

- importance of developing data skills
- importance of ensuring data underlying publication publication date
- rights of data creators to reasonable first use
- expectations of data users to acknowledge use of data



Data sharing
Influencing policy
Open access



There are many aspects to Open Research...

Including pre-registering of studies before you start data collection, reproducible data wrangling and analysis, open data, open code, open publications, and community science involving diversity and inclusivity.

Before data collection

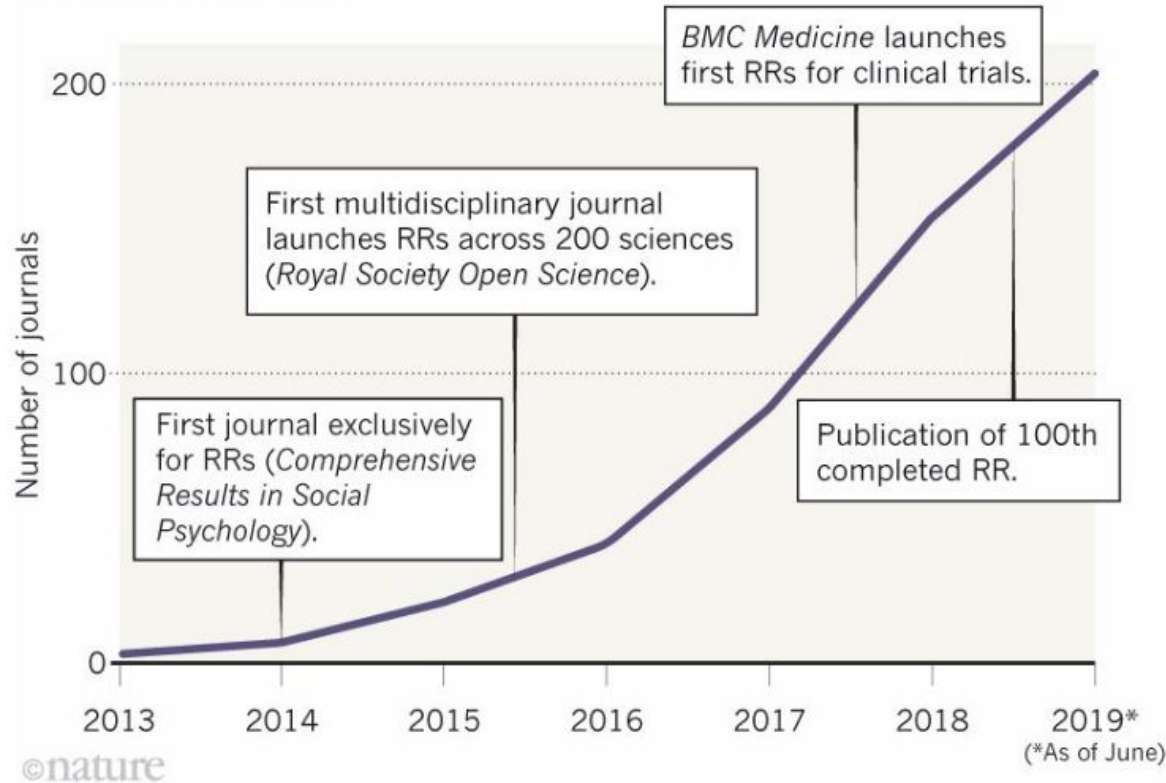
- Specify your hypotheses and analysis plan.
- Pre-register your hypotheses and analysis plan at osf.io
- Consider data simulation so that you can write your analysis script **before** you have your real data.
- Consider submitting as a **registered report** - currently more than 200 journals now support this route. This involves acceptance in principle before you have even started collecting your data - so you are **guaranteed** a publication regardless of what you find.

Registered Reports



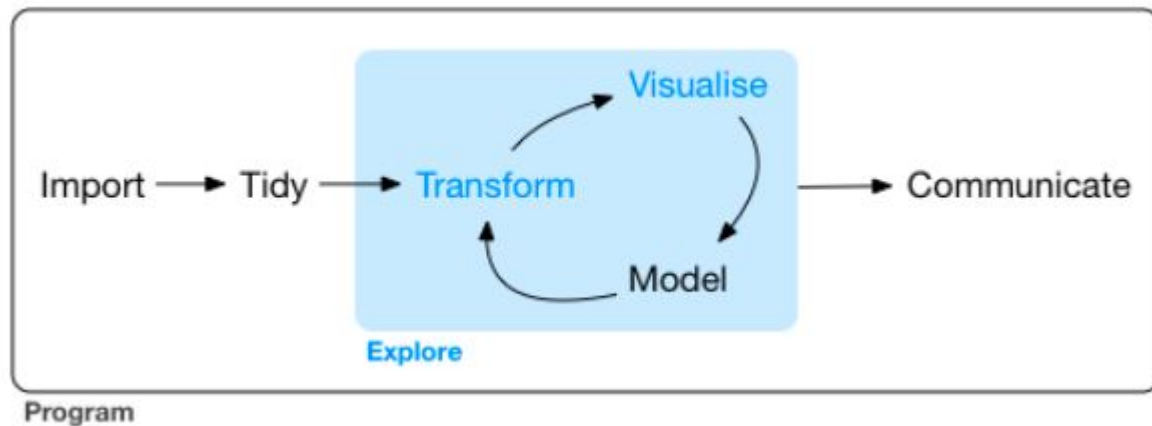
RAPID RISE

Since 2013, the number of journals offering Registered Reports (RRs) has risen to more than 200 titles.



After data collection

You need to use analysis software that allows for open sharing and reproducibility of the entire data wrangling/analysis/write-up workflow.



Hadley Wickham and Garrett Grolemund, [R4DS](#)



Lukas Schlögl @LukasSchlogl · Sep 7

Just priceless. An estimated 20% of **genetic** research papers contain errors because **Excel** converted some gene names into calendar **dates**.



	C. sp. 14	C. sp. 8	C. sp. 1
GenBank	QX1182	QX1182	QX1182
Accession	QX1182	QX1182	QX1182
Gene	QX1182	QX1182	QX1182
Species	QX1182	QX1182	QX1182

PLOS ONE PHYLOGENY/FlickR (CC BY 2.0)

One in five genetics papers contains errors thanks to Microsoft Excel

By **Jessica Boddy** | Aug. 29, 2016 , 1:45 PM



Andrew Whitby @EconAndrew · Sep 7

This is top shelf trolling, because thanks to Excel "1 in 5" genetics papers contain errors in gene names. sciencemag.org/news/2016/08/o ... twitter.com/msexcel/status...

[Show this thread](#)

186 4.6K 7.3K

Reinhart, Rogoff... and Herndon: The student who caught out the profs

By Ruth Alexander
BBC News

20 April 2013

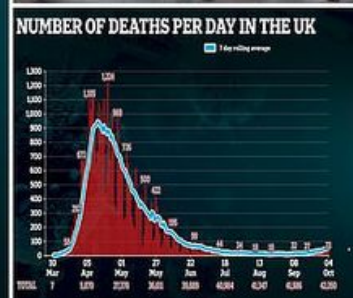
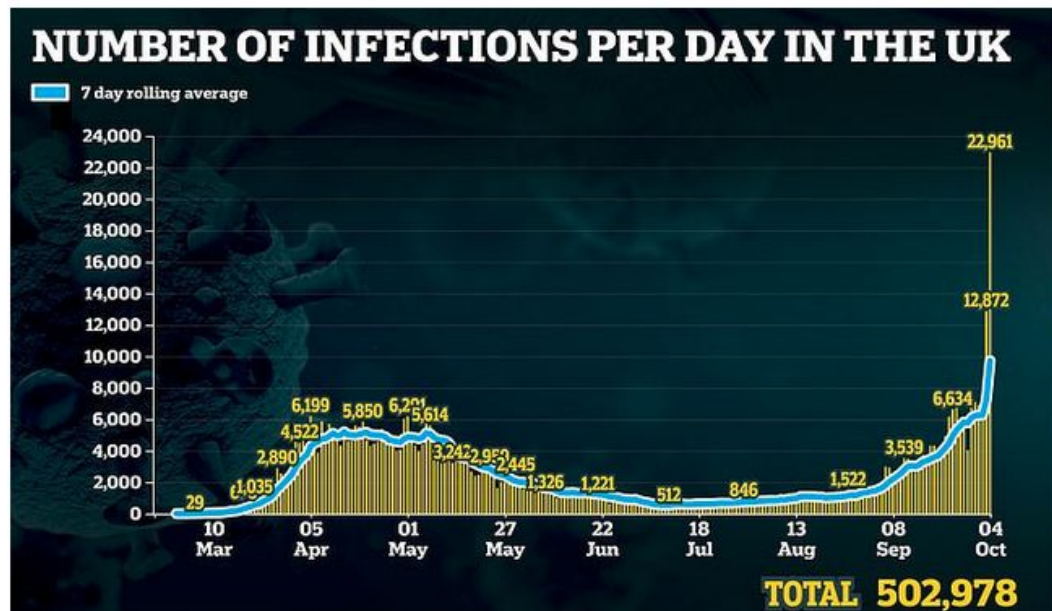
f t e Share

This week, economists have been astonished to find that a famous academic paper often used to make the case for austerity cuts contains major errors. Another surprise is that the mistakes, by two eminent Harvard professors, were spotted by a student doing his homework.

It's 4 January 2010, the Marriott Hotel in Atlanta. At the annual meeting of the American Economic Association, Professor Carmen Reinhart and the former chief economist of the International Monetary Fund, Ken Rogoff, are presenting a research paper called Growth in a Time of Debt.



Furious blame game erupts between PHE and testing tsar Dido Harding after 16,000 Covid cases are missed because an 'Excel spreadsheet maxed out and wouldn't update' - meaning thousands of potentially infected contacts slipped through net



TRACERS 'LOSE' 16,000 CASES

Codifying your Analysis Workflow

You can't use proprietary (closed) software like SPSS, GraphPad, MATLAB etc.

You need to use open source analysis software such as R, Octave or Python.

You need to think about your entire analysis pipeline from data importing, data wrangling, visualisation, statistical modelling, and report generation.

Scripts are fine for small tasks but what about the multiple tasks needed in a research project? How do you connect them together so the entire workflow can be reproduced?

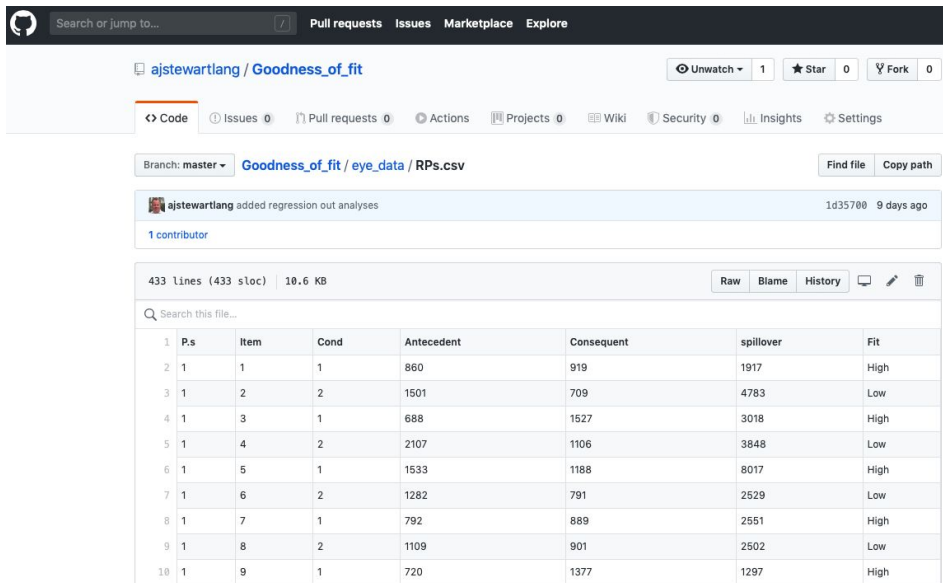
What happens when you want to share your workflow with colleagues elsewhere or in another lab (with a different infrastructure)?

"It worked on my machine!" - but it's not good when it doesn't work on your collaborators' machines (or on your new machine!)

Adopt literate programming principles

- Write analysis code that's easy for others (and future you!) to understand - have lots of commenting - and break your code down into manageable chunks or separate scripts/functions controlled by a master script.
- Later in this unit we'll explore one example of literate programming using R Markdown where you can generate documents containing a blend of narrative, code, and output 'knitted' together (in lots of possible document formats - html, pdf, doc etc.)
- The workshops in this unit are all written in R Markdown - you can even examine the source code behind each of these by looking at the .Rmd file in each workshop repository.

Sharing your data and code (and add a licence!)



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ajstewartlang / Goodness_of_fit Unwatch 1 Star 0 Fork 0

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1 contributor

433 lines (433 sloc) 10.6 KB Raw Blame History

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1	1	1	1	860	919	1917	High
2	1	2	2	1501	709	4783	Low
3	1	3	1	688	1527	3018	High
4	1	4	2	2107	1106	3848	Low
5	1	5	1	1533	1188	8017	High
6	1	6	2	1282	791	2529	Low
7	1	7	1	792	889	2551	High
8	1	8	2	1109	901	2502	Low
9	1	9	1	720	1377	1297	High



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Branch: master Goodness_of_fit / analysis_script.R Find file Copy path

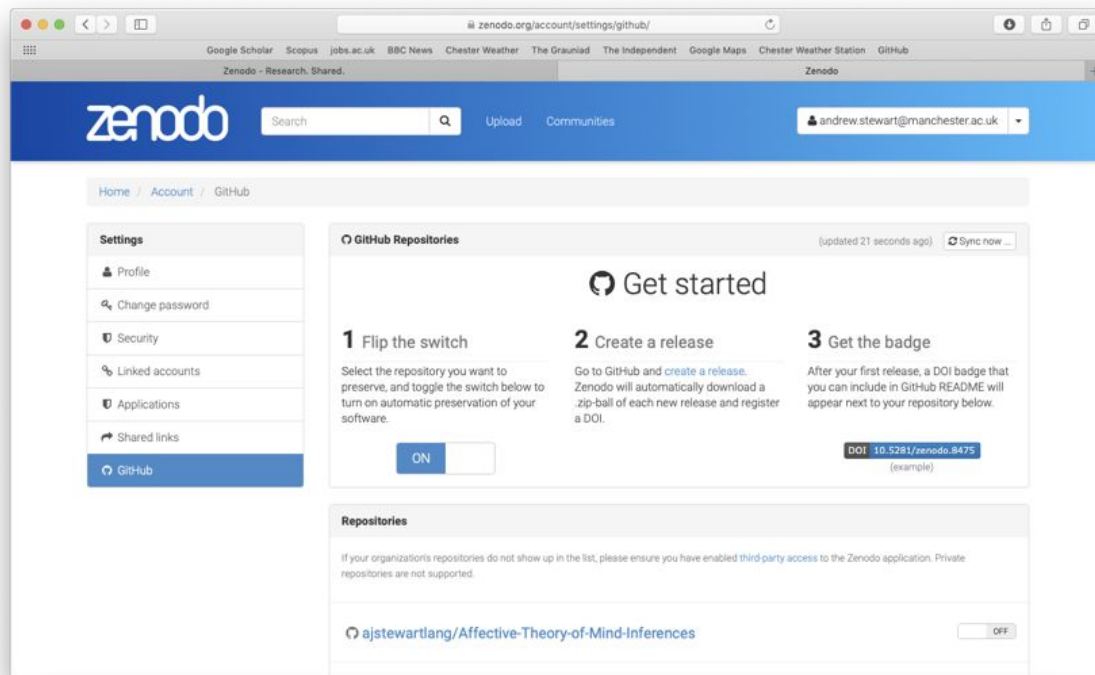
ajstewartlang push from rstudio f536247 9 days ago

1 contributor

287 lines (211 sloc) 9.81 KB Raw Blame History

```
1 library(tidyverse)
2 library(psych)
3 library(lme4)
4 library(lmerTest)
5 library(emmeans)
6 library(performance)
7
8 # Explanatory Goodness Start###
9
10 my_data <- read_csv("questionnaire_data/Explanation_QUALITY.csv")
11 my_data <- my_data[3:nrow(my_data),]
12 nrow(my_data) # 157
13
14 dat0 <- filter(my_data, Finished == 1)
15 nrow(dat0) # 142
16 dat <- filter(dat0, check == "7" & serious == "1" & UserLanguage == "EN")
17 nrow(dat) # 134
18
```


Make your data and code citeable – preserve it with a doi on Zenodo



Concordat on Open Research Data – Nine Principles

- Open access to research data is an enabler of high quality research, a facilitator of innovation and safeguards good research practice.
- There are sound reasons why the openness of research data may need to be restricted but any restrictions must be justified and justifiable.
- Open access to research data carries a significant cost, which should be respected by all parties.
- The right of the creators of research data to reasonable first use is recognised.
- Use of others' data should always conform to legal, ethical and regulatory frameworks including appropriate acknowledgement.

Concordat on Open Research Data – Nine Principles

- Good data management is fundamental to all stages of the research process and should be established at the outset.
- Data curation is vital to make data useful for others and for long-term preservation of data.
- Data supporting publications should be accessible by the publication date and should be in a citeable form.
- Support for the development of appropriate data skills is recognised as a responsibility for all stakeholders.

TOP GUIDELINES

TRANSPARENCY AND OPENNESS PROMOTION

Transparency, open sharing, and reproducibility are core values of science, but not always part of daily practice. Journals, funders, and societies can increase research reproducibility by adopting the TOP Guidelines.

8 MODULAR STANDARDS

CITATION STANDARDS Cite shared data to incentivize their publication	DATA TRANSPARENCY Disclose, require, or verify shared data
ANALYTICAL METHODS TRANSPARENCY Disclose, require, or verify shared code	RESEARCH MATERIALS TRANSPARENCY Disclose, require, or verify shared materials
DESIGN AND ANALYSIS TRANSPARENCY Sets standards for research design disclosures	PREREGISTRATION OF STUDIES Specification of study details before data collection
PREREGISTRATION OF ANALYSIS PLANS Specification of analytical details before data collection	REPLICATION Encourages publication of replication studies

ACROSS 3 TIERS

DISCLOSURE:

The article must disclose whether or not materials are available.

REQUIREMENT:

The article must share materials when possible.

VERIFICATION:

Third party must verify that the standard is being met.

HOW TOP IS IMPLEMENTED

TOP Statements are standardized tools for disclosing research outputs such as datasets.

Open Science Badges signal transparent research.

Registered Reports protect research against biased analysis and publication.

OVER 5,000 JOURNAL SIGNATORIES

LEARN MORE AT COS.IO/TOP

The Center for Open Science is a non-profit organization with the mission of improving openness, integrity, and reproducibility in scientific research.



COS: cos.io

| **OSF:** osf.io

| **Email:** contact@cos.io



CenterForOpenScience



@OSFramework

Your data need to be FAIR



Data and supplementary materials have sufficiently rich metadata and a unique and persistent identifier.

FINDABLE



Metadata and data are understandable to humans and machines. Data is deposited in a trusted repository.

ACCESSIBLE



Metadata use a formal, accessible, shared, and broadly applicable language for knowledge representation.

INTEROPERABLE



Data and collections have a clear usage licenses and provide accurate information on provenance.

REUSABLE

And you need to remember to add a license – such as CC BY



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Choosing a License

Which of the following best describes your situation?



I need to work in a community.

Use the **license preferred by the community** you're contributing to or depending on. Your project will fit right in.

If you have a dependency that doesn't have a license, ask its maintainers to **add a license**.



I want it simple and permissive.

The **MIT License** is short and to the point. It lets people do almost anything they want with your project, like making and distributing closed source versions.

Babel, **.NET Core**, and **Rails** use the MIT License.



I care about sharing improvements.

The **GNU GPLv3** also lets people do almost anything they want with your project, *except* distributing closed source versions.

Ansible, **Bash**, and **GIMP** use the GNU GPLv3.

PERSPECTIVE

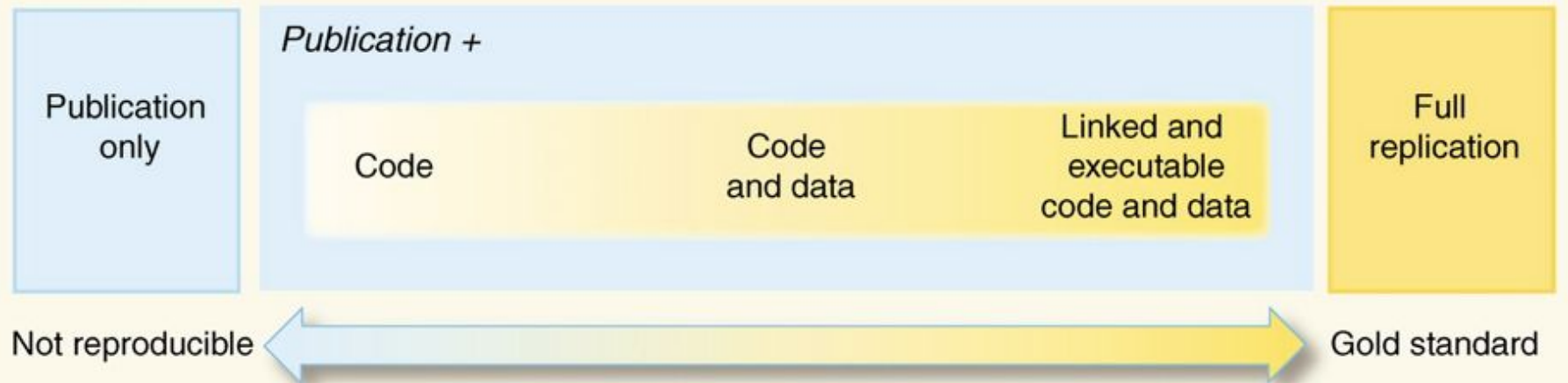
Reproducible Research in Computational Science

Roger D. Peng

+ See all authors and affiliations

Science 02 Dec 2011:
Vol. 334, Issue 6060, pp. 1226-1227
DOI: 10.1126/science.1213847

Reproducibility Spectrum



Why do we need to reproduce the computational environment?

Quite often analysis code 'breaks' - often in one of two ways:

Code that worked previously now doesn't - maybe a function in an R package was updated (e.g., `lsmeans` became `emmeans` so old code using `lsmeans` wouldn't now run).

Code that worked previously still works - but produces a slightly different result or now throws a warning where it didn't previously (e.g., convergence/singular fit warnings in `lme4` version 1.1-19 vs. version 1.1-20).

When R moved from version 3.5 to 3.6, the way in which random numbers were generated using the `sample()` function changed - so even with the same randomisation seed, *different* random numbers were produced.

Much Twitter confusion ensued!

Capturing your local computational environment

- You need to capture the versions of your software packages (plus their dependencies incl. system-level ones).
- This may sound trivial but trying running some old analysis code and be amazed at how many things now don't work as they once did!

Binder to the rescue!



Turn a Git repo into a collection of interactive notebooks

Have a repository full of Jupyter notebooks? With Binder, open those notebooks in an executable environment, making your code immediately reproducible by anyone, anywhere.

Build and launch a repository

GitHub repository name or URL

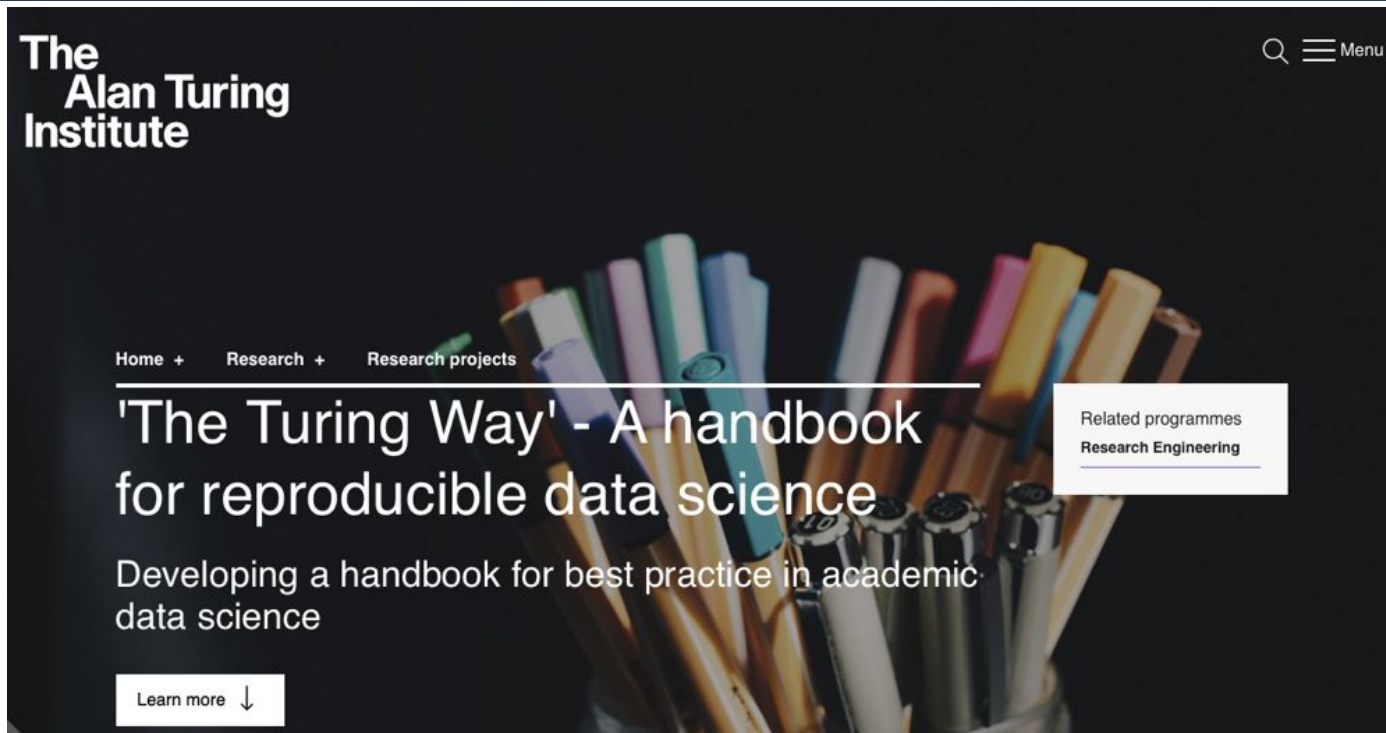
GitHub ▾

Git branch, tag, or commit **Path to a notebook file (optional)**

File ▾

launch

The Turing Way



<https://www.turing.ac.uk/research/research-projects/turing-way-handbook-reproducible-data-science>

Summary

- Open data and open code are the future - remember to make your data FAIR and add a license to both your data and code.
- Pre-registration allows you to capture your predictions - time-stamped at a point in time so when you come to write up your work you can use the pre-reg as evidence that you really did make your predictions before data collection commenced.
- In many cases conducting research in a reproducible manner is easy - it requires a bit of planning and organisation up-front, but the pay-off is huge.
- Not only will others be able to reproduce your results, but so will you at some future point in time.
- Working in an open and reproducible manner also makes large-scale collaborations easier - with the extra computational skills that you acquire, you'll be a more effective researcher.