Week 03
Intro to Reproducible Research

API209: Summer Math Camp

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Why Reproducibility?

Are We in a Crisis?

- The **replication crisis** in social sciences has highlighted significant issues in the credibility of research findings.
- Many high-profile studies have failed to replicate, raising concerns about the **reliability** of published results.
- The crisis has prompted a call for greater **transparency** and **rigor** in research practices.

The Replication Crisis

What Went Wrong?

- **Selective Reporting**: Only significant findings get published, leading to publication bias.
- **P-Hacking**: Manipulating data and analyses until nonsignificant results become significant.
- **Lack of Transparency**: Opaque methodologies that others cannot replicate or verify.

The Importance of Reproducibility

Building Trust in Research

- Reproducibility ensures that research findings are not just a result of **chance** or **specific conditions**.
- It allows others to **verify results** and build upon them, fostering cumulative knowledge.
- **Transparent reporting** of data and methods strengthens the credibility and utility of research.

How Can We Improve Reproducibility?

Adopting Best Practices

- **Pre-registration**: Outlining the study design and analysis plan before data collection.
- **Open Data and Code**: Sharing data and analysis scripts for others to verify and use.
- **Reproducible Workflows**: Using tools like Quarto to create dynamic documents that combine analysis and narrative.

Reproducibility: The Basics

Replicability: Expanding the Horizon

Reproducibility vs. Replicability

- **Reproducibility**:
  - → duplication with the same data and procedures;
  - → ensuring accuracy and precision.
- **Replicability**:
  - → tests the findings using new data *but the same methods*;'
  - → emphasizing robustness and generalization.

Both concepts are crucial for ensuring the credibility and reliability of research, but they serve different purposes within the scientific process.

enter Quarto

Quarto: A Tool for Reproducible Research

What is Quarto?

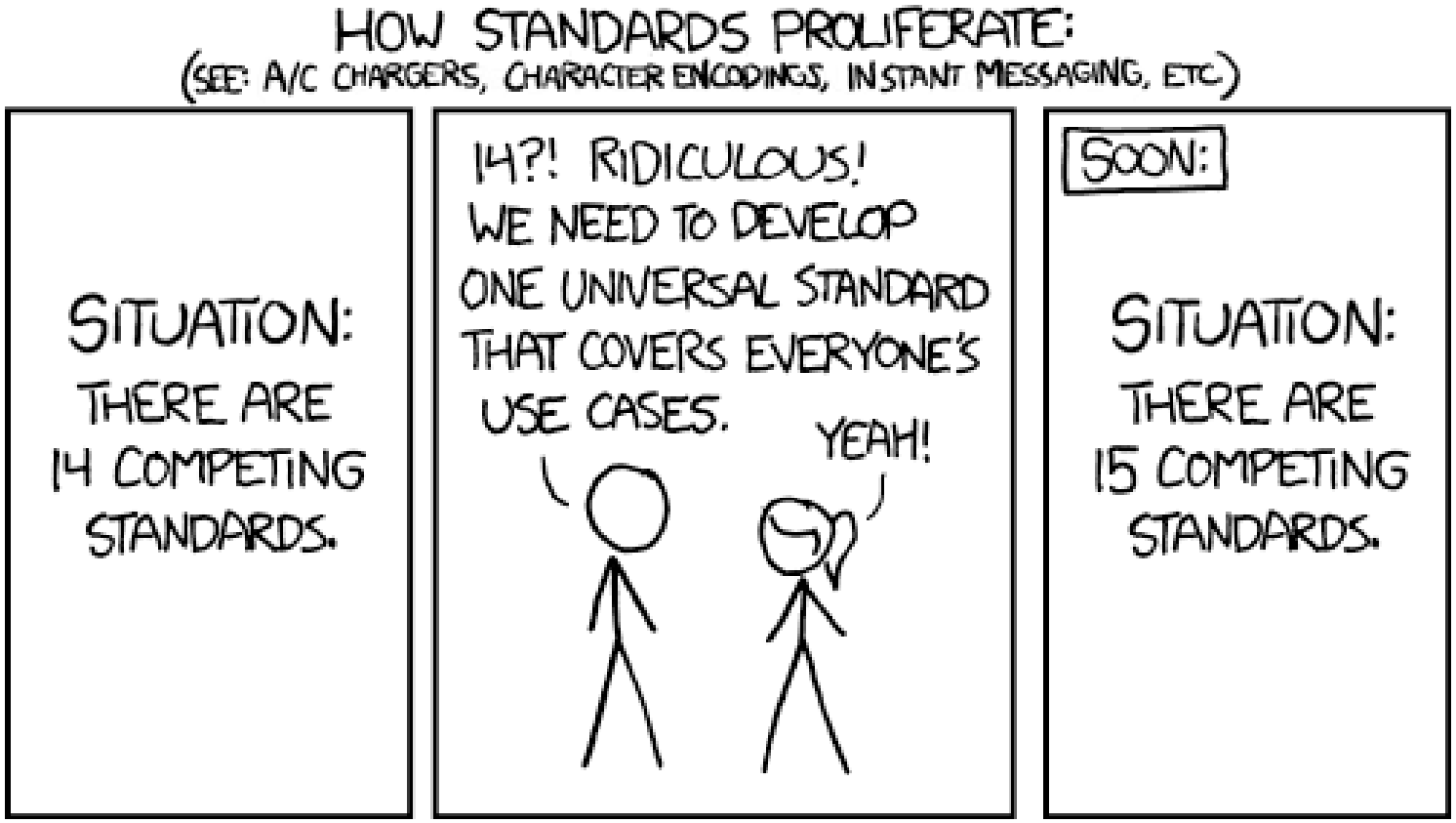
Quarto is an open-source scientific and technical publishing system that enables researchers to create dynamic documents, reports, presentations, and websites.

Why Quarto?

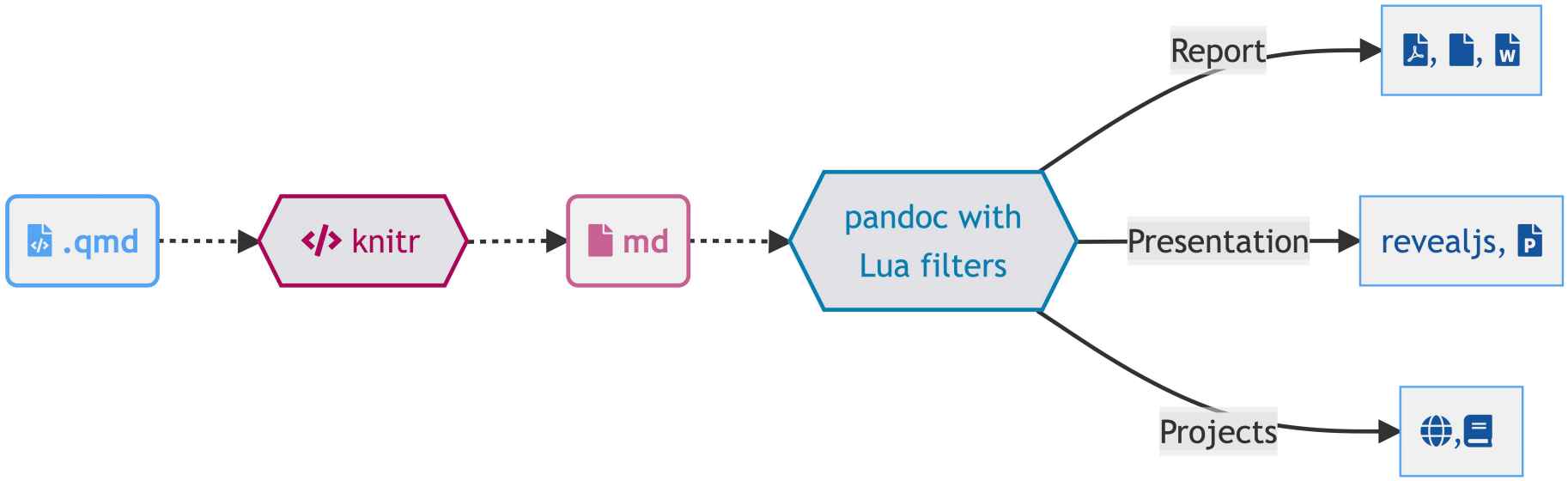
The Need for Reproducible Research

- Quarto ensures that your analysis and outputs (tables, figures, etc.) can be reproduced by others, enhancing the credibility of your work.
- **Integrated with R, Python, Julia, etc.**: Quarto supports multiple languages, making it versatile for various research needs.

Why Quarto?


HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)
SITUATION:
THERE ARE
14 COMPETING
STANDARDS.
14?! RIDICULOUS!
WE NEED TO DEVELOP
ONE UNIVERSAL STANDARD
THAT COVERS EVERYONE'S
USE CASES.
YEAH!
SOON:
SITUATION:
THERE ARE
15 COMPETING
STANDARDS.

Quarto for literate programming



Key Features of Quarto

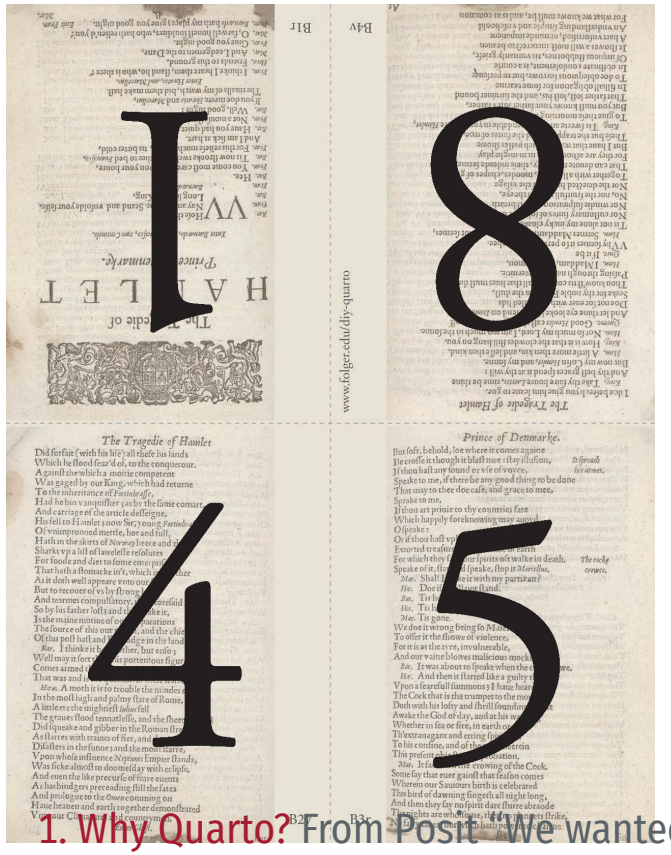
1. **Dynamic Documents**: Create documents that are automatically updated with the latest data and analysis.
2. **Multiple Outputs**: Generate reports, presentations, blogs, and books from a single source.
3. **Version Control**: Integrates seamlessly with Git for version control, tracking changes, and collaboration.
4. **Cross-Platform**: Works with RStudio, VSCode, or directly from the command line.

Why Use Quarto for Your Problem Sets?

Consistency and Organization

- Quarto helps you **organize your code, analysis, and narrative** in a single document.
- It ensures that your problem sets are **well-documented** and **easily understandable**.

Why the name “Quarto”?[1]



1. Why Quarto? From Posit - We wanted to use a name that had meaning in the history of publishing and landed on Quarto, which is the format of a book or pamphlet produced from full sheets printed with eight pages of text, four to a side, then folded twice to produce four leaves. The earliest known European printed book is a Quarto, the Sibyllenbuch, believed to have been printed by Johannes Gutenberg in 1452–53.”