



Why Users (Don't) Use Password Managers at a Large Educational Institution

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<https://www.usenix.org/conference/usenixsecurity22/presentation/mayer>

This artifact appendix is included in the Artifact Appendices to the Proceedings of the 31st USENIX Security Symposium and appends to the paper of the same name that appears in the Proceedings of the 31st USENIX Security Symposium.

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D Artifact Appendix

D.1 Abstract

This artifact comprises several files that aid in the replication of our study: (1) a QSF-file containing all questions in a survey format exported from Qualtrics and that can be easily re-imported there); (2) a CSV-file with the the data collected from our participants with identifiable information removed (to improve compatibility, also a tab-separated version is provided); (3) the analysis script with the majority of the quantitative analyses of the paper; (4) a Jupyter Notebook file with the CHI-squared test; (5) the codebook of the qualitative analysis with counts for each of the codes. Using the data set and the analysis script, all quantitative results in the paper can be replicated.

D.2 Artifact check-list (meta-information)

- **Program:** The analysis was run with R version 4.2.0 running in RStudio¹ 2022.02.3 Build 492 with knitr. The following packages are needed to run the script: dplyr, AICcmoavg. For the chi-squared test, we used a Jupyter Notebook, version 6.4.8 to conduct the analysis. The easiest way to use Jupyter Notebook is to install Anaconda² which comes pre-installed with the most popular Python libraries and tools. Anaconda navigator version 2.2.0 as well as Python version 3.9.12 were used for this analysis. The following packages are required to run this script: pandas, numpy, scipy, statsmodels.
- **Compilation:** Some of the R packages and their dependencies require compilation, but R should handle this automatically when installing the packages.
- **Data set:** The data set collected from the participants of our study is included in the artifact
- **Run-time environment:** Recommended is use of RStudio 2022.02.3 Build 492 with R 4.2.0. Other configurations are likely to work but are untested. A Jupyter Notebook version 6.4.8 is recommended but not required to run the .ipynb. You can easily access the Jupyter Notebook by installing Anaconda. All our analyses were run on macOS.
- **Hardware:** No specific hardware is needed.
- **Output:** The output on the R console and Jupyter Notebook represent the analyses as they were reported in the paper.
- **Experiments:** For a full replication of our study, the QSF-file can be used to import the survey back into qualtrics and distribute it among new participants. Note that the survey requires Javascript and therefore will not work with free Qualtrics accounts. For replication of the results reported in the paper, the analysis script and the data set collected from our participants should be used.
- **How much disk space required (approximately)?:** Negligible, less than 1MB.

¹<https://www.rstudio.com/products/rstudio/download/>

²<https://www.anaconda.com/products/distribution>

- **How much time is needed to prepare workflow (approximately)?:** This depends on whether the required environment (RStudio and Anaconda) and the required packages are already installed. If none of the aforementioned are present, setup should take 30 minutes or less on a modern computer.
- **How much time is needed to complete experiments (approximately)?:** This depends on hardware, but should take less than 5 minutes on any recent laptop.
- **Publicly available (explicitly provide evolving version reference)?:** The artifact will be made available in a GitHub repo with a tag marking the version submitted for the artifact evaluation.
- **Code licenses (if publicly available)?:** The R code and Jupyter Notebook script are licensed under the MIT license.
- **Data licenses (if publicly available)?:** The data is licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.³
- **Archived (explicitly provide DOI or stable reference)?:** GitHub Commit ID for the version submitted for artifact evaluation: 2ead79bbe026789bc78d87b420c487da4d980ff5
GitHub Commit ID for the version improved with the comments from artifact evaluation reviews: a90e474e2e2be23898b4b85570cd0daaba61970f

D.3 Description

D.3.1 How to access

The artifact can be downloaded from the GitHub repository.⁴

D.3.2 Hardware dependencies

N/A

D.3.3 Software dependencies

The analysis requires R to run. Recommended is RStudio 2022.02.3 Build 492 with R 4.2.0, since the authors used these versions. Other versions are likely to work but are untested. RStudio can be obtained for free online.⁵ The following R packages are needed to run the script: dplyr, AICcmoavg. For the chi-squared script, Jupyter Notebook version 6.4.8 is recommended but not required. To quickly use Jupyter Notebook, download Anaconda.⁶

D.3.4 Data sets

No third-party data sets were used.

D.3.5 Models

N/A

³<http://creativecommons.org/licenses/by-nc-nd/4.0/>

⁴<https://github.com/gwusec/2022-USENIX-Password-Managers>

⁵<https://www.rstudio.com/products/rstudio/download/>

⁶<https://www.anaconda.com/products/distribution>

D.3.6 Security, privacy, and ethical concerns

N/A

D.4 Installation

The setup consists of two steps. First, R needs to be installed. Recommended is RStudio 2022.02.3 Build 492 with R 4.2.0, since the authors used these versions. Other versions are likely to work but are untested. RStudio can be obtained for free online.⁷ After the installation of RStudio, R should be available as well.

When RStudio is installed it must be started and the analysis script can be opened using the File dialog. Then the following R packages need to be installed: dplyr, AICcmodavg. To install these packages using RStudio, open the Tools menu and then select Install packages... In the search box enter the first package. Then click install. Repeat these two steps for the second package. Installation of the packages might take some time if they need to be compiled. Once the two packages are installed, the analysis script can be run.

To run the .ipynb stats script that has the chi-squared test, first ensure you have Python installed as well as all the required dependencies. Python version 3.9.12 was used for this analysis. In addition to Python, the following dependencies also need to be installed: pandas, numpy, scipy, statsmodels. You can install them one by one from the terminal using pip (which is automatically installed with Python):

```
pip install pandas
pip install numpy
pip install scipy
pip install statsmodels
```

Once Python and all the above dependencies have been installed, you will be ready to run the Jupyter Notebook script. It is recommended you download Anaconda which comes pre-installed with Jupyter Notebook. Anaconda can be obtained for free online.⁸ Once Anaconda is installed, open it and launch Jupyter Notebook, and browse to the location of the script. Run all the cells, one by one from top to bottom. It should print the results to the screen.

D.5 Experiment workflow

The R analysis script is divided into several segments called “chunks”, each pertaining to the preparation of a specific variable or performing a specific analysis. These chunks are delimited by three accents before and after the block. Each chunk is labeled. The label is enclosed by curly brackets. The respective syntax looks like this:

```
``{r <section label>}
  <R code>
``
```

The easiest way to run the analyses is to run the script chunk-by-chunk from the top in RStudio. Running a chunk can be achieved in RStudio in three ways. Firstly, RStudio provides a small green right-arrow button on the top right for each chunk. Clicking it will run the respective chunk. Secondly, with the cursor in a chunk,

you can use the shortcut Ctrl + Shift + Enter (on macOS: Cmd + Shift + Enter) to run the respective chunk. Thirdly, with the cursor in a chunk, you can use the menu Code → Run Region → Run Current Chunk.

The Jupyter Notebook script is similarly divided into several cells. Run the cells one by one, from the top to the bottom and the results will be displayed on the screen.

D.6 Evaluation and expected results

Claim 1: Awareness and use of PMs is much broader than previously reported The overall high awareness and use of password managers are supported by the analyses in section “prepare pwdm awareness variable” and “prepare password manager use variable” respectively.

Claim 2: The vast majority of respondents reuse passwords across accounts The results pertaining to password reuse can be found in section “RQ-2 reuse.”

Claim 3: Perceived ease-of-use overall plays a key role in password manager adoption The results for the regression analysis identifying ease-of-use as predictor when all PM-users are considered can be found in section “pwdm use.” The regression analyses for only browser-based password managers, system password managers, and third-party password managers can be found in the sections “browser pwdm use,” “system pwdm use,” and “third-party pwdm use” respectively.

Claim 4: Third-party password manager users are significantly more likely to use the PM to generate passwords The results for this can be replicated by running the Jupyter Notebook file called chi_test.ipynb. These will be printed to the screen.

Claim 5: The majority of participants would adopt a PM if it was offered to them for free by their organization The analysis pertaining to the adoption of password managers when one is offered by the participant’s organization can be found in section “prepare pwdm use in organization variable.”

D.7 Experiment customization

N/A

D.8 Version

Based on the LaTeX template for Artifact Evaluation V20220119.

⁷<https://www.rstudio.com/products/rstudio/download/>

⁸<https://www.anaconda.com/products/distribution>