R you ready for some data?

Rick O. Gilmore[1,2], James LeBreton[1], Michael Hallquist[1], & Dan Albohn

[1] The Pennsylvania State University

[2] Databrary.org

Author Note

The authors are with the Department of Psychology at The Pennsylvania State University. The authors acknowledge support from the Department of Psychology and the Social, Life, & Engineering Sciences Imaging Center (SLEIC).

Correspondence concerning this article should be addressed to Rick O. Gilmore, Department of Psychology, The Pennsylvania State University, University Park, PA 16802 USA. E-mail: rogilmore@psu.edu

Abstract

Want to write a paper using R Markdown? Keep reading to see how.

Keywords: APA, R Markdown

Word count: Not that many.

R you ready for some data?

It is possible to write an entire APA-formatted article in R Markdown. This very brief paper shows how it might be done. As illustration, we use the data from a brief, informal survey of participants in the inaugural R Bootcamp at Penn State. We predicted that higher levels of enthusiasm for "Game of Thrones" would be reported by respondents with *lower* reported hours/day of preferred sleep, at least among younger respondents.

Methods

Consistent with open and transparent science practices, we report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study (Simmons, Nelson, & Simonsohn, 2011).

Participants

We asked participants in an optional "R Bootcamp" held at the Pennsylvania State University Department of Psychology to complete an anonymous survey using a Google Form. We asked participants to report their age in years. A total of 50 respondents answered the survey with a reported age of [23-54] years.

Material

The survey can be found at this URL: https://docs.google.com/forms/d/1l5OX8PcN_lfVn3ykr_PtHCzhRbWzMbxhqtgILD45zRg/edit. There were five questions asked:

1. Your current level of experience/expertise with R
2. Your enthusiasm for Game of Thrones [1..10 scale]
3. Age in years
4. Preferred number of hours spent sleeping/day
5. Favorite day of the week?

6. Are your data tidy?

Procedure

We emailed a link to the survey to the list of participants. We also include a link to the survey on the web page containing the course schedule (https://psu-psychology.github.io/r-bootcamp/schedule.html). We encouraged participants to complete the survey after the first day's material.

Data analysis

We used R (3.4.1, R Core Team, 2017b) and the R-packages *bindrcpp* (0.2, Müller, 2016), *dplyr* (0.7.2, Wickham & Francois, 2016), *foreign* (0.8.69, R Core Team, 2017a), *Formula* (1.2.2, Zeileis & Croissant, 2010), *ggplot2* (2.2.1, Wickham, 2009), *gmodels* (2.16.2, Warnes et al., 2015), *googlesheets* (0.2.2, Bryan & Zhao, 2017), *Hmisc* (4.0.3, Harrell Jr, Charles Dupont, & others., 2017), *lattice* (0.20.35, Sarkar, 2008), *MASS* (7.3.47, Venables & Ripley, 2002), *multilevel* (2.6, Bliese, 2016), *nlme* (3.1.131, Pinheiro, Bates, DebRoy, Sarkar, & R Core Team, 2017), *papaja* (0.1.0.9492, Aust & Barth, 2017), *plyr* (Wickham, 2011; 1.8.4, Wickham & Francois, 2016), *psych* (1.7.5, Revelle, 2017), *purrr* (0.2.3, Henry & Wickham, 2017), *readr* (1.1.1, Wickham, Hester, & Francois, 2017), *survival* (2.41.3, Terry M. Therneau & Patricia M. Grambsch, 2000), *tibble* (1.3.3, Wickham, Francois, & Müller, 2017), *tidyr* (0.6.3, Wickham, 2017a), and *tidyverse* (1.1.1, Wickham, 2017b) for all our analyses. The code used to generate these analyses is embedded in this document. To view it, see the R Markdown file in the GitHub repository associated with this paper.

Results

Table 1 summarizes the Game of Thrones ratings data by levels of R experience.

Let's examine the correlations between our continuous variables. As indicated in Table 2, there is a negative correlation ($r = -.92$, 95% CI [$-.95$, $-.85$]) between Game of Thrones enthusiasm and age ($t(48) = -15.76$, $p < .001$), a negative correlation ($r = -.39$, 95% CI

[−.60, −.13]) between Game of Thrones enthusiasm and sleep ($t(48) = -2.95$, $p = .005$), but no correlation ($r = .13$, 95% CI [−.16, .39]) between age and sleep ($t(48) = 0.88$, $p = .385$). Figures 1 and 2 depict these patterns.

To test the hypothesis that GoT enthusiasm varies as a function of R expertise and the extent to which respondents use tidy data, we carried out a one-way ANOVA. R experience ($F(4, 40) = 0.89$, MSE $= 4.00$, $p = .481$, $\eta_p^2 = .081$) and the use of tidy data principles ($F(1, 40) = 0.01$, MSE $= 4.00$, $p = .937$, $\eta_p^2 = .000$) did not predict enthusiasm for Game of Thrones. Table 3 summarizes these results.

Discussion

These results show how awesome it can be to use R, R Markdown, and literate programming principles to conduct and open, transparent, and reproducible psychological science. Yay, us!

There are no limitations to what we can accomplish using these tools. So, let's get to it.

References

Aust, F., & Barth, M. (2017). *papaja: Create APA manuscripts with R Markdown*. Retrieved from https://github.com/crsh/papaja

Bliese, P. (2016). *Multilevel: Multilevel functions*. Retrieved from https://CRAN.R-project.org/package=multilevel

Bryan, J., & Zhao, J. (2017). *Googlesheets: Manage google spreadsheets from r*. Retrieved from https://CRAN.R-project.org/package=googlesheets

Harrell Jr, F. E., Charles Dupont, & others. (2017). *Hmisc: Harrell miscellaneous*.

Henry, L., & Wickham, H. (2017). *Purrr: Functional programming tools*. Retrieved from https://CRAN.R-project.org/package=purrr

Müller, K. (2016). *Bindrcpp: An 'rcpp' interface to active bindings*. Retrieved from https://CRAN.R-project.org/package=bindrcpp

Pinheiro, J., Bates, D., DebRoy, S., Sarkar, D., & R Core Team. (2017). *nlme: Linear and nonlinear mixed effects models*. Retrieved from https://CRAN.R-project.org/package=nlme

R Core Team. (2017a). *Foreign: Read data stored by 'minitab', 's', 'sas', 'spss', 'stata', 'systat', 'weka', 'dBase', .* Retrieved from https://CRAN.R-project.org/package=foreign

R Core Team. (2017b). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from https://www.R-project.org/

Revelle, W. (2017). *Psych: Procedures for psychological, psychometric, and personality research*. Evanston, Illinois: Northwestern University. Retrieved from https://CRAN.R-project.org/package=psych

Sarkar, D. (2008). *Lattice: Multivariate data visualization with r*. New York: Springer. Retrieved from http://lmdvr.r-forge.r-project.org

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology:

Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychol. Sci.*, *22*(11), 1359–1366. Retrieved from http://journals.sagepub.com/doi/abs/10.1177/0956797611417632

Terry M. Therneau, & Patricia M. Grambsch. (2000). *Modeling survival data: Extending the Cox model*. New York: Springer.

Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with s* (Fourth.). New York: Springer. Retrieved from http://www.stats.ox.ac.uk/pub/MASS4

Warnes, G. R., Bolker, B., Lumley, T., Randall C. Johnson are Copyright SAIC-Frederick, R. C. J. C. from, Intramural Research Program, I. F. by the, NIH, ... Cancer Research under NCI Contract NO1-CO-12400., C. for. (2015). *Gmodels: Various r programming tools for model fitting*. Retrieved from https://CRAN.R-project.org/package=gmodels

Wickham, H. (2009). *Ggplot2: Elegant graphics for data analysis*. Springer-Verlag New York. Retrieved from http://ggplot2.org

Wickham, H. (2011). The split-apply-combine strategy for data analysis. *Journal of Statistical Software*, *40*(1), 1–29. Retrieved from http://www.jstatsoft.org/v40/i01/

Wickham, H. (2017a). *Tidyr: Easily tidy data with 'spread()' and 'gather()' functions*. Retrieved from https://CRAN.R-project.org/package=tidyr

Wickham, H. (2017b). *Tidyverse: Easily install and load 'tidyverse' packages*. Retrieved from https://CRAN.R-project.org/package=tidyverse

Wickham, H., & Francois, R. (2016). *Dplyr: A grammar of data manipulation*. Retrieved from https://CRAN.R-project.org/package=dplyr

Wickham, H., Francois, R., & Müller, K. (2017). *Tibble: Simple data frames*. Retrieved from https://CRAN.R-project.org/package=tibble

Wickham, H., Hester, J., & Francois, R. (2017). *Readr: Read rectangular text data*. Retrieved from https://CRAN.R-project.org/package=readr

Zeileis, A., & Croissant, Y. (2010). Extended model formulas in R: Multiple parts and

multiple responses. *Journal of Statistical Software*, *34*(1), 1–13. Retrieved from http://www.jstatsoft.org/v34/i01/

Table 1

Descriptive statistics of Game of Thrones enthusiasm by R experience.

R_exp	Mean	Median	SD	Min	Max
none	4.10	4.00	2.38	1.00	9.00
limited	5.20	6.00	2.04	1.00	8.00
some	4.30	4.50	2.06	2.00	7.00
lots	3.60	4.00	1.78	1.00	6.00
pro	3.60	4.00	1.26	2.00	5.00

Note. This table was created with apa_table()

Table 2

Correlation table of the example data set.

	GoT	Age_yrs
GoT		
Age_yrs	-0.92***	
Sleep_hrs	-0.39**	0.13

Note. This is a correlation table created using apa_table().

Table 3

ANOVA table for the analyis of the example data set.

Effect	F	df_1	df_2	MSE	p	η_p^2
R exp	0.89	4	40	4.00	.481	.081
Tidy data	0.01	1	40	4.00	.937	.000
R exp × Tidy data	0.58	4	40	4.00	.681	.055

Note. This is a table created using apa_print() and apa_table().

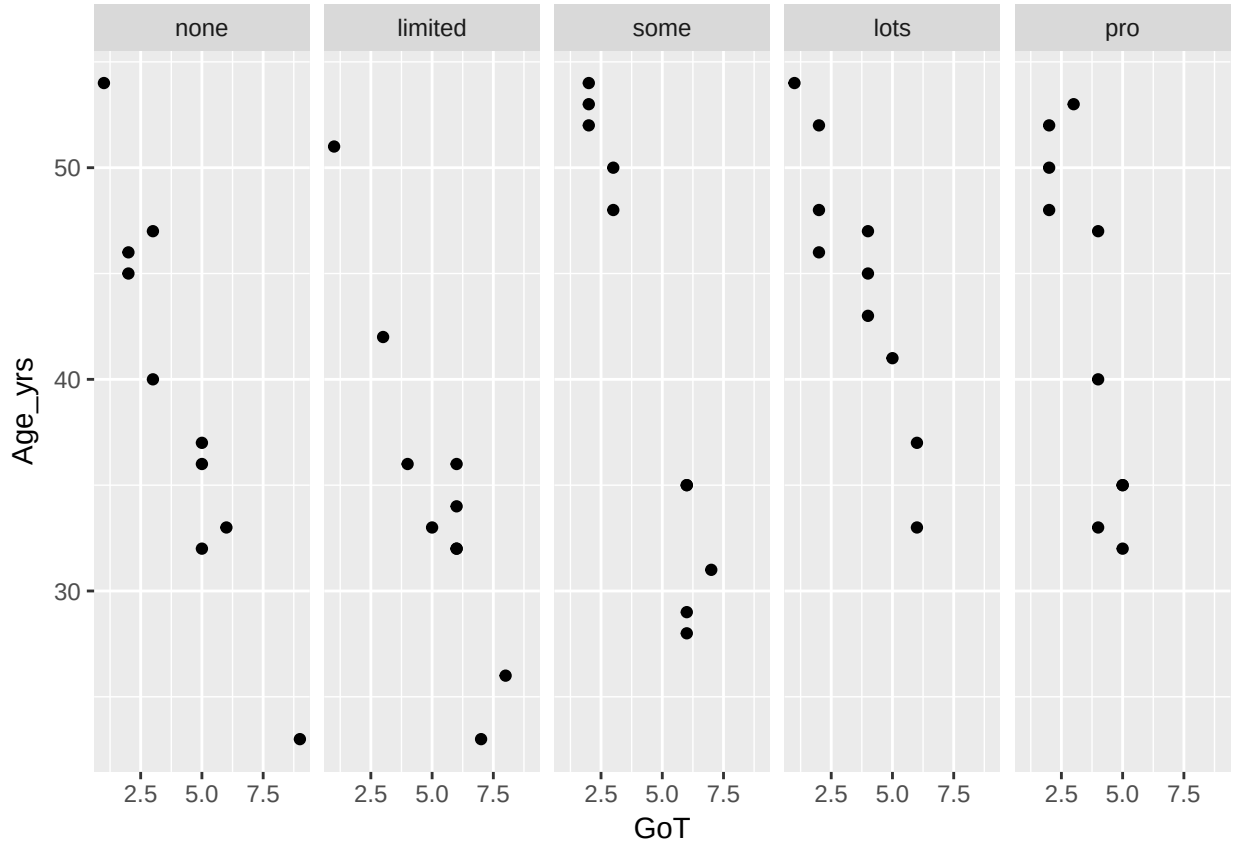

Figure 1. Game of Thrones enthusiasm by age and R experience

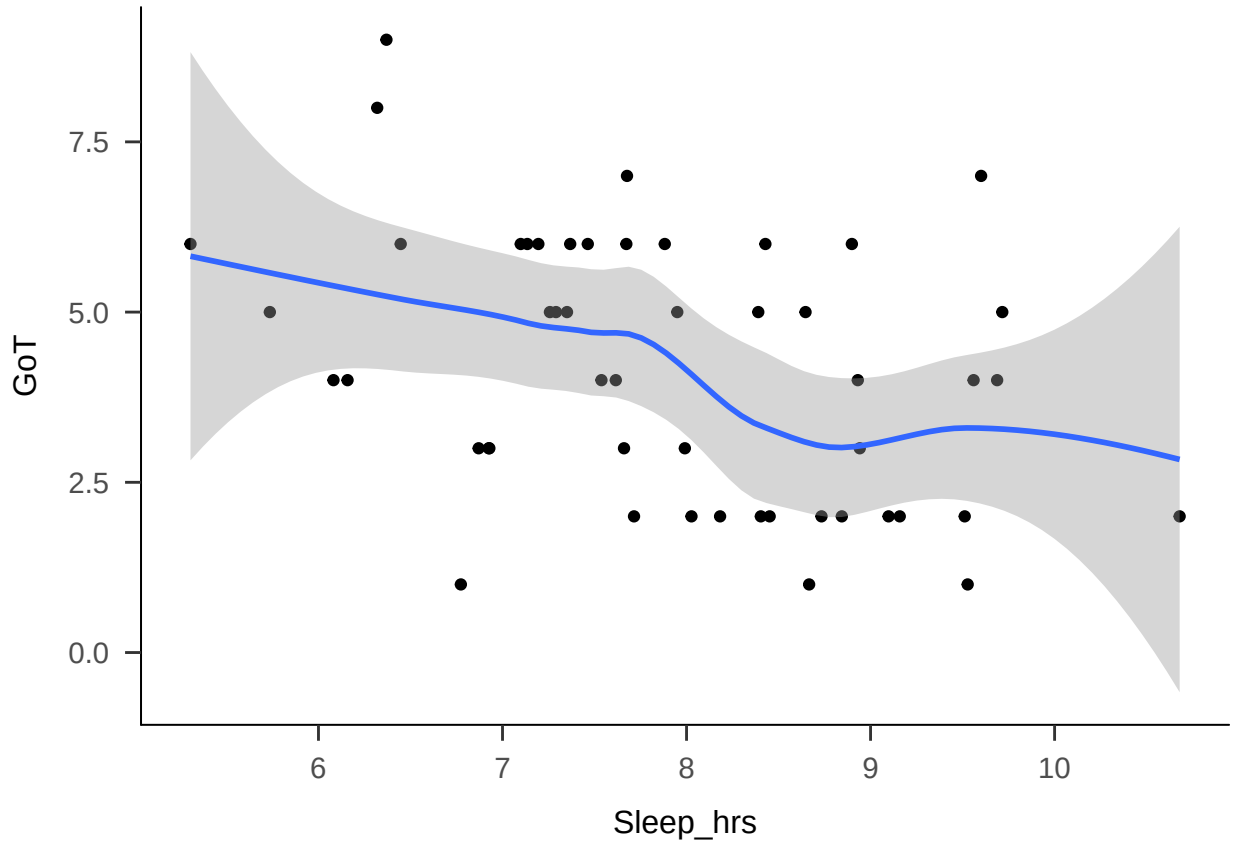

Figure 2. Game of Thrones enthusiasm by preferred hours of sleep