# A STUDY ON UNDERGRADUATE SOCIAL SCIENCE STUDENTS LEARNING STATISTICAL SOFTWARE

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## TEACHING SOFTWARE: A CHALLENGE FOR STUDENTS AND TEACHERS ALIKE

Competency with software for applying statistics has become an essential learning outcome in undergraduate studies and a must-have for professionals in data science (Bargagliotti et al., 2020). Still, professionals can struggle with using statistical programming software. Even with courses conveying the basics for bridging the gap in previous knowledge, the issue seems to affect a variety of students, preventing them from further progress.

Especially with modular, package-oriented languages such as R and Python, it is complicated to determine where exactly these issues are stemming from—for example, if certain procedures are causing problems or if these issues are related to the (mis-)understanding of the underlying statistical concepts. At the same time, teachers face the challenges of selecting topics from the wide array of possible applications in statistical software and conveying them for long-term learning success, complicated by the fact that software packages and commands vary, and new methods are constantly developing in the fast-changing field of data science.

Addressing these issues properly and offering support can be difficult, especially because "the research on how to assess students' thinking and interaction with these tools is not as evolved" (Woodard & Lee, 2021, p. 145). Hence, more insight into how students are using this software, how it intersects with their statistical understanding and learning progress, and how they deal with different approaches is needed.

## DATA COLLECTION ON THE USE OF STATISTICAL SOFTWARE

For gaining better insight into how students are learning statistical software and to support teachers in the implementation process, a study was realized in the seminar "Advanced Statistical Software (using R)" for social scientists at the Ludwig Maximilian University of Munich in Summer 2022. The participating students already had completed basic courses conveying statistical knowledge and statistical software.

The data collection was built on three columns: (a) an entry survey assessing the students' previous statistical and software knowledge; (b) experiments on self-learning competence with applying differing statistical concepts in R (inspired by research on animation (Berney & Bétrancourt, 2016) and student-developed Shiny applications (Wang et al., 2021)); and (c) a concluding survey linked with an anonymous ID to compare results with the entry survey.

Although facing the challenge of motivating the students to participate, the study provides a practice example, combining the tracking of the students' learning progress, equipping the teachers with a data foundation for trying methods on the intersection between statistical concepts and software, and evaluating the different factors in the end of the term.

## REFERENCES

Bargagliotti, A., Binder, W., Blakesley, L., Eusufzai, Z., Fitzpatrick, B., Ford, M., Huchting, K., Larson, S., Miric, N., Rovetti, R., Seal, K., & Zachariah, T. (2020). Undergraduate learning outcomes for achieving data acumen. *Journal of Statistics Education, 28*(2), 197–211. https://doi.org/10.1080/10691898.2020.1776653

Berney, S., & Bétrancourt, M. (2016). Does animation enhance learning? A meta-analysis. *Computers & Education, 101*, 150–167. https://doi.org/10.1016/j.compedu.2016.06.005

Wang, S. L., Zhang, A. Y., Messer, S., Wiesner, A., & Pearl, D. K. (2021). Student-developed Shiny applications for teaching statistics. *Journal of Statistics and Data Science Education, 29*(3), 218–227. https://doi.org/10.1080/26939169.2021.1995545

Woodard, V., & Lee, H. (2021). How students use statistical computing in problem solving. *Journal of Statistics and Data Science Education, 29*(sup1), S145–S156. https://doi.org/10.1080/10691898.2020.1847007

In S. A. Peters, L. Zapata-Cardona, F. Bonafini, & A. Fan (Eds.), *Bridging the Gap: Empowering & Educating Today's Learners in Statistics. Proceedings of the 11th International Conference on Teaching Statistics (ICOTS11 2022), Rosario, Argentina.* International Association for Statistical Education. iase-web.org 