

Increasing the reproducibility of scientific results in mathematics and related fields: Experiences and discussions with the research community

Freitag, 28. Oktober 2022 12:15 (25 Minuten)

Reproducible research results are vital to safeguard scientific quality assurance and to build a reliable foundation for sustainable research. The discussions on this issue accelerated when investigations on reproducibility showed that few scientific publications across many research fields allow for reproducing the published results. This reproducibility crisis is well known within the respective communities. However, through various procedures, such as introducing policies by scientific journals and funding agencies, establishing institutional support structures, and forming national initiatives, various stakeholders in science make efforts to engage on this matter.

Within this context, the Collaborative Research Center (CRC) 1294 –Data Assimilation applies state-of-the-art measures to support associated scientists in their research data management. The measures generally address the reproducibility of published research results and encompass the provision of an IT infrastructure for collaborative work and workshops for knowledge perpetuation. When we investigated the reproducibility of 108 papers published between 2017 and 2021 by the CRC's researchers, we found that the reproducibility rate increased over time. We associate our support structures in research data management and certain changes in research culture with this improvement. However, many publications did not allow for reproducing the published results, and the overall reproducibility rate and reasons for failed reproducibility correspond to previous investigations on reproducible science.

Since the CRC is located in applied mathematics and related fields, this naturally addresses the research culture in this area. Based on our experiences, we conclude that mandatory artifact sharing, support structures for scientists, the improvement of data quality, and the recognition of research data as scientific achievements are vital elements in improving the reproducibility of scientific results. Furthermore, we strongly recommend that researchers proposing new algorithms support their theoretical publications with computer code. Since our conclusions involve the practices of researchers in mathematics and related fields, we aim to bring the discussion to the community. We present our findings and examine the viewpoints of researchers to incorporate the community's interests in future measures to improve the reproducibility of research results.

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