

Reproducibility, Replicability and Reliability: Reflections of a Statistician and a Data Science Editor

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ABSTRACT

The terms reproducibility and replicability have been used interchangeably by some scientific communities and by media, and with the opposite meanings by others, causing much confusion. The 2019 report on “Reproducibility and Replicability in Science” issued by US National Academies of Sciences, Engineering and Medicine (NASEM) made an important contribution to delineate the two terms by equating reproducibility with computational reproducibility and replicability with scientific replicability. However, neither of them in itself can guarantee reliability. Reliability does not imply absolute truth, but it does require that our findings can be triangulated, can pass reasonable stress tests and fair-minded sensitivity tests, and they do not contradict the best available theory and scientific understanding, unless the findings are designed to challenge the existing common wisdom. The quality of data and information plays far important roles than their quantity in ensuring reliability. This talk reflects on these issues based on my statistical research on quantifying quality of big data, and as the founding Editor-in-Chief of Harvard Data Science Review (HDSR), an experience that has provided me a much broader data science perspective. Along the way, using US election prediction and COVID-19 testing as two recent examples, I will demonstrate how small our big data are when we take into account their quality.

disparity in mental health services, and quantifying statistical information in genetic studies). Meng received his BS in mathematics from Fudan University in 1982 and his PhD in statistics from Harvard in 1990. He was on the faculty of the University of Chicago from 1991 to 2001 before returning to Harvard, where he served as the Chair of the Department of Statistics (2004-2012) and the Dean of Graduate School of Arts and Sciences (2012-2017).

BIOGRAPHY

Xiao-Li Meng, the Whipple V. N. Jones Professor of Statistics, and the Founding Editor-in-Chief of Harvard Data Science Review, is well known for his depth and breadth in research, his innovation and passion in pedagogy, his vision and effectiveness in administration, as well as for his engaging and entertaining style as a speaker and writer. Meng was named the best statistician under the age of 40 by COPSS (Committee of Presidents of Statistical Societies) in 2001, and he is the recipient of numerous awards and honors for his more than 150 publications in at least a dozen theoretical and methodological areas, as well as in areas of pedagogy and professional development. In 2020, he was elected to the American Academy of Arts and Sciences. He has delivered more than 400 research presentations and public speeches on these topics, and he is the author of “The XL-Files,” a thought-provoking and entertaining column in the IMS (Institute of Mathematical Statistics) Bulletin. His interests range from the theoretical foundations of statistical inferences (e.g., the interplay among Bayesian, Fiducial, and frequentist perspectives; frameworks for multi-source, multi-phase and multi-resolution inferences) to statistical methods and computation (e.g., posterior predictive p-value; EM algorithm; Markov chain Monte Carlo; bridge and path sampling) to applications in natural, social, and medical sciences and engineering (e.g., complex statistical modeling in astronomy and astrophysics, assessing