

Leading statisticians establish steps to convey statistics a science not toolbox

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Convinced that better use of data will improve research, innovation and literacy across other disciplines, six leading statisticians recently published "Ten Simple Rules for Effective Statistical Practice" in the journal *PLOS Computational Biology*. Part of the popular open access "Ten Simple Rules (TSR)" series, this piece surpassed 51,000 views in only two weeks.

Authors Nancy Reid, of the University of Toronto, Rob Kass of Carnegie Mellon University, Brian Caffo of Johns Hopkins University, Marie Davidian of North Carolina State University, Xiao-Li Meng of Harvard University, and Bin Yu of the University of California, Berkeley, advise practitioners to first "treat [statistics](#) as a science, not a recipe."

In furthering this point, the authors stressed the need for researchers across various fields of science to avoid misperceptions and inaccurate claims resulting from faulty statistical reasoning. Grappling with such subtle phenomena requires principled statistical analysis, affirm the authors, who encourage researchers to consider statistics "a language constructed to assist this process, with probability as its grammar."

To this point, Meng notes "sound statistical practices require a bit of science, engineering, and arts, and hence some general guidelines for helping practitioners to develop statistical insights and acumen are in order. No rules, simple or not, can be 100% applicable or foolproof, but that's the very essence that I find this is a useful exercise. It reminds

practitioners that good statistical practices require far more than running software or an algorithm."

Kass became involved in the project because he believes that identifying major ideas in statistics, and also stating them clearly and concisely, helps scientists better appreciate what the field of statistics has to offer. "My own work in neuroscience has taught me the value of deep collaboration between statisticians and laboratory scientists. It takes time and commitment, but the results make the scientific process far more efficient and effective."

"Statistics is a pillar of data science, and we tried to make the basic ideas of statistics into a concise primer for biological and data scientists at large," said Yu. "We are quite happy with the positive feedback we received from colleagues in statistics and other fields including neuroscience, physics and chemistry."

Caffo appreciated the opportunity to work with respected statisticians and hopes this effort will help accomplish long term goals. "While it is gratifying to learn that this piece has been appreciated by many in just a few weeks, my desire is for the broader scientific community to realize how much is gained scientifically by engaging our sector and utilizing cutting-edge statistics. Of course, it goes both ways, as statisticians must also become more engaged with multidisciplinary research."

The idea for a TSR column on statistical practice came about after a meeting in 2014 between Davidian, then past-president of the ASA, and Philip Bourne, who originated the TSR collection. Long an advocate for broader engagement of statisticians with other scientists, Davidian hopes this column will lead to more scientists seeking out statisticians as collaborators from the outset. "Many scientists have solid statistical training, but with experiments and data being more complex, we hope this column will help make more scientists aware of the scientific

benefits of engaging statisticians beginning with a study's or experiment's design," she said.

Reid, who led the group's effort, recognized the potential in the TSR series to reach a broader scientific community even among challenges. "Most TSR articles have focused on something you do, but for us, statistics is not only a set of methods, but a field of scholarly inquiry. It was tricky to combine these two aspects of the discipline in a concise manner, and I hope our work is both useful to scientists and conveys the flavor of the discipline."

The 10 rules are:

Rule 1: Statistical Methods Should Enable Data to Answer Scientific Questions
Rule 2: Signals Always Come with Noise
Rule 3: Plan Ahead, Really Ahead
Rule 4: Worry about Data Quality
Rule 5: Statistical Analysis Is More Than a Set of Computations
Rule 6: Keep it Simple
Rule 7: Provide Assessments of Variability
Rule 8: Check Your Assumptions
Rule 9: When Possible, Replicate!
Rule 10: Make Your Analysis Reproducible

Provided by American Statistical Association

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