

Applied Data Analysis

Revamping and Pushing Intro to Statistics

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Are students in the mathematics program at your institution encouraged to take an introductory statistics course? If so, does the course satisfy assessment and instruction guidelines from the American Statistical Association?

The 2015 MAA curriculum guide includes the recommendation that “every mathematical sciences major should have . . . a command of data analysis and statistical inference at a level equivalent to that attained in an applied data analysis course” (*2015 CUPM Curriculum Guide to Majors in the Mathematical Sciences*, <http://bit.ly/20vDIJW>). In fact, every MAA curriculum guide for the past 30 years has recommended, with increasing emphasis, that students majoring in the mathematical sciences take such a course. However, many programs still do not even allow a course in applied statistics to count toward the major.

Why the disparity between the recommendations and the practice? Part of the problem is the way the introductory statistics course has evolved at many institutions. However, this is a time of exciting innovation (and rapidly growing student interest) in the introductory statistics course, making the (redesigned) course more relevant, more exciting, and more appropriate for all students, including students majoring in the mathematical sciences.

Advances in technology are driving many of the innovations. Statistical software packages have become more user friendly, making it easier to integrate one into the course. Free online applets have been developed to en-

hance student learning. Our access to data, across almost all fields, has dramatically increased. New free online software options allow us to incorporate simulation methods such as bootstrapping and randomization tests into the curriculum, helping to build student understanding and to connect the methods more directly to the key ideas.

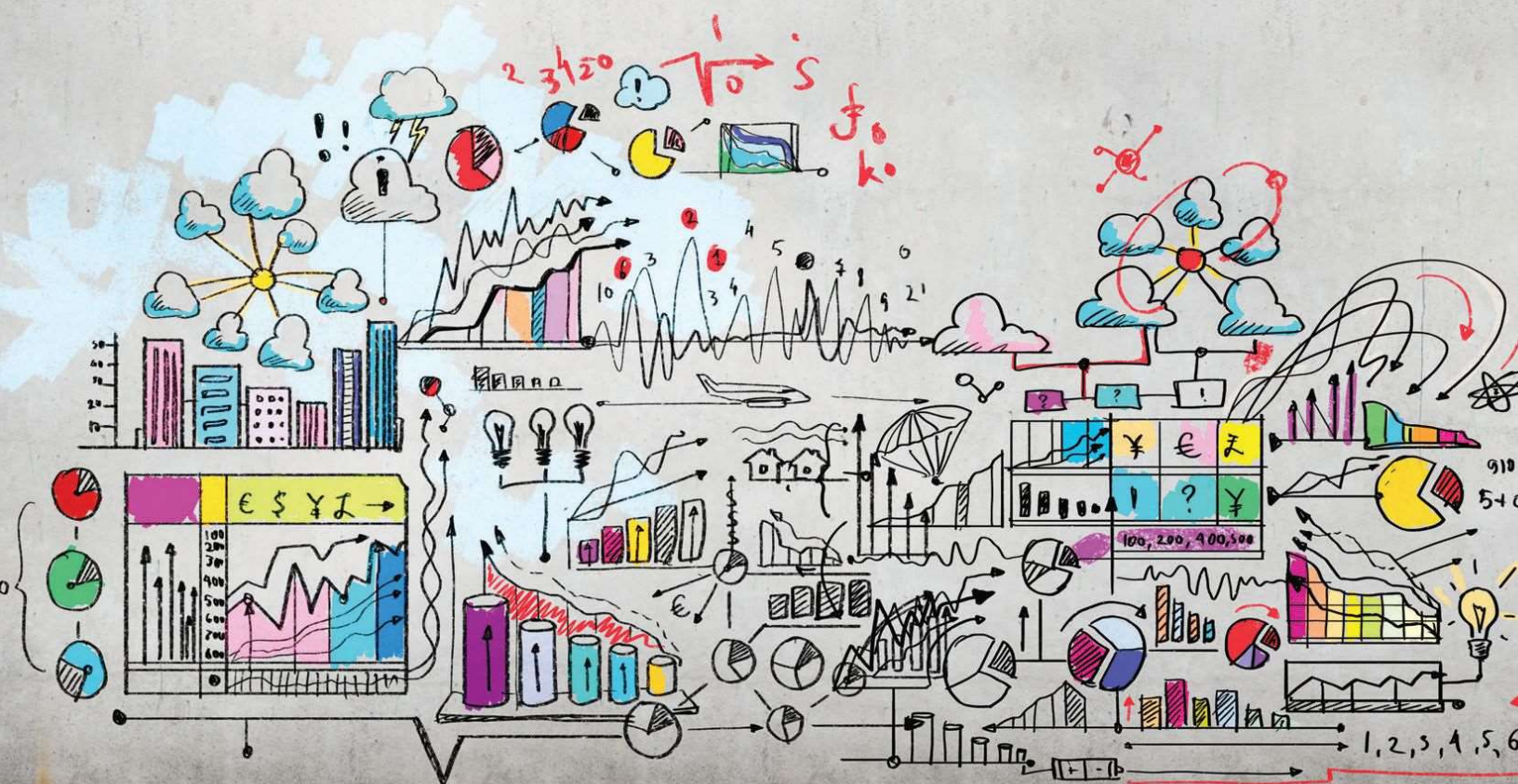
“Every mathematical sciences major should have . . . a command of data analysis and statistical inference”

—*MAA Curriculum Guide*

The recommended applied data analysis course is quite distinct from the usual upper-level sequence in probability and mathematical statistics. It is also sharply different from the low-level procedural or quantitative literacy course taught at many institutions. A strong data analysis course should be driven by real data, stress conceptual understanding, and introduce students to statistical technology. The focus should not be on algebraic manipulation or on the underlying mathematical theory, but rather on the effective collection and analysis of data, along with appropriate interpretation and communication of results. The statistical concepts of variability and strength of evidence are notoriously difficult for students to master, and a course focusing on these key concepts provides an intellectually rigorous experience for all students.

How can departments, already stretched for resources, afford to offer such a course? One solution is to reconfigure the introductory statistics course currently offered at many schools. That course, often designed as a relatively low-level probability and statistics course with a focus primarily on procedures and formulas, is not appropriate

CRAFTY (Curriculum Renewal Across the First Two Years) is a subcommittee of the MAA’s Committee on the Undergraduate Program in Mathematics (CUPM). This is the second in a series of articles about general recommendations to renew mathematics course work and instruction.



for mathematics majors. By making the course target statistical concepts, technology, and analysis of real data, the course remains viable (and better) for the current audience while also becoming an excellent course for students majoring in the mathematical sciences.


Tools to Choose

Many resources are available for developing such a course or improving an existing one. The most important of these is the widely respected and widely endorsed Guidelines for Assessment and Instruction in Statistics Education College Report (amstat.org/education/gaise/). The guidelines include detailed learning goals for an introductory statistics course as well as specific recommendations. Additional resources can be found in the 2015 MAA curriculum guide's section on applied statistics and data analysis courses.

For future teachers, the MET2 report (<http://cbmsweb.org/MET2/met2.pdf>) recommends a two-semester sequence in statistics, and the SET report (amstat.org/education/SET/SET.pdf) provides additional detail about

appropriate content for these courses.

For those looking beyond the introductory course, we recommend the Curriculum Guidelines for Undergraduate Programs in Statistical Science (amstat.org/education/pdfs/guidelines2014-11-15.pdf), endorsed by the American Statistical Association in 2014.

A strong course in applied statistics helps meet the cognitive goals for mathematics majors listed in the MAA 2015 curriculum guide, emphasizing critical thinking skills, communication skills, and the use of technology as a tool. It includes applications to a wide variety of different disciplines. Such a course enhances student perceptions of the vitality and importance of mathematics and statistics in the modern world, and it can attract more students to the mathematical sciences. 

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