



## Qualifications for Teaching an Introductory Statistics Course

*Prepared by the ASA/MAA Joint Committee on Undergraduate Statistics*

The [ASA/MAA Joint Committee on Undergraduate Statistics](#) encourages effective teaching in undergraduate statistical education, and our respective associations seek to be particularly helpful to those institutions where departments other than departments of statistics bear the primary responsibility for the teaching of statistics. Below are recommendations for qualifications for teaching a modern introductory statistics course, along with information and resources for assisting departments and faculty. Please direct questions or comments about these recommendations and resources to [Ron Wasserstein, Executive Director, ASA](#), or [Michael Pearson, Executive Director, MAA](#).

### **What is a Modern Introductory Statistics Course?**

A modern introductory statistics course introduces students to the concepts underlying the design of statistical studies and to the reasoning needed to interpret the results of statistical analyses. The necessity of data for good decision-making, the value of sound data production, the omnipresence of variability in underlying processes, and the understanding and quantification of variability are central to statistical reasoning. Statistical thinking begins with a real-world problem and explores data to answer key questions. Statistical thinking recognizes the limitations of studies based on available data and the strengths of well-designed studies that produce data with the right information content. Statistical thinking questions the assumptions made by statistical models that explain, predict, and forecast—and it qualifies their use with measures of uncertainty. And statistical reasoning requires clear communication of results so that decision-makers can understand how they contribute to the problem solution.

Experiences with data and appropriate use of technology to support data analyses are essential to the success of a modern course.

### **What Educational Training and Experience are Necessary to Teach Statistics?**

In order to successfully develop a student's ability to think statistically, a teacher of an introductory statistics course must have deep knowledge of statistics as well as an appreciation of the differences between statistical thinking and mathematical thinking. Statistics teachers need to understand the ways that statisticians work with real data and approach problems, and to experience the joys of making discoveries using statistical reasoning. Anyone unfamiliar with the data-driven techniques used in modern introductory statistics courses should be mentored by an experienced statistics instructor.

Ideally, a department considering hiring or selecting someone to teach an introductory statistics course should require a candidate to have at least a master's degree with a strong concentration in statistics. But because this is often not possible, the individual should have at a minimum at least the equivalent of

1. Two statistical methods courses including content knowledge of data collection methods, study design and statistical inference, and
2. Experience with data analysis beyond material taught in the introductory class. This experience could come from advanced courses, projects, consulting or research.

There is an active statistics education community and we strongly encourage all statistics instructors to make use of the many resources provided by the community. These include attending a workshop, minicourse or conference on teaching statistics, using available web resources, and reading articles from mathematicians and statisticians discussing key pedagogical differences between these fields. Examples are given in the following sections.

### **Workshops, Minicourses and Conferences on Teaching Statistics**

Workshops and minicourses on teaching statistics are co-sponsored by the Mathematical Association of America (MAA) through its Professional Enhancement Program (PREP <http://www.maa.org/programs/faculty-and-departments/prep-workshops>) and as part of the Joint Mathematical Meetings (JMM <http://www.maa.org/meetings/joint-mathematics-meetings>) and the MAA Mathfest (Mathfest <http://www.maa.org/meetings/mathfest>). The American Statistical Association (ASA) co-sponsors workshops and minicourses focused on introductory statistics as part of the Joint Statistical Meetings (JSM <http://www.amstat.org/meetings/jsm.cfm>). Prospective teachers can also participate in workshops co-sponsored by the Consortium for the Advancement of Undergraduate Statistics Education (CAUSE <https://www.causeweb.org/>).

Conferences on teaching statistics include the biennial United States Conference on Teaching Statistics (USCOTS <https://www.causeweb.org/uscots/>) and, in alternate years, the Electronic Conference on Teaching Statistics (eCOTS <https://www.causeweb.org/ecots/>). The Education Committee of the International Statistical Institute sponsors the International Conference on Teaching Statistics (ICOTS <http://icots.net/>) every four years.

### **Web Resources**

The Guidelines for Assessment and Instruction in Statistics Education (GAISE <http://www.amstat.org/Education/gaise/GAISECollege.htm>), supported by the MAA and the ASA, gives recommendations for teaching modern introductory statistics courses.

The Consortium for the Advancement of Undergraduate Statistics Education (CAUSE <https://www.causeweb.org/>) is a national organization whose mission is to support and advance undergraduate statistics education in four target areas: resources, professional development, outreach and research. Their website includes links to online presentations of interest to those teaching introductory courses.

The following online journals publish articles of interest to those teaching introductory courses: Journal of Statistics Education ([JSE https://www.amstat.org/publications/jse/](https://www.amstat.org/publications/jse/)), Technology Innovations in Statistics Education ([TISE http://www.escholarship.org/uc/uclastat\\_cts\\_tise](http://www.escholarship.org/uc/uclastat_cts_tise)), Statistics Educational Web (STEW) (<http://www.amstat.org/education/stew/>), and Teaching Statistics ([http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1467-9639/issues](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1467-9639/issues)).

### **The Difference between Mathematics Pedagogy and Statistics Pedagogy**

Although statistics uses mathematical concepts in an essential way, there are important differences between the fields and important differences between how each subject should be taught. The GAISE report referenced above is a good resource, as are the following articles:

- Chance, B.L. (2002), Components of Statistical Thinking and Implications for Instruction and Assessment, *Journal of Statistics Education*, 10(3), [www.amstat.org/publications/jse/v10n3/chance.html](http://www.amstat.org/publications/jse/v10n3/chance.html)
- Cobb, G. W. (1992). *Teaching statistics*, in L. A. Steen (ed.), *Heeding the Call for Change: Suggestions for Curricular Action*, MAA Notes 22 (pp. 3–23). Washington DC: Mathematical Association of America. The committee's report was unanimously endorsed by the Board of Directors of the American Statistical Association.
- Cobb, G. W. & Moore, D. S. (1997). Mathematics, Statistics, and Teaching. *The American Mathematical Monthly*, 41(9), 801–823.
- DeVeaux, R., and Velleman, P., (2008). Math is Music; Statistics is Literature. *Amstat News*, Sept 2008, No 375, p. 54.
- Garfield, J., & Ben-Zvi, D. (2007). How students learn statistics revisited: A current review of research on teaching and learning statistics. *International Statistical Review*, 75(3) 372-396.
- Greenhouse, Joel (2013), Statistical Thinking: The Bedrock of Data Science, Huffington Post Blog, 7/26/13, [http://www.huffingtonpost.com/american-statistical-association/statistical-thinking-the-bedrock-of-data-science\\_b\\_3651121.html](http://www.huffingtonpost.com/american-statistical-association/statistical-thinking-the-bedrock-of-data-science_b_3651121.html)
- Moore, D. S. and Cobb, G. W., (2000), "Statistics and Mathematics: Tension and Cooperation," *American Mathematical Monthly*, p. 615-630.