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Dynamic, Interactive Documents for Teaching Statistical Practice

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Summary

Significant efforts have been made to overhaul the *introductory* statistics courses by placing greater emphasis on statistical thinking and literacy and less on rules, methods and procedures. We advocate broadening and increasing this effort to *all levels* of students and, importantly, using topical, interesting, substantive problems that come from the actual practice of statistics. We want students to understand the thought process of the "masters" in context, seeing their choices, different approaches and explorations. Similar to Open Source software, we think it is vital that the work of the community of researchers is accessible to the community of educators so that students can experience statistical applications and learn how to approach analyses themselves. We describe a mechanism by which one can collect all aspects or fragments of an analysis or simulation into a "document" so that the computations and results are reproducible, reusable and amenable to extensions. These documents contain various pieces of information (e.g. text, code, data, exploration paths) and can be processed to create regular descriptive papers in various formats (e.g. PDF, HTML), as well as acting as a database of the analysis which we can explore in rich new ways. Researchers, instructors and readers can control the various steps in the processing and rendering of the document. For example, this type of document supports interactive components with which a student can easily control and alter the inputs to the computations in a semi-guided fashion, gradually delve deeper into the details, and go on to her own free-form analysis. Our implementation for this system is based on widely used and standardized frameworks and readily supports multiple and different programming languages. Also, it is highly extensible which allows adaptation and future developments.

Key words: Education; Technology; XML; R.

1 Introduction

Leading statistics educators have long called for reform in the way we teach our introductory courses to place greater emphasis on statistical thinking and data analysis and less on mathematical derivations and computational recipes (Cobb & Moore, 1997; Moore, 1997, 2005). We applaud the efforts many have made in this direction by introducing textbooks that include case studies to motivate statistical topics and activities to help convey basic statistical concepts (e.g. De Veaux *et al.*, 2007; Ramsey & Schafer, 2002; Scheaffer *et al.*, 1996; Watkins *et al.*, 2003; Utts & Heckard, 2003; Utts, 1999). Yet, we have not gone far enough in this direction. Reform must extend beyond our introductory courses to the entire curriculum, both undergraduate and