Teaching Statistics to Psychology Students using Reproducible Computing package RC and supporting Peer Review Framework

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There is increasing impetus towards a reform of statistics teaching in the face of a widespread recognition that traditional approaches to statistics education focussed on computational and analytical skills does not provide students with the ability to apply statistical thinking in real world situations (Garfield et al 2002). Moore (1997) argues for a revised approach requiring *"the abandonment of an 'information transfer' model in favour of a 'constructivist' view of learning:.."* (Moore, 1997). Furthermore, recent research suggests that there are clear benefits of collaborative working involving opportunities for peer review and feedback, particularly for female students who tend to use such opportunities most effectively (Wessa, 2008).

We have developed an undergraduate second year statistics course for psychology students based on principles of constructivist education, whose design is modelled on an established course in a business education setting, aiming to encourage "statistical thinking and literacy". The key software components applied were developed and introduced by Patrick Wessa: 1) the reproducible computing framework available at http://www.freesatistics.org via package **RC**; and, 2) a supporting online peer review (PR) management system (Wessa, 2009). Our presentation illustrates these components from the point of view of the student and the instructor.

Students receive instruction via traditional lectures and supporting workshops, however the workshop material is presented as a 'compendium', an enhanced document form containing all the data and computations necessary to fully reproduce and communicate the results of a statistical analysis. The students' task is to complete workshop assignments and create a new compendium (report) based on their own analysis and interpretation that contain links to their 'blogged' (i.e. archived in the reproducible computations repository) computations; their documents are then uploaded to the PR system and circulated anonymously to students' peers for review. The students' assessed assignment is to provide peer review feedback on up to 5 workshop compendiums they receive each week. The course design provides a social constructivist framework within which independent learning can flourish.

The instructor is able to monitor, evaluate, and control the learning process through a series of statistical reports and accompanying query tools which are available through the RC package and the PR system. The data that is retrieved through these systems can be used for the purpose of educational research based on objectively measured observations. Our analysis of students' performance over two years provides evidence that the combination of RC and PR leads to deep learning of statistical concepts. We briefly present the latest findings to support this conclusion, based on a structural equation model (PLS-PM) and a randomized experiment.

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