Electronic marking of statistics assessments for bioscience students

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Short Communication

Electronic marking of statistics assessments for bioscience students

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Abstract

We describe the main features of a program written to perform electronic marking of quantitative or simple text questions. One of the main benefits is that it can check answers for being consistent with earlier errors, so can cope with a range of numerical questions. We summarise our experience of using it in a statistics course taught to 200 bioscience students.

Keywords: e-marking, timely feedback, individualised assessment

Introduction

Students benefit from timely and informative feedback, and from regular assignments that allow them to engage in active learning (*e.g.*, Gibbs, 1999; Juwah *et al*., 2004). This is particularly true when teaching a subject like statistics to bioscience students: repeated practice helps students better understand the application and relevance of methods. However, with large classes it is difficult to mark assessments in a reasonable timeframe, without resorting to simple ticks and crosses which does not particularly assist students in overcoming their weaknesses. Computer-based marking of assessments allows for quicker completion of the marking process, and for meaningful feedback where obvious errors can be foreseen. Quicker feedback allows for better self-reflection.

When using technology to mark assessments, it becomes more feasible for students to have individualised data relating to quantitative or qualitative questions. Individualised assessments helps discourage plagiarism, as copying of solutions is no longer possible. At the very least, students who do not wish to attempt the questions on their own will have to consult others on how to answer them. This opens up the possibilities for peer-group learning, which can be effective in enhancing understanding (e.g., Juwah *et al.*, 2004).

The purpose of this article is twofold: to introduce a Microsoft® Excel-based program written by one of us (KLA) to perform automatic marking of simple quantitative and qualitative questions, and also to discuss how it worked in practice for a large bioscience class.

The e-Mark program

The e-Mark program is a set of Microsoft® Excel macros (in Visual Basic) which collate all student answers into a single worksheet from individual files, check them and annotate student sheets with pre-determined feedback. The code is generic and can be used whenever there is a quantitative or simple textual answer. The particular benefit of e-Mark is that it can award marks and provide feedback for answers that are incorrect only because earlier errors have been carried forward: it is important to check for such “consistent” errors in quantitative subjects such as statistics.

Some of the features of the program are that it:

- allows each student to be allocated their own set of data and solutions
- allows numeric solutions to be marked within a specified tolerance
- provides ticks/crosses as well as teacher-specified feedback for incorrect solutions
- checks solutions for errors caused by carrying forward earlier errors
- allows foreseen 'common' errors to be specified with feedback
- allows consistent and common error checks to be specified by the teacher as standard Excel functions
- allows manual updating of marks and feedback after auditing.

To provide a well-formatted interface for students to submit and receive work, we have made use of Word forms with mail merge.

The e-Mark program can be freely obtained from www.reading.ac.uk/personal/~sns99kla/ under 'Software'.

Issues with automatic marking

We have successfully used the e-Mark program for a statistics course taught to 200 second-year bioscience students. Assessments focused on data analysis and interpretation using statistical software. We were able to cover a wide range of different topics, asking students to provide numerical solutions, complete reports after carrying out data analysis and selecting appropriate graphs.

Designing an e-marking assessment

One of the key features of e-Mark is its ability to check solutions for consistency with earlier errors. In hand-marked assessments consistency is often checked by looking at the page of working. For e-Mark we had to provide deliberate stopping-off points in the question, so that relevant values to use in consistent error checks were available. This meant structuring the assessment to include results from intermediate calculations or components of computer output.

To set up the marking scheme answers that required consistency checks, and the answers that fed into them, needed to be identified. For common errors we had to determine which errors the students were likely to make and what informative feedback they should receive. We therefore went through an iterative process of designing the assessment and evaluating the marking scheme to ensure coherence.

Marking assignments

For the first year of implementation we found it difficult to think through all of the consistency checks and identify all common errors that could be made in advance of seeing student answers. Therefore the marking scheme required adjustment once scripts had been received and run through e-Mark for the first time. A clear advantage of e-Mark was that it was possible to change feedback provision and marks for consistent errors at this late stage, and re-run the program, without leading to inconsistencies in marking between students. Furthermore common errors identified this time can be retained in the program for future years so that over time feedback will improve as more types of errors are encountered.

Monitoring the process

Our experience of applying automatic marking is that some minor manual adjustment is required, often because students make errors such as transposing numbers or because they use different roundings.

Issues with generating separate datasets for each individual

Although not an issue *per se* with automatic marking, we have found that extra care needs to be taken when generating individualised datasets for students, to ensure that the question remains relevant to all solution sets and that the question is not harder for some students than others. We therefore iterated between assessment wording and data generation. For our statistics assignments, we have found it appropriate to specify a base model and randomly generate data from that.

Discussion

From a teacher's point of view, having the potential to mark a large volume of simple assessments in a timely manner is clearly of benefit. Furthermore, issues with plagiarism can be reduced since automatic marking makes individualised assessments more feasible. However, set-up costs should not be overlooked, because as well as the time taken to learn an automatic marking tool, significant time is needed in advance to design appropriate questions and datasets, determine marking schemes for partially correct solutions, and identify possible errors and meaningful feedback. Nevertheless, we feel that the benefits warrant our further pursuit of automatic marking of assessments for students in biosciences.

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