

## ASSESSMENT OF A WRITING COURSE IN STATISTICS

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*Several researchers have recommended the inclusion of writing exercises in statistics courses. This paper describes the initiation of a course designed to provide statistics students with experience in writing about statistics ideas and results. The curriculum for the new course specifies the procedure for the course, but leaves the statistics content open.*

*Assessment of an "experience" course like this is quite different from assessment of a "statistical techniques" course. A principal aim of the course is to improve students' ability to explain statistical techniques verbally. The process of verbalization is helpful in promoting a deeper understanding of techniques already introduced in earlier courses.*

*This paper describes the strategies used to adapt assessment to this new kind of statistics course. A protocol for marking revised reports as well as checking for authorship is described, as are the component weightings for student grades in the course.*

### INTRODUCTION

A popular focus of discussion in statistical education over the last five years has been the focus on teaching "statistical literacy". An important start to define the term was achieved by Gal (2002) and a series of developments begun about the same time is recorded on the web pages of the International Statistical Literacy Project maintained by Blumberg (<http://course1.winona.edu/cblumberg/islphome.htm>). The term uses "literacy" instead of "numeracy" to emphasize that a useful knowledge of statistics requires much more than computation. Gal's paper (Gal, 2002, p.2) suggests the following:

*" It is proposed here that in this context, the term "statistical literacy" refers broadly to two interrelated components, primarily (a) people's ability to interpret and critically evaluate statistical information, data-related arguments, or stochastic phenomena, which they may encounter in diverse contexts [and] (b) their ability to discuss or communicate their opinions regarding such statistical information."*

While it would seem to be fairly obvious that statistics courses should enhance statistical literacy so defined, few textbooks for these courses provide guidance for part (b): the communication of statistical information. Some books do spend some space on providing good graphical displays for summary purposes, but the verbal communication of statistical information seems to receive less emphasis. In fact, the survey reported by Gordon, Reid and Petocz (2005) confirms that statistics teachers generally omit mention of statistics communication skills when asked what they hope to achieve in their courses.

However, the focus on communication skills is starting to receive emphasis from the statistics education researchers. The ISI/IASE satellite meeting in Sydney in 2005 was organized around the theme "Statistics Education and the Communication of Statistics" (Phillips & Weldon, 2005). The importance of communication skills in other disciplines is also receiving more emphasis – for example, at Simon Fraser University, all graduates in all majors are now required to have obtained satisfactory grades in certain writing courses. Some requirements include writing courses in the major field of study.

To meet this requirement, a new course STAT 300 was recently initiated called "Statistics Communication". The course requires statistics majors to cope with technical verbalizations in several contexts. The series of assignments provided all the material for the class seminars. These assignments are outlined briefly below.

## COURSE CONTENT AND ASSIGNMENTS

Assignment 1 listed a number of controversial items and students were assigned them at random. The student had to present the item chosen and a discussion ensued with guidance from the instructor. Examples of the discussion topics are:

- i) Examples of non-numeric data include
- ii) The unbiasedness criterion for parametric estimators is controversial because ...
- iii) Other than for data screening, the main use of graphical methods is ...
- iv) The shortcoming of a chi-square test for independence between two variables when at least one variable is ordinal is ...

While the students would have been exposed to these ideas, it is likely that the ideas bear repetition. After the discussion, students were required to write a paragraph in class completing the lead phrase for their particular topic. These were edited by the instructor, returned to the student, revised and re-submitted for the instructor's assessment.

Assignment 2 asked students to review a paper "Summary of a Survey of Consultant Statisticians" (Gullion & Berman, 2006). This was discussed in detail during class time but the student would draft a summary equivalent in length to 1 page of the journal. This exercise exposed them to some information about consultants, the activities they perform and the techniques they use. The students were told to address their peers in their write-up, and to try to extract the most useful information. Since the article was filled with tables, and a brief commentary, it was instructive for students to realize that it took some work to express the results in English. Students had the feedback from the instructor before submitting their final draft.

Assignment 3 had the students design and carry out a study of reaction times using the dropped-ruler technique, and then to report on the results. The interest was in the diurnal pattern of reaction times, and so observations were taken on each student, morning, noon and night, but only on one particular day. They also did dominant and non-dominant hands. This minimal study produced some interesting results: a diurnal pattern, outliers, non-compliance with protocol, and small samples with apparent but not-significant results. Students learned about dealing with inconclusive results and nevertheless reporting them in an informative way. For example, there was mild evidence that the dominant hand was quicker than the non-dominant one, and that mid-day reaction times were less than in the morning or evening. The verbal discussion and subsequent report helped students to verbalize the situation.

Assignment 4 asked student to select from a number of items in the Chance News ([chance.dartmouth.edu/chancewiki/index.php/Main\\_Page](http://chance.dartmouth.edu/chancewiki/index.php/Main_Page)). Items such as

- i) A clumsy attempt at anonymization
- ii) Do man-made factors fuel hurricanes?
- iii) Newsweek says they were wrong

stimulated a lively discussion. Most of these articles were about statistical errors made by scientific researchers and journalists. The lesson here was that the subtleties of statistical reporting were not fully appreciated by many professionals writing the reports, and that training in statistics communication was something of value. The usual procedure of draft critique and final submission was used here.

Assignment 5 asked the students to select a paper from the IASE conference on "Statistics Education and the Communication of Statistics" held in Sydney in 2005. Each paper was discussed in class and then students had to give a Power Point presentation in no more than 7 minutes based on the content of the article. They had to respond to questions about their presentation and then submit a short written report on the same material. The papers again helped to "indoctrinate" the students with the idea that communication is an integral part of statistics education. Of course, it also provided an opportunity to put this idea into their own words.

Assignment 6 repeated the style of assignment 1, but with additional topics.

Assignment 7 required the students to explore the official statistics of Statistics Canada, and to analyze some data relating to a question of their individual interest. The exercise familiarized them with the considerable resources of Statistics Canada, and also gave them the opportunity to explore their personal interest through this medium. Learning how to ask an answerable question was a feature of the exercise. Reports were submitted as in the other written assignments.

## ASSESSMENT

The course numerical grade was based on the following:

20% - Timely submission of draft reports for reviewing.

20% - Participation in class discussions.

60% - Response to review and the quality of the final submission of the reports.

A weighting scheme for assessment of final reports (the 60%)

20% response to review of draft

20% statistical and scientific logic

20% layout and language clarity

Participation in the class discussions was assessed subjectively. No student expected to receive high marks on participation – the difficulty of the material constrained spontaneous discussion somewhat. Every student appreciated the need for timely submission of draft projects and this component was well rewarded. The major discriminator among student achievement in the course was the quality of the final submissions.

Although the assessment on final submissions was somewhat subjective, the feedback on the draft reports was detailed enough that students did not complain about the system. The time between return of the edited draft submissions and the final submission was only two days. This encouraged students to do a good job on the draft, even though it was not graded. There was no final exam: the content was not exactly the same for each student, and it was felt that the additional assessment was unnecessary.

In the absence of a final exam, there is a concern about the authorship of the final reports.

As a check on this, there were the following safeguards:

i) Assignments 1 and 6 had first drafts prepared in class.

ii) Assignments 1,4,5,6,7 required students to lead the class discussions of the particular material they had chosen. Also, the student could not get much help from classmates who were responsible for different material.

iii) Assignment 5 required an in-person presentation and response to questions.

These processes guaranteed that the student was immersed in each assignment, without much room for external assistance.

As a check on instructor subjectivity, the students provided parallel ratings of the presentation involved in Assignment 5. The correlation with the instructor's grade was .61. This suggested some need for more specific criteria for this kind of evaluation (almost no guidance was given).

Student marks on the course ranged from 71 (C+) to 92 (A) – the class had only eight students in it. Four of the students were ESL. The editing time was reasonable for the instructor because of the small class size. With fifteen or more students, a teaching assistant would be required to manage the workload, and this would involve some training of the TA on each assignment.

Assessing student performance was somewhat subjective but otherwise straightforward, even though the course style differed from most undergraduate statistics courses. A much harder task is to assess the effectiveness of the course in improving students' communication skills. One small bit of evidence is provided by the course evaluation done by students. While students generally felt the course was a bit "too difficult", most agreed that the assignments were "fair", and the course content was "very valuable". Only one student added a comment: "After taking this course, I am more confident in writing, reading and understanding statistical materials." Even though the statistical content was nominally covered in the prerequisite courses, the students found the repetition of the basics very useful and there were many instances where the students realized that they were only beginning to understand the basics.

Because of the small enrolment, the instructor did all of the editing - the difficulty of training a TA to do some of the editing was not experienced, although it is likely to be a problem for a larger enrolment. With greater enrolment, it is not clear if the assessment procedure would have worked as well.

## CONCLUSION

The verbalization process of discussion and writing about statistical concepts was perceived by statistics majors to be useful. The course material was felt to be challenging, but the assessment was judged as fair. The in-person components of the assessment ensured that students were not employing outside help, in spite of the lack of a final exam. The risk-free nature of initial draft submissions did not lead to shoddy draft submissions, since the time to final submission was so short.

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