

SOTS: a system for online testing of skills

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Abstract: This paper introduces the system SOTS for online testing of skills that involve software packages. Basic characteristics of the system are: 1) individual, 2) flexible, and 3) interactive. The system can examine skills efficiently. The efficiency is achieved by the possibility to give exams at different time slots, without increasing the teacher's workload unacceptably. Besides, the system also avoids the possibility for students to pass on answers or questions to each other. The system was used for the e-assessment of the 670 students for a statistics course.

Keywords: electronic assessment, computer skills, statistics, online testing

1 Introduction

One of the key questions in teaching is: did the students actually acquire the knowledge and skills that the course was intended to convey. To answer this question, students are examined. The examination of students can be done at various levels (see e.g. [1]). Besides theoretical knowledge one can also assess various skills. Indeed, in several courses, for instance courses on research methods and techniques, students should, besides theory and models, acquire certain computer skills. They may have to learn how to use software programs for content analysis in course on qualitative research, apply a statistical tool like SAS or SPSS in a statistics course, or use spreadsheet-based software like Excel.

To assess computer skills in a standard exam session requires computer facilities for all students at the same time. In the case of large groups of students, this can be a problem. This paper describes a system that can be used to electronically assess aforementioned skills for large groups of students. In the next section, this system for online testing of skills (SOTS) will be introduced. The system is applied in the case of a statistics course at the Faculty of Management and Organization of the University of Groningen. The paper presents the first results.

2 How to assess computer skills?

The problem of giving computer skills exams simultaneously in large group is difficult to solve due to infrastructural (space and time) as well as financial limitations (the number of computers available). The solution could be found in electronic assessment and individualized online testing. By using a computer for this individualized process, the workload of teachers can be minimized. The computer will generate the individual exams, and the computer would also do the grading. This is in principle the same online testing process as we know for several years (for example [2] and [7]).

However the specific demands in research computer skills are more complicated. Because of software used, you also need individualized data sets, and as a result, students produce individualized answers to test questions. To overcome these difficulties, we have developed an online testing system specific for computer software skills. This system is called SOTS (System for Online Testing of Skills). The following general operating procedure is applied:

- 1) The teacher creates a test bank of exam questions, which meet the learning objectives.

- 2) The student logs in for the exam.
- 3) The computer draws a stratified sample from the test bank of exam questions in order to create an individual exam for the student.
- 4) The student enters the answers in the computer.
- 5) The computer compares the correct answers with the entered answers of the student.
- 6) The computer computes feedback (general or question specific).

This system contains three important basic characteristics: it is individual, flexible and interactive. Individual, because every student receives an individual exam and is individually graded. Flexible, because the test bank can be easily adapted by the teacher due to differences in educational contents. Moreover, different kinds of skills can be examined, as well different types of questions can be tested (depending on learning objectives). Besides, teachers can use different software packages in their classes. Interactive, because students actions and computer reactions are dependent of each other at different moments in the exam process.

3 SOTS used in a statistics course

The Faculty of Management and Organization is part of the University of Groningen in the Netherlands. From Dutch perspective, it is a large faculty with about 3000 students. In the first year of the curriculum, students follow two introductory statistics courses. In these courses, attention is paid to descriptive as well as inferential statistical techniques. Although the faculty had some relapse in the number of students in the late 90's, the number of first years is rapidly growing. In 2005 there were 800 students who followed the statistics courses.

Central in the statistics program are: real life (business) situations,

conceptual knowledge of statistics, interpretation of statistical output, and managerial implications. As a consequence, calculations get little or no attention; the reading and application of formulas is not trained. On the other hand, much time is devoted in learning how to use statistical software, in our case SPSS. The choices and consequences can be transformed into the following learning objectives: 1) the student is capable of producing the right SPSS-output in practical as well as in statistical sense, 2) the student can select the right results (numbers) from the output, 3) the student can interpret these results in the right statistical context, and 4) the student can draw sound conclusions from these interpretations. The learning objectives are denoted as the PSIC-model: Produce, Select, Interpret, and Conclude. The instruction of this model is done in small-scaled practicals. Because of the large number of students that attend the statistics courses, there are many groups in the practicals. Also, these groups are scattered in time.

As lecturers, we want information about the degree in which students actually acquired the PSIC-skills. However, examination of all the students at the same time is not possible because of lacking facilities (space and computers). Taking tests at different times will give problems because of fraud prevention (a copy of the exam is not possible because the students will tell each other the right answers, and different versions of the exam will increase the work load for teachers unacceptably). Therefore, a different solution is needed to overcome these problems.

Although the above description is specific for the Faculty of Management and Organization, our situation is not unique. Firstly, there has been a general trend towards emphasizing data and concepts instead of calculations [5], [6], [8]. The use of statistical software is not only widespread in applied statistics education in universities, it has also changed or influenced the focus of introductory statistics education. Secondly, the group sizes of students participating in statistical courses are

growing, partly due to synergy objectives of university managers. Moreover, the student population in general has increased and changed. As a result we teach a more diverse and less specialized student population [6]. Even in many emergent and newly industrialized countries, the massification of university education is being replicated [3]. Therefore, many statistics teachers probably are familiar with the problems around testing skills as described above for the Faculty of Management and Organization in Groningen

In the winter of 2005, SOTS was introduced to assess statistical skills learned in the statistics course of the first-year Bachelor students of the Faculty of Management and Organization. The general procedure was adapted to the specific requirements of the assessment of statistical skills (see also Figure 1):

- 1) The teacher creates a basic data set, including different variables and a large number of respondents or other research units (possibly automatically generated by the computer).
- 2) The teacher creates a test bank of exam questions, which refer to the variables of the basic data set and meet the learning objectives.
- 3) The student logs in for the exam.
- 4) The computer draws a random sample of respondents (research units) from the basic data set; the student receives this individual test data set.
- 5) The computer draws a stratified sample from the test bank of exam questions in order to create an individual exam for the student.
- 6) The student starts analyzing the individualized data set with SPSS to answer the questions of the individual exam.
- 7) The student enters the answers in the computer.
- 8) The computer conducts analyses for the individual test

questions and the individual test data set.

- 9) The computer compares these answers with the produced and entered answers of the student.
- 10) The computer computes feedback (general or question specific).

However, due to some technical problems with interfaces between systems, the above mentioned SOTS-procedure for statistical skills was not completely implemented. The following modifications were necessary:

- a) Instead of one general data set (step 1), 5 different data sets were generated.
- b) In step 4 of the procedure, one of these 5 data sets was randomly chosen.
- c) The statistical analyses in step 8 were done beforehand. This was possible because the datasets were known.

SOTS was used to do the assessment PSIC-skills with respect to the use of SPSS for 670 students. The results were satisfying: 530 (79%) students passed the test, indicating that the level of difficulty was not too high. We also evaluated the system by asking a random sample of students (n = 45) what they thought about the new test form. Almost all students were enthusiastic about the possibility to do the test whenever they choose to do it. The new test was not perceived to be more difficult than other – more traditional - tests for the assessment of computer skills (the students could compare with other tests that are used in the curriculum). Also, most students were satisfied with the facilities to do the test. The results of the evaluation are in Table 1.

Table 1 Evaluation results for SOTS

Advantage of SOTS	Agree (%)
Time	93
Difficulty	81
Accessibility	74

4 Conclusion

Examining computer skills in research for large groups using specific software is problematic in situations with limited availability of means. The above-described system can, despite limited facilities, examine these skills efficiently. The efficiency will be achieved by the possibility to give exams at different time slots, without increasing the teacher's workload unacceptably. Besides, the system also avoids the possibility for students to pass on answers or questions to each other.

The usage of SOTS in the statistics course was satisfying. Although there were some technical problems, the assessment could be done, and the results were promising. Future research should show if the skills were assessed validly.

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FIGURE 1:

