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Using Streaming Video to Improve Delivery of Online Spreadsheet Based Classes

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Introduction

One has only to glance at the textbooks on our shelves to realize that a pedagogical shift has occurred over the last decade. A course in Data Analysis traditionally would have used a textbook focused on SPSS, SAS, MINITAB, or some other statistical package. A Management Science text might have come bundled with LINDO, and/or some other software, perhaps written by the authors.

Today, however, spreadsheets (typically Microsoft Excel) have become more common as the software tool of choice for quantitative classes. There are many reasons for this. First, the analytical tools native to Excel have grown increasingly sophisticated. While there remain some problems, these tools are a viable option. Second, many texts now

come with Excel add-ins that reduce or eliminate the weaknesses of Excel's native tools. Third, students, upon graduation, often find themselves without access to tools like SPSS MINITAB, and LINDO. This leads them to reject the use of the tools they have been trained to use. However, virtually graduates will have access to Excel.

The use of Excel presents its own pedagogical difficulties, the biggest being the complexity of the program. The mechanics of the analysis through the spreadsheet medium must be explained. This can prove a daunting task, particularly when the students' Excel skills are weak.

The problem is compounded in an online course. Textbooks typically rely on screenshots to explain the necessary steps. Professors often have no other tool than screenshots (and sometimes not even those) when providing feedback or answering questions.

This paper details an attempt to mitigate these problems through the use of computer generated streaming videos. These videos allow students to see a computer analysis being performed and to hear the instructor's running commentary. Over the past year, this method was used for several online sections of a spreadsheet based course. The videos were used for the delivery of lecture material, to answer student questions, and for feedback on assignments and exams. Student performance is compared with that of "regular" (offline) sections of the same course delivered by the same instructor.

Camtasia Studio

The software used to produce these streaming videos was Camtasia Studio v3.0, published by TechSmith. Camtasia is easily installed and mastered. At its most basic, the user can record all actions that appear on their computer screen (or a region of the screen), while simultaneously recording voice commentary with a microphone. The resulting video can then be processed into virtually any format the user desires, including MPG, Flash (SWF), Quicktime (MOV), AVI, WMF, or it can be packaged as an EXE file.

More advanced features allow the user to cut and paste, insert new audio, import videos or graphics, insert video from a web camera, zoom in and out, and add textbox callouts. Interactive callouts and menus allowing the user to jump to different spots in the video, subtitles, and quiz/survey questions may also be included. If the user wishes, a polished, professional computer video can be produced. Examples of the full range of the software's capabilities can be found at the company's web site (www.techsmith.com).

Motivation

The idea of using Camtasia came to me three years ago when I taught my first online class, a master's level course in data analysis and decision making. The class was administered through WebCt. Some of the students quickly mastered the material, typically those with strong quantitative and/or spreadsheet skills. However, some of the students were quickly overwhelmed by the material, and I was soon inundated with e-mails and phone calls from confused students. Many of the problems involved Excel

issues. Feedback on assignments (students submitted electronic copies of their spreadsheets) became tedious in that I was having to type lengthy (and ultimately confusing) explanations of what they needed to do differently. I soon realized that these issues were often handled speedily during a "regular" class, in that I could demonstrate "live" how to do something. With the online class, this was not possible. I realized that a concept that was taking me 20 minutes to explain (often unsuccessfully) in an e-mail message could usually be shown in just 2 minutes if the student could only watch me as I showed them what to do and explained why it should be done that way. I was soon muttering to myself that I wished I could just record my computer screen and send it to the students. It didn't take long before I began to look for software that could do just that.

Once I found Camtasia Studio, I began to use it for the second half of the class. I produced some fairly polished video lectures that could be used to supplement the text. I also answered all e-mail questions and graded all assignments via quickly produced videos. The effect was startling. Student performance improved dramatically and the entire tone of the postings on the WebCt discussion board became more positive. The student evaluations were unanimous that the course was much improved over the second half (phrases like "night and day", "a breath of fresh air", and "I finally began to hope that I could pass this class" appeared in the evaluations).

On final point: before I introduced the videos to the class, the performance was bimodal. Half the students were doing first rate work while the other half "just didn't get it". The

difference between the two halves was pronounced. That difference was greatly reduced after the introduction of the videos. However, I did notice that, since the top students were doing well before hand, the largest beneficiaries seemed to be the bottom half of the class. While the student feedback regarding the videos was universally positive, they did not seem to impact the grades of the top students (who had little room for improvement).

Experiment

The objective was to see if, through the use of streaming videos as detailed above, students in an online section would perform at least as well as students in a "regular" (offline) section. It is proposed that this difference in performance accrues mainly to the bottom half of the class. As per the anecdotal results from the master's class, the top students will probably do well either way, with little room for improvement.

The course was again Data Analysis and Decision Making. However, for this study undergraduates (juniors and seniors) were used, due to too few classes being offered at the master's level. Students from two offline sections were compared to two online sections. The offline sections were conducted in their normal manner. The online sections were executed through WebCt. The syllabus, textbook, assignments, exams, and instructor were the same for all sections.

There were three differences in how the online and offline sections were taught.

1) *Live lectures vs. video lectures*. The offline students received my normal lecture live in the classroom. Class was taught in a computer lab allowing periods where students could work problems, with the instructor circulating. During lecture examples, the students could work "along" with the instructor. The online students received prepared video lectures. These were versions of the lectures given to the offline sections. While the video production values did not rise to the level of professional grade, they did include many of the advanced features of Camtasia Studio, and were subjected to considerable editing. The videos covered theory as well as the practical execution through worked examples; in short all of the material the offline students received (including my usual arsenal of bad jokes).

2) *Written feedback for assignments and exams vs. video feedback.* All assignments and exams were performed within Excel and students were to submit the actual spreadsheet (not a printout) for grading. Offline students received their spreadsheet returned via e-mail with written feedback (via textboxes and comments) inserted in the spreadsheet. Online students received a video showing me reviewing their spreadsheet. Unlike the prepared lecture videos, all comments in these videos were "off-the-cuff"; I opened the spreadsheet, started recording, and spoke my thoughts aloud as I examined the students' work. Students could see and hear the diagnostic process (and not just see the final comments), as well as watch as I corrected any errors.

3) *Written responses to e-mail questions vs. video responses.* The offline students received normal, written responses to their e-mailed questions. If a question from an

online student could be answered in just a few sentences and did not involve explaining how to do something in Excel, then they too received a written response. However, if an online student had a question that required considerable writing or that involved an Excel question, they received a video response.

In comparing the sections, performance on the exams (midterm and final) was the criterion used. Assignments are provided strictly for feedback purposes, and so are graded to a different standard.

The general hypothesis to be tested is simple: do the students in the online courses perform better than the students in the offline courses? There were three alternative hypotheses tested.

H1: Students in the online course will score higher on average on the midterm exam than students in the offline course.

H2: Students in the online course will score higher on average on the final exam than students in the offline course.

H3: Students in the online course will score higher on a weighted average of the midterm and final exams than students in the offline course.

It was expected that each of the above alternatives would be accepted.

As mentioned earlier, however, it was felt that the real benefit of the videos would accrue to the students in the bottom half of the class. Therefore, three more hypotheses arose.

H4: The bottom 50% of student scores on the midterm exam from the online class will be higher on average than the bottom 50% of student scores from the offline course.

H5: The bottom 50% of student scores on the final exam from the online class will be higher on average than the bottom 50% of student scores from the offline course.

H6: The bottom 50% of student scores on a weighted average of the midterm and final exam from the online class will be higher on average than the bottom 50% of student scores from the offline course.

Again, it was expected that all three alternatives would be accepted.

Finally, since it was not felt that much benefit would be derived from the videos by the top half of the class, there are the last three hypotheses.

H7: The top 50% of student scores on the midterm exam from the online class will be higher on average than the top 50% of student scores from the offline course.

H8: The top 50% of student scores on the final exam from the online class will be higher on average than the top 50% of student scores from the offline course.

H9: The top 50% of student scores on a weighted average of the midterm and final exam from the online class will be higher on average than the top 50% of student scores from the offline course.

It was expected that the tests would not show significance and so would not lead to acceptance of the alternatives.

Hypothesis H1 through H3 could be tested with a simple t-test. However, it was felt that since H4 through H9 dealt with only the top half or bottom half of the class distribution, the resulting non-normality warranted a non-parametric test. The Wald-Wolfowitz run test was used.

Results and Discussion

The results for each hypothesis are shown in the table below. P-values significant at the 5% level are highlighted.

	Midterm Exam	*Final Exam*	*Both Exams*
Complete Class	H1 p = 0.1566	**H2 p = 0.0107**	**H3 p = 0.0101**
Bottom 50%	H4 p = 0.2122	**H5 p = 0.0005**	**H6 p = 0.0496**
Top 50%	**H7 p = 0.0463**	**H8 p = 0.0076**	**H9 p = 0.0011**

Two things leap out upon examination. First, the p-values for the top 50% (H7, H8, and H9, bottom row of the table) were all significant, contrary to expectations. (Recall that it

was felt that the top students would do well regardless, with little room for improvement). Second, results for the midterm exam (the first column of the table) were the poorest. H1 (the complete class) and H4 (the bottom 50%) were not significant and H7 (the top 50%) was barely significant with a p-value of 0.0463.

With regard to the unexpected significant results for the top 50%, it should be realized that this is a good thing. Apparently, there was room for improvement and the improvement was realized. What is surprising is that the top 50% row exhibited stronger results than the other rows. Several explanations come to mind. First, it is possible that the stronger students simply exploit tools like the videos to better effect than do the weaker students. They would therefore derive more benefit. Second, the distribution of exam scores was, as might be expected, highly left skewed. This means that the data for the complete class and for the bottom 50% exhibit greater variance than the data for the top 50%. If the actual mean difference between groups is examined, the complete class and bottom 50% data show greater improvement (by a factor of more than 2 to 1). However, when these differences are tested for significance, the greater standard deviations of the complete class and bottom 50% render these differences of greater magnitude less significant. Finally, the Wald-Wolfowitz test used for the bottom and top 50% data groups tests for differences in the underlying distribution; both difference in the mean and variance of the groups is taken into account. The stronger significance may be due to changes in the variance as much as a change in the mean.

As for the weak significance levels for tests involving the midterm, there are several considerations. Since the midterm represents the first major hurdle in the class, it often catches students by surprise. ("Oh, you mean the professor was serious about having to study?!?") At this point, students' study habits may improve, resulting in significant benefits for the final. This might also explain why these results were significant for the top 50% group: these are the better students, who study harder and who, from the beginning of the course, take advantage of all available tools. Second, while the results were not significant for H1 and H4, in each case the difference was in the predicted direction (higher results for the online class). With p-values of 0.1566 and 0.2122, the difference is approximately a full standard deviation in each case.

Conclusion

The use of spreadsheets as the analytic tool of choice for quantitative courses is becoming more prevalent. The increase in the frequency of online class offerings is also well known. The combination of these presents interesting pedagogical challenges. Instructors can get swamped by issues of the mechanics of the spreadsheet and get pulled away from the conceptual issues of problem identification and interpretation.

The use of online videos to provide course lectures and feedback on assignments, exams, and e-mailed questions appears to lead to improved student performance. This improvement seems to be across the entire spectrum of the classroom. The videos represent additional tools for the online student to use and they supply higher quality feedback than written responses (particularly with respect to the mechanics). The videos

also represent a broadening of the range of learning styles to which the instructor is catering, adding a visual/aural component to the read/write component normally available.

The workload required of faculty to provide these videos seems daunting at first glance. It is certainly true that if an instructor wishes to prepare high quality video lectures, beyond just recording their voice over PowerPoint slides, a considerable amount of time is involved as a form of setup cost. From then on, however, the instructor need only revise a video as it suits him. The use of videos for feedback on assignments and exams can require more time than written feedback. However, the quality of feedback is much higher and, with experience, the time demand can be reduced dramatically. For example, as patterns of common errors become apparent, the instructor can prepare a "stock" video. When grading, a simple statement such as "What you have done here is a very common error. Let's discuss why this is wrong with another example." The instructor can then splice the stock video into the personal response to the student, and then cut back and show the changes the student needs to make. I use this technique constantly, and have found it allows me to provide an extremely detailed video of several minutes length in only a fraction of the time (e.g. a 10 minute video to the student produced in only 3 minutes).

While this study examined an online spreadsheet based class, it is probable that these videos would be of use in either an offline class or with any other software. The videos allow the instructor to minimize in class discussion of the mechanics of the software,