

## Study and Development Fellowship Report

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During the summer of 2014, I was granted a fellowship to develop a set of online exercises using Maple TA for use in Theory of Finance.

During the winter and spring semesters, I selected and identified problems that I have used in Theory of Finance in the past that would serve as good problems for Maple TA. In addition, I created some new problems to ensure that a broad range of material was covered. I attempted to select problems that covered a wide variety of topics within the course and that encompassed a variety of learning stages. The problems included easier, more straightforward problems to allow the students to begin to understand the material and evolved into more complicated and difficult problems for students who have mastered the material. The problems cover all of the material that is covered in the course. For each problem I identified variables that could be algorithmic and an appropriate set of ranges for each of the variables.

During the summer, with the help of a graduate student, Esmond Lun, we entered 130 problems into Maple TA and coded the questions and answers. I spent a considerable amount of time checking and testing the questions. I checked the statements of the problems to make sure they were clear, contained all the relevant information, and that the numbers provided in the problems were appropriate. I tested every question multiple times to make sure that the answers were correct, made sense, and allowed an appropriate range of acceptable responses (questions involving one simple calculation require an exact response, while others that involve several complicated calculations allow a range of responses). Finally, I reviewed the solutions to every question to ensure that they were correct and provided enough information to enable the students to understand how to solve the problem.

Once Esmond and I were satisfied with all the problems, we enlisted the help of Asha Sadanand and Michael Batu to test the problems again from fresh perspective. They provided invaluable assistance in helping us to fine-tune all of the questions and responses.

This semester I am using Maple TA in my two sections of Theory of Finance. Each week the students receive a new assignment relating to the material covered in the previous week. For three days they have access to a practice version of the assignment where they can see and attempt the problems that will be on the graded assignments. After that, the practice version of the assignment closes and the graded version becomes available. The students then have four days to complete the graded version of the assignment. They are allowed five attempts and the best one of their five attempts counts towards their mark in the course. Once the graded version of the assignment closes a review version of the assignment becomes available so that the students can continue to practice and review the problems to

prepare for exams. Because the problems are all algorithmic, each time a student attempts the assignment the problems are different, thus minimizing the opportunity for academic misconduct. Also students receive immediate feedback and see solutions while the question is still fresh in their minds, enhancing understanding and learning.

Even though we are only a few weeks into the semester, I am already experiencing some of the benefits of Maple TA. Students appear to be spending more time working on problems and consolidating the material than they have in the past. On average students have been attempting the assignments between two and three times, with many students using all five attempts. They are asking questions and working to understand the concepts and are engaged with the material. I am able to spend more time in class getting students to think about the problems we are solving and the economic and financial concepts involved. I can cover the material in more depth and spend more time on concepts and applications, both because of the extra time available that is not being devoted to quizzes and because the students are better prepared in class. In addition, TAs are not having to spend their time invigilating and marking quizzes, so they have more time to spend providing office hours and helping the students. I have had students approach me after class to tell me how beneficial they find Maple TA and how they enjoy the time I am able to spend in class discussing applications.

The real test of this project will come at the end of the semester with the final exam and course results for the students. At the end of the Winter 2014 semester I conducted a survey of my students to determine their attitudes towards learning, their study habits, and some demographic information. I also obtained their consent to participate in a study examining student attitudes toward learning and how learning can be improved or enhanced using different testing and assessment methodologies. In November I will be conducting a similar survey in my Fall 2014 classes. I will then be able to compare student attitudes and performance in the two groups: one which had non-graded assignments and in-class quizzes, and one which had graded Maple TA assignments. Because the cohort of students taking Theory of Finance in the Fall differs from the group taking the course in the Winter, I plan to continue the study with my students in the Winter semester. Once I have the data analyzed, I will be reporting the results in conjunction with a university-wide study on the effectiveness of online testing and assessment.

I would like to thank the Study and Development Fellowship committee for providing me the opportunity to undertake this project. I view this as a work in progress as I will continue to develop new questions and add them to the ones in place. I also hope to be working to incorporate Maple TA into the Distance Education version of Theory of Finance. I feel the Maple TA problem sets are providing a means to enhance the learning experience for our students both inside and outside the classroom and are providing a valuable benefit to my class and teaching.