JOURNAL OF ECONOMICS and FINANCE EDUCATION

JEFE

editor
E. F. Stephenson
MANAGING EDITOR

AEF
ACADEMY of ECONOMICS and FINANCE

Volume 20 FALL 2021 Number 2

Academy of Economics and Finance

Metacognition and Performance: Evidence from Intermediate Corporate Finance Students

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ABSTRACT

We examine whether metacognitive skills are important for finance students. We find that students with better metacognitive skills perform better in intermediate corporate finance courses. We find a statistically significant and positive relationship between students' achievements and their metacognitive awareness even after controlling for performance in the introductory finance course, major, time spent on assignments, senior status, and gender. We overcome the literature's concerns regarding capturing metacognitive abilities by focusing on students' low stakes self-learning assignments and utilizing metacognitive data collected by the McGraw-Hill LearnSmart platform. We find evidence that teaching metacognitive skills may benefit students in higher education.

Introduction

Metacognition means "thinking about thinking" or "knowing about knowing." The root word meta means "beyond," which makes metacognition akin to beyond thinking. The term is credited to John H. Flavell in 1979, where he defined it as knowledge and control about cognition. To illustrate Flavell's (1979) definition, you can think of a student as engaging in metacognition if she understands she is having trouble grasping bond pricing more than time value of money. In other words, the student is aware of her unawareness and aware of her awareness.

Metacognition also implies that students should consider their own study skills and monitor their own ability to learn. Metacognitive skills may enhance learning. In fact, metacognition has been linked to success in college students. Young and Fry (2008) use a survey to assess whether metacognitive skills are linked to performance for a sample of college students. They find positive correlations between metacognitive knowledge and overall academic achievement, including cumulative grade point average. Tempelaar (2006) studies a group of Dutch business students taking entry level business core classes. He finds that metacognition is important for finance class performance, but not important for economics and management courses. Tempelaar (2006) notes that in the Netherlands, students are taught metacognitive skills in secondary school training prior to arriving at a university. Schleifer and Dull (2009) survey accounting students from 1995-2004. They find metacognitive attributes are associated with better performance in accounting classes.

While metacognition may be difficult for students to master, textbook publishers are increasingly placing emphasis on adaptive and student-centered learning. An example of this is McGraw-Hill's LearnSmart tool. LearnSmart uses adaptive learning technologies to tailor the study material to each individual student's skills and knowledge. Gebhardt (2018) shows that students who complete LearnSmart assignments achieve higher course grades in microeconomics. While she does not examine the metacognitive aspects of the product directly, Thadani and Bouvier-Brown (2016) use LearnSmart to assess what they term "metacognitive scaffolding." While they find, in general, that students have trouble with thinking metacognitively, they also discover that students using LearnSmart with metacognition scaffolding questions that aided them in monitoring and repairing areas of difficulty demonstrated greater learning gains. Zhao and Mo (2016) also use LearnSmart to capture metacognition. They show that metacognitive awareness is positively correlated with student performance in basic accounting classes.

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In our paper, we extend this literature by examining whether metacognitive skills are important for finance students. We focus on U.S. students from a large, public university. We use the LearnSmart platform from McGraw-Hill to assess metacognitive skills. We use a non-introductory course, specifically intermediate corporate finance, to ensure that all students have at least some prior knowledge about the subject matter as well as familiarity with the LearnSmart platform. Thus, our sample focuses on students who should have an important baseline for assessing their metacognitive skills.

We find that greater metacognitive awareness is associated with better performance. We measure performance with average exam scores as well as final course average. Students earning As in the course have the highest metacognitive scores, while students that did not pass the course had the lowest metacognitive awareness. When we regress performance on metacognitive awareness, we find a statistically significant and positive relation even after controlling for performance in the introduction to finance prerequisite course, major, time spent on assignments, senior standing, and gender. With respect to gender, we find no significant differences between males and females in terms of class performance or metacognitive abilities. However, major does seem to be important. Finance and accounting majors have higher metacognitive skills and better performance in the class. Overall, our evidence supports the notion that metacognition is important to student performance in intermediate finance classes.

Literature Review

Studies investigating the association between student characteristics and performance in introductory level finance courses show that gender, age, prior education, performance on prior course work (especially mathematics, accounting, and economics), and student grade point average (GPA) all positively affect overall performance in the course. For example, Schaffer and Calkins (1980), using a sample of 252 students, document that performance in the prior accounting course is the most predictive factor in student performance in business finance courses. Borde et al. (1998) find that males, non-college-transferred students, students with higher prior GPA, and students with higher grades in prior accounting courses perform better in the introductory finance course for a sample of 766 students. More recently, Pilloff and Kling (2017), considering the current trends in higher education, find that student employment negatively affects overall course grades while repeating a course is associated with better performance. They also find that college-transferred students do not perform worse than non-transferred students.

However, research examining intermediate level courses in finance seems to be scarce. An exception is Borde (2017) who examines student performance for finance majors by surveying 281 students taught by a single instructor at the University of Central Florida. He collects data on student gender, high-school background, and college-transfer status and finds males, US high school graduates, and high school GPAs are positively related to course grades, while African-American and college-transferred students tend to underperform.

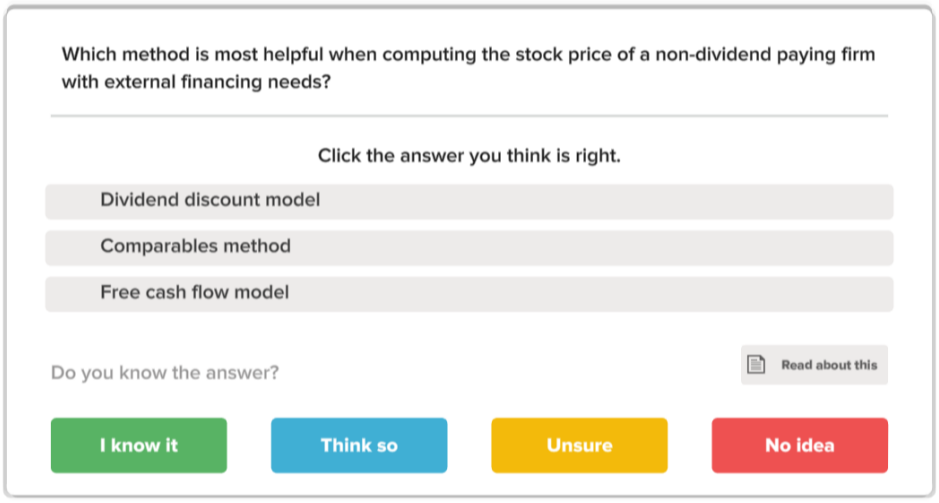
Another strand of the literature examines how a student's learning ability and style might affect performance and stresses the importance of the instructor's awareness to improve student performance. Filbeck and Smith (1996) find that introverted and sensing students as indicated by their Myers-Briggs Type Indicator perform better on multiple-choice quantitative questions, while students preferring introversion for focusing their attention perform better on open-ended quantitative questions among 94 students taking an undergraduate finance course required for all business majors. Ashraf et al. (2013) extend the work of Filbeck and Smith (1996) and report that student personality types and learning styles only significantly impact performance at higher learning levels (application, analysis, and synthesis) based on Bloom's Taxonomy for a group of 77 students taking the introductory financial management course.

Extending this strand of the literature, we examine how students' awareness of their own cognitive ability impacts their performance in an intermediate level finance course. The literature on metacognition generally finds that higher metacognitive knowledge is associated with better performance measured by end-of-course grade, overall GPA, or student success in college (Schraw and Dennison 1994, Everson and Tobias 1998, Young and Fry 2008). Assessing metacognitive knowledge, however, is often accomplished through surveys of students such as the Metacognitive Awareness Inventory developed by Schraw and Dennison (1994). Young and Fry (2008) point out that asking students to assess their metacognition during tests can be stressful to the students. Hence, we overcome this concern by using the LearnSmart adaptive learning program by McGraw-Hill and measure students' cognitive awareness in actual self-learning but low stakes assignments.

LearnSmart

LearnSmart is an adaptive learning program developed by McGraw-Hill. Students answer questions and assess their confidence surrounding their answer. In Figure 1, we provide a sample question. Based on the student's responses, an individualized learning path is provided for the student. The grading on the assignment is based on completion, so all students are encouraged to achieve mastery of the content.

Figure 1: Sample LearnSmart Question



While grading is based on completion, there are inherent incentives to answer correctly and to honestly evaluate metacognition. If a student misses a question, that same question or a similar question that tests the same learning objective will be repeated. Clicking through the assignment will cause the student to take more time to complete the assignment and receive full credit for completion. Students are given immediate feedback as to the correctness of their response. Self-assessment of student confidence affects the schedule of questions as well as guides the types of questions a student sees. Thadani and Bouvier-Brown (2016) highlight that students are able to monitor their performance and accuracy of their assessments in real-time. Reports are available to students that list topics or subsections that were more challenging to them. Thadani and Bouvier-Brown (2016) contend that these tools aid students' self-regulating of learning.

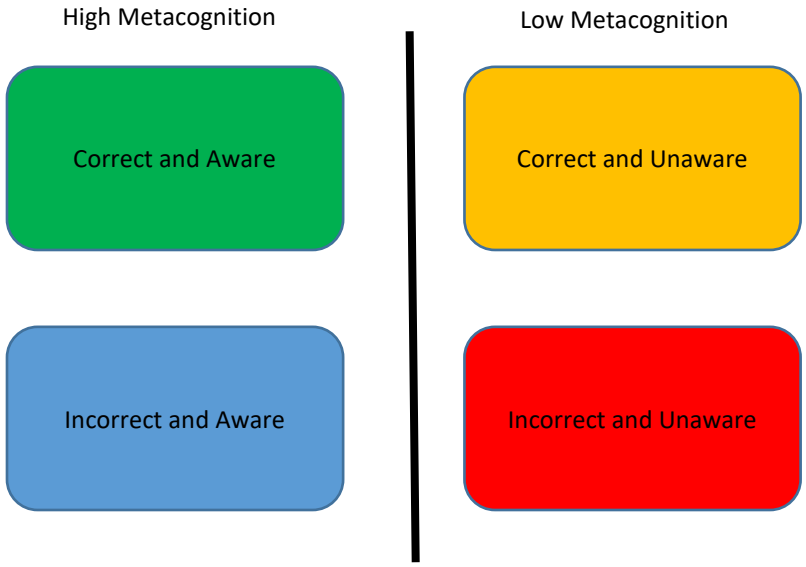
At the beginning of the semester, strategy instruction is provided to students in class and online by the instructor. Gutierrez and Schraw (2014) show that strategy training as well as incentives for students lead to improved performance and calibration accuracy. Miller and Geraci (2011) show that incentives improve metacognition of students. Thus, while we cannot completely reject the notion that students do not take the assignments seriously, incentives as well as strategy training are provided and should reduce such concerns.

In the intermediate corporate finance course, the majority of the LearnSmart questions are conceptual in nature. However, there are some multiple-choice questions that require basic calculations. The focus of LearnSmart is to ensure that the student is reading and comprehending the chapter content. More challenging calculation questions are left for end-of-chapter problems. While the majority of the questions are multiple choice, there is variation in the types of questions. Some questions require the students to type in a one- or two-word response (i.e. fill in the blank), while other questions are essentially matching problems where the students drag and drop the matching items. In addition, the multiple-choice questions often require the students to select multiple correct answers from the choice list (i.e. select all). In Appendix A, we have provided sample questions from LearnSmart to illustrate the types of questions the students would encounter.

The metacognitive awareness of the student is captured when the student ranks his or her confidence as "I know it", "Think so", "Unsure", or "No Idea". Thus, the student is reporting whether they know what they know or know what they do not know. Aghababyan et al. (2017) use the LearnSmart responses to create a confidence profile, where confidence and knowledge are interacted. Following their approach, in Figure 2 we show how student responses can be classified into high and low metacognition. LearnSmart uses student responses to calculate their confidence and whether the answer was correct. The metacognitive skills report

provided by McGraw Hill's Connect platform then shows four categories as illustrated in Figure 2. To be highly cognitive, students should be correct and aware that they know the answer or incorrect but aware that they do not know the answer. In contrast, low cognitive abilities would be from students who were unaware that they were either correct or incorrect.

Figure 2: Student Metacognitive Skills



Sample and Data

Setting

Our sample contains 350 intermediate corporate finance students enrolled at the University of Central Florida (UCF) during the fall semesters of 2016, 2017, and 2018. UCF is one of the largest universities in the United States, with an enrollment of 69,525 as of Fall 2019. It is classified as very a high research activity university by Carnegie Classification. The students of UCF are very diverse (see Table 1), primarily nonresidential, and 91% of the student body are classified as in-state.

Within UCF, the College of Business is the largest college by number of degrees conferred. It is the third largest college in the university by undergraduate enrollment, with 8,019 students. Finance is the sixth largest degree program in the university and the largest declared major by enrollment in the College of Business, exceeded only by the general business major.

The majority of the students in our sample are finance majors (79%). In order to become a finance major, students must apply for admission to the finance program. Requirements for admission are that the student has completed the UCF General Education program or have an AA degree from a Florida College System or State University System institution and have completed introductory economics or statistics courses with a C or better. Further, students must have passed certain introductory business core classes with a GPA of 3.0, including receiving a B or higher in the introductory finance course. During the Fall 2019 semester, 1,067 students completed this introductory finance course, achieving a 2.3 GPA on average. 44% of these students achieved a B or higher, and thus would be eligible to become finance majors, assuming they met the other qualifications. Finance majors must also maintain a 2.75 GPA in the major to graduate with a finance degree.

The intermediate corporate finance sample used in this study spans six sections of the course during the Fall semesters of 2016, 2017, and 2018. The average class size is 58. While this results in slightly different experiences for the students in different sections or semesters, every section was taught by the same instructor using the same materials, minimizing variation in instructional content or experience. This course covers topics such as estimation procedures for cash flow timing, WACC inputs, project valuation and decision making, firm valuation, and short-term financial management. The book used for all sections in our sample is Ross et al. (2017). The LearnSmart assignments correspond to chapters in the book.

Table 1: University of Central Florida Student Demographics

Panel A: Enrollment by Student Type	**Number**	**Percentage**
Undergraduate	59,483	86%
Freshman (New Admit | Summer-Fall 2019)	7,377	11%
Transfer (New Admit | Summer-Fall 2019)	7,797	11%
Graduate	9,553	14%
Medical Professional	489	1%
Panel B: Enrollment by Race	**Number**	**Percentage**
White	32,525	46.80%
Hispanic/Latino	18,592	26.70%
Black	7,450	10.70%
Asian	4,436	6.40%
International	3,082	4.40%
Multiracial	2,560	3.70%
Not Specified	674	1.00%
Native Hawaiian/Other Pacific Islander	104	0.10%
American Indian/Alaska Native	102	0.10%
Panel C: Enrollment by Florida Residency Status	**Number**	**Percentage**
In-State	63,106	91%
Out-of-State	6,419	9%
Panel D: Freshman Class Profile		
Average SAT Score	1332	
Average ACT Score	29.1	
Average High School GPA (weighted)	4.17	
Panel E: Average Ages of Students by Student Type		
Freshman	18.5	
Sophomore	19.5	
Junior	22.1	
Senior	24.6	
Over Age 25	22%	
Average Age	23.7	
Master's	30.1	
Specialist	29.9	
Doctoral	32.2	
Professional	25.9	
Undergraduate	22.6	
Graduate	31	

Panel F: Enrollment by Gender and Student Type	**Male**	**Female**	**Not Specified**
University Total	31,188	38,331	6
Undergraduate	27,037	32,442	4
Graduate	3,896	5,657	–
Medical	255	232	2

The class is essentially the second corporate finance class required for finance majors. The advantage of using this course is that all students have a baseline of knowledge about finance. Thus, we believe the students should be able to assess their metacognitive skills more accurately since the majority of the course material is not totally new to them. Also, the students are familiar with the LearnSmart platform, since it was also required in business core courses that are prerequisites for the intermediate corporate finance course.

In the intermediate course, students are required to complete thirteen LearnSmart assignments. Due dates are set prior to class in a partial flipped classroom model. Students are expected to have a baseline knowledge of the material prior to class, so that class time can be used effectively for questions and covering more challenging material. This is achieved by requiring completion of the LearnSmart activities prior to class. Scores for LearnSmart assignments are based on completion and are thus low stakes assignments. The average on the LearnSmart assignments is weighted as 5% of the students' final class average. Students are

allowed to drop their lowest LearnSmart score. Students are also aware that the LearnSmart assignments will help them prepare for higher stakes assignments like exams. Three exams account for 75% of the students' final class average. We omit students who drop the course so that all students in our sample have a final class average. While the LearnSmart assignments are low stakes in terms of final course grades, scores of zero, which means the student never started the LearnSmart assignment, account for only 6% of the grades. This includes scores that the students may choose to drop, since they are allowed to drop their lowest LearnSmart grade. In other words, students attempt 94% of the LearnSmart assignments. If the students start the assignment, they are highly likely to complete the assignment. Less than 1% of students who start the assignment do not finish. Thus, we believe the students are incented to complete the assignments. We are also confident that LearnSmart assignments provide incentives for students to honestly assess their own metacognition skills in a low-pressure environment. Hence, LearnSmart metacognitive data addresses the main criticism in other studies (Hacker et al. 2000; Nietfield et al. 2005) that use the widely popular Metacognitive Awareness Inventory (Schraw and Dennison 1994) during student exams.

Sample

Table 2 provides background information on the students in our sample.

Table 2: Student Background

Average GPA in introduction to finance	3.53
Percentage of students who got an A in introduction to finance	52.86%
Percentage of students who repeated introduction to finance	9.25%
Percentage of female students	28.29%
Percentage of seniors	66.00%

Performance in the intermediate corporate finance course is likely influenced by prior performance in related classes by the students. We gather data on the students' performance in the introduction to finance course, a prerequisite for intermediate corporate finance. We are able to get the student letter grade received in the introductory class as well as whether the student repeated the course going back to 2015. While we are not able to match all 350 of our sample students, we are able to obtain performance data for 227 students.[2] The average GPA of students in our sample in the introduction to finance course is quite high at 3.53, with almost 53% having scored an A in that course. Students are restricted from majoring in finance unless they score at least a B in this prerequisite course, so high performance in the introductory course is not surprising. Students are allowed to repeat the introductory course to earn a B and Table 2 shows that only about 9% of our sample students repeated the introductory course.

To capture gender, we use class roster photos. Females comprise only 28.29% of our sample. Goldsmith and Goldsmith (2006) find that male students are more confident than females about their financial knowledge, although Barboza et al. (2016) find that women are more overconfident. Tempelaar (2006) finds that female students possess stronger metacognitive skills than males, while Barrett and Lally (2002) find no difference in metacognitive skills by gender for online learning environments.

Finally, the intermediate corporate finance course is restricted to students with junior or senior standing at UCF in terms of credit hours. For our sample, 66% of our sample are seniors. While senior status may suggest greater maturity and perhaps better performance and/or metacognitive skills, juniors in the course may have self-selected to take the class earlier or may have completed all prerequisite courses in an efficient manner.

In Table 3, we break down our sample by major. The majority of our students (about 79%) are finance majors. The second largest major is accounting, comprising 20 of our 350 students. Table 3 also shows performance in the intermediate corporate finance course. The Average Exam Score is the average of the three required exams. The Final Score is the students' final class average with includes a 75% weight on exams, a 10% weight on an Excel-based project, a 10% weight on homework problems, and a 5% weight on LearnSmart assignments. Table 3 shows that finance and accounting majors are the top performers in the course. Economics, general business, and real estate majors struggled the most with the course.

[2] The missing data for the introductory course are likely caused by the student taking the introductory course prior to 2015, taking the course at another institution, and name/id changes. We have no reason to anticipate any bias in the missing data; however, regression analyses are run omitting data on the prerequisite class performance. All findings are robust.

Table 3: Majors

Major	Number	Average Exam Score	Final Score
Finance	276	79.59	83.06
Accounting	20	82.60	86.14
General Business	16	66.65	73.44
Real Estate	12	69.00	73.29
Marketing	8	75.21	79.90
Economics	5	62.47	66.17
Management	3	83.67	85.60
Other	10	82.87	85.33

Table 4 shows the grade distribution. The majority of students earn an A or a B in the intermediate corporate finance course. However, almost 7% of students earn a D or an F, which requires them to repeat the course.

Table 4: Grade Distribution

Letter Grade	Number	Percentage	Average Exam Score	Final Score
A	83	23.71%	91.48	93.01
B	157	44.86%	80.81	84.02
C	86	24.57%	69.98	75.11
D	17	4.86%	57.98	64.53
F	7	2.00%	31.95	44.99

Data

To capture metacognitive skills, we use the reports generated by McGraw-Hill. We create a variable called *Aware* if the student is "correct and aware" or "incorrect and aware," since metacognition focuses on self-awareness. *Unaware* includes "correct and unaware" and "incorrect but unaware" responses. We note that Zhao and Mo (2016) only consider correct and aware versus incorrect and unaware. While this captures the largest proportion of our sample, we believe combining correct and incorrect based on aware and unaware more accurately captures the metacognitive skills of the students.

We also gather the time spent completing the LearnSmart assignments in minutes. The LearnSmart assignments are meant to introduce the students to the topics. They are not intended as a substitute for class lectures. When creating LearnSmart assignments, faculty can select the topics within the chapter to include. In addition, faculty can scale the assignment based on an estimated time to completion. McGraw Hill uses its data to provide time estimates. In intermediate corporate finance, all LearnSmart assignments are scaled to have an estimated completion time of between 15 and 30 minutes based on the complexity of the chapter.

Table 5 provides summary statistics for our sample. The average time spent on the assignments during the semester was over four hours (254 minutes) across the thirteen assignments. The per-assignment average is just under 20 minutes, which is consistent with the scaling done to keep these assignments as introductory. Interestingly, the maximum time spent was over twelve hours, suggesting the assignments were fairly time consuming for some students. In terms of student performance, the average of the exam scores was 78.59 (out of 100) and the final average was 82.24 (out of 100).

Table 5: Summary Statistics

	Mean	Median	Minimum	Maximum	Std. Dev.
Time spent (minutes)	254.48	221.00	65.00	753.00	119.50
Average exam score	78.59	80.00	11.00	100.00	12.03
Final score	82.24	83.19	26.05	100.00	9.75
Correct and aware	62%	64%	3%	93%	15%
Incorrect and aware	4%	1%	0%	65%	8%
Correct and unaware	2%	0%	0%	45%	6%
Incorrect and unaware	33%	30%	0%	68%	15%

For the metacognitive skills, students are correct and aware of their knowledge an average of 62% of the time. The top student was correct and aware 93% of the time. However, 33% of the time students were incorrect and unaware. The maximum for unaware and incorrect is rather high at 68%. Incorrect and aware and correct and unaware are much less common with means of 4% and 2% respectively. Aghababyan et al. (2017) refer to incorrect and unaware as "overconfident" and incorrect and aware as "realistic." Our results are consistent with their findings that students are much more likely to be overconfident than realistic.

Results

In Table 6, we present metacognitive results by letter grade achieved in the course. In Panel A, we report the detailed metacognitive groups, while in Panel B we aggregate our metacognitive measures into *Aware* and *Unaware*. Letter grades for the course are assigned using fairly standard grade break points of 89.5 for an A, 79.5 for a B, and 69.5 for a C. We combine D and F grades, since we have relatively few observations for F grades. Also, in this course, students must achieve a C to not have to repeat the course. In other words, a C is really a passing grade, while Ds and Fs are both essentially failing grades.

Table 6: Metacognition by Final Letter Grade

Panel A: Metacognitive Score and Assignment Result

Letter Grade	Correct and Aware	Incorrect and Aware	Correct and Unaware	Incorrect and Unaware	Time (minutes)
A	67.42%	2.10%	1.35%	29.01%	223.31
B	61.34%	3.28%	1.79%	33.54%	253.55
C	59.00%	4.87%	3.02%	33.06%	285.45
D or F	55.83%	5.04%	2.79%	36.25%	257.42

Panel B: Metacognitive Score and Final Letter Grade

Letter Grade	Aware	Unaware
A	69.52%	30.36%
B	64.62%	35.33%
C	63.87%	36.08%
D or F	60.88%	39.04%

It is interesting to note that the best students spent the least amount of time on the assignments, suggesting they may have grasped the concepts much faster. This is also consistent with the adaptive learning component of LearnSmart. LearnSmart assesses the student's answers and identifies which topics they need to practice. Thus, the adaptive technology gives each student a personalized learning experience, where students with a better understanding of the material progress more quickly through the LearnSmart assignments. The C students in our sample spent the most amount of time on the assignments. This may suggest lower academic ability but a stronger work ethic than the failing students, who spent on average less time than the C students.

From both Panel A and Panel B, it is clear that better students are associated with stronger metacognitive skills. In the column capturing "Correct and Aware" in Panel A, the mean is highest for the A students and decreases steadily by each letter grade. Likewise, "Incorrect and Unaware" is highest for the students who did not pass the course, and lowest for the students who earned an A letter grade. This supports Grimes (2002), who finds that economics students who over-predicted their exams scores were less accurate than students who under-predicted their exam scores.

Panel B summarizes metacognitive skills. *Aware* is highest for A students (almost 70%) and progressively declines to about 61% for the failing students. *Unaware* is about 39% for the worst performing students and only 30% for the top performing students. While we do not attempt to address causality, our results are consistent with prior literature that suggests metacognitive abilities are important for learning. The best performing students have the highest metacognition and the failing students had the lowest metacognition.

In Table 7, we present a series of differences in means tests. We report the p-value from t-tests. In Panel A, we compare metacognitive skills of finance majors to all non-finance majors. We find no significant differences in terms of metacognition, but finance students do significantly outperform non-finance students. This suggests major is an important predictor of success. In Panel B, we combine our accounting and finance majors. These majors represent the top performers in the intermediate corporate finance class. Panel B shows

that finance and accounting majors have significantly higher metacognitive skills. They are *Aware* about 66% of the time, which is significantly higher than the 62% for non-finance or accounting majors.

Table 7: Difference in Means Tests

Panel A: Finance Major			
	Finance Major	**Non-Finance Major**	**p-value**
Aware	65.81%	63.59%	0.20
Unaware	34.12%	36.35%	0.20
Correct	64.28%	62.42%	0.30
Incorrect	35.65%	37.53%	0.30
Average exam score	79.59	74.86	0.00
Final grade	83.06	79.16	0.00
Panel B: Finance/Accounting Major			
	Finance or Accounting	**Non-Finance or Accounting**	**p-value**
Aware	66.03%	61.57%	0.02
Unaware	33.89%	38.41%	0.02
Correct	64.57%	60.17%	0.03
Incorrect	35.36%	39.81%	0.03
Average exam score	79.79	72	0.00
Final grade	83.27	76.57	0.00
Panel C: Grade in Introduction to Finance			
	A	**Below A**	**p-value**
Aware	67.59%	62.31%	0.00
Unaware	32.28%	37.67%	0.00
Correct	66.05%	60.93%	0.01
Incorrect	33.82%	39.06%	0.01
Average exam score	83.11	76.66	0.00
Final grade	85.84	80.78	0.00
Panel D: Repeated Introduction to Finance			
	Repeated	**Did not repeat**	**p-value**
Aware	65.43%	65.07%	0.91
Unaware	34.43%	34.86%	0.89
Correct	64.67%	63.53%	0.73
Incorrect	35.19%	36.40%	0.71
Average exam score	77.81	80.3	0.31
Final grade	81.39	83.66	0.26
Panel E: Gender			
	Females	**Males**	**p-value**
Aware	65.54%	65.27%	0.86
Unaware	34.40%	34.67%	0.87
Correct	64.23%	63.75%	0.77
Incorrect	35.71%	36.18%	0.77
Average exam score	78.02	78.82	0.58
Final grade	82.06	82.31	0.42
Panel F: Senior			
	Senior	**Junior**	**p-value**
Aware	66.01%	64.04%	0.19
Unaware	33.89%	35.96%	0.17
Correct	64.63%	62.45%	0.16
Incorrect	35.27%	37.55%	0.14
Average exam score	77.95	79.83	0.17
Final grade	81.59	83.49	0.09

In Panel C, we examine metacognition by whether the students achieved an A in the introductory course. Consistent with prior literature, we find that better-performing students have significantly higher awareness.

Students who earned an A in the introductory course are *Aware* almost 68% of the time compared to students who did not earn an A who are *Aware* only 62% of the time. Panel D shows no significant difference for students who repeated the introductory course.

Panel E shows no significant differences by gender across any measure of metacognition or performance for our sample. Females are *Aware* an average of 65.54% of the time, while males are *Aware* 65.27% of the time. While our results differ from Borde (2017), our findings are consistent with Barrett and Lally (2002). Males and females in our courses showed similar levels of metacognition and performance. Finally, Panel F looks at whether seniors perform better or have different metacognitive skills than juniors. We do not find any significant differences between junior and seniors in terms of metacognition; however, juniors have a slightly higher final course average, significant at the 10% level.

To further explore the relation between metacognitive skills and performance, we use regression analysis. Results are reported in Table 8. Specifically, we predict both average exam score as well as final score based on the percentage of time the student was Aware, our measure of high metacognition, and several control variables. For performance, we use the students' overall final grade as well as their average on the three in-class exams. While the final average does have a 5% weight placed on LearnSmart assignments, the average of the exam scores does not have this mathematical relationship with LearnSmart. However, student grades for LearnSmart assignments are based on completion, not their metacognition. Using the average exam scores allows us to address any potential endogeneity concerns, but these should be minimal given metacognition is not scored in their LearnSmart grade.

Table 8: Regression Analyses on Performance and Metacognition

		Average		Average
	Final Score	**Exam Score**	**Final Score**	**Exam Score**
Intercept	91.102***	94.687***	72.059***	72.498***
	(6.142)	(7.504)	(7.512)	(8.998)
Aware	19.310***	27.096***	14.629***	21.358***
	(4.034)	(4.928)	(4.461)	(5.343)
Natural log of minutes	-4.641***	-6.982***	-2.922**	-5.056***
	(1.181)	(1.442)	(1.352)	(1.619)
Finance/accounting major dummy	5.375***	5.916***	4.055**	3.954*
	(1.389)	(1.697)	(1.852)	(2.218)
Female dummy	0.598	0.271	1.382	1.134
	(1.095)	(1.337)	(1.204)	(1.442)
Senior dummy	-1.451	-1.381	-0.136	0.237
	(1.043)	(1.274)	(1.123)	(1.344)
Grade in introduction to finance			3.890***	4.778***
			(1.037)	(1.242)
Repeated introduction to finance dummy			-2.053	-2.142
			(1.897)	(2.272)
Observations	350	350	227	227
F Statistic	10.92	12.51	6.96	7.93
p-value	0.00	0.00	0.00	0.00
R^2	13.70%	15.38%	18.20%	20.23%
Adjusted R^2	12.45%	14.15%	15.58%	17.68%

We control for time spent on the assignments, major, gender, class rank, grade in introduction to finance, and whether the introductory course was repeated. For time spent on the assignments, we take the natural log of the total minutes the student spent on all the LearnSmart assignments. Time spent may proxy for the student's aptitude for corporate finance as well as effort. Since finance and accounting majors perform better in intermediate corporate finance, we include a binary variable equal to one if the student is a finance or accounting major and zero otherwise.[3] We include a binary variable equal to one if the student is female and zero otherwise. We include another binary variable equal to one for seniors and zero for juniors. Finally, in the last two columns, we control for performance in the introduction to finance course. We include their

[3] Reported results are robust to using a binary variable equal to one for finance majors and zero otherwise; however, this variable does lose significance.

grade in the introduction to finance course (using a 4.0 for an A, 3.75 for an A-, 3.25 for a B+, 3.0 for a B, 2.75 for a B-, 2.25 for a C+, 2.0 for a C, 1.75 for a C-, 1.25 for a D+, 1.0 for a D, 0.75 for a D-, and 0 for an F) as well as binary variable equal to one if the student repeated the introductory class and zero otherwise.[4]

Consistent with results in Table 6, we find that high metacognitive skills are statistically significant and positive in all model specifications. *Aware* is positive and highly significant even after we control for performance in the introductory course. This supports the idea that students who are aware of their knowledge or lack of knowledge perform better. Time spent is negatively related to performance, suggesting weaker students take longer to complete the assignments. Finance and accounting majors perform significantly better than non-majors. We find no significant difference for female students or students with senior rank in terms of performance. Unsurprisingly, the grade earned in the introductory course is positively and significantly related to performance in the intermediate course.

Causality

While our results suggest that students with better metacognitive skills earn higher grades in intermediate corporate finance, we cannot rule out reverse causality. It is possible that better performing students have better awareness of what they know and what they do not know. In fact, our results may simply reflect the Dunning-Kruger effect. Dunning (2011) provides empirical evidence of this effect. Specifically, he shows that poor performers in both social and intellectual domains are largely unaware of how deficient their expertise is. He contends that people's misguided knowledge leads them to making more mistakes as well as preventing them from recognizing when they are making mistakes.

While we leave the issue of causality for future work, we acknowledge the limitation of our study. Our findings with metacognitive skills and performance should be interpreted as associations. However, we consider our results strongly supportive of the logic of enhancing metacognitive skills in students, consistent with the current literature. Future research could compare a treated sample of students who were exclusively taught metacognition skills before or during the course and a control sample of students who were not taught metacognition skills to better establish a causal relationship.

Conclusions

Metacognition is knowledge about what you know and what you do not know. Prior literature suggests that higher metacognition is associated with better performance. We explore whether this extends to finance students at a large U.S. university in an intermediate corporate finance class. To capture metacognitive abilities, we use McGraw Hill's LearnSmart product. We find strong evidence that when students are aware of their knowledge, they perform better. Being aware continues to be a strong predictor of performance even after controlling for student performance in the introductory finance course. While our paper does not address causality, our results strongly suggest a link between classroom performance and metacognition.

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Appendix: Sample Questions from LearnSmart

Fill in the blank (free response)
Question: Using your personal savings to invest in your business is considered to have an _____ _____ because you are giving up the use of these funds for other investments or uses, such as, a vacation or paying off a debt.
Answer: opportunity cost

Select all
Question: Which of the following are usually included in a bond's indenture?
Answers: The bond's rating, The total amount of bonds issued, The repayment arrangements, The names of the bondholders

Question: Which of the following statements are true about shareholders' equity?
Answers: Shareholders' equity is the difference between the value of the firm's debt and its current assets, Shareholders' equity is the difference between the value of a firm's assets and its debt, Shareholders' equity is a residual claim on a firm's assets, Shareholders' equity represents the claim on a firm's assets by the firm's creditors

Multiple Choice (calculation)
Question: A small project has cash flows of -$10 and $45, and a large project has cash flows of -$30 and $70. What is the incremental IRR?
Answers: 188%, 52%, 32%, 25%

Question: What is the total return for a stock that currently sells for $108, pays a dividend in one year of $3.20, and has a constant growth rate of 3.5%?
Answers: 6.70%, 6.46%, 2.96%, 5.37%

Multiple Choice (conceptual)
Question: Sensitivity analysis is also known as _____.
Answers: bop (best, optimistic, and pessimistic) analysis, profit and loss analysis, what-if analysis, simulation analysis, break-even analysis

Question: Financial leverage affects the performance of a firm because the range of possible values for _____.
Answers: operating income is smaller, earnings per share is smaller, earnings per share is wider, operating income is wider

Matching – Drag statements on the right to match the left.
Match the titles with the duties of short-term financial managers.

Cash manager	Marketable securities
Credit manager	Accounts receivable
Purchasing manager	Accounts payable
Payables manager	Inventory

Multi-Stage Stock Pricing Techniques for the Classroom

Maura Alexander, Tom Arnold, and Ge Wu[1]

ABSTRACT

A process for multi-stage stock pricing is presented with evidence of improved classroom performance. The technique is expanded for more advanced class presentations and for potential fintech applications by taking advantage of present value annuity and future value annuity due structures. Although advanced, the expanded technique can be performed iteratively on a financial calculator.

Introduction

Introductory finance texts (e.g., Ross et al. 2019) and investment texts (e.g., Bodie et al. 2018) both introduce students to stock pricing with temporary abnormal dividend growth or sometimes referred to as two-stage stock pricing. The abnormal dividend growth rate (G_1) is expected to occur for (N_1) periods and then normal dividend growth (g) set below the discount rate (k) is applied in perpetuity. The stock price can be found as (D_0 is the most recent dividend or "current dividend"):

$$\text{Stock price} = \frac{D_0(1+G_1)}{(1+k)^1} + \cdots + \frac{D_0(1+G_1)^{N_1}}{(1+k)^{N_1}} + \frac{(1+G_1)^{N_1}D_0(1+g)}{(1+k)^{N_1}(k-g)} \quad (1)$$

The two-stage growth model is a more realistic representation of companies' growth opportunities and payout ratios when compared to the Gordon growth model. However, students tend to struggle with this application because of the multiple growth rates and the tedious calculation. In a 2019 introductory finance class, 43 of 94 students (45.74%) performed this calculation incorrectly on a take-home assignment. Applying a new technique that is introduced in the next section, only 19 of 72 students (26.39%) in a spring 2020 introductory finance class performed the calculation incorrectly on a similar take-home assignment (the classroom environment had not changed at this point in the semester due to the pandemic and all classes had the same instructor). This result is encouraging, but admittedly, not a thorough test of the students being truly more knowledgeable. The students may simply find the new technique easier to execute.

In the first section, the new technique with a common factor in the stock pricing model is introduced. In the second section, an algorithm is developed that incorporates a future value annuity due or a present value annuity calculation. In the third section, a generalized version of the algorithm is presented which accounts for multiple growth rates in a company's life cycle. This algorithm can be easily implemented in Excel, Google Sheets or other platforms. In the fourth section, the algorithm is implemented using a financial calculator which may be more useful for testing. The fifth section summarizes the paper.

New Technique

To introduce the new technique, values are introduced for the variables in equation (1). Let D_0 = \$0.65, G_1 = 15.00%, N_1 = 3, g = 6.00%, and k = 10.00%. Equation (1) becomes:

$$\text{Stock price} = \frac{\$0.65(1+15\%)}{(1+10\%)^1} + \frac{\$0.65(1+15\%)^2}{(1+10\%)^2} + \frac{\$0.65(1+15\%)^3}{(1+10\%)^3} + \frac{\$0.65(1+15\%)^3(1+6\%)}{(1+10\%)^3(10\%-6\%)} \quad (2)$$

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First, demonstrate to the students, there is a common factor $\frac{(1+15\%)}{(1+10\%)}$:

$$\text{Stock price} = \$0.65\left[\frac{(1+15\%)}{(1+10\%)}\right]^1 + \$0.65\left[\frac{(1+15\%)}{(1+10\%)}\right]^2 + \$0.65\left[\frac{(1+15\%)}{(1+10\%)}\right]^3 + \left[\frac{(1+15\%)}{(1+10\%)}\right]^3 \frac{\$0.65(1+6\%)}{(10\%-6\%)} \quad (3)$$

Define the common factor as Z_1:

$$Z_1 = \frac{(1+G_1)}{(1+k)} = \frac{(1+15\%)}{(1+10\%)} = 1.0455 \quad (4)$$

After some simplification, equation (3) becomes:

$$\text{Stock price} = \$0.65[(1.0455) + (1.0455)^2 + (1.0455)^3] + (1.0455)^3\left[\frac{\$0.65(1+6\%)}{(10\%-6\%)}\right] \quad (5)$$

$$\text{Stock price} = \$2.1327 + (1.0455)^3[\$17.2250] = \$2.1327 + \$19.6822 = \$21.82 \quad (6)$$

Having demonstrated the technique numerically, a general formula is presented.

$$\text{Stock price} = D_0\left[Z_1 + {Z_1}^2 + \cdots + {Z_1}^{N_1}\right] + {Z_1}^{N_1}\left[\frac{D_0(1+g)}{(k-g)}\right] \quad (7)$$

Equation (7) works well in the classroom and can technically be simplified further, however, having the last term as the familiar stock pricing formula seems to have the most appeal to students.

Developing an Algorithm

For fintech applications and more advanced classes, adjusting equation (7) into an algorithm has benefits. This adjustment can be performed using a future value annuity due or with a present value annuity. Given the current structure of equation (7), a future value annuity due presentation is simpler to demonstrate. Let $z_1 = Z_1 - 1$ or $Z_1 = (1 + z_1)$. Equation (7) changes in the following manner:

$$\text{Stock price} = D_0[(1+z_1) + (1+z_1)^2 + \cdots + (1+z_1)^{N_1}] + (1+z_1)^{N_1}\left[\frac{D_0(1+g)}{(k-g)}\right] \quad (8)$$

Reverse the order of the sum in the first bracketed term and factor in D_0:

$$\text{Stock price} = [D_0(1+z_1)^{N_1} + \cdots + D_0(1+z_1)^2 + D_0(1+z_1)] + (1+z_1)^{N_1}\left[\frac{D_0(1+g)}{(k-g)}\right] \quad (9)$$

The first term can now be viewed as a future value annuity due for N_1 periods and a cash flow equal to D_0:

$$\text{Stock price} = \frac{D_0}{z_1}[(1+z_1)^{N_1} - 1](1+z_1) + (1+z_1)^{N_1}\left[\frac{D_0(1+g)}{(k-g)}\right] \quad (10)$$

In Excel, equation (10) becomes: $= FV(z_1, N_1, -D_0, -\frac{D_0(1+g)}{(k-g)}, 1)$. A financial calculator can perform the future value annuity due calculation and then the final term as a separate calculation. However, changing the algorithm to a present value calculation will make the financial calculator more useful.

Let $K_1 = \frac{(1+k)}{(1+G_1)}$, this is the inverse of Z_1. Let $k_1 = K_1 - 1$ or $1 + k_1 = K_1$. The variable k_1 acts like a growth adjusted discount rate[2]. Equation (7) can now be viewed as:

$$\text{Stock price} = \left[\frac{D_0}{(1+k_1)} + \frac{D_0}{(1+k_1)^2} + \cdots + \frac{D_0}{(1+k_1)^{N_1}}\right] + \left[\frac{D_0(1+g)}{(k-g)}\right] \div (1 + k_1)^{N_1} \quad (11)$$

The first term is a present value annuity:

$$\text{Stock price} = \frac{D_0}{k_1}\left[1 - \frac{1}{(1+k_1)^{N_1}}\right] + \left[\frac{D_0(1+g)}{(k-g)}\right] \div (1 + k_1)^{N_1} \quad (12)$$

The algorithm in equation (12) is similar to a bond with D_0 as the coupon and $\left[\frac{D_0(1+g)}{(k-g)}\right]$ as the par payment at maturity. In Excel, equation (11) becomes: $=PV(k_1, N_1, -D_0, -\frac{D_0(1+g)}{(k-g)})$. A financial calculator can perform the bond pricing with N = N_1, I/Y = k_1×100, PMT = $-D_0$, and FV = $-\left[\frac{D_0(1+g)}{(k-g)}\right]$. From an algorithmic perspective, the bond pricing version of the two-stage stock price may be more appealing than the future value annuity due version.

Expanding the Algorithm

There can be more than one period of abnormal dividend growth and equation (7) can be expanded to accommodate such a situation. Suppose there are two periods of abnormal dividend growth, $G_1 = 15\%$, $N_1 = 3$, $G_2 = 12\%$, and $N_2 = 3$. Correspondingly, $Z_1 = \frac{(1+G_1)}{(1+k)} = \frac{(1+15\%)}{(1+10\%)} = 1.0455$ and $Z_2 = \frac{(1+G_2)}{(1+k)} = \frac{(1+12\%)}{(1+10\%)} = 1.0182$. Equation (7) expands in the following manner:

$$\begin{aligned}\text{Stock price} = {} & D_0\left[Z_1 + {Z_1}^2 + \cdots + {Z_1}^{N_1}\right] + (D_0)\left({Z_1}^{N_1}\right)\left[Z_2 + {Z_2}^2 + \cdots + {Z_2}^{N_2}\right] \\ & + \left(Z_1^{N_1}\right)\left(Z_2^{N_2}\right)\left[\frac{D_0(1+g)}{(k-g)}\right]\end{aligned} \quad (13)$$

Applying future value annuity due equations with $z_1 = Z_1 - 1 = 4.5455\%$ and $z_2 = Z_2 - 1 = 1.8182\%$:

$$\begin{aligned}\text{Stock price} = {} & \frac{D_0}{z_1}[(1+z_1)^{N_1} - 1](1+z_1) + \frac{D_0(1+z_1)^{N_1}}{z_2}[(1+z_2)^{N_2} - 1](1+z_2) \\ & + (1+z_1)^{N_1}(1+z_2)^{N_2}\left[\frac{D_0(1+g)}{(k-g)}\right]\end{aligned} \quad (14)$$

$$\begin{aligned} = {} & \frac{\$0.65}{4.5455\%}[(1+4.5455\%)^3 - 1](1+4.5455\%) \\ & + \frac{\$0.65(1+4.5455\%)^3}{1.8182\%}[(1+1.8182\%)^3 - 1](1+1.8182\%) \\ & + ((1+4.5455\%)^3)((1+1.8182\%)^3)\left[\frac{\$0.65(1+6\%)}{(10\%-6\%)}\right]\end{aligned} \quad (15)$$

$$= \$2.1327 + \$2.3102 + \$20.7755 = \$25.22 \quad (16)$$

Let FVA-DUE (interest rate, number of periods, periodic cash flow) symbolize the future value annuity due equation. A generalized version of equation (14) for "J" stages of abnormal growth becomes:

$$\begin{aligned}\text{Stock price} = {} & \text{FVA-DUE}(z_1, N_1, D_0) + \text{FVA-DUE}(z_2, N2, D_0 \times (1 + z_1)^{N_1}) + \ldots \\ & + \text{FVA-DUE}(z_J, N_J, D_0 \times (1 + z_1)^{N_1} \times (1 + z_2)^{N_2} \times \ldots \times (1 + z_{J-1})^{N_{J-1}})\end{aligned}$$

[2] k_1 equals k^* in Arnold and James (2000).

$$+\frac{D_0(1+g)}{(k-g)} \times (1 + z_1)^{N_1} \times (1 + z_2)^{N_2} \times \ldots \times (1 + z_J)^{N_J} \quad (17)$$

Exhibit 1 provides an Excel example with three abnormal periods of growth using a future value annuity.

Exhibit 1: Excel Spreadsheet of Three Periods of Abnormal Dividend Growth (4-Stage Stock Pricing)

	A	B	C	D
1	Current dividend:	**$0.65**		
2	G1:	**15.00%**		
3	N1:	**3**		
4	G2:	**12.00%**		
5	N2:	**3**		
6	G3:	**10.00%**		
7	N3:	**3**		
8	Perpetual growth rate (g):	**6.00%**		
9	Discount rate (k):	**10.00%**		
10				
11		**FVA-DUE Version:**		
12	Z1:	1.0455 = (1+ B2)/(1 + B9)	z1:	4.5455% = B12 – 1
13	Z3:	1.0182 = (1 + B4)/(1 + B9)	z2:	1.8182% = B13 – 1
14	Z3:	1.0000 = (1 + B6)/(1 + B9)	z3:	0.0000% = B14 – 1
15				
16	G1-stage:	$2.1327 =FV(D12,B3,-B1,,1)		
17	G2-stage:	$2.3102 =FV(D13,B5,-B1*B12^B3,,1)		
18	G3-stage:	$2.3159 =FV(D14,B7,-B1*B12^B3*B13^B5,,1)		
19	Perpetual growth stage:	$20.7755 =B12^B3*B13^B5*B14^B7*B1*(1 + B8)/(B9 – B8)		
20	Stock price:	$27.57 = SUM(B16:B19)		
Values in bold are inputs for the stock price calculation. Excel programming is beneath the associated value in the given spreadsheet cell				

Equation (14) can also be adapted for applying a present value annuity (See Appendix for details). Let $K_1 = \frac{(1+10\%)}{(1+15\%)} = 0.9565$ and $K_2 = \frac{(1+10\%)}{(1+12\%)} = 0.982143$. Correspondingly, $k_1 = K_1 - 1 = -4.3478\%$ and $k_2 = K_2 - 1 = -1.7857\%$. Equation (14) becomes:

$$\text{Stock price} = \frac{D_0}{k_1}\left[1 - \frac{1}{(1+k_1)^{N_1}}\right] + \frac{D_0}{k_2}\left[1 - \frac{1}{(1+k_2)^{N_2}}\right] \div (1+k_1)^{N_1} + \left[\frac{D_0(1+g)}{(k-g)}\right] \div (1+k_1)^{N_1} \div (1+k_2)^{N_2} \quad (18)$$

$$= \frac{\$0.65}{-4.3478\%}\left[1 - \frac{1}{(1+(-4.3478\%))^3}\right] + \frac{\$0.65}{-1.7857\%}\left[1 - \frac{1}{(1+(-1.7857\%))^3}\right] \div \left(1 + (-4.3478\%)\right)^3 \quad (19)$$

$$+ \left[\frac{\$0.65(1+6\%)}{(10\%-6\%)}\right] \div \left(1 + (-4.3478\%)\right)^3 \div \left(1 + (-1.7857\%)\right)^3 \quad (20)$$

Let PVA (interest rate, number of periods, periodic cash flow) symbolize the present value annuity equation. The generalized version of equation (18) for "J" stages of abnormal growth becomes:

$$\begin{aligned}\text{Stock price} = {} & \text{PVA}(k_1, N_1, D_0) + \text{PVA}(k_2, N_2, D_0 \div (1 + k_1)^{N_1}) + \ldots \\ & + \text{PVA}(k_J, NJ, D_0 \div (1 + k_1)^{N_1} \div (1 + k_2)^{N_2} \div \ldots \div (1 + k_{J-1})^{N_{J-1}}) \\ & + \left[\frac{D_0(1+g)}{(k-g)}\right] \div (1 + k_1)^{N_1} \div (1 + k_2)^{N_2} \div \ldots \div (1 + k_J)^{N_J} \qquad (21)\end{aligned}$$

Using either the present value annuity (see Exhibit 2) or the future value annuity due versions of the generalized algorithm provides a context for programming in Excel, Google Sheets, and other formats within a fintech course or for an advanced assignment within an investments course.

Exhibit 2: Spreadsheet of Three Periods of Abnormal Dividend Growth (4-Stage Stock Pricing)

	A	B	C	D
1	Current dividend:	**$0.65**		
2	G1:	**15.00%**		
3	N1:	**3**		
4	G2:	**12.00%**		
5	N2:	**3**		
6	G3:	**10.00%**		
7	N3:	**3**		
8	Perpetual growth rate (g):	**6.00%**		
9	Discount rate (k):	**10.00%**		
21				
22		**PVA Version:**		
23	K1:	0.9565 = (1 + B9)/(1 + B2)	k1:	-4.3478% = B23 – 1
24	K2:	0.9812 = (1 + B9)/(1 + B4)	k2:	-1.7857% = B24 – 1
25	K3:	1.0000 = (1 + B9)/(1 + B6)	k3:	0.0000% = B25 – 1
26				
27	G1-stage:	$2.1327 =PV(D23,B3,-B1)		
28	G2-stage:	$2.3102 =PV(D24,B5,-B1/B23^B3)		
29	G3-stage:	$2.3159 =PV(D25,B7,-B1/(B23^B3*B24^B5))		
30	Perpetual growth stage:	$20.7755 = (B1*(1 + B8)/(B9 – B8))/(B23^B3*B24^B5*B25^B7)		
31	Stock price:	$27.57 = SUM(B27:B30)		
Values in bold are inputs for the stock price calculation. Excel programming is beneath the associated value in the given spreadsheet cell				

Interactive Process for a Financial Calculator

Although spreadsheet programming may be preferred for a demonstration or an assignment, it may not be preferred for testing. Although "complicated", the spreadsheet example in Exhibits 1 and 2 can be performed on a financial calculator.

The stock price is:

$$\$27.57 = \frac{\$0.65(1+15\%)}{(1+10\%)} + \frac{\$0.65(1+15\%)^2}{(1+10\%)^2} + \frac{\$0.65(1+15\%)^3}{(1+10\%)^3} + \frac{\$0.65(1+15\%)^3(1+12\%)}{(1+10\%)^4} + \frac{\$0.65(1+15\%)^3(1+12\%)^2}{(1+10\%)^5} + \frac{\$0.65(1+15\%)^3(1+12\%)^3}{(1+10\%)^6} + \frac{\$0.65(1+15\%)^3(1+12\%)^3(1+10\%)}{(1+10\%)^7} + \frac{\$0.65(1+15\%)^3(1+12\%)^3(1+10\%)^2}{(1+10\%)^8} + \frac{\$0.65(1+15\%)^3(1+12\%)^3(1+10\%)^3}{(1+10\%)^9} + \frac{\$0.65(1+15\%)^3(1+12\%)^3(1+10\%)^3(1+6\%)}{(1+10\%)^9(10\%-6\%)} \quad (22)$$

To begin the iterative process, define the following variables:

$$K_1 = \frac{(1+k)}{(1+G_1)} = \frac{(1+10\%)}{(1+15\%)} = 0.9565 \quad (23)$$

$$k_1 = K_1 - 1 = -4.3478\% \quad (24)$$

$$K_2 = \frac{(1+k)}{(1+G_2)} = \frac{(1+10\%)}{(1+12\%)} = 0.9812 \quad (25)$$

$$k_2 = K_2 - 1 = -1.7857\% \quad (26)$$

$$K_3 = \frac{(1+k)}{(1+G_3)} = \frac{(1+10\%)}{(1+10\%)} = 1.0000 \quad (27)$$

$$k_3 = K_3 - 1 = 0.0000\% \quad (28)$$

The iterative process starts with a bond pricing structure using k_3 as the yield to maturity, D_0 as the coupon, N_3 as the bond maturity, and $\left[\frac{D_0(1+g)}{(k-g)}\right]$ as the par payment at maturity.

$$\text{Answer 1} = \frac{\$0.65}{0.0000\%}\left[1 - \frac{1}{(1+0.0000\%)^3}\right] + \left[\frac{\$0.65(1+6.00\%)}{(10.00\% - 6.00\%)}\right] \div (1 + 0.0000\%)^3 \quad (29)$$

Note: when the discount rate is zero, the annuity portion of the equation should be adjusted to equal the periodic cash flow multiplied by the number of payments, i.e. $D_0 \times N_3$ or \$0.65 × 3. Spreadsheet functions and financial calculators perform this adjustment automatically for an annuity whenever the discount rate is zero. If the annuity equation is part of a computer program, the coder needs to be aware to make this adjustment as well.

In a financial calculator, set N = 3, I/Y = 100 × k_3 = 0.0000, PMT = -0.65, and FV = $-\left[\frac{\$0.65(1+6.00\%)}{(10.00\% - 6.00\%)}\right]$ = -17.2250. Solving for PV produces "Answer 1" which equals 19.1750. Answer 1 becomes the par payment for the next bond pricing structure based on k_2 as the yield to maturity, D_0 as the coupon and N_2 as the bond maturity.

$$\text{Answer 2} = \frac{\$0.65}{-1.7857\%}\left[1 - \frac{1}{(1+(-1.7857\%))^3}\right] + \left[\frac{19.1750}{(1+(-1.7857\%))^3}\right] \quad (30)$$

In a financial calculator, set N = 3, I/Y = 100 × k_2 = -1.7857, PMT = -0.65, and FV = -19.1750. Solving for PV produces "Answer 2" which equals 22.2618. Answer 2 becomes the par payment for the next bond pricing structure based on k_1 as the yield to maturity, D_0 as the coupon and N_3 as the bond maturity.

$$\text{Stock price} = \frac{\$0.65}{-4.3478\%}\left[1 - \frac{1}{(1+(-4.3478\%))^3}\right] + \left[\frac{22.2618}{(1+(-4.3478\%))^3}\right] \quad (31)$$

In a financial calculator, set N = 3, I/Y = 100 × k_2 = -4.3478, PMT = -0.65, and FV = -22.2618. Solving for PV produces the stock price which equals 27.5703 = \$27.57.

To illustrate the iterative bond pricing process, define BP (k, N, Coupon, Par) as:

$$\text{BP}(k, N, \text{Coupon}, \text{Par}) = \frac{\text{Coupon}}{k}\left[1 - \frac{1}{(1+k)^N}\right] + \frac{\text{Par}}{(1+k)^n} \quad (32)$$

The process for "J " stages of abnormal growth is:

Answer 1 = BP (k_J, N_J, D_0, $\left[\frac{D_0(1+g)}{(k-g)}\right]$)
Answer 2 = BP (k_{J-1}, N_{J-1}, D_0, Answer 1)…
Stock price = Answer J = BP (k_1, N_1, D_0, Answer (J – 1)) (33)

Note: 4 to 6 decimal place accuracy for intermediate calculations is suggested to reduce significant rounding error.

If desired, the method suggested for introducing this technique with the financial calculator is to quiz/assign portions of the technique in steps:

- Have the students calculate values for k_1, k_2, and k_3 and then calculate Answer 1
- Provide k_1, k_2, and Answer 1 and then calculate Answer 2 and the final stock price
- Have the student perform the entire calculation providing intermediate calculation solutions for: k_1, k_2, k_3, Answer 1, Answer 2, and the final stock price
- Have the student try the whole calculation without reporting intermediate steps

In essence, train the student in the technique by purposefully introducing the student to portions of the algorithm before having them compute the algorithm in its entirety.

Conclusion

Based on classroom performance between two semesters, the two-stage stock price formula in equation (7) appears to have some benefits. Expanding on equation (7) generates an algorithm based on future value annuity due or present value annuity structures for N-stage stock pricing. This algorithm is readily implementable in Excel, Google Sheets, and other programming formats for a fintech course or as an advanced assignment for an investments course. However, even in an advanced form, the algorithm can still be performed using a financial calculator if so desired.

Further, although an abnormal growth rate is generally viewed as a growth rate that is above the discount rate, technically, abnormal growth is any growth rate that deviates from the "normal" perpetual growth rate "g." Consequently, problems based on a temporary slow growth period can also be considered. For example, let D_0 = \$0.65, G_1 = 3.00%, N_1 = 3, g = 6.00%, and k = 10.00%. $Z_1 = \frac{(1+3\%)}{(1+10\%)} = 0.9364$ and equation (5) becomes:

$$\text{Stock price} = \$0.65[(0.9364) + (0.9364)^2 + (0.9364)^3] + (0.9364)^3\left[\frac{\$0.65(1+6\%)}{(10\%-6\%)}\right] = \$15.85 \quad (34)$$

By considering both slow and high growth scenarios, multi-stage stock pricing can provide a much greater depth of analysis than what has been traditionally taught in the classroom.

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Bodie, Zvi, Alex Kane, and Alan Marcus. 2018. *Essentials of Investments* (11th ed.). New York: McGraw-Hill.

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APPENDIX

Converting a future value annuity due (FVA-DUE) into a present value annuity (PVA)

$$\text{FVA-DUE} = \frac{\text{CF}}{\text{g}}[(1+\text{g}^{\text{N}})-1](1+\text{g}) \tag{A1}$$

where CF is a constant periodic cash flow

Let $\text{k} = \frac{1}{(1+\text{g})} - 1 < 0$ assuming g > 0

Equivalently, $(1 + \text{k}) = \frac{1}{(1+\text{g})} < 1$ assuming g > 0

Apply some algebra:

$$\text{k} = \frac{1}{(1+\text{g})} - 1 = \frac{1}{(1+\text{g})} - \frac{(1+\text{g})}{(1+\text{g})} = -\frac{\text{g}}{(1+\text{g})} \tag{A2}$$

Take the inverse of equation (A2)

$$\frac{1}{\text{k}} = -\frac{(1+\text{g})}{\text{g}} \tag{A3}$$

Solve for (1 ÷ g)

$$-\frac{1}{(1+\text{g})} \times \frac{1}{\text{k}} = \frac{1}{\text{g}} \tag{A4}$$

Make substitutions into equation (A1) and simplify:

$$-\frac{1}{(1+\text{g})} \times \frac{1}{\text{k}} \times \text{CF}\left[\frac{1}{(1+\text{k})^{\text{N}}} - 1\right](1+\text{g}) \tag{A5}$$

$$-\frac{\text{CF}}{\text{k}}\left[\frac{1}{(1+\text{k})^{\text{N}}} - 1\right] \tag{A6}$$

$$\frac{\text{CF}}{\text{k}}\left[1 - \frac{1}{(1+\text{k})^{\text{N}}}\right] = \text{PVA} \tag{A7}$$

Again, note that if g > 0 in the FVA-DUE equation, then k < 0 in the equivalent PVA equation.

Student Reaction to Online Learning During COVID-19

Kristine Beck and Hsin-Hui Chiu[1]

ABSTRACT

This paper explores student adaptation to online learning as a result of higher education courses moving into distance learning during the COVID-19 pandemic. We conduct surveys of students enrolled in fully asynchronous online Introductory Corporate Finance classes and find that student effort plays a significant role in student perception of online courses. We also find that those studying a lot are happy with online courses and will take more online courses after the pandemic, but others expect to enroll in fewer or the same number of online courses post-pandemic.

Introduction

In mid-March 2020, the U.S. responded to the COVID-19 pandemic by shifting most schooling online; except for essential industries, business also shifted online. The virtual environment created both opportunities and problems for most industries and education. Some research indicates that the COVID-19 pandemic and associated distance learning have impaired students' social emotional development.[2] Prior research shows that the importance of motivational methods based on social capital such as sense of community, connectedness with students, and emotional support cannot be overlooked for student success (Holder et al. 2017). However, it is more difficult to achieve these methods in a virtual learning environment. An earlier study by Grossmann et al. (2014), presents a transatlantic project that requires business school students in different locations to videoconference and solve a real-world finance problem. Although facing some challenges connecting via videoconferencing, this transatlantic project provided students with cross-cultural understanding and enhanced their globalization experience.

Several organizations have conducted research in learning loss due to the pandemic. For example, a recent McKinsey and Company report suggests that students learned only 67 percent of math and 87 percent of reading expected for that grade-level.[3] Although this report is based on assessment of K-12 students, higher education is also subject to learning loss due to the sudden switch into an entirely online mode.

Learning loss is challenging to assess in higher education due to lack of standardized tests and a greater variety of subjects. However, learning experience and satisfaction can be measured, and can provide higher education future direction on offering more or fewer virtual courses. We examine the relationship between student effort and performance as well as student satisfaction with delivery modalities. Since most higher education courses were forced into online learning, we examine student effort and satisfaction by conducting surveys of students enrolled in fully asynchronous online Introductory Corporate Finance classes in the Fall 2020 semester. Of the 610 students enrolled in fully asynchronous sections, 338 completed the survey (55.4% response rate). Based on experience and previous research we expect to find that (1) in general, students

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[2] https://insidesel.com/2020/11/19/the-impact-of-the-covid-19-pandemic-on-student-learning-and-social-emotional-development/

[3] https://www.mckinsey.com/industries/public-and-social-sector/our-insights/covid-19-and-learning-loss-disparities-grow-and-students-need-help#. Statistics are from the October 2020 brief: https://www.curriculumassociates.com/-/media/mainsite/files/i-ready/iready-diagnostic-results-understanding-student-needs-paper-2020.pdf, "Understanding student needs: early results from Fall assessment." The sample is restricted to students who took the i-Ready Diagnostic in their school building to enable a more comparable year-over-year comparison. A historical average is derived for each subject across the fall testing window from the prior three academic years: 2017–2018, 2018–2019, and 2019–2020. This historical average serves as a comparison for the more recent results from the 2020–2021 school year.

prefer face-to-face (FTF) instruction, (2) weaker students will have a stronger preference for FTF courses while better-performing students will value the flexibility of online courses, (3) students will perceive online exams to be less difficult than FTF exams, and (4) students anticipate switching back to FTF and hybrid courses after the COVID-19 pandemic.

Literature Review

The efficacy of online instruction has received considerable attention in the field of education and is of importance as higher education shifted entirely online during the COVID-19 pandemic. Smith Terry (2002) examines a large sample of introductory corporate finance students and finds student performance related to gender, major, prerequisite grades, grade point average (GPA), and whether the course was taken in the summer. Smith Terry also finds that the type of exam used to measure performance is a significant factor. Fendler et al. (2011) examine learning online and in traditional lecture formats and find that learning differences are explained by different learning levels. Their findings suggest that while online students perform similar to in-class students at lower levels of learning, online students underperform at the highest level of learning according to Bloom's taxonomy definitions. Koch and McAdory (2012) examine the performance of a group of undergraduate managerial economics students, where some learn in a conventional classroom format while others learn via different televised modes. Their findings suggest that students who had the chance to interact FTF perform better than those lacking the opportunity to learn in person.

Ferreras-Garcia et al. (2021) compare competencies and learning outcomes in FTF and online learning environments using senior projects in the field of entrepreneurship. They find student competency very high for both learning environments, but those in the FTF environment outperformed online students regarding ethics. The online students also did better utilizing information and communication technology. These findings suggest that difficulty level, subject matter, and non-academic concerns may affect student performance in online and traditional lecture formats. Dutton et al. (2001) find students in online versions of courses perform significantly better than lecture students. Nemetz et al. (2017) show that online students perform as well as FTF students; they find the most important task choice for FTF success is regular class attendance, whereas for online students it is completion of interactive worksheets. They also find that minimizing uncertainty is important to success, along with self-discipline, clarity of instructions, and the virtual presence of an instructor.

However, Bredthauer and Fendler (2016) find that performance in online courses is lower for students with low GPAs and/or significant distractions outside of class. Cox (2018) uses a large sample in an online Introduction to Finance course and finds dropout rates for online classes are more than twice that of students in FTF classes. Anstine and Skidmore (2005) use a small sample of MBA students to examine the FTF and online formats and find that online outcomes are inferior to the traditional format. Other research examines student performance in hybrid/online and FTF courses and finds no significant relationships between course modalities and student final grade (Marquis and Ghosh 2017; Haughton and Kelly 2015; Dellana et al. 2000).

Student effort also matters in course performance. Spivey and McMillan (2014) examine effort and performance using online versus traditional in-person testing procedures. They find a strong positive relationship between student effort and course performance. Johnson et al. (2002) also examine the relationship between performance and effort. Effort is not self-reported, but measured by the number of attempts made and the amount of time spent by students on repeatable computerized quizzes. They find effort positively influences student performance.

Recent literature also includes surveys of student online learning resources and satisfaction. For example, Jamison and Bolliger (2020) suggest that students are dissatisfied with the sense of community and desire more interactive instructors (ones who participate in more discussions and provide timely responses to emails and phone calls). Banerjee and Olsen (2020) examine online learning tools and find, independent of the type of course, low student enthusiasm but a preference for PowerPoint lectures. Homework is ranked second for quantitative classes; in-class discussions are ranked second for qualitative classes.

A separate stream of literature examines student satisfaction and perception of course modalities. Marquis and Ghosh (2017) find students prefer hybrid to either online or FTF courses. According to Young (2002), hybrid courses provide the best of both worlds, offering some of the convenience of fully online courses without the complete loss of FTF contact. Wiechowski and Washburn (2014) find students in hybrid and online classes are more satisfied than those in traditional FTF classes. This study has a large sample, but the analysis is based on course evaluations rather than student performance in the course. Landrum et al. (2020)

conduct a qualitative analysis of how students evaluate their satisfaction with online courses. They suggest that student satisfaction with online courses depends on the convergence of expectations and educational goals. In other words, what students want must be related to what they are receiving from the course.

The influence of students' perceived learning outcomes on student satisfaction is also relevant. Using data from South Korea and India during the COVID-19 pandemic, Baber (2020) finds interaction in the classroom, student motivation, course structure, instructor knowledge, and facilitation positively influence perceived learning outcomes and student satisfaction. Jiang et al. (2021) conduct a study on student satisfaction at Chinese Universities from the IT perspective during the COVID-19 pandemic. They find that Chinese university students' satisfaction with online learning platforms is impacted by their computer self-efficacy and the perceived ease of use and usefulness of the platform. Gopal et al. (2021) conduct a quantitative study during the pandemic and find quality of instructor, course design, prompt feedback, and expectation of students positively impact students' satisfaction.

Other research examines student perception and the reasons behind choosing an online or hybrid course. Based on previous research, students may choose online courses based on expectations of timely graduation, flexibility, or health reasons. In such cases, student effort matters in format preference. Blau et al. (2016) use a sample of undergraduates taking at least one synchronous online or hybrid course. They find positive correlations between student perception of timely graduation and the perceived use of technology, student motivation, and new learning. Blau et al. (2017) compare student preferences for online, hybrid, and FTF courses. They find that those who preferred online expect to graduate faster and are more likely to recommend online or hybrid courses. Student perception of graduation success and institutional commitment were not related to format preference. Beck et al. (2022) examine how students respond to COVID-19 and find most upperclassmen intend to finish their degrees in the online learning environment, which supports the idea that online formats support timely graduation. In Landrum et al.'s (2020) qualitative survey, students mention flexibility and health concerns as reasons to take online courses.

Methodology

Based on previous literature, student effort is highly associated with performance in online courses. Findings also show that convergence of expectations, timely graduation, and a flexible schedule may contribute to students choosing more online courses. Problems generated by the COVID-19 pandemic include both delivery and modality choice. Instructors had very little time to prepare for online delivery, and students were unexpectedly thrust into online learning. We examine two issues: (1) whether student effort is positively related to performance in these just-in-time online courses, and (2) whether students plan to continue taking online courses after the pandemic. Table 1 articulates hypothesized responses and relationships.

Table 1: Hypothesized Relationships Between Survey Responses

Student effort	• Expect positive relationship between self-reported GPA and self-reported hours studying per week • Expect positive relationship between self-reported GPA and expected grade • Expect lower GPA students and those studying fewer hours per week to report would have earned a higher grade in another format • Expect higher GPA students and those studying more hours a week to report that format does not matter with respect to grade • In-class exams are more difficult than online exams
Preferred course format	• Lower GPA students and those studying fewer hours per week will prefer FTF • Lower GPA students and those studying fewer hours per week will take fewer courses online after the pandemic • Lower GPA students and those studying fewer hours per week will wish they could have taken the class in another format • Higher GPA students and those studying more hours a week will adapt well to online courses • Higher GPA students and those studying more hours a week will continue taking online courses after the pandemic

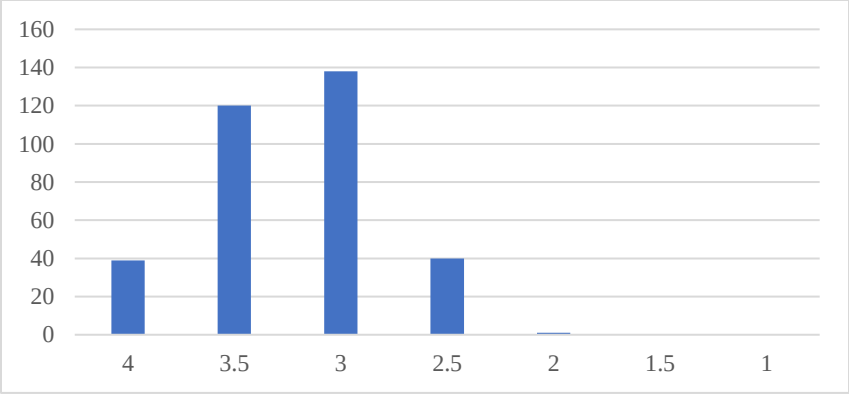
We conduct surveys of students enrolled in fully asynchronous online Introductory Corporate Finance classes at a large public institution in the Fall 2020 semester. The survey consists of ten questions, two demographic and eight regarding student perceptions of course format. One of the format questions is an open-ended request for opinions on course format for Introductory Corporate Finance. The survey was conducted in September and October 2020. Survey data are analyzed using Dunn's test, a nonparametric method of making pairwise comparisons across groups.

Of the 610 students enrolled in asynchronous sections, 338 completed the survey (55.4% response rate). These students are enrolled in five sections across three instructors. There are another 166 students enrolled in a synchronous online section and 210 enrolled in two hybrid asynchronous/synchronous sections. Of the eight online sections, only 120 seats were intended to be fully online prior to the pandemic. The total number of seats is comparable to a typical fall semester; there was no drop in enrollment due to the pandemic.[4]

Results

Demographic survey questions cover self-reported GPA and hours studying per week for asynchronous online Introductory Corporate Finance. Figure 1 illustrates survey results for the first demographic question, in which most students report a GPA of B or higher. This finding, which seems questionable, may be explained by better students responding to the survey or an otherwise unrepresentative sample. Weaker students may choose to take qualitative courses in the online environment, saving quantitative courses until the university returns to teaching in multiple formats. It is also possible that students are overconfident regarding their GPA. Herman and Nelson (2009) find that students with higher GPAs reported their GPA more accurately than those with lower GPAs. Marley and Platau (2017), using a sample of accounting seniors, find a strong correlation between self-reported GPA and actual GPA.

Figure 1: Self-reported Overall GPA



The second demographic question concerns student self-reported time studying per week.[5] Results, shown in Figure 2, indicate that most students, 54.1%, spend three to six hours per week studying for their asynchronous online Introductory Corporate Finance course while 23.1% study less than three hours a week.

Of the students responding to the survey, 54.4% expect to earn an A and 37.0% expect a B in the Introductory Corporate Finance course. This unexpectedly high result could be realistic given lower expectations of instructors for online courses, reflect overconfidence due to cheating, or be due to unrealistic grade expectations. Previous research finds self-reported confidence is highly correlated with final grade (Al-Bahrani et al. 2018). Separately, only 41.1% of respondents believe that exams in traditional lecture classes are more difficult than online exams.

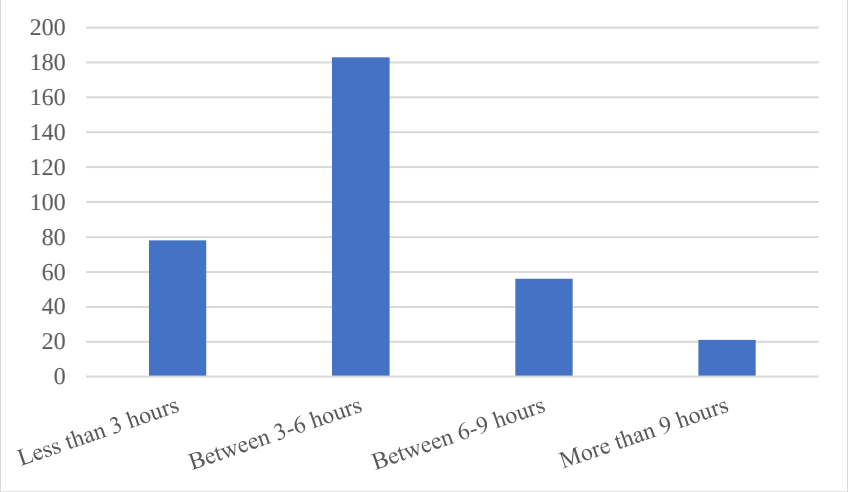
The remainder of the survey questions address student perceptions regarding course format. When asked whether they would have preferred another class format, 55.6% responded they would have preferred to take the course FTF or hybrid FTF/online. 36.7% of students indicate that the course format does not matter. Only

[4] Fall 2020 enrollment at both the college and university levels was 102% of the enrollment target, which was slightly above Fall 2019.

[5] We did not find relevant research on the correlation between self-reported time studying versus actual time studying.

23.1% of surveyed students respond that the online version of the course is worse than they expected, and 31.4% report that online delivery was better than they expected. However, 43.0% expect to take fewer online courses when the pandemic is over. Only 27.3% of the students indicated that they would take more online courses when the university resumes FTF courses. Figure 3 shows the results of the survey question on course format preference. Some students miss step-by-step examples in lecture format (29.0%), but 26.6% say online fits their schedule better, leading to timely graduation.

Figure 2: Self-reported Weekly Study Time for Online Asynchronous Intro. Corporate Finance



Cross tabulation results, shown in Table 2, indicate support of hypotheses is mixed. Using Dunn's test for pairwise comparisons, some subcategories show significant differences. Not surprisingly, we find more hours studying per week positively related to overall grade point average. Specifically, we find a significant relationship between self-reported grade closest to 4.0 and studying between 6-9 hours per week. We also find that those studying a lot (more than nine hours per week) are happy with online courses and will enroll in more after the pandemic, but all others expect to take fewer or the same number of online courses post-pandemic. Similarly, A students will continue to take online courses after the pandemic but B+ students will take FTF courses. B and lower GPA student responses were not significant on this question. Two expected relationships were also not significant: (1) that FTF exams are more difficult, and (2) that students would have preferred to take the course in another format. The latter result may be influenced by students resigning themselves to the COVID-19 environment. We do find that student effort plays a role in preference of delivery format; students who study more than 6 hours per week believe that online courses fit their schedule better.

Table 3 lists a few sample statements from the open question on the student survey. For the most part, students enjoy organized online courses and like to know everything that is required from beginning to end. Setting expectations seems to help students allocate time to do their work and succeed. However, some students indicate traditional face-to-face is better in retaining information. Students also indicate that taking online courses requires more time and effort. Learning from their professors' personal life also adds to the learning experience for some.

Conclusions

Given that students were forced into an entirely online environment during the pandemic, we could not test whether students self-selected into a particular delivery modality. Instead, we focus on student effort, expectations, and satisfaction from taking an online asynchronous course. This study also investigates whether students are interested in taking online courses going forward after the pandemic and the reasons behind taking online courses.

Our results, using a large sample from online asynchronous classes, indicate that student effort plays a key role in course success and satisfaction. There is a strong relationship between student effort and course delivery mode preference. Not surprisingly, more hours studying per week is positively related to reported

overall GPA. Students with higher self-reported GPA indicate they will continue to take online courses while others will not. Those studying a lot (more than 9 hours per week) adapt well to online courses and will continue to take more after the pandemic. Students who put in fewer hours of study expect to take traditional lecture classes after the pandemic compared to those studying more hours per week, who believe that online fits their schedule better.

Although this survey gives a current assessment of student response to being forced into fully online courses unexpectedly, future research could address student perceptions and satisfaction pre- and post-pandemic. Future research could also shed further light on whether there is a sample selection issue, e.g., better students responding at a higher rate. After the pandemic is over, it will be interesting to examine whether students self-select into course modalities due to actual GPA, expectation of studying time, or personal schedule. Future research could also complement current research by categorizing whether graduating seniors have different preferences and whether there are differences in preferences across gender and academic major.

Figure 3: Reason for Course Format Preference

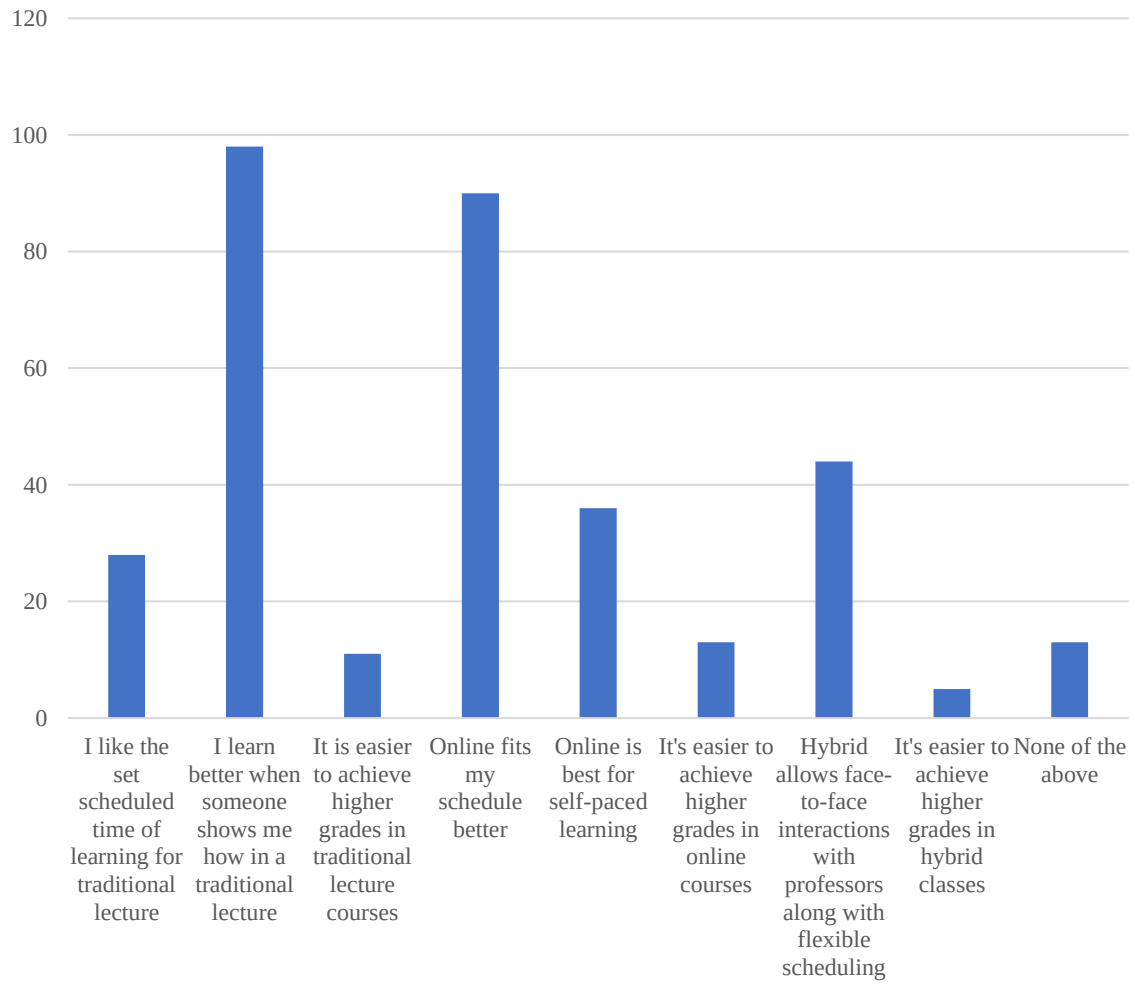


Table 2: Cross Tabulation Results (Subcategory Significance Based on Dunn's Test)

Survey Question	Self-reported overall GPA	Weekly Hours Studying
How much time per week are you currently spending on studying for this class?	• 33% of A students study between 6-9 hours per week, significantly higher than B+ and B students	
Is the online version of this course {better than, worse than, the same as} you expected?	Not significant	• 48% of those studying more than 9 hours a week believe the online version is better than they expected, significantly higher than those studying less than 3 hours per week
Will you take {more, fewer, the same number of} online courses when the pandemic is over?	• 44% of A students expect to take the same number of online courses when the pandemic is over, significantly higher than B+ students; • 49% of B+ students expect to take fewer online courses when the pandemic is over, significantly higher than A students	• 43% of those studying more than 9 hours per week expect to take more online courses, significantly higher than those studying less than 3 hours per week; • 49% of those studying between 3-6 hours per week expect to take fewer online courses, significantly higher than those studying between 6-9 hours per week; • Both those studying < 3 hours per week and those studying 6-9 hours expect to take the same number of online courses, significantly higher than those studying between 3-6 hours per week
What grade do you expect to earn in this class?	• Significantly higher than other students: 90% of A students, 65% of B+ students, and 46% of B students expect to earn an A in the course; • 45% of B students expect to earn a B; 25% of C+ students expect to earn a C	• Both those studying 6-9 hours per week (64%) and those studying > 9 hours a week (76%) expect an A in the course, significantly higher than those studying < 6 hours; 44% those studying < 3 hours a week expect a B
Do you think you would have earned a higher grade in another classroom format?	Not significant	• 45% of those studying 6-9 hours a week say the class format does not matter with regard to grade, significantly higher than those studying < 3 hours
Do you believe in-class exams are more difficult than online exams?	Not significant	Not significant
Do you wish you could have taken this course in a different teaching format?	Not significant	Not significant
Select the main reason for your course format preference (traditional lecture, online, or hybrid lecture/online)	Not significant	• Both those studying 6-9 hours per week (36%) and those studying > 9 hours a week (43%) believe online fits their schedule better, significantly higher than those studying < 3 hours per week

Table 3: Sample Qualitative Statements from Survey

Sample statements
This fully online course has been a great experience. It does require that you focus, and allocate the appropriate time to do the work, but it's not impossible to succeed in this format.
I like being aware of everything that is required of me to do in the class from the beginning to the end.
In class, the experience is totally different than online. I believe I retain information if I'm attending the class rather than going through the lecture online.
It is immensely difficult to learn online by myself, and it takes more time and efforts (sic).
Love the class and the effort being put in, however with learning I need to be in an actual school environment with a professor, not at home on my bed.
Traditional classes are much better because it is easier to learn and retain the information. The whole format of online classes results in a reduced quality of education. I know we can't do much about it but I'm just giving my two cents.
Having the ability to re-watch the lectures gives me (and other students) the advantage of note taking at our own pace without being in a rush.
I also like learning from the professors (sic) personal life which most of the time adds to the learning experience.
As long as it's organized well, and everything is nicely planned out and communicated to students (like this course right now), I do just fine learning and studying everything on my own.

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Options Trading Strategies with Bloomberg: A Practical Guide for the Undergraduate Classroom

Scott Mackey, Michael Melton, and Lucas Watt[1]

ABSTRACT

Today more business schools are investing in Bloomberg terminals to provide an experiential learning environment designed to better prepare students for industry. This paper illustrates how Bloomberg terminals can be incorporated in today's financial derivatives curriculum resulting in a merger between theory and practice. Through the illustration of six options trading strategies and the functionality of the Bloomberg System, both instructors and students will have a better comprehension of the uses and benefits of this system in the classroom today. In doing so, students will be better prepared for future careers in the finance industry.

Introduction

The purpose of this paper is to demonstrate the usefulness of the Bloomberg Professional Service, i.e., the Bloomberg terminal, in the classroom for teaching the basics of options trading strategies. In over ten years of teaching undergraduate students options trading strategies, we have found that students learn more effectively and feel more engaged by using real options data and trading tools that are used by professional options traders. The Bloomberg terminal is foremost a system designed for professional traders, sitting on the desks of 325,000 of the world's most influential decision makers.[2] However, its functionality is not necessarily designed with teaching students in mind. This methodology provided in this paper helps instructors use the Bloomberg terminal to engage students and create deeper learning of options trading strategies. We hope that other instructors will use the detailed examples in this paper to help them utilize the Bloomberg terminal to more effectively teach their students the basics of options trading strategies. We also suggest that this paper could be both used as a student supplement and as a basis for practical assignments. For example, instructors may have students first create (or export directly from the Bloomberg terminal) Excel worksheets of each of the six options strategies, calculate the key strategy measures, and keep track of them over time. Thus, instructors could use the assignment as a basis for introducing more advanced topics such as nonlinearities and the Greeks for managing real portfolios of options.

The rest of the paper is organized as follows: In the next section we provide a brief review of literature focusing on the importance of experiential learning in academia today, as well as how the Bloomberg system has played a role in this. The third section of this paper introduces the methodology and learning outcomes with a summary of key options analysis functions in Bloomberg. The fourth section incorporates Bloomberg functions within examples of six major option trading strategies – Straddle, Strangle, Bull spread using Calls, Bear spread using Puts, Covered Call, and Protective Put. Finally, the last section concludes the paper.

Review of Literature

One of the first recorded arguments for experiential learning came from John Dewey (1916) who stressed the need for curricula to accommodate activity-based learning – theorizing that "learning means something which the individual *does* when he or she studies." Later researchers like O'Brien and Hart (1999) called it

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[2] Bloomberg Professional Services, https://www.bloomberg.com/professional/solution/bloomberg-terminal/.

"Action Learning," while others like Tuluca and Zwick (2016) have called it "Hands-on Learning." Yet others such as Hodge et al. (2011) used the term "Practice-Based Learning." Regardless of label, Payne and Tanner (2011) concluded that, through experiential learning, instructors can not only teach students the tools they need for success, but that the use of those tools enhances their understanding of the finance principles that they are learning.

Exposure to real-world data and analysis software enhances students' marketable skills. Payne and Tanner (2011) state that employers desire to hire students with strong skills in the tools that enhance their ability to do their job. Research by Moffit et al. (2010) concluded that a stock market simulation is an effective pedagogical tool. Melton and Mackey (2010) build on this concept through the introduction of a course dedicated solely to the management of real dollars, in real-time, in an industry-replicated environment, rather than a simulation.

Not until Coe (2007) was Bloomberg discussed as a tool for experiential learning. He was the first to introduce the Bloomberg Professional System and to identify potential applications for illustrating the financial data available compared to the reference materials in a university's library holdings. He concluded that although it was perceived to be expensive, the Bloomberg system proved to be a more cost-effective and convenient alternative to those library resources. In a subsequent paper, Scott (2010) illustrates how finance professors can add Bloomberg's Global Product Certification Program into their curricula, enhancing students' resumes with usable skills that transfer to industry after graduation. At this point, research focused more on the Bloomberg terminal's attributes, such as real-time data, without a direct connection to various classes in the finance curriculum.

Lei and Li (2012) bridged this gap by showing how to use the information available through the Bloomberg terminal to prepare an analyst report in an equity-focused security analysis and portfolio management course. Lei and Li (2012) identify and illustrate the key Bloomberg functions, enabling students to not just know where to find each, but to better understand their applicability. Kazemi (2015) expanded on this research to introduce a way of using the Bloomberg terminal's technology to teach economics and finance in a variety of lower and upper level undergraduate and graduate courses. In doing so, Kazemi (2015) illustrates how Bloomberg, when used to complement traditional methods of teaching, provides instructors the opportunity to cover more complex topics in a significantly greater degree of depth. Keys (2016) extended earlier research by providing finance departments with a guide to incorporating trading lab resources throughout the entire curriculum, particularly into Corporate Finance. Additionally, the author was the first to strategize and map the usefulness of Bloomberg within a Finance curriculum. Gehy and Smith (2016) cited the reasons for the underutilization of Bloomberg terminals in academia, including the large amount of time and effort required to learn the software and the availability of free Internet-based or lower-cost data sources. To counter this, the authors outline an assigned stock analysis report that combines both the quantitative and qualitative aspects of financial analysis. In doing so, they outline the ability to assess learning goals, as defined by the Association to Advance Collegiate Schools of Business (AACSB), to focus on student knowledge, technical competence, and effective communication skills.

Some studies provide more specific recommendations for implementing Bloomberg terminals in the classroom. With regards to adopting the usage of Bloomberg terminals in corporate finance courses, Schmutz (2017) introduced assignments for various topics in the introductory level corporate finance course. At any level, intro or advanced, Li and Wang (2017) provided detailed illustrations to present a comprehensive review of how faculty can use Bloomberg to enhance their teaching on a wide range of essential corporate finance topics. Additionally, Tuluca and Zwick (2016) demonstrate the use of the Bloomberg terminal in a Financial Markets and Institutions course by analyzing the relationship between the yield curve and monetary policy. Through the introduction of the Bloomberg exercise, and analysis with the outlined objectives, the authors used this research as a starting point in considering how to incorporate the Bloomberg terminals in other classes. Finally, Annabi (2019) provides a broad outline of assignments for teaching derivatives using Bloomberg, referencing tutorials on "how to" using the Bloomberg User Manual. More importantly, her research provides survey results indicating the growth and success in learning outcomes derived from the use of Bloomberg terminals.

Methodology

Much of the previous literature focused on the usage of Bloomberg terminals in a variety of courses with no direct mention of the application to an undergraduate derivatives course or the trading of options. In this

paper we follow the most widely used undergraduate derivatives text by Hull (2017) and his presentation of options trading strategies in Chapter 11 – Trading Strategies Involving Options. As noted by Hull, strategies for European options are presented first but may be extended American options with the understanding that linear payoff diagrams assume that the positions are held to maturity and that American options will be more expensive. We combine the presentation in Hull with live options prices on Bloomberg as well as highlight the great flexibility provided on the Bloomberg system to vary each parameter and perform a wide range of scenario analysis.

Our focus is first and foremost on getting students to understand when and why each option strategy should be considered, including up-front cost and break-even points. We have found that the options strategies that students most intuitively grasp are the Straddle, followed by the Strangle combination strategies. We therefore present these first. We follow these strategies with two common spread strategies, the Bull and Bear Spread, and then present two of the most common strategies of owning the underlying stock plus a position in a single option, the Covered Call and the Protective Put. This is the reverse of the way that these strategies are presented by Hull; however, we have found that students most easily understand the Straddle strategy as a starting point. Furthermore, we have found that understanding these six basic variations of options strategies is critical before more advanced topics are presented. All too often we have found that failure to achieve these basic topics only compounds student frustration as advanced topics are introduced. Finally, our experience has shown that mastering these six variations of options strategies allows students to more easily grasp more complex strategies.

In order to define clear learning objectives, students must understand the reasoning behind when a specific option trading strategy is appropriate and why that option trading strategy should be considered. In order to do so, they are required to describe each option trading strategy in terms of:

1. What is the purpose of each strategy, i.e., under what expectations would it be appropriate?
2. What is the up-front cost of the position?
3. What are the break-even points, areas of loss, and areas of profit?
4. What percentage price movement (from the Spot price) is required to reach each area described above?

Now, assuming that students have a basic familiarity with Bloomberg, the instructor should take time to relate the questions listed above with the steps to be followed below to show how each option can be seen in Bloomberg.

1. Look at live option prices using OMON (Option Monitor).
2. Use OVME L (Option Valuation Monitor Equity) to create each strategy (the "L" indicates listed options).
3. Look at the strategy graphically. Find the break-even points, etc.
4. Run a scenario analysis using historical data.
5. Connect to how option traders "actually" trade – they tend to buy/sell each position successively (roll it) rather than exercising a position and taking delivery or selling the underlying.
6. However, it is important to connect that the value from each position, such as a Straddle, is derived from the value of being able to exercise the position and receive the payoff.
7. Be sure to emphasize how fixing a parameter (in amber) in OVME such as strike then sets all other values, which Bloomberg calculates automatically.

We summarize the key options analysis functions available on Bloomberg in Exhibit 1. We have also added notes and an example for each of the major functions. Our examples use Apple's common stock, symbol AAPL.

Briefly, to enhance users' grasp of the Bloomberg terminal, we describe each of the functions listed in Exhibit 1, then we show how to use them to create each of the options trading strategies:

OMON: Option Monitor. This function provides live options prices for the security of interest. All of our examples use the common stock of Apple, symbol AAPL.

OVME L: Option Valuation Monitor Equity Listed. We add the command "L" to use listed options prices. This is where students will create their options trading strategies, as shown in the following sections. We note some common functions that may be helpful for this.

OSA: Option Scenario Analysis. This is where students can save their strategies as "Deals" and can track the performance of their strategies over time, including Profit & Loss (P&L).

Exhibit 1: Key Bloomberg Options Analysis Functions

Initial Option Evaluation		
OMON	Option Monitor	Ex: AAPL Equity OMON [GO]
OMON will allow evaluation of option premiums by option type, strike, and expiration to find the optimal contracts for each strategy.		
Evaluating and Creating Positions		
OVME L	Option Valuation Monitor Equity Listed	Ex: AAPL EQUITY OVME L [GO]
HIVG	Historic Volatility Graph	Ex: AAPL EQUITY HIVG [GO]
MOSO	Most Active Options	Ex: AAPL EQUITY MOSO [GO]
OVME L is the key to creating strategies; the "L" specifies to use Listed Options prices. Select Products from the red bar, then click "browse all" to see all available options strategies. The Actions Tab allows you to save or load strategies previously created.		
Creating a Portfolio		
OSA	Options Scenario Analysis	Ex: OSA [GO]
*OSA is where students can upload strategies saved as "Deals" in OVME. Students can track performance and analyze their P&L during real-time events in the market.		

*Once in OSA, users can right click on their saved strategies and click on OVME to revert back to the original pricing screen.

The following steps summarize the general process we follow in creating each option trading strategy:

1. Create a Portfolio to save strategies using OSA.
2. View live options prices using OMON. Exhibit 1 lists other helpful functions such as Historic Volatility Graph (HIVG).
3. Evaluate options trading strategies using OVME L. Back-test each strategy if desired.
4. Save each strategy as "Deals" and add to Portfolio for future reference.

In the next section we summarize the information for the six basic options trading strategies we cover.

Bloomberg Examples as Applied to Six Major Option Strategies

As stated earlier, this section incorporates Bloomberg functions within examples of six major option trading strategies – Straddle, Strangle, Bull spread using Calls, Bear spread using Puts, Covered Call, and Protective Put.

Basic Options Trading Strategies

The examples of each trading strategy using Bloomberg should connect these "formulas" so that students gain the intuition behind each strategy by practice with live option prices. Specifically, our focus is on the intuitive connection between live option prices and the key areas that students must understand for each options trading strategy. We follow the assumptions and notation presented by Hull (2017) in Chapter 11 – Trading Strategies Involving Options. For example, we assume that the underlying asset is a stock (Apple common stock in our examples) and that the payoff from the various trading strategies are the difference between the final payoff and the up-front cost without discounting. In addition, we do not consider margin requirements.

The information for the six basic options trading strategies we present in this paper are summarized in Exhibit 2. This should be helpful to instructors and students for understanding the basic strategies and how to calculate the various key strategy points.

It is important to note that Bloomberg uses the sign convention where all costs (buy positions) are treated as positive values and sell positions are treated as negative values. All formulas in Exhibit 2 and our examples reflect this sign convention, except where noted for explanatory calculations for the Bull and Bear spread strategies.

In the next section we begin with a detailed example using the straddle combination strategy.

Exhibit 2: Summary of Basic Options Trading Strategies

Strategy Type	Description	Net Premium (NP; Up-Front Cost)	Key Strategy Points		
Combinations					
Straddle	Buy a Call and a Put with the same strike, K, and expiration.	Net Premium = $C + P$	BE_1 = K - NP	BE_2 = K + NP	
Strangle	Buy a Call with higher Strike, K_2, buy a Put with lower Strike, K_1; same expiration.	Net Premium = $C + P$	BE_1 = K_1 - NP	BE_2 = K_2 + NP	
Spreads					
Bull spread	Buy a Call with a lower Strike, K_1, Sell a Call with higher Strike, K_2; same expiration.	Net Premium = $C_1 + C_2$	Max Profit = K_2 - K_1 - NP	BE = K_1 + NP	Max Loss = -NP
Bear spread	Buy a Put with higher Strike, K_2, Sell a Put with lower Strike, K_1; same expiration.	Net Premium = $P_1 + P_2$	Max Profit = K_2 - K_1 - NP	BE = K_2 - NP	Max Loss = -NP
Positions in stock and option					
Covered Call	Buy underlying Stock, S_0, Sell a Call on same underlying stock.	Up-front Cost = $S_0 + C$	Max Profit = $K - S_0 - C$	BE = $S_0 + C$	Negative Profit < $S_0 + C$
Protective Put	Buy underlying stock, S_0, Buy a Put on same underlying stock.	Up-front Cost = $S_0 + P$	Max Loss = $K - S_0 - P$	BE = $S_0 + P$	Positive Profit > $S_0 + P$

Creating Portfolios for Strategies

Before creating a strategy, we have found it helpful to create a portfolio specifically for the strategy by:

1. Type OSA into the Bloomberg Command Line.
2. Click Actions and select New Portfolio.
3. Assign the Portfolio a name - we name our Straddle strategy as, "AAPL 5/21/2020 STRADDLE".
4. Next click Save. This makes adding the strategy into a portfolio much easier later on.

Next, we begin our strategy analysis by accessing live options prices for Apple common stock (AAPL) using the Options Monitor function (OMON) in Bloomberg.

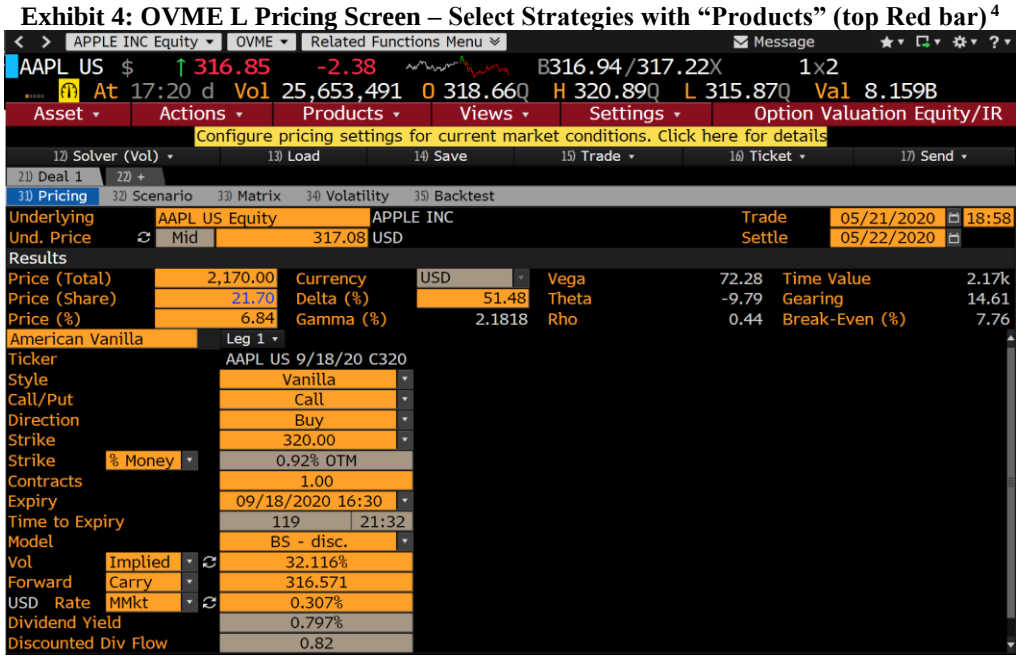
Evaluating Live Options Prices using Options Monitor: OMON

Find the desired security, in this case AAPL, and go to its option chain following the directions in Exhibit 1; for example, AAPL Equity OMON [GO]. Exhibit 3 depicts the screenshot for live AAPL options as of 5/21/20. This screen depicts live option premiums compared to the different expiration dates. All of the fields highlighted in amber represent parameters that may be varied by the user. For example, to change the number of strike prices listed for each expiration date simply use the amber drop-down menu under "Strike" to increase or decrease the range of strike prices. In Exhibit 3, we have changed the "Strike" parameter from the default value of 5 to 7 for 9/18/20 expiration Calls and Puts.

We suggest that the OMON screen is a helpful place for instructors to show how option prices reflect expectations and that prices vary by the three main determinants of options prices: 1) intrinsic value, 2) time value, and 3) volatility. The Historic Volatility Graph function (Ex: AAPL EQUITY HIVG [GO]) can also be helpful here. Analyze these prices, because they do not automatically fill into OVME where each strategy is created. Once the desired Strike price and expiration date are determined, type "OVME L" into the command bar. The screen will load strategies for the underlying security. The underlying security can be changed anytime by typing the ticker into the Underlying field in OVME L at the top of the page. The screen should look similar to Exhibit 4.

Exhibit 3: AAPL EQUITY OMON [GO] - DATA FROM 5/21/2020[3]

Exhibit 4: OVME L Pricing Screen – Select Strategies with "Products" (top Red bar)[4]



To view a full list of the available Options Strategies, click on "Products" (red bar), then go to "browse all" towards the bottom of the drop-down menu. Then, click on "Options Strategies." For the detailed example, we first analyze the Straddle; however, all of the strategies can be located in the way described above. For example, students will also find the Strangle, Call/Put spread which is used to create the Bull and Bear spreads, and the Buy Write strategy for the Covered Call and Protective Put. The drop-down bar provides detailed descriptions of each strategy.

[3] All exhibits are sourced from Bloomberg Professional.

[4] The message highlighted in yellow, "Configure pricing settings…" at the top of ***all*** exhibits denotes a new choice from Bloomberg to change market pricing configurations to account for current market conditions that have recently resulted in negative options prices amidst heightened volatility.

The cost for each "Leg" may be seen on the "Pricing" screen by scrolling down to the rows labeled "Leg Prc (Total)" and "Leg Prc (Share)." These are the prices for each leg on a total (100 shares) and per share basis. This information is used to help calculate the key strategy points. The "Scenario (32)" tab shows the strategy graphically. The plots may be annotated and edited.

It is also important to note that the option premiums in OVME will differ from the live prices (OMON) because the information remains static for OVME. However, the prices can be updated with the refresh button next to "Leg Price." In the next section, we begin with a detailed example using the Straddle combination strategy.

Creating a Straddle Strategy using OVME L

We present a detailed example with the Straddle combination strategy. A Straddle is a combination strategy that involves taking a position in both a Call and a Put with the same strike price, *K*, and the same maturity on the same underlying asset (refer to Exhibit 2). A Straddle position is appropriate when the investor is expecting large price movements in the underlying stock but is unsure of the direction, e.g. during periods of high expected volatility. Typically, in a Straddle, options with strike price near to the current Spot price are chosen; thus, the resulting break-even points "straddle" the current Spot price. The investor hopes the stock price will move significantly, but is unsure of the direction. If the stock price remains close to the strike price, then the strategy leads to a loss. The cost of creating a Straddle is typically high because the cost of At-the-Money (ATM, or near to) options is relatively high. Therefore, large changes in the underlying stock price are necessary for a typical Straddle strategy to be profitable.

We follow the process described above to create a Straddle position for AAPL. Both the Pricing and Scenario screens are shown below in Exhibit 5 and Exhibit 6, including screenshots of the price (Call and Put premium) of each "Leg" of the Straddle. For our example Straddle, we chose a 09/18/2020 Call and Put with a strike price of 320.00 when the Spot price of AAPL was 317.08 (shown as the "Mid" price between the Bid and Ask). We note that the Call is 0.92% Out-of-the-Money (OTM) and the Put is 0.92% In-the-Money (ITM). The up-front cost (Net Premium), break-even points, areas of loss and profit, and percentage changes in the Spot price are discussed below. We also note that Bloomberg options prices are quoted to four significant figures; however, for simplicity, we have rounded them to two significant figures in all our examples.

Exhibit 5: Pricing and Scenario Screens for Straddle

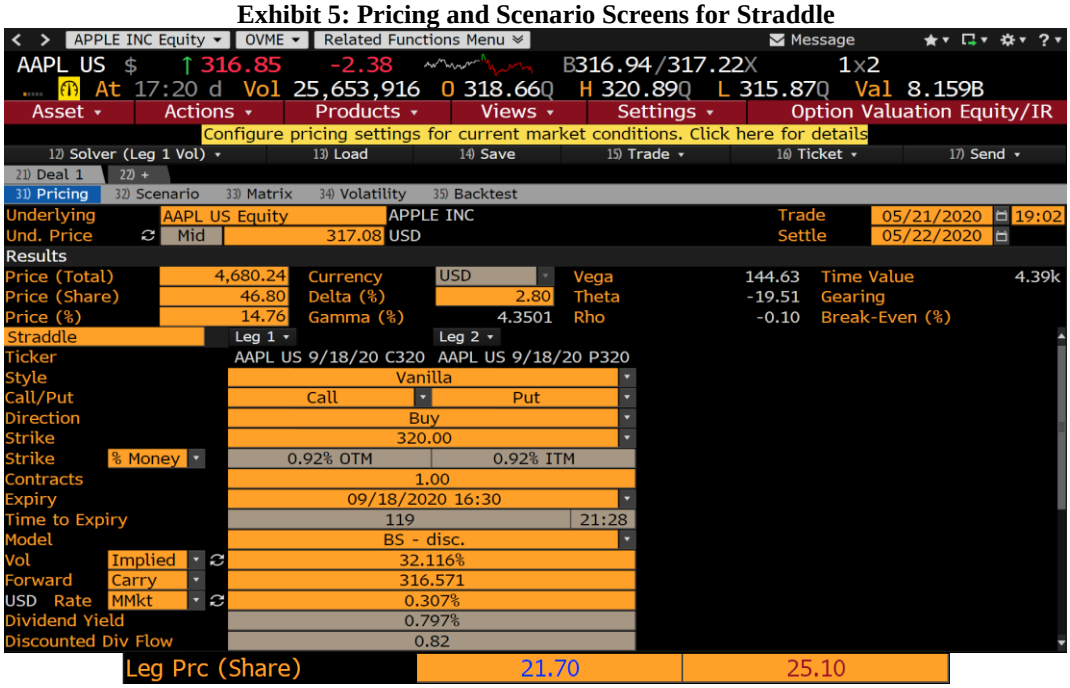
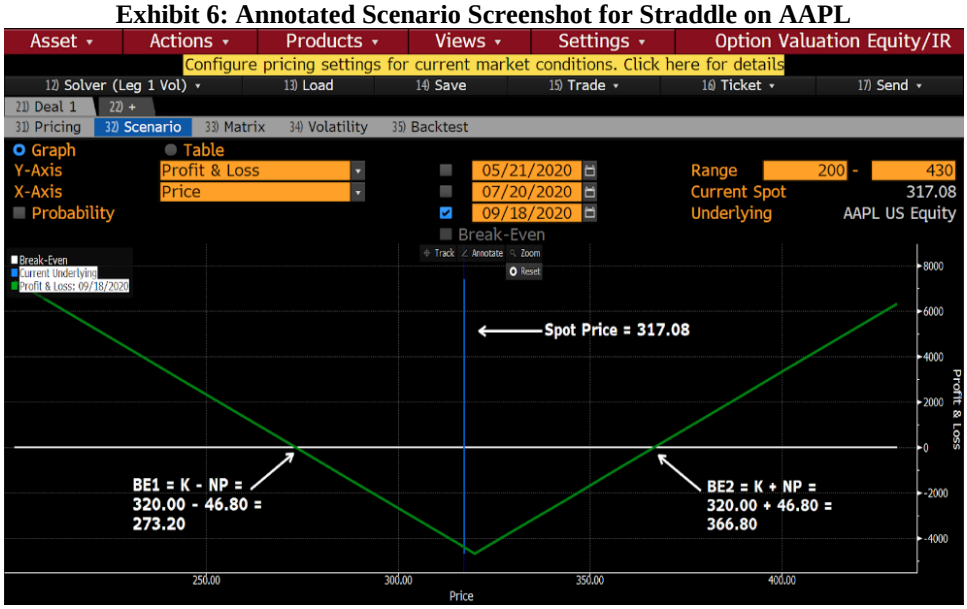


Exhibit 6: Annotated Scenario Screenshot for Straddle on AAPL



We summarize the key strategy variables and points for the Straddle below in Exhibit 7.

Exhibit 7: Straddle Summary Calculations

S_0	C	P	K	Net Premium, NP (Up-Front Cost)	BE_1 (BE_1%)	BE_2 (BE_2%)
317.08	21.70	25.10	320.00	46.80	273.20 (-13.84%)	366.80 (15.68%)
Spot	Call Price	Put Price	Strike	= C + P	= K - NP	= K + NP

The summary calculations shown in Exhibit 7 are detailed below:
The Net Premium (NP) is the total up-front cost of creating the Straddle (the Call and Put premiums). Students will note that this up-front cost is high: Net Premium (NP) = 21.70 + 25.10 = 46.80
The two Break-Even (BE) points are (these are the two points that "straddle" the current Spot price):
BE_1 = Strike Price - Net Premium = 320.00 – 46.80 = 273.20
BE_2 = Strike Price + Net Premium = 320.00 + 46.80 = 366.80
As a percentage of the current Spot price both BE points are:
BE_1% = 273.20/317.08 – 1 = -13.84%
BE_2% = 366.80/317.08 – 1 = 15.68%

This shows that for the Straddle to break-even, Apple's stock price must either increase by 15.7% or decrease by -13.8%. If the stock price does not change by at least these percentages, then the Straddle will result in a loss (the triangular area shown in Exhibit 6) because the value of the Straddle will be less than the cost of creating it. This helps students gain an understanding of the magnitude of price movements required for the Straddle position to become profitable and to connect the concept that options prices incorporate expectations about future price movements. As we will see later using the example of the Strangle, which is similar to the Straddle, the up-front cost of the Strangle is lower, but larger price movements in the underlying stock are generally required in order for the strategy to be profitable. Before moving on to the next strategy, we first highlight the ability to back-test strategies using historical time periods.

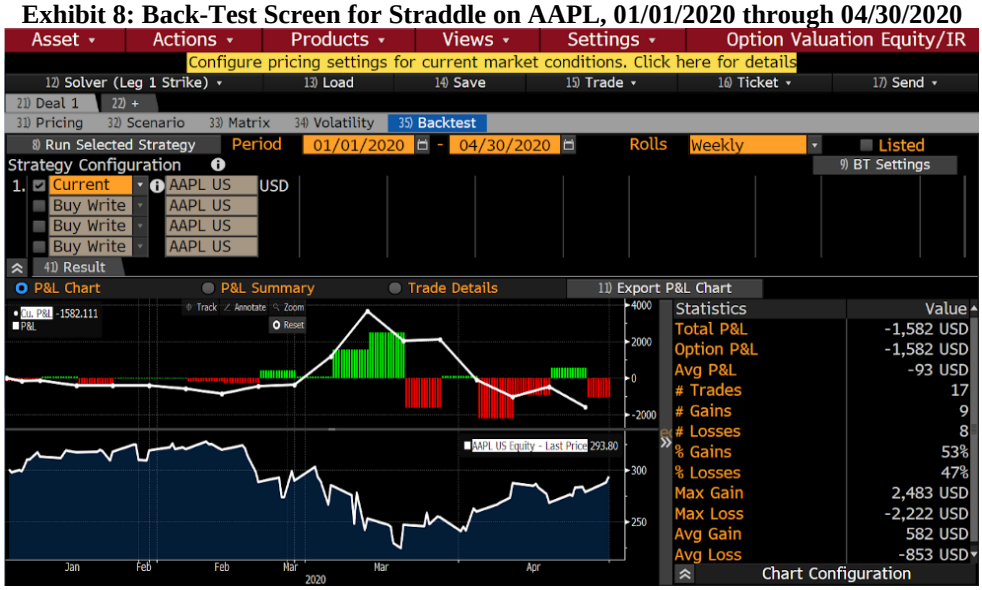
Back-Test (35)

A variety of functions are also available, including: Matrix (33), Volatility (34), and Backtest (35). We suggest using the Backtest function to back-test each position over a variety of historical scenarios. We chose to run the Backtest function over the time period of January 1, 2020 through April 30, 2020, during which

markets experienced extremes in volatility. We note that the Profit & Loss values generated by Bloomberg are for successively rolling (entering and exiting) the Straddle position on a weekly basis for the entire time period; the frequency of the Roll may be varied by adjusting the amber field labeled "Roll." This gives students a view to how many options traders "actually" trade, e.g. traders will sell their options rather than exercise them. We suggest that it is important to point out that the value of the position is fundamentally linked to the ability to exercise the position.

With the Roll frequency set to weekly, next click Run Selected Strategy to the left of the screen as shown below in Exhibit 8.

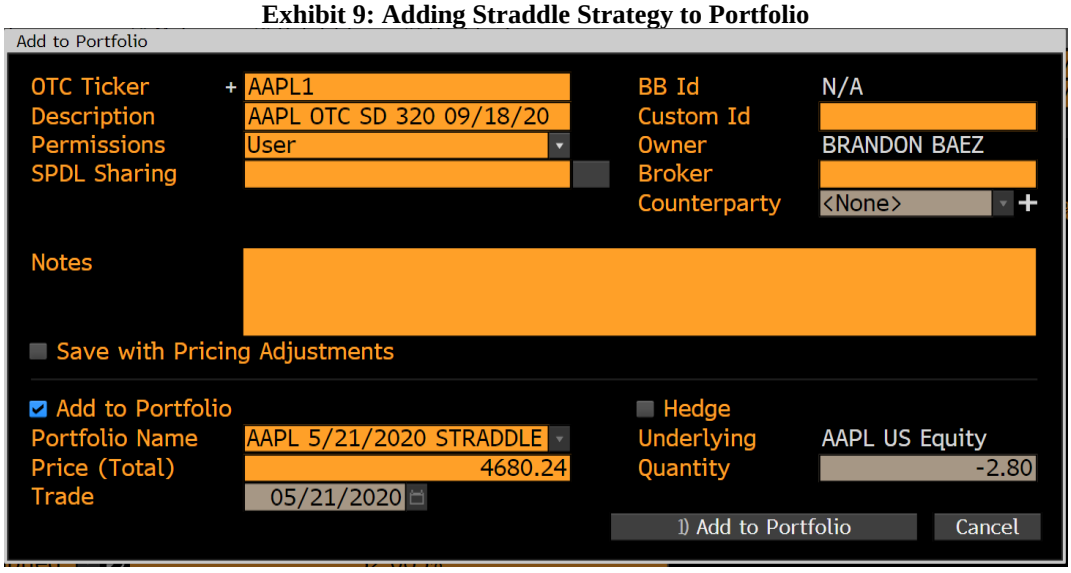
Exhibit 8: Back-Test Screen for Straddle on AAPL, 01/01/2020 through 04/30/2020



As shown above, the P&L (Profit & Loss) is depicted graphically, but clicking through "P&L Summary" will show the monetary performance for each entry and exit. The "Trade Details" view shows each transaction detail.

To save the Straddle position, click on the "Actions tab" (in red), then click "Save Deal As." To add this Straddle to the Portfolio, simply click "add to portfolio" and select the Straddle Portfolio from the OSA function and click "add to portfolio." The pricing adjustments box simply brings in real-time data, but for our purposes we can leave it blank; this is shown below in Exhibit 9.

Exhibit 9: Adding Straddle Strategy to Portfolio

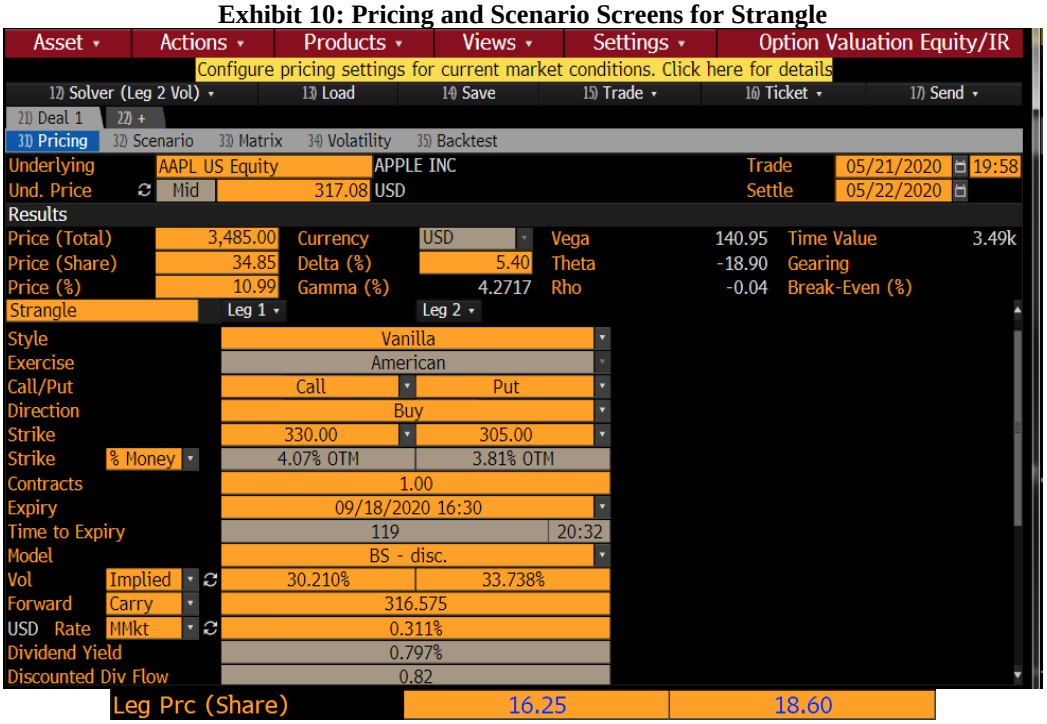


To view the Straddle strategy in the Portfolio, simply search OSA. Click on Actions, then open Portfolio. The most recent Portfolios will be there. Simply select the correct Portfolio and the saved strategy will appear. Using the Bloomberg terminal makes creating and experimenting with options trading strategies very simple. The general steps described above for the Straddle may be used to easily create the remainder of the basic strategies. The only change the user will need to make is during the actual strategy manipulation in OVME.

Creating a Strangle Strategy using OVME L

A Strangle strategy is a combination strategy that involves purchasing a Put and a Call with the same expiration date but different strike prices. The Call strike price, K_2, is higher than the Put strike price, K_1. Similar to a Straddle, a Strangle position is appropriate when the investor expects large price movements of the underlying stock, but is unsure of the direction of the price changes. However, with a Strangle, the up-front cost of creating the position is lower, but the tradeoff is that larger price movements must occur for a Strangle to be profitable than for a Straddle. Also, the downside risk if the stock price ends up not moving much is less with a Strangle because the up-front cost of a Strangle is generally lower than for a Straddle. The profit pattern depends on how close together the strike prices are. The farther apart they are, the less the downside risk and the farther the stock price has to move for a profit to be realized. We follow the process described above to create a Strangle position for AAPL. Both the Pricing and Scenario screens are shown below in Exhibit 10 and Exhibit 11, including screenshots of the price (Call and Put premium) of each "Leg" of the Strangle.

Exhibit 10: Pricing and Scenario Screens for Strangle



We can see this relationship graphically in Exhibit 11 and in the summary calculations in Exhibit 12. The up-front cost of the Strangle is 34.85, as opposed to 46.80 for the Straddle. The Spot price is 317.08, so we chose to buy a Put with a Strike price of 305.00 and a Call with a Strike price of 330.00. Our break-even points show that slightly larger stock price movements are required for the Strangle to be profitable as compared to our Straddle example. Our Strangle uses options that are approximately 4% Out-of-the-money (OTM). If we chose options with a narrower range of Strike prices, the up-front cost of the position would increase. We next examine two basic spread strategies, the Bull spread using Calls, and the Bear spread using Puts.

Exhibit 11: Annotated Scenario Screenshot for Strangle on AAPL

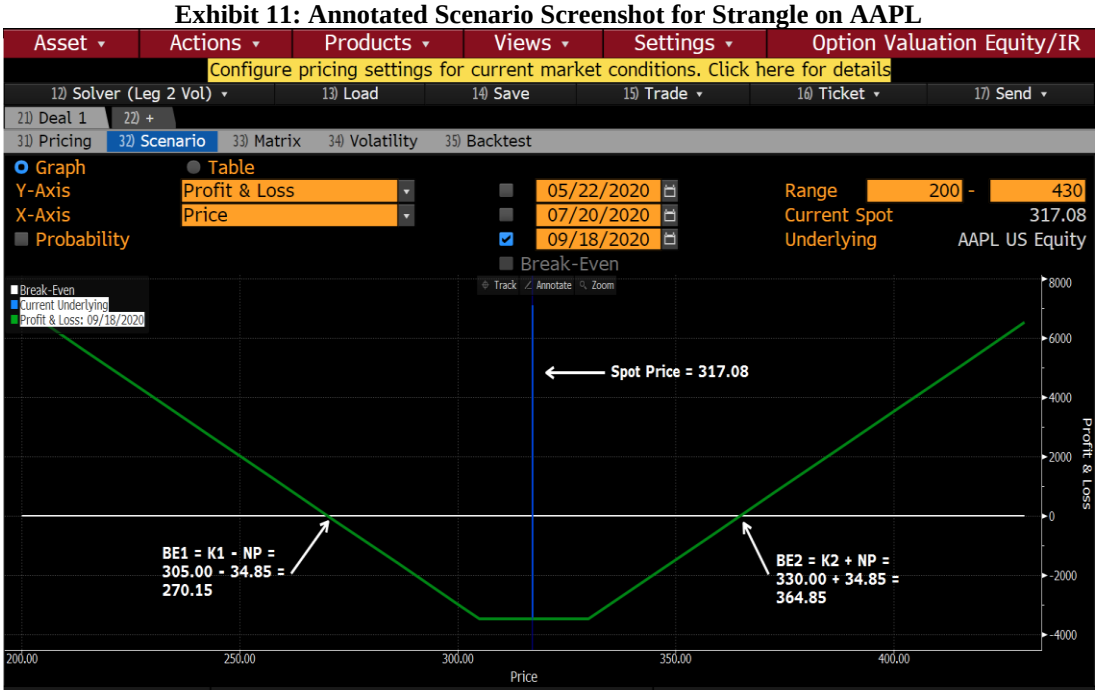


Exhibit 12: Strangle Summary Calculations

S_0	C	P	K_1 (Put)	K_2 (Call)	Net Premium, NP (Up-Front Cost)	BE_1 (BE_1%)	BE_2 (BE_2%)
317.08	16.25	18.60	305.00	330.00	34.85	270.15 (-14.80%)	364.85 (15.07%)
Spot	Call Price	Put Price	Put Strike	Call Strike	$= C + P$	$= K_1$ - NP	$= K_2$ + NP

Creating a Bull Spread Strategy using OVME L

A Bull spread strategy is appropriate when an investor is expecting that the underlying stock price will increase but is willing to accept a limited gain in return for a limited loss in case the stock price declines. Specifically, with a Bull spread stock price increases lead to gains, while stock price decreases lead to losses. The tradeoff of the limited maximum gain is the reduced loss when the stock price decreases. Thus, this strategy creates a "spread" or upper and lower limit on gains and losses.

The Bull spread strategy is created by buying a Call with a lower strike price equal to K_1, and gives up some upside potential by selling a Call with a higher strike price, K_2. Both Calls have the same expiration date. In return for giving up some upside potential, the investor earns the premium for the option with the higher strike price, K_2. Following the methodology outlined above, we create a Bull Spread position for AAPL where both the Pricing and Scenario screens are shown below in Exhibit 13 and Exhibit 14.

We can see in Exhibit 15 that the cost of the Call with the lower strike price bought is higher than for the higher strike price Call sold. The up-front cost is the difference of the two premiums, 8.30. We note that it is very important to remind students of the Bloomberg sign convention that all costs (buy positions) are treated as positive values while all sell positions are treated as negative values. The break-even point occurs when the stock price is above the lower strike price, 315.00, plus the up-front cost, 8.30, for a total of 323.30. At points below the break-even stock price the Bull spread results in a loss, but is limited to -8.30 (we add a negative sign to indicate a loss), while at prices above break-even the profit is positive with a maximum of 6.70.

Exhibit 13: Pricing and Scenario Screens for a Bull Spread

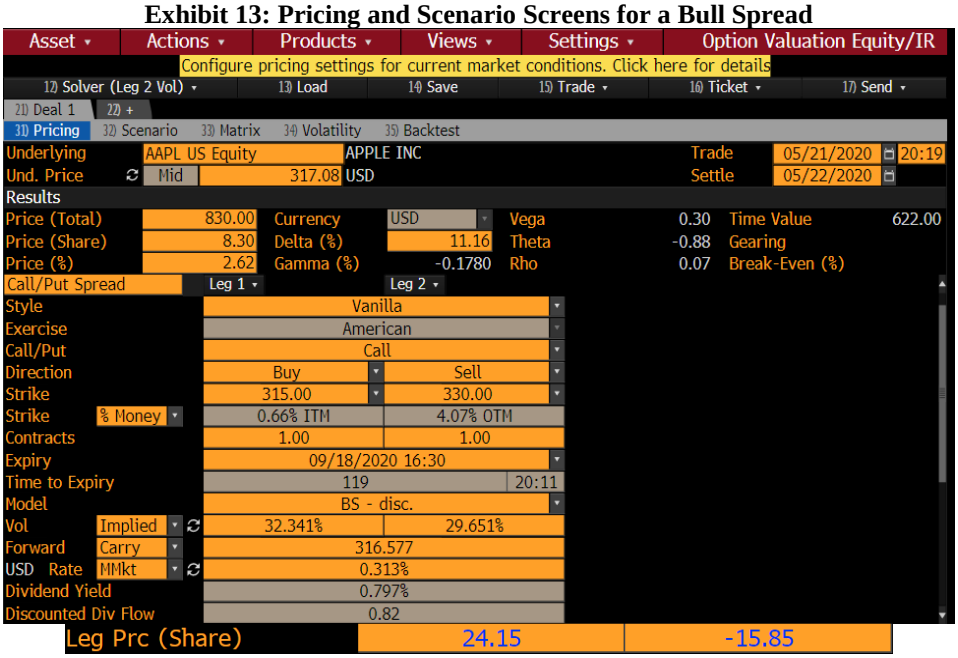


Exhibit 14: Annotated Scenario Screenshot for Bull Spread on AAPL

Exhibit 15: Bull Spread Summary Calculations

S_0	C_1	C_2	K_1	K_2	NP (Up-Front Cost)	Max Profit	BE	Max Loss
317.08	24.15	-15.85	315.00	330.00	8.30	6.70	323.30	-8.30
Spot	$Call_1$ Price	$Call_2$ Price	$Strike_1$	$Strike_2$	$= C_1 + C_2$	$=K_2 - K_1$ - NP	$=K_1$ + NP	= -NP

The Max Profit, Max Loss, and break-even (BE) values may not be readily apparent to students so we add the following explanatory calculations to show students that the value of the strategy is related to the ability to exercise the options for a range of stock prices. The current stock price is denoted as S_t. For these

calculations we must revert to the usual sign convention that buys are negative values and sells are positive values.

Max Profit occurs when $S_t \geq K_2$ (330.00)

1. $Call_1$ (Bought): exercise $Call_1$, buy stock for 315.00 (K_1)
2. $Call_2$ (Sold): gets exercised, sell stock from $Call_1$ for 330.00 (K_2)
3. Profit = K_2 - K_1 - NP = 330.00 - 315.00 - 8.30 = 6.70

At stock prices between the strike prices, $K_1 < S_t < K_2$, the profit may be positive, negative, or at break-even.

1. $Call_1$ (Bought): exercise $Call_1$, buy stock for 315.00 (K_1), sell stock for S_t
2. $Call_2$ (Sold): does not get exercised
3. Profit = S_t - K_1 - NP = S_t - 315.00 - 8.30
4. To solve for BE we set the Profit equal to zero and solve for S_t to get: $S_t = K_1$ + NP = 315.00 + 8.30 = 323.30

Max Loss occurs when $S_t < K_1$ (220.00)

1. $Call_1$ (Bought): no exercise
2. $Call_2$ (Sold): no exercise
3. Profit: -NP = -8.30 (again, we add the negative sign to denote a loss)

Creating a Bear Spread Strategy using OVME L

A Bear spread strategy is appropriate when an investor is expecting that the underlying stock price will decrease but is willing to accept a limited gain in return for a limited loss in case the stock price increases. Specifically, with a Bear spread stock price decreases lead to gains, while stock price increases lead to losses. Similar to the Bull spread, the tradeoff of the limited maximum gain is the reduced loss when the stock price increases.

A Bear spread strategy can be created using two Put options: buy one Put option on a stock with a higher Strike price, K_2, and sell a Put option on the same stock with a lower strike price, K_1. Both options have the same expiration date. This strategy creates a position where the investor has to pay an initial outlay because the price of the Put sold is less than the price of the Put purchased (the Put purchased has a higher strike price). In return for giving up some of the profit potential, the investor earns the premium for the Put sold. Examples of the Pricing and Scenario Screens and a table of summary calculations are shown below in Exhibits 16 through 18, respectively.

Exhibit 16: Pricing and Scenario Screens for a Bear Spread

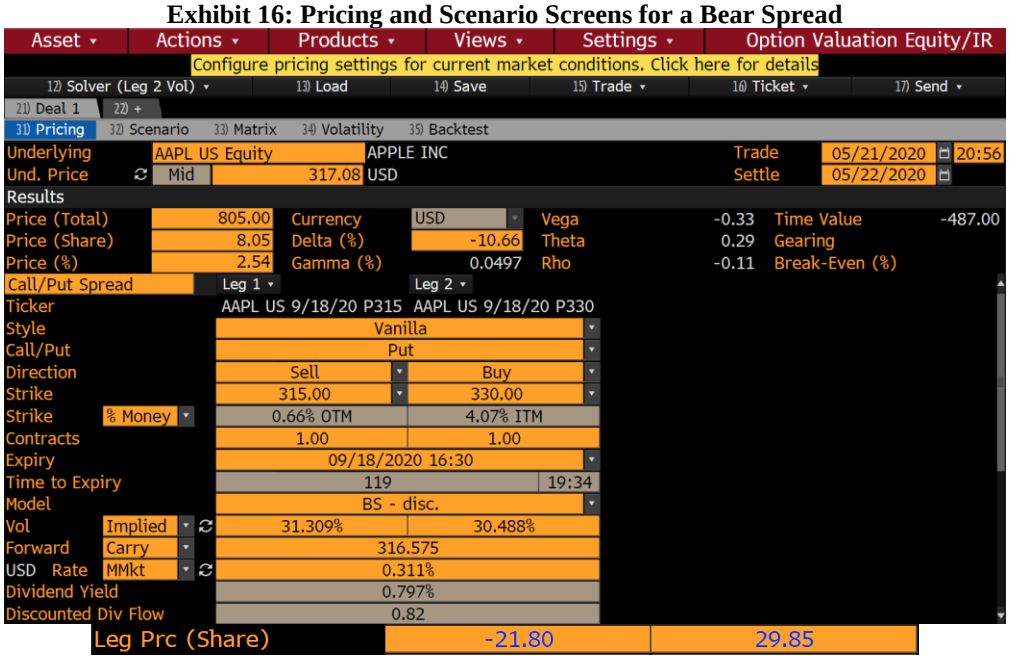


Exhibit 17: Annotated Scenario Screenshot for Bear Spread on AAPL

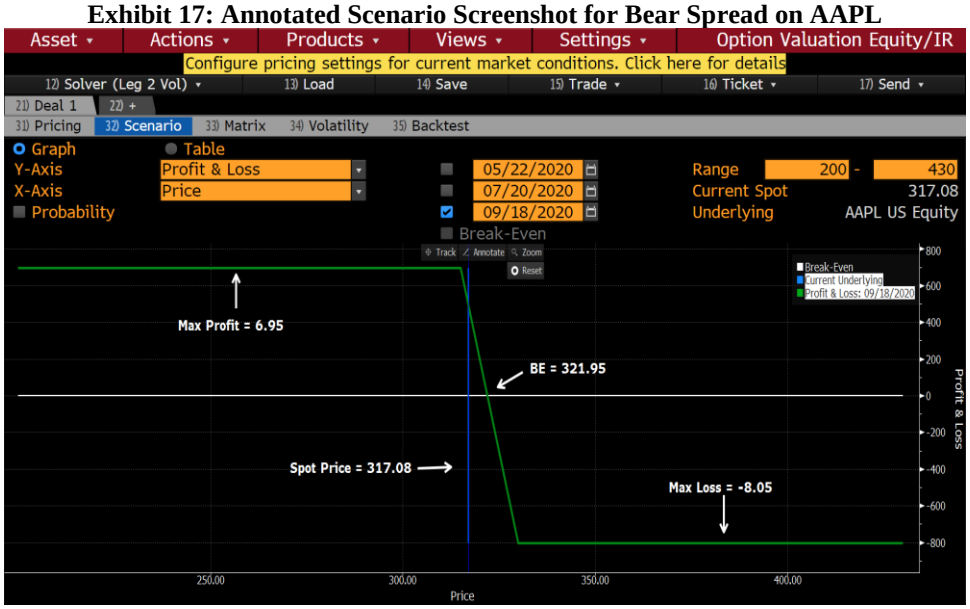


Exhibit 18: Bear Spread Summary Calculations

S_0	P_1	P_2	K_1	K_2	NP (Up-Front Cost)	Max Profit	BE	Max Loss
317.08	-21.80	29.85	315.00	330.00	8.05	6.95	321.95	-8.05
Spot	Put_1 Price	Put_2 Price	$Strike_1$	$Strike_2$	$= P_1 + P_2$	$= K_2 - K_1$-NP	$= K_2$ - NP	= -NP

We can see in Exhibit 18 that the cost of the Put sold with the lower strike price is lower than for the higher strike price Put bought. The up-front cost is their difference, 8.05. In our example Bear Spread the Spot price is already below the break-even price of 321.95, so our strategy is near to the maximum profit. At points above the break-even stock price the strategy results in a loss but is limited to -8.05, while at prices below break-even the profit is positive with a maximum of 6.95.

The Max Profit, Max Loss, and break-even (BE) values may not be readily apparent to students, so we add the following explanatory calculations to show students that the value of the strategy is related to the ability to exercise the options for a range of stock prices. As before, for these calculations to make sense we must revert to the usual sign convention that buys are negative values and sells are positive values.

Max Profit occurs when $S_t < K_1$ (315.00)

1. Put_1 (Sold): gets exercised, buy stock for 315.00 (K_1)
2. Put_2 (Bought): exercise Put_2, sell stock for 330.00 (K_2)
3. Profit = K_2 - K_1 - NP = 330.00 - 315.00 - 8.05 = 6.95

At stock prices between the strike prices, $K_1 < S_t < K_2$, the profit may be positive, negative, or at break-even.

1. Put_1 (Sold): no exercise
2. Put_2 (Bought): purchase stock for S_t, exercise Put_2, sell stock for 330.00 (K_2)
3. Profit = K_2 - S_t - NP = 330.00 - S_t – 8.05
4. To solve for BE we set the Profit equal to zero and solve for S_t to get: $S_t = K_2$ - NP = 330.00 - 8.05 = 321.95

Max Loss occurs when $S_t > K_2$ (230.00)

1. Put_1: no exercise
2. Put_2: no exercise
3. Profit: -NP = -8.05 (again, we add the negative sign to denote a loss)

We next examine two basic example of strategies that are long the underlying stock and long or short an option on the same stock: Covered Call and Protective Put.

Creating a Covered Call Strategy using OVME L

With this strategy the investor is expecting that the underlying stock price will increase (so the long position in the stock will benefit), but not so much that it reaches the strike price of the Call sold. The investor sells a high strike price Call in order to earn additional return from the premium. This enhances the gains in the strategy from stock price increases. If the stock price does reach the strike price (or above), the investor is "covered" with their long position in the underlying stock, i.e. they own the shares that will have to be sold if the Call is exercised.

Writing a covered Call involves taking a long position in the underlying stock (buying it) and writing (selling) a Call option on the same stock with a strike price that is higher than what the investor anticipates the stock price will increase to. This strategy sets an upper limit on the profit that can be earned. The break-even value is reached when the change in the stock price is exactly equal to the up-front cost of the stock purchase price less the Call premium. Example Pricing and Scenario Screens and a table of summary calculations are shown below.

Exhibit 19: Pricing and Scenario Screens for a Covered Call

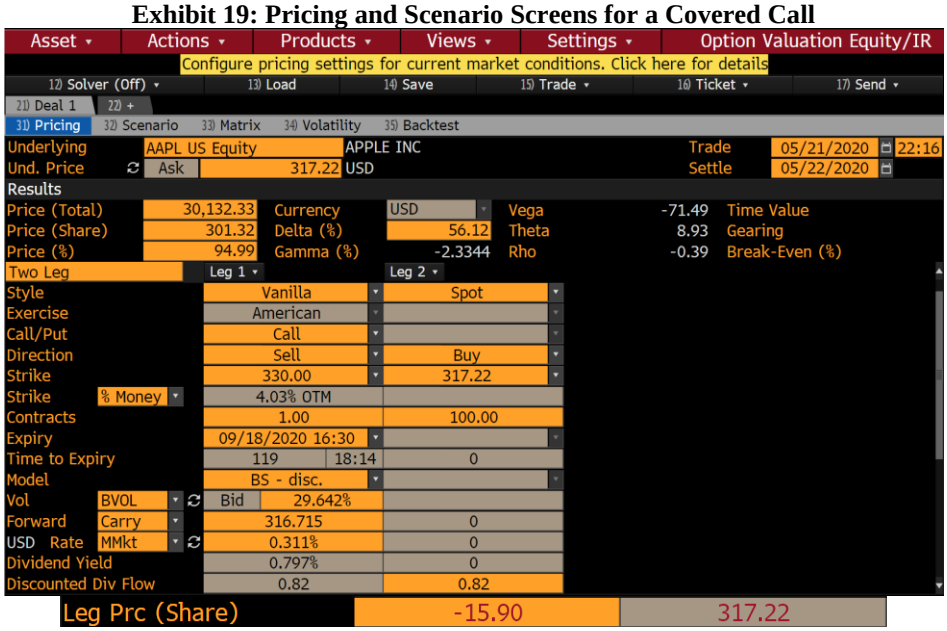


Exhibit 20: Annotated Scenario Screenshot for a Covered Call on AAPL

Exhibit 21: Covered Call Summary Calculations

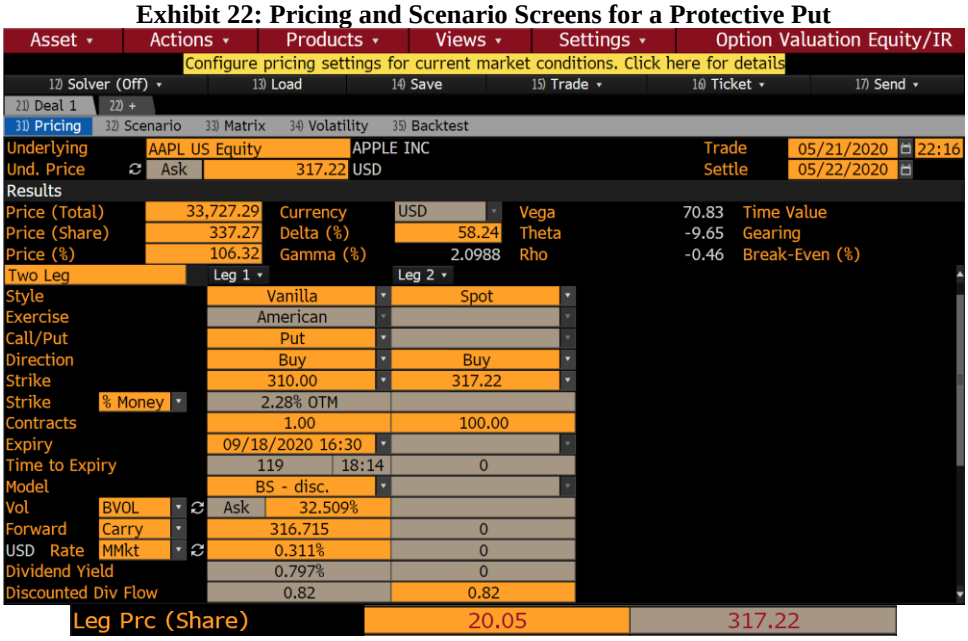
S_0	C	K	Up-Front Cost	Max Profit	BE	Neg. Profit
317.22	-15.90	330.00	301.32	28.68	301.32	< 301.32
Spot	Call Price	Strike	$= S_0 + C$	$= K - S_0 - C$	$= S_0 + C$	< BE

We can see from the calculations in Exhibits 20 and 21 that we assume the stock price was purchased at the "Ask" Spot price of 317.22 (because we are buying the underlying) and a Call with strike price 330.00 was sold for -15.90. The break-even stock price is the stock purchase price less the Call premium received. If the stock price increases to less than the strike price of 330.00, the strategy return is enhanced by earning both the stock price increase and the Call premium. However, at the strike price of 330.00 the investor is at risk of having the Call exercised and surrendering the shares for 330.00 - the maximum profit is thus obtained. This is the change in the stock price, 330.00 – 317.22 = 12.78, plus the Call premium of 15.90 for a maximum profit of 28.68. Strategies involving both the change in the underlying stock price and the value of an option are generally more difficult for students to grasp. The incorporation of the Bloomberg terminal in this strategy will help students to better visualize various positions for different prices.

Creating a Protective Put Strategy using OVME L

The Protective Put strategy is appropriate when an investor expects that the long stock position will increase in value but wants to purchase downside protection to limit losses in case the stock price declines. In this strategy, the investor is long the underlying stock and long a Put option on the same stock. This strategy creates a "floor" on losses (a maximum loss), which is why it is referred to as a "Protective Put" strategy. The break-even stock price is obtained at the sum of the initial stock price plus the cost of the Put. For this final example, Pricing and Scenario Screens and a table of summary calculations are shown in Exhibit 22.

Exhibit 22: Pricing and Scenario Screens for a Protective Put



We can see from the calculations in Exhibits 23 and 24 that we assume that the stock price was purchased at the "Ask" Spot price of 317.22 (because we are buying the underlying) and a Put with strike price 310.00 was bought for 20.05. The break-even stock price is the stock purchase price plus the cost of the Put purchased (this is the same as the up-front cost). If the stock price increases above the break-even price, the profit is positive. However, if the stock price falls to the strike price of 310.00 the investor can exercise the Put and sell the shares for 310.00 - the maximum loss is thus obtained. This is the change in the stock price, 310.00 – 317.22 = -7.22, plus the cost of the Put of -20.05 for a maximum loss of -27.27. Again, this strategy is often

difficult for students to grasp because it involves both a change in price of the underlying stock and the option.

Exhibit 23: Annotated Scenario Screenshot for a Protective Put on AAPL

Exhibit 24: Protective Put Summary Calculations

S_0	P	K	Up-Front Cost	Max Loss	BE	Positive Profit
317.22	20.05	310.00	337.27	-27.27	337.27	> 337.27
Spot	Put Price	Strike	$= S_0 + P$	$= K - S_0$ - P	$= S_0 + P$	> BE

Conclusion

As academia continues to focus on the need to incorporate experiential learning in today's business schools, the Bloomberg terminal and its real-time financial data provide the ideal opportunities to merge theory and practice. Motivated by the lack of research addressing utilizing Bloomberg terminals in derivatives courses for the purpose of comprehending option trading strategies, this paper addresses the functionality of the Bloomberg System in evaluating six option trading strategies – Straddle, Strangle, Bull and Bear Spreads, and a Covered Call and a Protective Put.

The six basic options trading strategies we describe in this paper can easily be created, viewed, and analyzed using the powerful tools of the Bloomberg terminal. In doing so, the methodology outlined in this paper will help students connect option valuation theory with live option prices and the most common option trading strategies outlined in Hull (2017). Furthermore, this paper provides a foundation to help instructors learn how to utilize the Bloomberg terminal as a teaching tool in the classroom. With a firm understanding of the intuition and concepts of these basic strategies, more complex trading strategies may be more readily understood, including managing portfolios of options. With the ultimate goal of better preparing our students for industry, the practical use and popularity of the Bloomberg terminal in a derivatives course is a significant advantage for those schools who have invested in this real-time financial platform.

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#ECON1950: Integrating Twitter and a Learning Management System to Reach Students Outside the Classroom

Joel Wood[1]

ABSTRACT

A course-specific Twitter hashtag can be used to categorize tweets related to course material. Embedding a Collection of these tweets within a Learning Management System course page is an easy way to share this information with students. A guide to embedding a twitter feed within Moodle, Canvas, and Blackboard Learn is provided. Examples of how Twitter can be used to share information to students in a Macroeconomics course are provided. Student survey results indicate that most students agreed that the Twitter feed helped connect the course material to examples, was worthwhile, and stimulated their interest in economics.

Introduction

Repeatedly in my course evaluations when teaching Principles of Macroeconomics, students request more real-world examples. The heavy use of abstract models in economics may discourage students from pursuing future studies in economics if they cannot see the link to the real world. This may especially be a problem for economics departments that are in business schools, as the link to the real world for other business major subjects is patently obvious to students. Frank (2006) argues that connecting students with real-world examples stimulates their interest in economics and aids in retention of key concepts. The micro-blogging social media platform Twitter can be a useful and low opportunity cost tool for disseminating real-world examples and applications of economics course material.

Twitter is already a useful way for economists to follow and engage on economic policy and economic research issues. Over 1,500 academic economists have registered their Twitter accounts with the online bibliographic database Research Papers in Economics (RePEc), hosted online by the Research Division of the Federal Reserve Bank of St. Louis (*https://ideas.repec.org/i/etwitter.html*). Holmberg and Thelwall (2014) find that academic economists on Twitter share more links than academics from other disciplines. Many economics and economy-related institutions also have Twitter accounts that disseminate useful information (e.g., @federalreserve, @bankofcanada, @OECD, @StatCan_eng, @BrookingsEcon, etc.). Twitter is also heavily used by journalists to report breaking news and analysis, some of which relates to economic policy and economic indicators. Furthermore, there are also columnists (who happen to be Ph.D. trained economists) who provide economic policy analysis in real-time (e.g., @paulkrugman, @noahpinion, @stephenfgordon, and many others).

For economics instructors not yet participating on Twitter, there are low adoption costs to begin sharing information from Twitter with their class using a course-specific hashtag, Collection (a curated list of tweets), or account. For economics instructors who are already participating in the economics Twitter community, the adoption costs are even lower. A hashtag is an alphanumeric label following a pound sign written in a tweet (e.g., #ECON1950, #teachecon, #cdnecon, #econtwitter). Twitter uses these hashtags to categorize tweets, so entering a specific hashtag into Twitter's search function returns a list of tweets that include that hashtag. A course-specific hashtag can then be viewed by students on Twitter. Additionally, TweetDeck (*https://tweetdeck.twitter.com/*) can be used to create a course-specific Collection of tweets; a link to this

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Collection can then be shared with students. A Collection is a curated list of tweets where the user (the instructor) has complete control over the ordering of the tweets, whereas Twitter usually displays tweets in reverse chronological order. An alternative option is to tweet from a course-specific Twitter account (e.g., @ECON1950). TweetDeck, Hootsuite, and many other applications allow users to tweet from multiple Twitter accounts, and the recent redesign of Twitter's standard browser interface now allows one user to tweet from multiple accounts. Students would then need to follow the course-specific account on Twitter using their own twitter account.

However, in informal discussions with students, many indicated that they did not use Twitter or were concerned about privacy. Indeed, Al-Bahrani et al. (2015) find that only 67% of students use Twitter and that a small percentage of students have privacy concerns about interacting with professors on social media. Privacy concerns and student non-use of Twitter can be overcome for Collections and accounts. Embedding a Twitter feed of a Collection or an account within a Learning Management System (LMS) course page is an easy way to ensure your use of Twitter for the course is inclusive to students whether they use Twitter or not. In the past, it was possible to embed a feed of a specific hashtag, but this approach was discontinued in July of 2018; however, it is still possible to easily embed a course-specific Collection or account in a LMS.

I expand on one use of social media mentioned by Al-Bahrani and Patel (2015): using Twitter to share information (e.g., graphs of economic data, news articles, blog posts, etc.) with students. Many economists have argued in favour of sharing articles in newspapers and business periodicals about real-world economic events as a complement to introductory economics material (e.g., Kelley (1983), Cochran and Brown (1989), Bredon (1999), among others). Creating these supplemental opportunities for students is important, as reading articles in the popular press about real-world economic issues and events has been shown to improve student understanding of the theoretical material presented in-class (Craig and Raisanen 2013). In this article, I focus on my experience combining Twitter with a Learning Management System to provide students with real-world examples relevant to the course material. It merges the two competing methods (Twitter vs. LMS posts) evaluated by Al-Bahrani et al. (2017b) into a single teaching tool.

In the next section, I review the economics education literature focused on using Twitter to aid in teaching economics. In the third section, I provide details on embedding a Twitter feed of a course-specific Collection or account into three common LMS (specifically Moodle, Blackboard Learn, and Canvas). In the fourth section, I provide examples I have shared to students through Twitter. In the fifth section, I present and discuss results from a short student survey conducted related to the embedded Twitter feed. In the final section, I make conclusions.

Twitter and Economics Education

Kassens (2014) recounts experience using Twitter assignments in a Principles of Macroeconomics class to promote active learning and student engagement. Students were required to tweet in response to questions posed on the course hashtag by the instructor and/or guest tweeters (prominent economists @JustinWolfers and @BetseyStevenson). The students were also asked to tweet reflection on course material. Their tweets were assessed by a rubric created by the students on the first day of class and were worth 15% of their final course grade. Kassens (2014, pp. 107) concludes that the Twitter assignments "have the potential to improve reflection and writing skills." However, she notes that the assignments may not work for larger classes, which are the norm for introductory economics courses at some post-secondary institutions.

However, some economics educators have incorporated Twitter into larger class sizes. For example, Jones and Baltzersen (2017) outline their use of Twitter to facilitate in-class discussions of business cases in large economics lectures. Students in the large class tweet questions and responses related to the case under discussion to a case specific Twitter hashtag. The feed for the case specific hashtag is then displayed on the overhead projector and the instructor can follow the discussion and highlight important comments to the entire class. Jones and Baltzersen (2017) survey participating students and find that a large majority agreed or strongly agreed that using Twitter for this purpose increased their participation and understanding.

Dowell and Duncan (2016) outline a group assignment for Principles of Macroeconomics that uses Twitter and Periscope (a live video Twitter application) to help students learn about the connection between standard of living and real GDP per capita. Students use Periscope to interview people from other countries about their living standards and then compare the responses to data on real GDP per capita. Dowell and Duncan (2016) argue the assignment increases student engagement, digital literacy, cultural competency, and global awareness.

Al-Bahrani and Patel (2015) provide an introduction to three social media platforms (Twitter, Instagram, and Facebook) and a detailed guide in the many possible uses for teaching economics in and out of the classroom. They highlight both voluntary and mandatory uses, as well as active (students participate and contribute) and passive uses (instructors relaying information). One aspect they highlight relevant to the current paper is that instructors can use social media to connect students with real-world examples relevant to course material to stimulate student learning and interest in economics. They also comment that "the collaboration and engagement culture on Twitter is more developed" than on Facebook or Instagram, but they reiterate that "privacy concerns remain a major issue" (Al-Barhrani and Patel 2015, p. 64).

Al-Bahrani et al. (2015) survey undergraduate students about their use and preferences regarding social media platforms. Almost 80% of students report checking social media multiple times a day, whereas only 48% report checking their LMS several times a day; however, almost 90% of students reported checking their LMS at least once a day. They found that Facebook, YouTube, Instagram, and Twitter were the most popular amongst students; however, only 67% of students reported using Twitter. They also highlight that a small percentage of students had privacy concerns in regards to interacting with professors on social media.

Al-Bahrani et al. (2017a) surveyed economics educators who participated in the American Economics Association's Conference on Teaching and Research in Economic Education between 2011 and 2014 about their use of social media. They find that most instructors who use social media in their teaching are using it as a passive instructional tool to share relevant content with students outside the classroom and that most of this material is YouTube videos. A small percentage of respondents were using social media for active learning through graded or non-graded assignments. Their survey results also lead them to conclude that "faculty are reluctant to use it, not because of a lack of understanding, but because they want to limit access to personal information and educational content" (Al-Bahrani et al. 2017a, p. 49).

Al-Bahrani et al. (2017b) conduct an experiment over six sections of introductory economics at three institutions to test the effectiveness of Twitter on student learning. For their treatment classes, they use Twitter to share articles related to the course material. For their control classes, they use an LMS (Blackboard) to share the same information. They then use regression methods to estimate the effects of the treatment on various indicators of student learning. They are unable to conclude that using Twitter is more effective than using an LMS. However, they do highlight that their experimental design does not make use of many of Twitter's features that are theorized to increase student learning. Their study does use Twitter in a similar way to that described in the present paper. Embedding Twitter within a LMS could be viewed as an additional possible treatment that was not tested. Another caveat the authors add in the conclusion is that the benefits of Twitter may not just be related to traditional indicators of student learning (i.e., grades), "but may rather be in the form of engagement, teacher evaluations, and fostering interest in the topic" (Al-Bahrani et al. 2017b, p. 251). The last benefit is specifically why I began using Twitter to share information with my students: to try to increase their interest in economics!

When using Twitter for sharing content, students without Twitter accounts must "opt-in" to receive the content by joining Twitter. This may be a large default rule to overcome, especially considering that according to Al-Bahrani et al. (2015) one third of students do not use Twitter. This can also be an issue for students on Twitter who choose not to follow the instructor for privacy reasons; they must opt-in to viewing the course hashtag each time they log in (opt-in by searching it). Kassens (2014) makes Twitter assignments part of the course grade and therefore provides a real, extrinsic incentive to overcome status-quo bias. However, if Twitter is being used as a passive, supplemental learning tool (e.g., sharing course-relevant news articles), there is no incentive to overcome the default. Embedding a Twitter feed into the LMS eliminates the problem; students no longer have to opt-in to viewing the course-specific Twitter feed. This ensures that access to the supplemental learning material provided through Twitter is more inclusive. It also makes the feed unavoidable for students who check the LMS, which may nudge some students into clicking on the links.

Integrating Twitter with a Learning Management System

In this section I provide a guide for the process of embedding a Twitter feed within a course site in a Learning Management System (LMS). The guide is specific to Moodle as an example LMS, but I also provide instructions for Canvas and Blackboard Learn. The process is simple to generalize to other systems so long as they allow the use of html code.

Rather than displaying your entire Twitter feed for students to see, the use of a course-specific hashtag allows an instructor to share targeted information with their students. For my purposes, I have used #ECON1950 and #ECON3410 among others, the subject and course codes for first-year Principles of Macroeconomics and third-year Economics of Climate Change at Thompson Rivers University. It is important to search the hashtag prior to using it to ensure that it is not already in use by someone else. Unfortunately, a feed of a hashtag can no longer be embedded; however, course-specific hashtags are still useful for categorizing relevant tweets for use in a Twitter Collection or for use later.

One way to share course-relevant Tweets through a LMS is to curate a Twitter Collection using TweetDeck. In Fall 2018, I created a Collection in TweetDeck and then embedded a feed of this Collection in my Moodle course page when teaching Principles of Macroeconomics. TweetDeck is a browser interface for Twitter that allows multiple columns of tweets to be viewed, and I set it up in the following way: One column was a feed of the tweets of all accounts I follow with my personal account, one column was a feed of my own tweets, one column was a search of the course-specific hashtag, and one column was the course-specific Collection. One can then add tweets by dragging and dropping them into the Collection column. Unlike the rest of Twitter, tweets within a Collection are not necessarily ordered in reverse chronological order; the user has complete control over the ordering of tweets within the Collection. The major advantage of using a Collection is that it allows the most control for the user to choose how the tweets included in the Collection appear to the viewers. It allows for tweets from other accounts to be placed in the Collection. An instructor would not even have to include any of their own tweets; it could consist only of tweets from other accounts if the instructor so desired. This further minimizes the costs of adoption for instructors. They can use relevant tweets from other accounts found easily on economics-related hashtags (e.g., #EconTwitter, #TeachEcon) and essentially free-ride on existing economics-related Twitter content. The disadvantage of using a Collection is that it requires the use of TweetDeck, which makes it slightly more inconvenient than the discontinued approach of embedding a feed of a course-specific hashtag. The collection can then be embedded using an html widget obtained from *https://publish.twitter.com* or directly from TweetDeck.

An alternative approach is to create a course-specific Twitter account. The course-specific account can then be used to retweet relevant tweets from your personal Twitter account and the course-specific hashtag. The normal Twitter browser interface now supports the use of multiple accounts, or other interfaces such as TweetDeck and Hootsuite can be used. It is possible to automate the process using Kearney's (2019) rtweet package in the statistics program R (essentially creating a retweet bot that automatically retweets the tweets that contain the course hashtag); however, the process is relatively technical to set up and it is probably easier for most instructors to manually retweet the relevant tweets. The tweets of the course-specific account can then be embedded using an html widget.

There are two ways to obtain the needed html widget to embed either a Collection or an account. One way is to go to *https://publish.twitter.com* and enter the URL of the collection or the account in the box under the text "What would you like to embed?". Alternatively, within TweetDeck, embedding is listed as an option when you click on the "Share" option of a Collection or account column. Either option will provide the required html code that you can now copy.

Within your Moodle course site, click "Edit" on one of the Moodle modules within your site, and select "Edit week" (or "Edit topic") from the drop down menu. Now select the html button (<>) and paste the html code that you copied from Twitter into the text box. If the html button is not visible, you will need to select the button that displays "Show me more options" when you hover the cursor over it. Finally, by clicking on Save Changes, you have now embedded a Twitter feed of your course-specific Collection or account into your Moodle course site. Step-by-step directions are listed below. The Twitter feed should now be displayed as in Figure 1.

Step 1: Go to https://publish.twitter.com

Step 2: Enter the URL to a Twitter account or Twitter collection

Step 3: Copy the resulting html code

Step 4: Within Moodle, click "Edit" on a Moodle module within your course site; Select "Edit Week"

Step 5: Select html (<>) & paste the widget. Save.

Figure 1: Moodle Screenshot with Embedded Twitter Feed

The process to embed a Twitter feed in Blackboard Learn is similar to in Moodle. According to Linzy (n.d.), you go to the desired content area within your Blackboard Learn course site and choose "Build Content" and "Item". In the resulting text editor, click the "HTML Code View" button and paste the Twitter widget. After clicking through to finish the process, the Twitter feed should appear.

The process in Canvas is quite more involved.[2] Detailed instructions have been provided by Gibbs (n.d.) at the website *https://canvas.ou.edu/courses/56095*, and are summarized in the following sentences. Once you have the html widget, you need to paste it into a text editor (e.g., Notepad) and save the .txt file. Rename the .txt file as .html and upload it to Canvas. Click on the file to get three key pieces of information from the file address; e.g., if the address is *https://canvas.instructure.com/courses/2002536/files?preview=93780762*, the needed information is canvas.instructure.com, 2002536, and 93780762. Now create a Canvas Page, name the page, and click the "html" button. You now need to insert the following iframe code using the three pieces of information you obtained:

<iframe src="https://canvas.instructure.com /courses/2002536/files/93780762/download" width="450" height="850"></iframe>

You can now click "Save and Publish" and the editor should display on the page.

If you want the feed to be displayed as the course homepage so that it is the first thing students see when they go into the course page, do the following. When viewing the page, click on the three dots in the upper right corner and select "Use as Front Page." Then exit to the "Home" and select "Choose Home Page" on the

[2] Canvas does have a Twitter app that makes it very easy to embed a Twitter feed; however, the app does not display the pictures from tweets, only the text.

right-hand side. Select "Pages Front Page" from the listed options, and the Twitter feed should now display as the home page for the course site.

Using Twitter as a Tool to Promote Learning

In the first class of the semester I provide students with my Twitter handle and the course hashtag when providing my other contact details (e.g., office location, email address, etc.). I provide a brief overview of why I think Twitter is useful for connecting the course material to real-world applications in the news, current events, and public policy. I also mention that I embed a Twitter feed in the Moodle course site, so students who prefer not to use Twitter can still access the information.

I have used Twitter mainly as a tool for sharing information about current events, economic research, and public policy to supplement the course material in an effort to stimulate learning and to foster interest in economics. This is consistent with the way that most economic educators are currently using social media (Al-Bahrani et al. 2017a). For example, the two tweets displayed in Figure 1 provide supplemental information about monetary policy, specifically inflation targeting. One tweet repeats information from their last lecture on the mandate of the Bank of Canada, but supplements with a time series graph displaying annual inflation in Canada between 1962 and 2015 with lines indicating the bounds of the inflation target. The second tweet visible in Figure 1 provides a link to a Bank of Canada document outlining the benefits of low, positive inflation; the document is written in a way that is accessible to the general public.

There is potential for the shared information to encourage more than just passive learning. For example, when sharing an article in a tweet, the instructor can pose a question in the tweet for students to consider while reading the article, thereby encouraging students to think critically about the material they are reading. As pointed out by Cochran and Brown (1989), many articles about economics topics in the popular press make mistakes about introductory economics concepts, and can potentially impede student learning about those concepts. When sharing a tweet about an article that makes a mistake, the instructor can point the error out in the tweet. This will aid students in learning to identify these types of mistakes themselves. For example, when sharing news articles about changes in the local unemployment rate, I have pointed out in the tweet that the changes are not statistically significant due to the small number of people sampled in the local area.

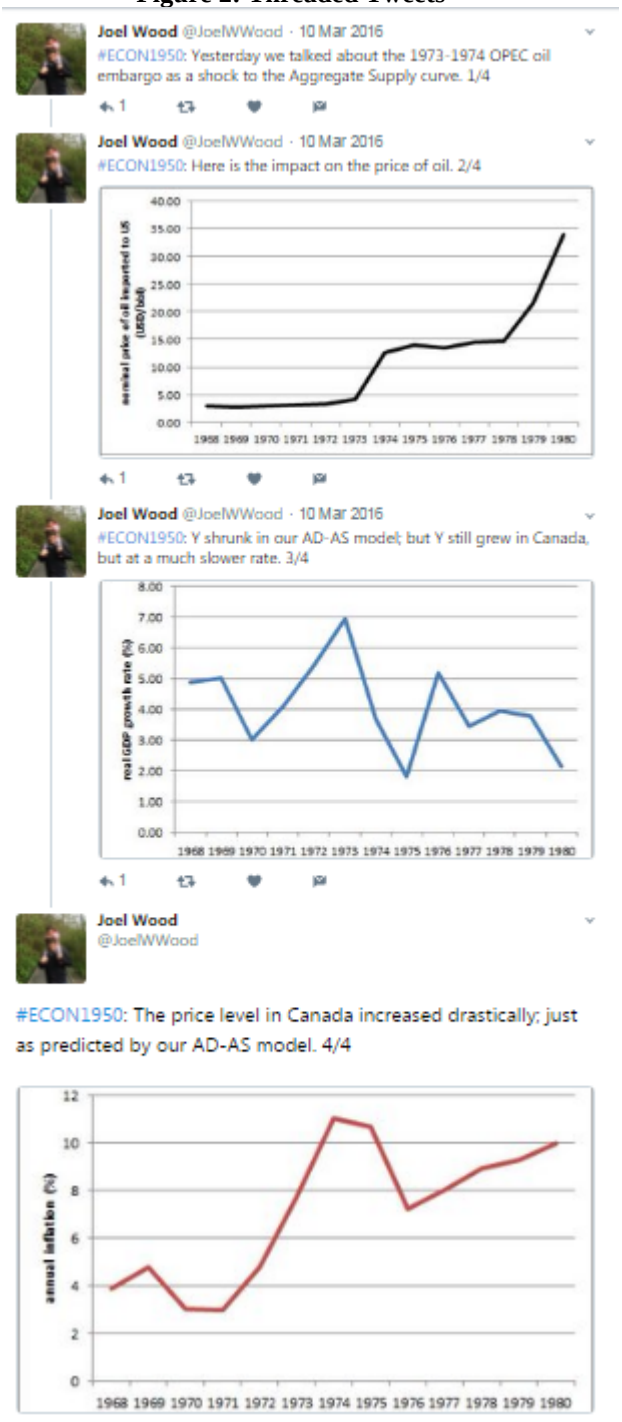
A useful technique for sharing a linked series of tweets (a "Twitter essay") is called "threading." This technique can be used to provide a longer narrative than is allowed by Twitter's character limit (280 characters per tweet). To thread a series of three tweets, write and then post the first tweet in the series, then use the reply button on that tweet to send the second tweet in the series, and then reply to the second tweet to send the third tweet. Rather than replying to each tweet, it is possible to make the thread all at once. If you write out the first tweet, before sending it, you can click on a "plus" sign to add an additional tweet. If a student clicks on the third tweet, the series of three tweets is displayed; the link to this tweet can also be shared as a link to the thread of tweets. It is also useful to number the tweets in a series, so that when they show up in the Twitter feed, students know the order (e.g., 1/3, 2/3, and 3/3).

An example of a Twitter thread in #ECON1950 is displayed in Figure 2. The first tweet in the series references an example explored in class: the impact of the 1973 OPEC oil embargo in the standard Aggregate Demand-Aggregate Supply model. The next three tweets display related time series data: tweet number two has the nominal oil price, tweet number three has the growth rate of Canadian real GDP, and tweet four has the inflation rate. The text of the tweets points out that the prediction of our AD-AS model was not entirely correct for real GDP, but correct for the price level.

When creating a feed (either a Collection or an account) that is going to be embedded, Quote Tweets should be avoided. A Quote Tweet allows the user to provide comment with a link to a specific tweet. Within Twitter's browser interface, the quoted tweet will be visible; however, when a Quote Tweet is displayed in the embedded feed within the LMS, the quoted tweet is not visible, only the comments you tweeted about it.

By embedding a course-specific Twitter feed, students are exposed to new examples related to the course whenever they sign in to the LMS. Hopefully, the supplemental content encourages learning and stimulates interest in economics. If the Twitter feed stimulates interest in economics, this could potentially also help foster increased engagement, participation, and active learning within the classroom. The next section presents results from a short survey about students' perceptions of the Twitter feed.

Figure 2: Threaded Tweets



Survey Results

The #ECON1950 Twitter feed was embedded in the Moodle course sites of two sections of Principles of Macroeconomics at Thompson Rivers University (TRU) in the Fall 2017 semester. TRU is a small,

undergraduate-focused public university located in western Canada. One section contained 43 students and the other contained 52 students.[3]

With Research Ethics Board approval, a short, six-question anonymous survey was administered in class concurrently with regular course evaluations. The survey was administered by a third party and was not reviewed until after the final grades for the course were submitted. Students had the option of opting out of participation by leaving the survey blank or not handing it in.

The first three questions of the survey were the following:

1. What type of student are you? (Domestic, International, or Prefer not to say)
2. Do you have a personal Twitter account?
   (Yes (use regularly), Yes (but do not use regularly), or No)
3. How frequently did you click on links posted on the Twitter feed embedded in Moodle?
   (Never, Once, Once a month, Once a week, or Multiple times a week)

Students were then asked to indicate whether they "Strongly Disagree," "Disagree," "Agree," or "Strongly Agree" with the following three statements:

4. The Twitter feed embedded in Moodle helped connect the course material to real world examples and current events.
5. The Twitter feed embedded in Moodle was a worthwhile addition to the course.
6. The Twitter feed embedded in Moodle helped stimulate my interest in macroeconomics and current events.

In total, 56 surveys were fully completed,[4] reflecting 58.9% of the enrolled students. The survey was administered in the final class of the course when attendance turned out to be low; however, 56 is still a reasonable sample size. The low attendance on the day the surveys were administered may add selection bias if a particular type of student was less likely than usual to attend. Attendance records for the day of the survey are only available for the 43-student section of the course. In this section, the average final grade of the 31 students in attendance was 72.5%, whereas the average final grade of absent students was 52.1%. In the other section, although attendance records are not available for the specific day of the survey, records of past attendance indicate that the average final grade of the 28 students who missed fewer than two classes (the most likely students to be in attendance on the day the survey was administered) was 70.4%, whereas the final average grade of the students who had missed three or more classes was 55.8%. This information on class attendance suggests a selection bias towards high-achieving students.

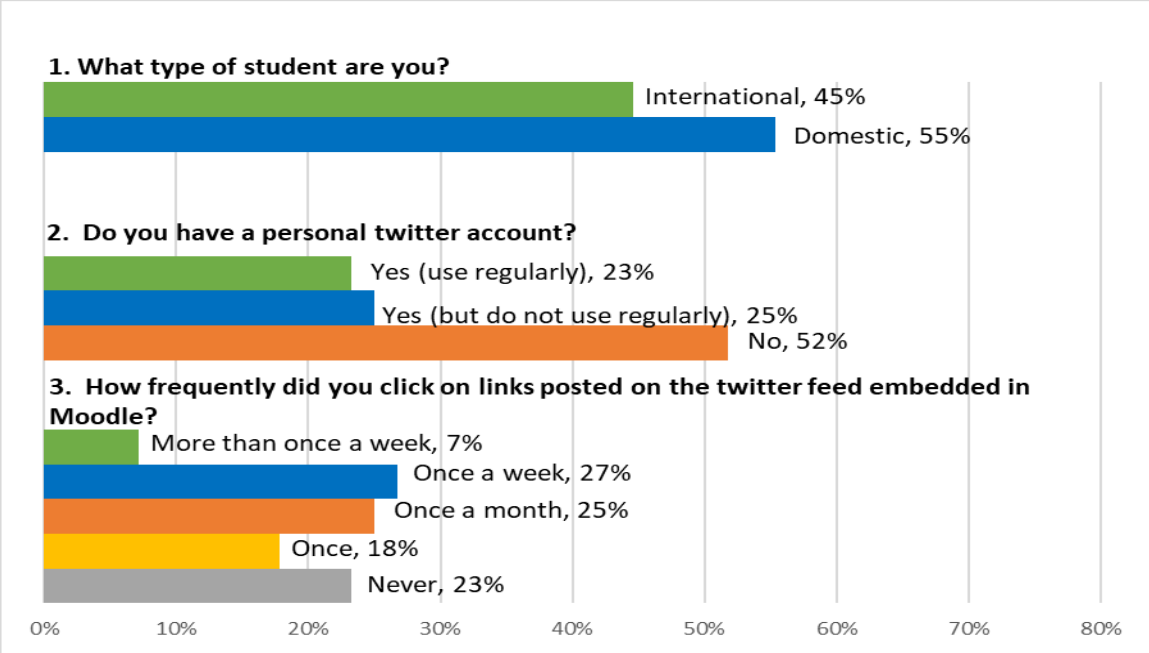
The responses to question 1 were coded 0 if a respondent indicated they were an international student and 1 if they indicated they were a domestic student. The responses to question 2 were coded 0 for no Twitter account and 1 for having a Twitter account (regardless of whether they use it regularly or not). The responses to question 3 were coded on a 1-to-5 scale with 1 being "Never" and 5 being "Multiple times a week." The responses to questions 4, 5, and 6 were coded on a 1-to-4 scale with 1 being "Strongly disagree" and 4 being "Strongly agree."

The results for questions 1, 2, and 3 are displayed in Figure 3. The survey responses are from a relatively even mix of domestic (55%) and international (45%) students. Nearly half of the respondents had a personal Twitter account. Thirty-four percent of the responding students clicked the links posted to the Twitter feed at least once a week and a majority of responding students clicked the links at least once a month. A large share (41%) of responding students reported only clicking on a link once or not at all; this is concerning considering that an average of 4.21 tweets shared per week included only text and a link. However, this does not necessarily indicate that the feed was not worthwhile for these students because posting additional readings related to the course material was not the only way in which the Twitter feed was used. Graphs of economic data as well as threaded series of tweets referencing course material were also used. Two tweets a week, on average, included graphs/images; therefore, the feed may have been valuable in other ways for students who did not click on the links.

[3] There were originally an additional 11 students enrolled in the course, but these students withdrew, either officially or unofficially (Did Not Complete) during the semester.

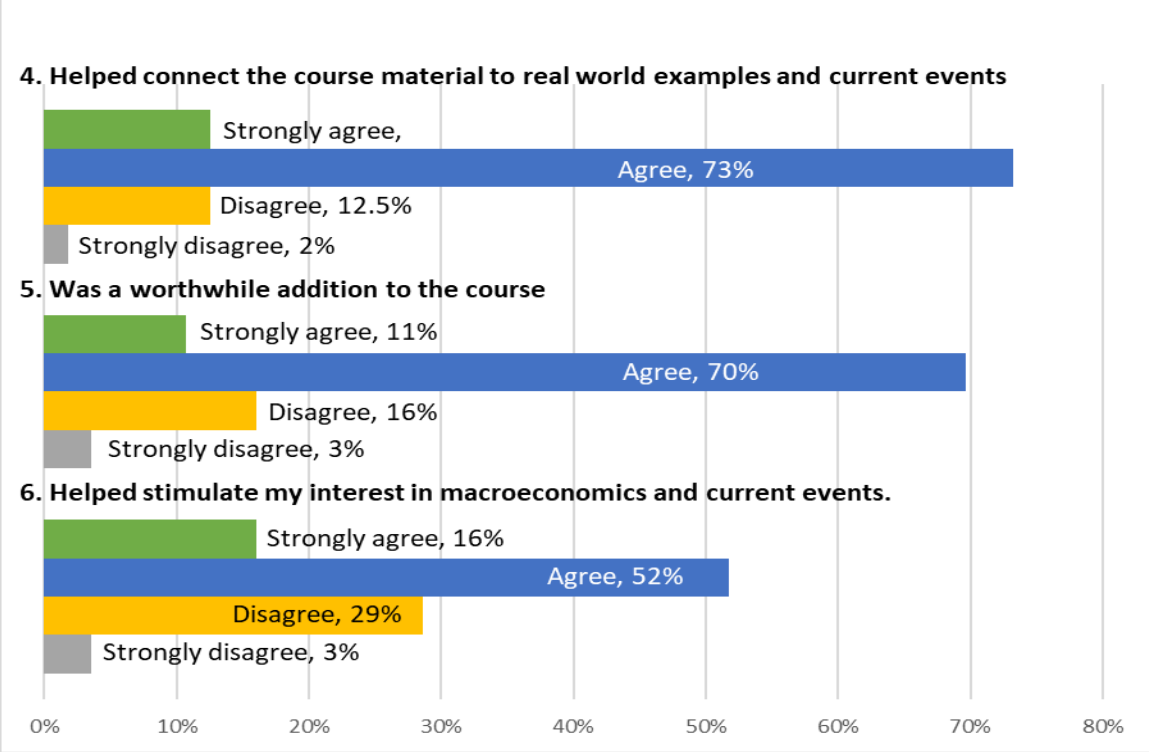
[4] 59 surveys were returned, but three were only partially completed.

Figure 3: Survey Results Part 1



The results for questions 4, 5, and 6 are displayed in Figure 4. Almost 85% of the responding students agreed or strongly agreed that the Twitter feed helped connect the course material to real-world examples, even though some of these students did not regularly click the provided links. In this sense, the Twitter feed helped address prior feedback from students requesting more examples, whether they used those examples or not. Forty-five (81%) respondents felt the Twitter feed was a worthwhile addition to the course. However, only 38 (68%) felt that the feed helped encourage their interest in macroeconomics.

Figure 4: Survey Results Part 2



In summary, most students did not click, at least weekly, on the links to supplemental readings provided through the feed. However, an overwhelming majority of students thought the feed helped connect the course material to real-world examples and was a worthwhile addition to the course. In addition, a majority of students felt the feed increased their interest in macroeconomics.

Table 1 displays t-tests conducted on the difference in mean responses between different groups of students. On average, international students clicked on links in the feed more frequently than domestic students (statistically significant at a 90% confidence level, but not a 95% confidence level). For all the other questions, I cannot conclude that the mean responses of the international students differs from that of the domestic students.

Column three of Table 1 compares the responses of students who have Twitter accounts with those who do not. For all questions, I fail to reject the null hypothesis that the mean responses between these two groups are different. Finally, column four compares the responses of users of the embedded Twitter feed (students who reported clicking the links at least once a month) to those who did not use the Twitter feed (students who reported never clicking on the links or clicking on only one link). The null hypothesis of no difference in means is rejected for questions 4, 5, and 6. The students who chose to access the linked information in the Twitter feed had a more positive view of the Twitter feed for connecting the course material to real world examples and felt more strongly that it was a worthwhile addition to the course. These students also felt more strongly that the feed stimulated their interest in macroeconomics and current events.

Data obtained from Twitter Analytics was used to compare my course-related tweets with my non-course-related tweets between September and December 2017. Course-related tweets received on average 6.95 twitter engagements, whereas non-course-related tweets received on average 11.34 twitter engagements; a t-test of means indicates the difference is statistically significant at the 1% level. Course-related tweets that contained a weblink received on average 2.72 link clicks, whereas non-course-related tweets that contained a weblink received on average 2.25 link clicks. However, the difference is not statistically significant from zero. Ultimately, when using an embedded Twitter feed, it is difficult to obtain meaningful information using Twitter Analytics because student views of the feed will not register as "impressions," and the only way for students who do not have Twitter accounts to engage with a tweet is to click the link (they cannot retweet or like a tweet).

Table 1: Difference in Means

	Domestic vs. International	Twitter account vs. no Twitter account	Clicked on links vs. Did not
Q2 Have personal Twitter account?	0.12	-	-
	(0.429)		
Q3 Frequency of clicking on links?	-0.64	-0.32	-
	(0.072)	(0.340)	
Q4 Connects to real world examples?	-0.05	-0.13	0.48
	(0.730)	(0.410)	(0.003)
Q5 Worthwhile addition to the course?	-0.07	-0.01	0.58
	(0.697)	(0.916)	(0.001)
Q6 Stimulated interest in macroeconomics?	-0.19	-0.05	0.79
	(0.340)	(0.790)	(0.000)

Notes: t-test p-values in parentheses.

Conclusions

Bredon (1999) theorized that there were three factors influencing whether instructors choose to share course-relevant news articles with their students: 1) Perceptions of educational value, 2) the search costs of

finding suitable articles, and 3) the costs of reproducing the material. Bredon argued that the internet had reduced the costs related to 2) and 3), making it easier for instructors to share material with students. If the internet initially lowered these costs, the combination of social media and LMS has further reduced these costs in a drastic way. Twitter is useful for academic economists to follow current events and research and to engage with their colleagues, students, and the general public. It is also a great place to gather information relevant to undergraduate economics courses, drastically reducing the time and effort required to find suitable examples. A course-specific Twitter feed embedded in a LMS is a relatively easy way to share this supplemental information with students. The costs of instructors joining Twitter and sharing course-relevant tweets with their classes through an embedded feed are extremely low. Furthermore, for instructors that are already active on Twitter, the adoption costs are even lower.

The approach of embedding a Twitter feed in a LMS avoids the issue of choosing between Twitter and the LMS for sharing information with students studied by Al-Bahrani et al. (2017b). It also makes accessing the information as easy as possible for the students; there is no need to join Twitter or search a hashtag or account. And since there is no need to join Twitter, it also ameliorates the concern over privacy and social media that a small percentage of students have.

Unfortunately, a slight majority of students do not access the supplemental information on a weekly basis (though a slight majority reported clicking on links at least monthly). Despite this, most students thought the embedded Twitter feed and supplemental information was a worthwhile addition to the course and helped stimulate their interest in economics. International students clicked on the links more frequently than domestic students; this may indicate a fruitful avenue for additional research. I failed to identify a difference in responses between students with Twitter accounts and those without. Perhaps unsurprisingly, the students who accessed the linked information in the Twitter feed responded more positively about the feed than students who did not access the linked information. The students who clicked on links at least monthly responded more strongly that the feed helped connect the course material to real-world examples, was worthwhile, and stimulated their interest in macroeconomics and current events. This is *prima facie* evidence that the approach is worthwhile; however, the sample was relatively small and relied only on student ex-post perceptions. More detailed studies using larger sample sizes and more sophisticated research designs are needed to provide greater insight into the impact on student learning and interest in economics.

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On the Importance of Teaching Real Estate in the Finance Curriculum: an Applied Project for Basic Finance Courses

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ABSTRACT

Real estate is the world's largest asset class. It plays an important role in the economy as a whole and in the portfolios of many individuals around the world. However, most business and even finance students have little exposure to real estate concepts. This paper discusses the importance of real estate and presents a series of exercises that can be assigned in introductory finance classes. Through these exercises, students enhance their overall finance knowledge and learn concepts not usually covered by introductory textbooks, such as choosing a mortgage, refinancing decision, and house affordability.

Introduction

While finance theory suggests that investors should be diversified, the majority of individuals in the developed world invest a disproportionate amount of their assets in real estate through the purchase of their primary residence. The overweighting of real estate may have increased over time since the homeownership rate in developed countries increased 20 percentage points in 50 years, from 40% in around 1950 to 60% in the 2000s (Jorda et al. 2014). Nearly 65% of individuals in the US own their homes.[2]

Primary residences account for the majority of individuals' wealth in many countries. Moreover, middle-class individuals are less diversified than top earners. Bloomberg shows that the top 20% of Americans are much more diversified than the next 60% (Greeley 2013). It reports that according to a recent study from 1983 to 2012, for the top 20% of Americans, principal residence as a share of net worth was around 30%. For the next 60% of Americans, which is the majority, the principal residence as a share of net worth rose from 62% to 67% of total wealth. Moreover, around 30% of Americans have zero or negative wealth outside of primary residence.[3]

Such a large allocation to real estate far exceeds recommended levels. In fact, many textbooks and financial advisor websites suggest that 100 minus a person's age should be the percentage of assets invested in stocks, with the remainder invested in bonds. They rarely mention real estate as a potential investment, and when they do, the recommended level of investment is between 5%-30%.

Despite the fact that the majority of individuals around the world allocate a disproportionate amount of their assets to real estate, many struggle to understand the complexities of mortgage financing and know little about real estate return and risk. The subprime mortgage boom and subsequent bust demonstrated the lack of understanding of real estate by many market participants, especially homeowners who took out larger mortgages than they could afford and assumed that home prices can only go up. Famous economist Robert Shiller (2009) argues that one of the main causes of the financial crisis of 2008 was that individuals undertook larger mortgages than they could afford, mainly because they did not understand many implications of mortgage financing.

Regular homeowners' lack of understanding of real estate is not surprising, given that even business

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[2] https://www.census.gov/housing/hvs/files/currenthvspress.pdf.

[3] https://www.financialsamurai.com/percentage-wealth-outside-primary-residence/.

students majoring in finance often graduate with little exposure to real estate.[4] Introductory and portfolio management classes rarely include real estate as a portfolio allocation choice. The most popular textbooks do not include real estate in their examples for risk and return discussions or time value of money problems. Few schools offer real estate as an elective, and even fewer offer real estate as a concentration or a major. Weeks and Finch (2003) find that only 40 (6.7%) out of 593 AACSB-accredited business schools (which are located around the world) offer real estate majors and 27 (4.6%) offer real estate concentrations.

In this article, I describe a project dealing with essential concepts of real estate that most students will encounter in their lives. This project can be assigned in its entirety or as a series of exercises in introductory finance classes and should be very relatable for students because it uses real-life scenarios and data. This project can be further enhanced with additional problems to make it a comprehensive personal finance project for the introductory finance class taken by all business students. In addition to introducing students to real estate concepts, the project expands students' knowledge of time value of money and Excel.[5]

The Importance of Real Estate for All Students

When assigning the exercises described in this paper, instructors can also discuss the importance of real estate. Today, real estate is the world's largest asset, whereas farmland was the largest class in the 18th century and factories were the largest class in the 19th century (*The Economist* 2020). Savills World Research reports the value of the world's real estate in 2017 to be US$280.6 trillion.[6] Residential real estate represented US$220.6 trillion, commercial real estate accounted for US$33.3 trillion, and agricultural and forestry real estate made up the remaining US$27.1 trillion. Real estate was followed by $105.3 trillion of outstanding debt, $83.3 trillion of global equity, and $114.1 trillion of oil reserves. Real estate represents by far the biggest store of wealth, representing 3.5 times global GDP. However, most real estate value is concentrated in North America and Europe. At the same time, China accounts for the largest share of global residential value. In the US, Foldvary (2016) estimates the value of US real estate at $65 trillion in 2016. Historically, the US's real estate and related industries accounted for roughly 18% of its GDP.[7] Jorda et al.'s (2014) study of 17 developed countries found the value of mortagages as a percentage of GDP increased from nearly 20% at the beginning of the 20th century to 69% in 2010 in the developed world As is mentioned in the introduction, real estate constitutes a large portion of the average assets of individuals around the world.

Bardos and Zaiats (2011) explain that real estate wealth has an important link to consumption and GDP growth. Specifically, fluctuations in housing wealth affect household consumption more than do fluctuations in financial assets. This observation is supported by studies that examine the elasticity of consumption with respect to housing versus financial wealth in global markets. Studies find that elasticity of consumption with respect to housing wealth ranges from 0.05 to 0.09, while the elasticity of consumption with respect to financial wealth is around 0.02 (Case et al. 2005, Bostic et al. 2009, Benjamin et al. 2004). This means that for housing wealth of $100, a one-dollar increase in house prices increases consumption by 5 to 9 cents, while a one-dollar increase in financial wealth increases consumption by only 2 cents. Case et al. (2005) find similar results in their examination of 14 developed countries during the period 1975-1996.The high elasticity of consumption with respect to housing wealth suggests that real estate has a higher impact on GDP growth in the United States, where nearly 70% of GDP growth is attributed to consumption. Bostic et al. (2009) show that a 10 percent decline in housing wealth from 2005 levels results in a one percent decline in real GDP growth. Such decline is nontrivial given that the average GDP growth in the United States is under 3%.

Real estate is also important is because it is more sensitive to changes in interest rates than other assets. This is important because changing interest rates is an important policy tool for central banks around the world. Case (2008) argues that one of the main reasons for the subprime crisis was the reaction of the real estate market to the historically low levels of interest rates and widely available credit. In the early 2000s, stocks and bonds were not performing well in the US and most of the cheap available credit flowed into real

[4] The overall level of financial literacy is also low. BenDavid-Hadar (2015) conducted a study of 283 educators studying at universities and teachers' colleges in Israel and found that they answered only 42% of the questions correctly.

[5] Cagle et al. (2010) find that students do better when assigned Excel work in introductory finance classes.

[6] https://www.savills.com/impacts/market-trends/8-things-you-need-to-know-about-the-value-of-global-real-estate.html.

[7] http://economistsoutlook.blogs.realtor.org/2014/04/17/always-important-real-estates-influence-grows/.

estate equity and debt markets and the financial sector. The size of the U.S. residential mortgage market increased from $4.8 billion to $10.5 billion between 2000 and 2007 (Federal Reserve Statistics Release 2010).

Prior research has also shown that individuals have biased perceptions about real estate returns. Case (2008) shows through a survey that expectations are backward-looking, that buyers perceive little risk in purchasing a home, and that the expected returns are unrealistic. For example, two-thirds of respondents of the survey in the spring of 2008 in Boston and San Francisco believed that prices would rise, not fall, that year. Results were similar for other cities. While there were many parties to blame for the financial crisis of 2008, it is clear that the subprime mortgage crisis would not have happened had individuals not bought houses they could not afford, not understanding mortgage payments over the life of the mortgage and hoping for continuous price appreciation of their homes. Gerardi et al. (2010) find that higher numerical ability is associated with lower delinquency and default, controlling for sociodemographic variables, various aspects of cognitive ability, and characteristics of the mortgage contracts. This shows that financial literacy played an important role in the subprime mortgage crisis (*The Economist* 2010).[8]

Given the importance of real estate and the importance of financial literacy, I argue that even an introductory finance course should, at a minimum, include time value of money exercises based on real estate data. I present a project that deals with many of the aspects of purchasing a home as well as refinancing decisions that, given homeownership rates, will be faced by the majority of students.

Active Learning Through Real Life Examples

Bredthauer (2016) highlights the importance of active learning. Active learning can be defined as anything that "involves students in doing things and thinking about what they are doing" (Bonwell and Eison 1991, p. 19). Bredthauer (2016, p. 246) defines active learning as a "method of instruction that engages students through the use of writing exercises, projects, and problem-solving activities. It allows students to build upon skills learned in the classroom, yet provides a different dimension to the learning experience by reinforcing these skills through the use of hands-on experience." Miller and Metz (2014) find that 78% of faculty are interested in learning more about incorporating active learning in their pedagogy, while students would like to see 40% of regular class time dedicated to active learning (something other than lecture).

I believe active learning is most effective in the context of real-life examples that students feel are relevant to them. Baird (2013) argues that students learn better when placed in a realistic setting and forced to discover things on their own. Real-life problems can create enthusiasm for the subject matter and give students confidence that they can do something immediately useful as they enter their professional lives. While most finance majors learn the concepts they need to apply to mortgage mathematics such as annuity calculations and non-annual compounding, at least 50% of the students in my upper-level finance class are unable to calculate a fixed-rate mortgage payment. Most mistakes stem from the inability to properly adjust for monthly compounding. Also, even though students learn to create an amortization schedule in introduction to finance or my class, few students can set it up in Excel for a mortgage example without assistance. When we finish constructing the amortization schedule, I always ask students to calculate total mortgage payments, total interest payments, and total principal repayments. Only after this exercise do students understand that the total principal repayment is the amount borrowed. But most importantly, I always get a loud "wow" when students calculate total interest payments. Prior to this exercise, none of my students realize that even at the current low mortgage interest rates, total interest payments can equal the amount borrowed. Including mortgage mathematics as part of time value of money problems using realistic numbers has proven an effective way of introducing students to important real-life financial problems.

According to Bredthauer (2016, p. 246), the main impediments to the practice of active learning are "the increased time required for faculty to integrate this style of instruction into their curriculum, the consumption of class time, and the lack of comfort with an alternative approach to teaching." The exercises described in detail in this paper can be implemented without any modifications; thus, integration costs are low. I believe that the proposed exercises can be incorporated even into the introductory finance class without significant loss of class time. At the most, one would need one or two additional classes devoted to real estate applications, which can be combined into a personal finance project. At the minimum, one can include just mortgage amortization schedule exercises, which would take approximately 30-45 minutes but I believe would be of great value.

[8] A number of studies highlight the importance of financial literacy in general (Brau et al. 2015, Anthes 2004, Maurer 2014).

A Personal Finance Project with Real Estate Concepts

The following is the project description addressed to students. The project contains both qualitative and quantitative questions. I found it beneficial to assign students into groups.

Project Description

Project Summary:

This project requires you to use time value of money concepts to analyze the decision to buy a house. You are required to work with real-life data during every step of the project so that you may better internalize time value of money concepts. Working on this project should serve as a good first step in helping you to transition toward financial independence and will help you relate to concepts covered in class.

Objectives:

-To apply time value of money concepts to a real-life problem.
-To learn the basics of personal financial planning.
-To deepen the understanding of mortgage financing.
-To improve Excel and analytical skills.
-To enhance team working and leadership skills.

Find a Team:

You MUST work on this project in a group of three or four. You are asked to work in teams for a few reasons. First, this will enable you to enhance your teamwork and leadership skills. Second, you will have an opportunity to learn from your fellow students. Every student in the team is required to put equal effort into the project. Every team member will receive the same grade for the project.

Detailed Project Description:

You are required to submit a spreadsheet with required calculations as well as a written report. You must label all answers clearly.

Let's assume you would like to buy a house in 10 years. Follow the steps outlined below and answer all questions.

1. **Owning versus renting**. What are the advantages of owning a house? Do you think buying a house in 10 years is a good investment? When is it better to rent rather than buy? Why did we experience such a run-up in house prices in recent years and then a collapse in property prices?
2. **Choose a house** you would hypothetically like to buy in 10 years. How much does it cost? To do so, you can check real estate listings on zillow.com, realtor.com, trulia.com, or raveis.com (selected states only).
3. **How much money do you need in 10 years? How much should you save?** You are hoping to save 20% of the house price for the down payment and to take out a mortgage for the remaining 80% of the house price. You also need to save for closing costs, which you assume will be 2% of the house price. You plan to invest $200 a month for the next 2 years while you are still at school. After you start working you would like to start saving a larger amount per month so that you have enough for the down payment and closing costs when you buy a house in 10 years. What should this amount be? You can find the rate on savings accounts at www.bankrate.com.
4. **Conforming versus nonconforming loans.** Describe the difference between conforming loans and nonconforming loans. Which loan would you be able to take out for the house you would like to purchase?
5. **Adjustable versus fixed-rate mortgages.** Why is the interest rate on adjustable-rate mortgages (ARMs) lower than the interest rate on fixed-rate mortgages? What are the advantages and disadvantages of ARMs relative to fixed-rate mortgages? When would you consider taking out an ARM?
6. **Mortgage payment.** Even though interest rates will change in 10 years, you will use current mortgage rates for your calculations. You decided to compare several mortgages and see which one will be most beneficial. Visit www.bankrate.com or the website of a mortgage provider (national or local commercial banks or mortgage companies) to find mortgage rates for the following mortgages and calculate their mortgage payments: 30-year fixed-rate mortgage, 15-year fixed-rate mortgage, and 30-year ARM.
7. **Amortization schedule.** Construct an amortization schedule for 30-year fixed-rate mortgage and 15-year fixed-rate mortgage using the template in Table 1.

Table 1: Amortization Schedule Template

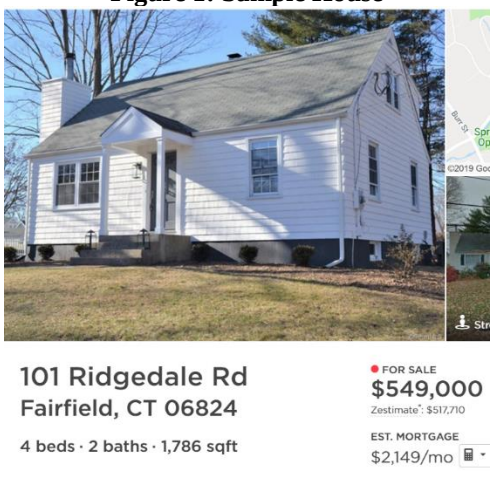
(1)	(2)	(3)	(4)	(5)	(6)
Month	**Beginning Balance**	**Mortgage payment**	**Interest Payment**	**Principal Payment**	**Ending Balance**

8. **Mortgage calculations.** Calculate the following:
-Total mortgage payment, total interest payment, total principal payment for both a 15-year and a 30-year mortgage. (Hint: you can sum columns 3, 4, and 5. Can you find the answers without using an amortization schedule?)
-Most experts believe that you should not spend more than 25-35% of your income on housing. Your housing expenses include your mortgage and your real estate taxes. Calculate the salary you need to earn to afford the house if you take out a) a 30-year fixed-rate mortgage, and b) a 15-year fixed-rate mortgage. You don't want to spend more than 30% of your income on housing expenses.
-Using the information so far in part 8, what are your observations about 30-year versus 15-year mortgages?
-For a 30-year fixed-rate mortage, if you increased your mortgage payment by $100 a month, how much sooner will you be able to repay your mortgage? How much less interest would you pay?
-For a 30-year fixed-rate mortage, if you decided to sell the house after 5 years (60 months), how much would you owe the bank (what would the outstanding mortgage balance be)? What amount of interest would you have paid over a 5 year period? What amount of principal have you repaid? Can you find these numbers without an amortization schedule?
9. **Refinancing.** Assume that the interest rates drop by 1% in 5 years. It costs you $4,000 to refinance. Should you refinance or not? You will take out a 25-year loan for the amount needed to repay your old loan.

Teaching Note

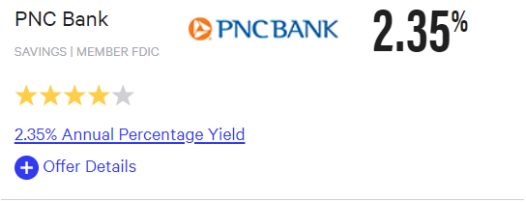
Below please find a sample solution to the project with commentary about which concepts can be emphasized during the discussion of the project.
1. **Owning versus renting**. It is better to buy because it allows you to build up equity (you are not throwing away money on rent). Moreover, you have a place to call home, which you can modify to your taste. However, there are also many advantages to renting. One of the main advantages is flexibility. First-time buyers often keep their house for less than five years and there are substantial costs to buying and selling real estate. Mortgage payment goes mainly toward interest payment in the early periods. You will build up equity only if prices appreciate. If you invest all your wealth into your house, you do not diversify, and other assets can yield better returns. Moreover, one doesn't need a large down payment to rent. One might be constrained by the lack of credit history or have bad credit. Homeownership carries the risk of maintenance. Besides, there are bubbles in house price which might make it challenging to time the market with the purchase.
2. **Choose a house**. For illustration, Figure 1 shows a house near Fairfield University where I work. It is listed for $549,000. I will assume the house sells for the listing price. Its property taxes are $9,387 a year.

Figure 1: Sample House



3. **How much money do you need in 10 years? How much should you save?** First, a student must find a rate he/she can earn on the savings account. Figure 2 shows a rate obtained from www.bankrate.com.

Figure 2: Sample Mortgage Quote



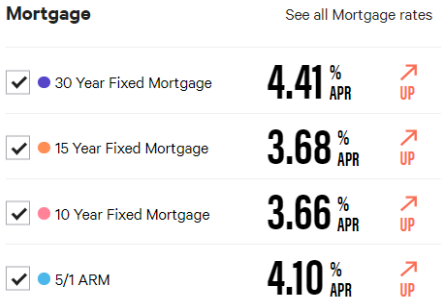
The total amount that needs to be saved is equal to 20% of the house price plus 2% for closing costs: 20%*549,000+ 2%*549,000= $120,780. To meet this goal, you will be saving $200 a month for 2 years. To find the FV of that savings: PMT=200, PV=0, N=2*12, I=2.35%/12. Solving for FV = $4,909.67. Now we need to find how much one needs to save for the remaining 8 years for the down payment and closing costs. This is an annuity problem. PV=- $4,909.67, FV=$120,780, N=8*12, I=2.35%/12. Solving for PMT= $1,088.64.

4. **Conforming versus nonconforming loans.**[9] Conforming loans are the ones conforming to the criteria established by the Federal Housing Finance Agency (FHFA) and meeting the funding criteria of Freddie Mac and Fannie Mae. Lenders that originate loans that can be sold to Freddie Mac and Fannie Mae usually charge lower interest and fees compared to non-conforming loans because it is more difficult for the lender to sell non-conforming loans in the secondary market. In 2019, conforming loan limit in most of the US is $484,350. The limit is higher in high-cost areas, like Connecticut which has a limit of $726,525. Hence, one can take out a conforming loan to purchase the chosen house.

5. **ARMs versus fixed-rate mortgages.** The interest rate on the ARM is lower than the interest on fixed-rate mortgages because it carries lower interest rate risk for the lender. Lenders' risk associated with fixed-rate mortgages is asymmetric. Lenders will incur a loss if they originate fixed-rate mortgages and interest rates increase after origination. Lenders will gain if they originate fixed-rate mortgages and interest rates decline. However, a decline in interest rates results in prepayments. Lenders often borrow short and lend long. ARMs allow lenders to match changes in interest rate costs with changes in interest revenue. However, ARMs do not eliminate all interest rate risks. The longer the loan's adjustment period, the greater the interest rate risk. Since longer adjustment periods increase interest rate risk, they should correspond to higher yields. At the time of origination, the expected yield on an adjustable should be less than on a fixed-rate mortgage. Both lenders and borrowers face uncertainty when making ARMs. Borrowers might find it difficult to estimate the cost of borrowing given the effect of different ARM characteristics. Borrowers' default risk increases (hence, the shift of interest rate risk can be counterbalanced).

6. **Mortgage payment.** Figure 3 shows mortage rates obtained from www.bankrate.com on March 7, 2019. Table 2 shows payment calculations for different mortgages. Note that all loans are fully amortizing, hence FV=0 because you owe nothing to the bank after you make the last payment.

Figure 3: Sample Mortgage Rates: Different Terms



[9] This section can be omitted if project is adopted for students outside of the US.

Table 2: Payment Calculation for Different Mortgages

Mortgage type	**Solving for PMT**	Rate (Rate in Figure 2 divided by 12)	PV House price*.80	N	FV
30-year fixed	**$2,201.94**	0.37%	439,200	360	0
15-year fixed	**$3,178.73**	0.31%	439,200	180	0
ARM	**$2,122.21**	0.34%	439,200	360	0

7. **Amortization schedule.** Table 3 shows the first three and the last three months of a 30-year mortgage's amortization schedule. Please note that the ending balance in month 360 is zero. To set up an amortization schedule, start with the beginning balance. For month 1, it is the mortgage amount (house price*0.80=549,000*0.80=439,200). In month 2, it is month 1's ending balance. The mortgage payment is calculated in step 6. The interest payment is the beginning balance times interest. So for month 1, it is 439,200.00*0.37%. The principal payment is equal to the mortgage payment minus interest payment (= $2,201.94-$1,614.06=$587.88). The ending balance is equal to the beginning balance minus the principal payment (= 439,200-587.88=438,612.12). Table 4 shows the calculations for a 15-year fixed rate mortgage.

Table 3: Completed Mortgage Amortization Schedule – 30-Year Fixed-Rate Mortgage

Month	**Beginning Balance**	**Mortgage Payment**	**Interest Payment**	**Principal Payment**	**Ending Balance**
1	439,200.00	$2,201.94	1,614.06	$587.88	438,612.12
2	438,612.12	$2,201.94	1,611.90	$590.04	438,022.09
3	438,022.09	$2,201.94	1,609.73	$592.21	437,429.88
358	6,557.55	$2,201.94	24.10	$2,177.84	4,379.72
359	4,379.72	$2,201.94	16.10	$2,185.84	2,193.87
360	2,193.87	$2,201.94	8.06	$2,193.87	(0.00)

Table 4: Completed Mortgage Amortization Schedule – 15-Year Fixed-Rate Mortgage

Month	**Beginning Balance**	**Mortgage Payment**	**Interest Payment**	**Principal Payment**	**Ending Balance**
1	439,200.00	$3,178.73	1,346.88	$1,831.85	437,368.15
2	437,368.15	$3,178.73	1,341.26	$1,837.47	435,530.68
3	435,530.68	$3,178.73	1,335.63	$1,843.10	433,687.58
178	9,478.00	$3,178.73	29.07	$3,149.66	6,328.34
179	6,328.34	$3,178.73	19.41	$3,159.32	3,169.01
180	3,169.01	$3,178.73	9.72	$3,169.01	0.00

8. **Mortgage calculations.** First, *using an amortization schedule*, we can calculate the sum of the mortgage payment, interest payment, and principal payment columns for the life of the loan. Tables 5 and 6 show the sum of mortgage payement, interest payment and principal payment columns over the life of the loan for 30-year and 15-year fixed rate loans, respectively.

Table 5: 30-Year Mortage: Payment, Interest and Principal After 30 Years

Total Mortgage Payment	**Total Interest Payment**	**Total Principal Payment**
$ 792,697	$ 353,497	$ 439,200

Table 6: 15-Year Mortgage: Payment, Interest and Principal After 15 Years

Total Mortgage Payment	**Total Interest Payment**	**Total Principal Payment**
$ 572,171	$ 132,971	$ 439,200

Without an amortization schedule, one can recognize that principal payment is equal to the loan amount. The total mortgage payment is equal to payment times the number of periods. For example for a 30-year mortgage it is equal to $2,201.94*360 = $792,697. Hence, the total interest paid over the life of the loan must be equal to the difference between the total mortgage payment and loan amount (total principal payment): $792,697 - $439,200 = $353,497.

To calculate the required income, one needs to calculate the total housing expense. It equals the monthly mortgage payment plus monthly real estate taxes (Table 7). To calculate the required monthly income, divide the total housing expense by 30%. The required annual income is 12 times the required monthly income.

Table 7: Required Income Calculations

	30-year mortgage	15-year mortgage
Mortgage payment	$2,201.94	$3,178.73
Real estate taxes	$782.25	$782.25
Total housing expense	$2,984.19	$3,960.98
Required monthly income	$9,947.29	$13,203.27
Required annual income	$119,367.48	$158,439.21

In step 7, we established that a 15-year mortgage has a much larger monthly payment than a 30-year mortgage. Not surprisingly, the income required to afford a 15-year mortgage is much higher than the income required to afford a 30-year mortgage ($158,439.21 versus $119,367.48, respectively). However, the advantage of the 15-year mortgage, as shown above, is that the total interest paid over the life of the loan is much smaller than the total interest paid for the 30-year mortgage [$132,971 (Table 6) versus $353,497 (Table 5)]. This illustrates the power of compounded interest.

To determine how much sooner you will repay your mortgage if you increase your mortgage payment by $100, one needs to solve the following problem: PV= -$439,200.00, PMT=$2,201.94+$100, I=0.37%, FV=0. Solving for N gives N = 329. This is 31 months shorter than the original maturity of 360 months.

To solve for the amount of interest one would pay, first calculate total mortgage payment =($2,201.94+$100)*329 = $757,338. The total interest payment is equal to total mortgage payment, just calculated, minus the loan amount = $757,338-$439,200=$318,138. This is $35,359 smaller than the total interest payment shown in Table 5.

To find the loan balance after 60 months, one can find the answer on the amortization schedule by checking the ending balance in month 60 as shown in Table 8.

Table 8: Ending Balance After 5 Years – 30-Year Mortgage

Month	Beginning Balance	Mortgage Payment	Interest Payment	Principal Payment	Ending Balance
60	400,546.78	$2,201.94	1,472.01	$729.93	$399,816.86

You owe $399,816.86 after 5 years. We can find this number using an FV calculation with the following inputs: PV=-439,200.00, PMT=2,201.94, N=60, I=0.37%. Solving for FV yields $399,816.86, matching the figure shown in Table 8. Then we can sum corresponding columns for 60 months (Table 9) to obtain mortgage, interest, and principal payments over the first five years of the mortgage.

Table 9: Payment, Interest and Principal After 5 Years – 30-Year Mortgage

Mortgage Payment over 60 months	Interest Payment over 60 months	Principal Payment over 60 months
$132,116.22	$92,733.08	$39,383.14

Note that you can find these numbers without an amortization schedule. The calculations are somewhat more involved than when calculating these numbers over the life of the loan. First, we can recognize that the principal paid over 60 months is the loan amount ($439,200) minus the loan balance after 60 months ($399,816.86). We indeed get the amount in the table above: $39,383.14. Finding the total mortgage payment over 60 months is easy, since the payment is constant: $2,201.94*60=$132,116.4. Now we can find the interest payment over 60 months as the difference between mortgage payment over 60 months and the

principal paid over 60 months: $132,116.4 - $39,383.14=$92,733.26 (the small difference between this number and the one found adding the column in an amortization schedule is due to rounding).

9. **Refinancing.** Assume that interest rates drop by 1% in 5 years. It costs you $4,000 to refinance your house. Should you refinance or not? There are two ways to approach the decision to refinance.

Method 1: When you refinance, your refinancing costs get you a lower payment. Let's find the difference in payments. We found the payment on the old loan earlier. We also found the loan balance in month 60. This becomes the balance on the new loan. Knowing the payments on both the old and the new loan, we can find the return on investing refinancing costs to save $219.61 per month. Solving for I, PV=$4,000, PMT=$219.61, N=25*12, FV=0, yields the solution I=5.49% (Table 10). Annualizing we get 65.88%. This rate should be compared to the rates of returns of securities of similar risk. If this return is higher, you should refinance. This return is very high, so you should refinance.

Table 10: Refinancing Calculations – 30-Year Mortgage

	Old loan	New Loan
Loan amount	$439,200.00	$399,816.86
Rate	4.41%	3.41%
Term	30	25
PMT	$2,201.94	$1,982.33
PMT (Old) - PMT (New)	$219.61	
Return:	5.49%	

Method 2: Another way to evaluate the refinancing decision is to calculate the effective borrowing cost for the new loan accounting for the $4,000 refinancing cost. Solving for I, PV=$399,816.86-$4,000, PMT=$1,982.33, N=25*12, FV=0, yields the solution I=0.29%. Annualizing you get 3.50%. This rate should be compared to the rate on the old loan (4.41%). Since this rate is lower, you should refinance.

Feedback from Students

I taught Introduction to Finance for the first time in Fall 2008 and because of events like the subprime mortgage crisis, I spent a lot of the time discussing current events with my students. That is when it became apparent to me that business majors had very little knowledge of the housing market and mortgage mathematics. That is when I introduced the project described in this paper to my students. Many students commented in class and during my office hours how they understood the subprime mortgage crisis much better after completing the project. At the end of the class, students had to fill out both quantitative and qualitative teaching evaluations. Qualitative teaching evaluations asked: “What aspects of the course contributed the most to my learnings?” In Fall 2008, 84.6% of students listed the project when answering this question (26 students filled out teaching evaluations, and 22 listed the project as contributing the most to learning). None of the students listed the project when responding to the question “Were there aspects of the course that did not contribute to your learning?” I have taught Introduction to Finance a total of five times, and the average number of students listing the project when answering the question “What aspects of the course contributed the most to my learnings?” was over 80% (the average number of responses per class was 25.6 students).

Conclusion

This paper argues that there is currently a gap in education of business students because they are not exposed to real estate concepts. This is troubling given the importance of real estate both for the overall economy and from a personal finance standpoint. The project developed in this paper is designed to significantly enhance students’ knowledge of real estate concepts. The project is based on real-life data and therefore is based on active learning. While assigning this project in my introductory classes, I found that when students spend the time to find a house they would like to hypothetically buy as well as research the

interest rates, they start to fully understand time value of money. I think an essential part of this project is using real-life data. This is particularly important when calculating mortgage payment and the total interest paid over the life of the loan. When seeing these values for scenarios students can relate to, they become enlightened. I think an important payoff of the project is calculating house affordability. This gives students a reality check. I believe assigning this project or its parts using real-life data can greatly enhance students' financial literacy and better prepare them for the real world.

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