A Study of Time Value of Money Educational Interventions

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Time Value of Money (TVM) concepts are foundational to learning in personal financial planning and finance courses. This study applied Connectivism Learning Theory (CLT) to create educational interventions meant to increase student understanding of TVM using Excel and a financial calculator as learning tools. Results show students exposed to the learning intervention using a financial calculator performed better than those exposed to Excel alone or a combination of Excel and a financial calculator. These findings point to the structural entrenchment of the financial calculator in the teaching of TVM, and the challenges an instructor might face when introducing other methods to supplant it.

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Introduction

Time Value of Money (TVM) concepts are foundational for students studying personal financial planning and finance. TVM helps students and individuals concretize present-future tradeoffs, a key element in understanding benefits related to delayed gratification behaviors and more advanced applications in retirement and investment planning. These advanced subjects include topics such as the calculation of education and retirement needs and investment fund selection (and the related opportunity cost of other prospects). Students who do not adequately comprehend TVM concepts could struggle with increasingly complex topics in subsequent coursework. As such, many professors invest significant resources and time in teaching TVM within foundational courses in the major sequence.

TVM can be taught via several instructional strategies. Common methods of teaching include in-class lectures and videos (created by the professor or attained through platforms like YouTube) and the use of tools such as financial calculators and Microsoft Corporation's Excel spreadsheet software (hereafter referred to simply as Excel). Another important variable in lesson planning is how long to expose students to TVM topics before moving on to other lessons. The questions underlying these selections are crucial to student comprehension. Subsequently, this research probes best practices in teaching TVM concepts, both in terms of duration of exposure and selection of effective tools.

Literature Review

TVM has a long history of use in decision-making across industries, making it necessary learning for business, finance, and personal financial planning students. Shrieves & Wachowicz (2001) noted that using discounting

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methods found in TVM calculations dates to the Old Babylonian period of 1800 B.C. To cite only a few examples of how TVM is used in industry, Lucko (2013) explored the role of singularity functions for the application of TVM in the budgeting process in the construction industry. Baruom & Patterson (1996) discussed the use of heuristics and Net Present Value (NPV) – a finance concept closely related to the time-based value of money in financing decisions – in improving financial calculations beyond the traditional approaches in operations management. Finally, Weil (1990) explored the relationship between generally accepted accounting principles (GAAP) and the discounting of cash flows within the accounting profession.

Once students gain a solid understanding of basic TVM concepts, they quickly learn how integral TVM is to all areas of finance. A review of an open-source finance textbook, *Principles of Finance* (published by OpenStax), shows that it introduces the most basic, single-payment TVM problems in Chapter 7 after teaching students about accrual accounting, financial statements, ratio analysis, and corporate structure and governance (Dahlquist & Knight, 2024). Once this foundational TVM idea is presented, more complex concepts are introduced, including multiple payments, both equal and unequal. This level unlocks a whole new world of financial learning, including NPV analysis and other computational methods for capital budgeting decisions, loan amortization schedules, interest rate comparisons, and stock and bond valuations.

However, gaining a basic understanding of TVM, before scaffolding into higher levels of financial analysis, is not without its challenges. Learning TVM can be difficult due to the potentially challenging mathematical relationships underpinning the calculations (Delaney et al., 2016; Jalbert, 2002). Additionally, problems quickly build in complexity when graduating from single, lump sum calculations to multi-period payments (i.e., annuities). Consequently, different experiential and simplified approaches to teaching TVM have previously been explored, including using graphical approaches and Excel. Arellano et al. (2012) demonstrated the use of Excel to teach students TVM concepts using a retirement model. Martinez (2013) assessed the use of graphics (the "Time Value of Money Tree") within Excel to simplify the learning of TVM (p. 107). Jalbert (2002) developed a flow-chart system to help students answer TVM problems (see also Jalbert et al., 2004, for an updated version of this method). Jalbert's process was later modified by Newfeld (2012) for use with students with dyslexia. Gardner (2004) introduced several pedagogical changes to simplify TVM calculations, including helpful modifications to the variable inputs. Finally, Dempsey (2003), based on the encouraging results of an experimental study conducted by the author, encouraged educators to teach TVM problems mathematically for maximum educational benefits.

Theoretical Framework

Pedagogically, it is certainly beneficial to test the efficacy of various technologies in learning TVM. Indeed, this study presents evidence of varying efficacy of using a financial calculator or Excel in the learning of TVM concepts. However, another pedagogical question remains: To what extent does supplementary practice, trial and error, and extra exposure to TVM concepts assist students in learning these important concepts? Does practice truly make perfect? To answer this question, this research uses a relatively new educational theory formulated by Siemens (2005) and Downes (2008): Connectivism Learning Theory (CLT). CLT accepts the role of technology in education and seeks to explain its role in the learning process. It also emphasizes the importance of interaction and building connections (i.e. "emergence") and active learning in the acquisition of knowledge (Downes, 2008; Siemens, 2005). A key concept of CLT is "network learning" where connections are formed from exposure to new content, associations, and learning interactions (Downes, 2008; Siemens, 2005). CLT posits that learning evolves in a similar way to the training process for machine learning, which develops through a tree-like structure of pathways ("if this, then that; if not that, then this" programmatic logic) using nodes and connections (Siemens, 2005). Crucially, greater exposure to a concept (such as TVM) helps build one's learning network by creating new nodes that contain new information,

which in turn builds stability into the knowledge structure (Siemens, 2005). Simplistically speaking, the CLT learning process describes the progression of exposure to new concepts through trial and error to aid in the acquisition of knowledge. Indeed, Downes (2008) uses the term "artificial" – not in the same usage as the term artificial intelligence, *per se* – but to explain the interpretive nature of learning connections as filtered through neurons and neural clusters.

This research is dual-purpose. First, this study applies CLT by investigating supplementary, interactive learning experiences and opportunities for trial and error (beyond lecture and existing course content) to increase student learning of TVM. Stated differently, does additional exposure to TVM content help build a more stable knowledge structure for students – one that leads to better assessment results? This underpins the CLT premises that "repetition is an excellent way of strengthening connections" (i.e., creating nodes) and engagement with active learning is a positive development in the education process (Siemens, 2005). Second, this study tests the efficacy of student exposure to different technologies (financial calculator and Excel) to aid in the learning of TVM concepts.

Hypotheses

This study introduces three hypotheses for testing:

- Hypothesis 1: Students who practice TVM questions using Excel will increase the number of questions answered correctly in the second exam (E2) as compared to the baseline exam (E1).
- Hypothesis 2: Students who practice TVM questions using a financial calculator will increase the number of questions answered correctly in the second exam (E2) as compared to the baseline exam (E1).
- Hypothesis 3: Students who practice TVM questions using Excel **and** a financial calculator will outperform all other groups in the second exam (E2) as compared to the baseline exam (E1).

Methodology

This experimental study was administered to students enrolled in an introductory financial planning course at a midwestern university during the fall 2023 semester. Figure 1 provides an overview of the research design. Before interventions from this study, students were exposed to a TVM lecture on September 5 and a 10-question quiz that included 5 TVM questions due September 13 in the Canvas learning management system (notated as Q1 in Figure 1). This lecture and quiz constituted the previously built-in exposures to TVM concepts for this course, in addition to recorded TVM financial calculator videos housed in Canvas. The lecture was a live demonstration of working through TVM problems with the calculator shown on the screen. After the typical teacher-student interaction and quiz, students took a longer exam (Exam 1) on September 14 that contained 10 TVM questions (see Appendix A for the questions contained in the first exam)[3]. This first exam in the experimental sequence – notated as E1 in Figure 1 – was the baseline knowledge assessment for this study in lieu of a control group. Afterward, three TVM educational interventions were randomly assigned to students enrolled in the class using Qualtrics between October 16 and October 26. The three treatment groups are notated as treatment groups A, B, and C in Figure 1. Treatments were administered to students after voluntary enrollment in the experiment and the signing of an informed consent form (see IC box in Figure 1). The three educational interventions assigned to the respective groups were:

1. Group A: One 28-minute video explaining how to complete various TVM questions using Excel. The video was recorded using the screen-sharing feature in Zoom. The video's content starts with one of the authors (Anderson) introducing himself at the beginning of the video and then proceeding to share his screen to display the 10 TVM

[3] This quiz tested TVM as well as tax concepts covered in the course.

questions in a Word document, complete with the answers to each question shown at the end of the page. After these questions were introduced, Anderson proceeded to share an Excel workbook on the main screen. The Excel workbook was set up with 10 worksheets (one for each question), with a prebuilt area containing the TVM variables: N for number of periods, PV for present value, FV for future value, I for interest rate, and PMT for payment. The final, eleventh sheet displayed the answers and relevant formulas for each question. Anderson then worked through each worksheet by first reading a question from the list of 10 questions, inputting the variables corresponding to N, PV, FV, I, and PMT in the prebuilt area, filling in the necessary calculations to uncover the correct answer, and checking the answer against the answer worksheet. The full intervention can be viewed on YouTube at the following link: https://www.youtube.com/watch?v=ZjCVF6yqw6I. As a part of the intervention, students were encouraged not only to watch the video but also to complete the questions on their own using Excel.

2. Group B: One 28-minute video explaining how to complete various TVM questions using a financial calculator (specifically, the Texas Instruments BA II Plus). Like the Excel intervention, the video was recorded using the screen-sharing feature in Zoom. The video's content starts with Anderson introducing himself with a digital version of the BA II Plus projected to the main screen before sharing the Word document with the 10 TVM questions and answers. Anderson then re-shared the calculator on the main screen and explained the relevant keys present on the calculator, including buttons to enter TVM variables, clear work, change from BEG and END mode, and make a number negative. Anderson proceeded to read each TVM question and input the appropriate variables into the BA II Plus to achieve the correct answer. The full intervention can be viewed on YouTube at the following link: https://www.youtube.com/watch?v=-MqHKBefeko. Again, students were encouraged not only to watch the video but also to complete the questions on their own using their financial calculator.

3. Group C: This group was assigned the 28-minute video explaining how to complete various TVM questions using Excel **and** the 28-minute video explaining how to complete them using a financial calculator (for approximately 1 hour total).

These three interventions were designed to increase the students' exposure (time) to TVM concepts and opportunity to engage in trial and error with TVM problems, in line with CLT. This is why duration was allowed to vary across interventions (i.e., ~30 minutes vs. 1 hour). Students were allowed to take a no-credit TVM quiz to practice the concepts during the interventions and is notated as Q2 in Figure 1. The intervention videos continued to be available to students once released by the Qualtrics survey. After the completion of the interventions, students took a longer exam (Exam 2) on November 9 in Canvas to assess the efficacy of the educational interventions. This exam is notated as E2 in Figure 1.[4] Consistency between surveys was upheld by maintaining a common question structure, wording choice, and number of questions (10) while ensuring at least three numerical values were modified for N, PV, FV, I, or PMT.

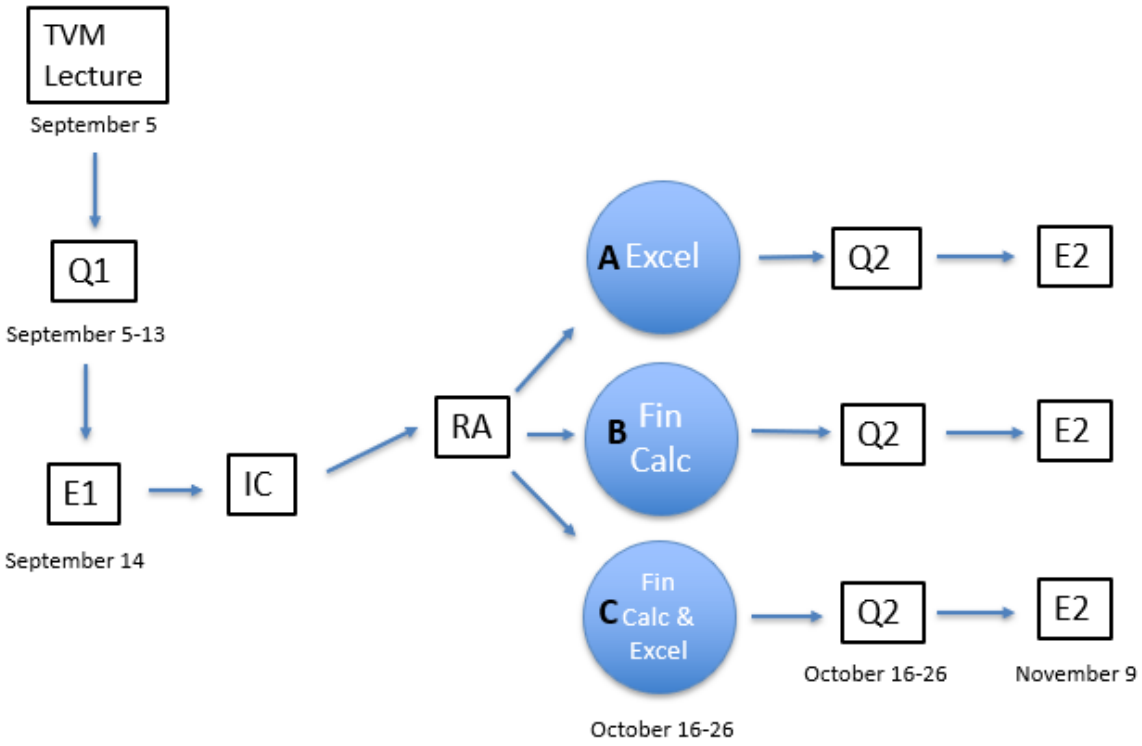
Post-testing showed some differences between the intervention groups. Group A had the highest ending grades for the semester (94% received As) while Groups B and C had 81% and 88% As, respectively. The average scores on E1 were 9.12, 8.25, and 8.78 for Groups A, B, and C. The average scores on E2 were 9.06, 8.91, and 8.44 for Groups A, B, and C.

[4] This exam tested TVM as well as insurance concepts covered in the course.

Results and Analysis

Of the 108 students enrolled in the course, 97 students participated in the study's interventions. Of the 97 who participated in the interventions, two students were dropped from the study for not completing E2. Of the remaining 95 participants, 31 were randomly assigned to Group A (Excel intervention), 32 to Group B (calculator intervention), and 32 to Group C (Excel and calculator). Timestamps for submissions on the Qualtrics survey ranged from the 10-day period between the dates of October 16 to October 26, 2023, with one outlier showing December 5. Statistics provided by YouTube for the intervention videos on the dates of October 16-26 were exported and shown in Table 1, whereas post-intervention viewing data is shown in Table 2. During the intervention period, the Financial Calculator TVM YouTube video had 74 views and the Excel TVM Video 67 views. The average watch time (per view) and total watch time for the Excel video exceeded that of the financial calculator.

Figure 1. TVM Experimental Research Design



In other words, the average view duration and total watch time statistics show students gained more exposure to the Excel intervention as compared to the calculator intervention. The average view duration for both videos was less than the total video length, indicating the videos were not watched for their entire duration. This data does not show, however, the breakdown of exposure between the various intervention groups, as unique viewer identifying information was not available from YouTube.

Table 1. YouTube Video Statistics for October 16 - 26

	Views	Total Video Length	Average View Duration	Total Watch Time (hours)
Excel	67	28:51	9:41	10.8
Calculator	74	28:28	7:50	9.7

Table 3 shows descriptive statistics for the total gains (or losses) from E1 to E2 by intervention (n = 95). Results show the financial calculator intervention was the most effective in improving scores between exams, with a score increase of .656.

Table 2. YouTube Video Statistics for October 27 - November 9

	Views	Total Video Length	Average View Duration	Total Watch Time (hours)
Excel	10	28:28	0:33	0.1
Calculator	5	28:51	2:51	0.2

On the other hand, the Excel intervention was neutral while the combined intervention showed an average score drop of -0.344 points. Data collected shows that the reinforcement of the learning of calculators led to the most students increasing scores and the lowest decreasing scores.

Table 3. Descriptive Statistics for Gains by Intervention

	Observations	Mean	Std. Dev.	Min	Max	Higher Score	Lower Score
Excel	31	0.000	1.414	-4	2	10	7
Calculator	32	0.656	1.911	-4	5	12	4
Excel + Calculator	32	-0.344	1.945	-9	3	6	6

A regression analysis of TVM exam score gains (E1 to E2) on each intervention is shown in Table 4. The only significant result in this analysis is, unsurprisingly, for the financial calculator intervention independent variable ($p < 0.05$). Results show that, all other things held equal, the financial calculator intervention, as compared to the lack of an intervention, predicts a score increase of 1.55. This regression model accounts for 6.2% of the variance in TVM exam score gain. Given the findings outlined in this section, hypothesis 1 is rejected as students did not display an increase in TVM exam scores after the Excel educational intervention. There is support for hypothesis 2, as students demonstrated a significant increase in exam scores due to the financial calculator intervention. Hypothesis 3 was rejected, as students did not show an increase in exam scores after being exposed to both interventions.

Discussion and Limitations

Teaching TVM to future financial planners is a complex task. This study presented limited evidence of the efficacy of using a financial calculator to teach TVM concepts to undergraduate students in personal financial planning. This finding is limited, however, by the fact that all students were taught how to use a financial calculator within the course before this study's interventions, and subsequent learning was on that foundation.

Table 4. Regression of Intervention on Score Gain

	Coeff		SE	95% Confidence Interval	
Excel	0.889		0.732	-0.563	2.340
Calculator	1.545	*	0.729	0.0988	2.991
Excel + Calculator	0.545		0.729	-0.901	1.991
Constant	-0.889		0.644	-2.167	0.389
Model fit statistics					
R-squared	0.062				
Adjusted R-squared	0.034				

* Significant at $p < 0.05$

They were also offered support and resources geared toward using the financial calculator instead of Excel, including a lecture and recorded videos. Past sections of this course only used the financial calculator, so assigned course peer mentors would have been able to assist with the calculator, but not Excel.

The intervention groups were not pre-tested for more accurate sorting. This resulted in an interesting finding which confirmed the usefulness of continuing historical methods, i.e., using a financial calculator to teach TVM. Two factors, scores correlated with higher overall grades and improvements being ascribed to lower initial scores, were counteracted by the slightly unbalanced populations. It could be assumed that the group with the highest grades would perform the best. Instead, the calculator-only group had the lowest overall grades in the class and yet improved the most from E1 to E2. Further, the calculator-only group erased its gap from E1 to E2 and performed similarly on E2 compared to the group with the highest grades (the Excel-only group). To counteract improvements due to reversion to the means, the two groups had similar E2 scores, but only one group had a statistically significant improvement between E1 and E2.

It is certainly possible that students gravitated to the financial calculator – and performed well using this tool – simply due to its structural entrenchment in the teaching of TVM. After all, the syllabus encourages students to buy a financial calculator but mentions nothing of Excel. Even outside of the historical use of the financial calculator to teach TVM, a brief survey of online resources shows financial calculator videos and study materials are more readily available for students studying TVM. Prerecorded lectures from previous years are also available and solely demonstrate effective use of a financial calculator. Efforts from this study and others trying to introduce new tools (i.e. Excel) and methods to teach TVM face significant headwinds going against the traditional teaching methods. Given that software such as Excel can be intimidating to master, and financial calculator tools are readily available, it is perhaps difficult to have students transition to a new way of dealing with the problems. In other words, our findings might be a nod to entrenched structural support more so than a win for a specific

educational intervention, especially considering the YouTube average view duration and total watch times for the Excel intervention were greater than for the financial calculator. It may simply be more effective to continue teaching TVM using whatever method with which students are most familiar.

Theoretically, processing information using different methods would expand knowledge and understanding. This may be true once the individuals have somewhat mastered one method before being introduced to another. Data collected from YouTube showed limited student engagement with the interventions, given that the average viewing time for videos was significantly lower than their full length. In other words, even though the study participants assented to the Qualtrics question "I have watched the video and followed along with the exercises," YouTube analytics showed this was not the case for all students. This might help explain the perplexing contrast between score gains for the financial calculator, yet a potential drop when exposed to both the Excel and financial calculator interventions. The drop in score might be explained by the longer intervention time (i.e. watching two videos for 1 hour versus one for 30 minutes) or because students became overwhelmed by learning two different methods for TVM calculations. The fact that there was limited interaction with the videos post-intervention could indicate that students felt fully prepared for the upcoming examination or, perhaps, they found little value in continuing to view them after multiple exposures to TVM concepts within the course (see Table 2). The practice videos provided examples of 10 calculations each, and students may have skipped solutions to check understanding and stopped after a few were understood. The similar question structure between the quizzes and exams could have played a part, too, in less-than-full engagement from students. Alternatively, students could have simply skipped to the parts of the video they found most helpful. This study was not structured to answer these questions, although a future study could do so through design improvements.

To expand on potential improvements to the study design, the authors offer the following suggestions. First, YouTube analytics for video interventions and responses collected in Qualtrics for the educational intervention could not be merged at the individual response level, as no unique viewer identifying information was available from YouTube. This precluded the ability to connect watch times to exam performance or highlight potential outliers based on engagement, especially considering student engagement with the videos post-intervention was very limited. Future research could connect these two data sources using an alternative video delivery method. Second, a data collection of student capabilities and experiences interacting with the various interventions might better explain differences in student scores and engagement. Third, future research might go beyond TVM questions that require simplistic manipulation of one missing variable to attempt a better assessment of a more holistic understanding of TVM. In other words, do educational interventions – with the tools presented here or others – help students apply TVM concepts to case studies, client problem solving, and real-world scenarios? CLT would bolster such a distinction, as both real-life experience and exposure to information are ways to create and strengthen new learning nodes yet remain distinctive paths within the theoretical framework (Siemens, 2005). If one tool promotes the learning of TVM concepts at a higher level, its use might be justified beyond a simple increase in assessment scores.

Conclusion

What was learned from this study that can benefit the teaching of TVM concepts? First, this study expounded on the efficacy of using a financial calculator to teach TVM concepts. Although many methods exist for teaching TVM, innovative teachers might first acknowledge a potentially uncomfortable reality: the entrenched method of using a financial calculator to teach TVM might be adequate, even preferred. When most resources support one way of teaching, adopting the supported approach might prove to be the most efficient path forward (even if learning a new method brings unique advantages). In fact, this conundrum is analogous to financial professionals who try to introduce a new software, method, or process into their firm:

there can be significant headwinds. When the wind gets too strong, swimming with the current is recommended. A second point of learning is to acknowledge another observation: students are savvy at building their own learning journey. This study's comparison of video and intervention data shows students tailor learning to fit their specific needs – even if it means dropping a potentially helpful video once it has served its purpose. However, as long as the course's learning outcome is achieved, this might be perceived as a positive, rather than a negative, outcome. Finally, the results of this study – and specifically the finding that a longer intervention (Excel and a financial calculator) was less effective than a shorter one (the financial calculator alone) – encourage teachers to adopt a streamlined approach (i.e., "keep it simple") to teaching TVM.

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Appendix A – TVM Quiz Questions

Exam 1 (E1)

1. How much must you invest today at 8% interest in order to see your investment grow to $15,000 in 10 years (round the answer to the nearest dollar)?
    a. $6,330
    b. **$6,948 (correct answer)**
    c. $7,500
    d. $7,620

2. At what annual rate would $500 grow to $1,948 in 12 years?
    a. 10.0%
    b. 11.0%
    c. **12.0% (correct answer)**
    d. 12.5%

3. If Lucky Louie won a lottery and chose to take $1,000,000 in cash (disregarding taxes), how much money would he have in 30 years if he invested at 6% per annum (round the answer to the nearest dollar)?
    a. **$5,743,491 (correct answer)**
    b. $5,804,268
    c. $6,050,972
    d. $7,890,345

4. Sally contributes $3,000 each year to her Roth IRA (a type of retirement savings account). What is the value of her account after 5 years if her annual return is 4% per year (round the answer to the nearest dollar)?
    a. $3,650
    b. $8,453
    c. $12,931
    d. **$16,249 (correct answer)**

5. Dan can earn an 8% annual interest rate. If he invests $20,165 today, how many years does he have to wait to accumulate 32,000 (round to the nearest whole year)?
    a. 2 years
    b. 4 years
    c. 6 years (correct answer)
    d. 8 years

6. A client intends to place a $2,500 lump sum amount into a savings account that earns 5% interest, **compounded monthly**. If the lump sum is left to accumulate, how much will be in the account in the future, at the end of 4 years (round the answer to the nearest dollar)?
    a. $2,057
    b. $2,542
    c. $3,039
    d. **$3,052 (correct answer)**

7. Judy would like to have $200,000 saved in her retirement account in 20 years. At an interest rate of 7 percent, how much should she contribute each and every year (round the answer to the nearest dollar)?
    a. $3,492
    b. $3,569
    c. $5,684

   d. **$4,879 (correct answer)**

8. Every year, Mark puts $500 in a bank account that earns an annual rate of return of 6% at the BEGINNING of the interest rate cycle. How much will you have in that bank account after 6 years? (round the answer to the nearest dollar and **USE BEGIN MODE**)
   a. -$3,697
   b. -$3,488
   c. $3,488
   d. **$3,697 (correct answer)**

9. Billy wants to attend McPherson College when he graduates high school in 7 years. Current annual tuition is $19,000. If tuition rates are rising at 6%, what will be the annual tuition cost when Billy enters college in 7 years (round the answer to the nearest dollar)?
   a. $12,636
   b. $23,825
   c. $28,514
   d. **$28,569 (correct answer)**

10. If Jim wants $25,000 in 5 years and can earn an 8.33% interest rate that is **compounded quarterly,** how much does he need to invest today (round the answer to the nearest dollar)?
   a. **$16,554 (correct answer)**
   b. $16,980
   c. $20,410
   d. $37,755

Exam 2 (E2)

1. How much must you invest today at 15% interest in order to see your investment grow to $20,000 in 15 years (round the answer to the nearest dollar)?
   a. $1,568
   b. $1,786
   c. **$2,458 (correct answer)**
   d. $2,594

2. At what annual rate would $1,500 grow to $2,221 in 10 years?
   a. 3.0%
   b. 3.5%
   c. **4.0% (correct answer)**
   d. 4.5%

3. If Lucky Louie won a lottery and chose to take $500,000 in cash (disregarding taxes), how much money would he have in 15 years if he invested at 8% per annum (round the answer to the nearest dollar)?
   a. **$1,586,085 (correct answer)**
   b. $1,698,345
   c. $2,467,711
   d. $2,679,345

4. Sally contributes $5,000 each year to her Roth IRA (a type of retirement savings account). What is the value of her account after 10 years if her annual return is 8% per year (round the answer to the nearest dollar)?
   a. **$72,433 (correct answer)**
   b. $75,699

c. $76,606
d. $77,556

5. Dan can earn a 4% annual interest rate. If he invests $29,230 today, how many years does he have to wait to accumulate 40,000 (round to the nearest whole year)?
   a. 2 years
   b. 4 years
   c. 6 years
   d. 8 years (correct answer)

6. A client intends to place a $4,000 lump sum amount into a savings account that earns 6% interest, **compounded monthly**. If the lump sum is left to accumulate, how much will be in the account in the future, at the end of 5 years (round the answer to the nearest dollar)?
   a. $3,529
   b. $4,557
   c. **$5,395 (correct answer)**
   d. $6,722

7. Judy would like to have $400,000 saved in her retirement account in 15 years. At an interest rate of 9 percent, how much should she contribute each and every year (round the answer to the nearest dollar)?
   a. $13,624 (correct answer)
   b. $13,331
   c. $14,444
   d. $14,561

8. Every year, Mark puts $1,000 in a bank account that earns an annual rate of return of 8% at the BEGINNING of the interest rate cycle. How much will you have in that bank account after 8 years? (round the answer to the nearest dollar and **USE BEGIN MODE**)
   a. -$11,488
   b. -$10,311
   c. $10,311
   d. $11,488 (correct answer)

9. Billy wants to attend McPherson College when he graduates high school in 5 years. Current annual tuition is $12,000. If tuition rates are rising at 5%, what will be the annual tuition cost when Billy enters college in 5 years (round the answer to the nearest dollar)?
   a. $14,101
   b. $14,387
   c. $15,211
   d. **$15,315 (correct answer)**

10. If Jim wants $22,000 in 7 years and can earn a 7.22% interest rate that is **compounded quarterly,** how much does he need to invest today (round the answer to the nearest dollar)?
    a. **$13,332 (correct answer)**
    b. $15,554
    c. $16,707
    d. $17,605