Journal of
# Instructional Techniques In Finance

VOLUME 5-6, 2013-2014

*DEDICATED TO EFFECTIVENESS IN TEACHING FINANCE*


Stock Simulations: Game and Group Design to Reduce Risky Behavior and Enhance Learn-

**Empirical Finance in R: An Introduction**

*Filling in the Gaps: An Excel Based Integration of Financial Performance and Condition*

**Teaching the Time Value of Money: Advantages of the Continuous Compounding (Exponential) Method**

**Best Practices: Experiential Education in Finance**

A Publication of the
*INSTITUTE OF FINANCE CASE RESEARCH*

VOLUME 5-6, 2013-2014

# Journal of Instructional Techniques in Finance

**A publication of the *INSTITUTE OF FINANCE CASE RESEARCH***



**The Editorial Board is responsible for the selection of manuscripts from among those submitted for consideration. Editors accept final manuscripts electronically and make suitable alterations solely for the purpose of organization, pagination, and aesthetics.**

**For additional copies, please contact the IFCR. Those interested in subscribing, advertising, or submitting manuscripts to the Journal of Instructional Techniques in Finance, as well as other communications, should contact the current editor.**

**Jose Gutierrez, Editor, JITF**
**General Business and Finance, COBA**
**Box 2056, Huntsville, TX 77341**
**(936) 294-1283**

**Note from the previous Editor, Steve Johnson:**
***During 2015, Jose Gutierrez will transition into the role of Editor of the Journal of Instructional Techniques in Finance. I will stay on as an Associate Editor, assisting Jose with the transition and remaining actively involved in the review process. I have enjoyed my time as Editor, and appreciate the excellent contributions of our authors to the teaching of finance.***

## CONTENTS:



COVER PHOTO: The Venetian, Las Vegas, Nevada

# Best Practices of Experiential Education in Finance

*Cheri Etling, Speros Margetis, Nicole Taranto, and Samantha Taranto*

*Experiential education provides a pedagogical approach to facilitate learning through direct experience. The principles of best practices of experiential education are applied to finance pedagogy to provide a resource to faculty interested in creating learning experience opportunities. Faculties at The University of Tampa apply a variety of experiential pedagogical approaches across the finance curriculum. We briefly describe experiential education as a pedagogical approach followed by various applications of experiential education in finance curriculum.*

## INTRODUCTION

How does learning occur? There are a variety of approaches and learning models that provide theories of how learning occurs. Experiential education is an approach that engages learners through direct experiences and focused reflection. The student benefits of experiential education are well stated in the literature and provide a framework for creating valuable learning experiences. Students become engaged learners by applying concepts and techniques to situations faced in the workplace. Following an experience students internalize the knowledge through reflection. This approach provides students a deeper understanding of concepts than traditional approaches. These experiences prepare students to enter the workforce with the ability to apply analytical techniques to a variety of situations.

Experiential education is an instructional approach based on the notion that ideal learning occurs through direct experience. The Association for Experiential Education (2013) defines experiential education as a philosophy that inform practices in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities. The National Society for Experiential Education (2013) developed the "8 Principles of Good Practice for All Experiential Learning" to outline conditions, steps and actions that are necessary for success in experiential learning. According to the NSEE there is a mutual responsibility in the learning process and in the relationship between the learner and any facilitator(s) of learning. All parties are empowered to achieve the principles, which follow.

1. Intention
2. Preparedness and Planning
3. Authenticity
4. Reflection
5. Orientation and Training
6. Monitoring and Continuous Improvement
7. Assessment and Evaluation
8. Acknowledgement.

The facilitator(s) of learning are expected to initiate the process in ensuring both the quality of the learning experience and of the work produced and in supporting the learner to use the principles, which underlie the pedagogy of experiential education (NSEE, 2013). Finance faculty members apply experiential education principles through a variety of approaches across their curriculums. These techniques facilitate learning through experiences and reflection. The following is a brief description of several experiential learning activities within multiple courses that are designed to prepare future business leaders. Any assignments discussed for the following courses are available from the author upon request.

## INTERMEDIATE FINANCIAL MANAGEMENT

Senior finance majors who will be graduating in a semester or two make up the majority of students in this course. Consequently, it is important for them to apply the concepts taught to real companies and situations. The topics covered in the course include dividend policy, capital structure, cost of capital, capital budgeting, working capital management and Du Pont analysis.

This course has always been applied with numerous projects. The change to a more experiential format involves tying the topics together into a semester long project so that the students see how all of the corporate finance topics are related. It also gives students a greater opportunity to apply their knowledge to analyzing one company from a variety of angles.

The major experiential component involves a semester long project that incorporates an analysis of dividend policy, capital structure, cost of capital, components of working capital management and Du Pont analysis. It includes written communication through two memos, Excel analysis, and an oral presentation. Finally, it requires both individual work throughout the bulk of the semester with the final Du Pont analysis and presentation completed as a team. Students complete an individual reflective piece as a component of the final group assignment. The primary goal of this experiential exercise is to encourage students to

stretch their skills beyond structured textbook examples to the messiness of the real world.

**Learning Objectives Assessed:**

Students will:

- Complete a Du Pont analysis and evaluate the strengths and weaknesses of a firm
- Complete a weighted average cost of capital for a firm
- Discuss the static theory of capital structure and the implications for firm value
- Explain and use a variety of techniques in the analysis and management of a firm's working capital
- Identify and describe the key determinants of dividend policy
- Communicate analysis and recommendations effectively with professional business documents
- Develop and use spreadsheets effectively

**Assignments**

The overarching premise of the assignments is that each student has been hired by the Board of Directors of a company for a three-month period to evaluate areas of the firm's performance. The final project is a team Du Pont analysis and presentation to the Board. While the students do not work with the actual company in this assignment, they are evaluated on how professionally and effectively they communicate with the intended audience. The students are each assigned a publicly traded company that has a presence in the local economy. The number of companies per class depends on class size but it is best to have three to four students per company. This a good team size for the final project while allowing for the fact that some students may drop. Students are not told who is on their team until the team assignment is provided at the end of the semester. The students are reminded multiple times that the initial projects are individual work.

Du Pont analysis is introduced at the beginning of the semester and students are reminded with each assignment that they will be presenting a Du Pont analysis at the end of the semester. The goal is to encourage them to collect relevant data and information as they complete each deliverable. Students are also introduced to a number of web sites that can be used to find the required information or help with professional communication. A list of the sites introduced is provided in the Appendix.

The first assignment has three parts. The first part is to determine an appropriate benchmark to use when evaluating the firm's performance. The second part is to investigate the firm's dividend policy over the last five years by looking at dividend payout rates. The students are to consider the firm's policy relative to the chosen benchmark, along with reasons discussed in class for high and low dividend payouts. Their task is to incorporate this information into a discussion about whether the firm is currently following an appropriate dividend policy. The third part is to evaluate the firm's capital structure relative to the benchmark and to consider differences in book value capital structure versus market value capital structure. They are to make recommendations to the Board regarding the appropriateness of the capital structure incorporating the static theory, pecking order theory and the information content of financing decisions. They are required to present the information in a professional one-page, single spaced memo with appropriate APA citations and works cited.

The second assignment requires students to collect the data to estimate the company's overall weighted average cost of capital. They are required to use Excel for all calculations. They must estimate the market value of debt based on information in the most recent 10-k or 10-Q and find the appropriate cost of debt based on whether the firm has publicly traded or privately held debt. They have to estimate the cost of equity using the dividend growth model, if appropriate, and the CAPM. All data must be collected from online sources. This assignment is submitted as a professionally formatted Excel document.

The third assignment focuses on working capital management. The students are required to calculate the firm's cash cycle relative to the benchmark and discuss the implications for short-term financing needs. They must also determine if the firm has a flexible or restrictive working capital policy and discuss how that impacts credit analysis, inventory management, and cash management. This assignment is also submitted as a one page, single-spaced memo with appropriate APA citations and works cited page.

Student teams are formed after completion of the third assignment and are given a week to put together a Du Pont analysis for the firm. This final project is designed to allow students to learn from each other as they see how others collected and interpreted information. Each team is given between 10 and 15 minutes to present their analysis to the Board (the other students in the class). They are evaluated individually on professional attire and presentation skills. The team is evaluated on a smooth and cohesive presentation and the professionalism and effectiveness of the presentation materials.

The benefit of this approach over the traditional lecture, exams and stand alone assignments is that it provides students practice finding and interpreting company information as it relates to finance theory and management. Since every company is different, there is inherent ambiguity in the assignment structure and in how the information is presented within the various sources. This forces the students to think critically about what information is relevant and how to use it. Tying all of the assignments to the same company allows students to see the interrelatedness of the decisions that financial managers make. The series of assignments requires them to utilize

spreadsheet skills along with written and oral communication skills. These are all skills that companies demand but that students often have little practice using in a traditional lecture format.

Another benefit is that it provides students with a complete analysis that they can discuss during the interview process to illustrate what they have learned and the type of analysis they are capable of completing. At least two students have gotten jobs and/or internships with the companies that were analyzed in class in part because of the work that they had done. Copies of the assignments are available from the authors upon request.

**ENTREPRENEURIAL FINANCE**

Entrepreneurship students typically take the Entrepreneurial Finance course in their junior year after they have conducted a feasibility analysis for a business they intend to launch. If a student does not intend to launch a business they are connected with other entrepreneurs who have completed a feasibility analysis for a business being launched. Each student creates a dynamic business model projecting cash flows each month for the first year and then quarterly out to five years. Monte Carlo simulation is utilized to analyze the risk return profile for the new business. The feasibility analysis provides the basis for the assumptions in the business model. It is critical that each assumption is realistic and is thoroughly researched prior to being entered into the model.

**Learning Objectives Assessed:**

- Create financial forecasts that allow the entrepreneur to predict the timing and amounts of financing required to grow the firm.
- Use working capital management to minimize the problems associated with the lack of liquidity of the new venture and to prevent the insolvency of the new venture.
- Determine the optimal capital structure that maximizes the value of the new venture for the entrepreneur.

The course begins with an unannounced elevator pitch designed to break the ice and engage students in the learning process. Each student is asked to provide a two minute elevator pitch of their business venture followed by questions and answers. After all the presentations are completed, the instructor demonstrates a completed business model that includes a Monte Carlo simulation using Crystal Ball software. Appropriate techniques for efficiently creating a dynamic business model utilizing Monte Carlo simulation are identified. Crystal Ball provides cumulative probability distribution graphs of forecasted variables along with sensitivity analysis of all assumptions (Margetis 2009). This presentation initiates a class discussion where each student is asked to identify the key assumptions in their business models so that they can begin to form the structure of their model. Students submit their completed feasibility analysis from a previous course and prepare to build their model in Excel.

During the next two class periods students create their business model. They are encouraged to collaborate and help work through issues with their peers. The instructor provides the students with general techniques that are helpful in overcoming common issues that students encounter when building a business model. Each assumption entered into the model is thoroughly examined and must be meticulously documented. Students present their business model in the following class. These presentations provide the instructor an opportunity to vigorously question each assumption and the projected cash flows. Students are encouraged to question their peers during the presentations. The presenters have their business models "torn apart" by the instructor and other students in class in order to force the students to think critically about their business model. They quickly realize that their business models and assumptions are inadequate during this first round of presentations. Each student is asked to write a one page reflection on what they need to do to improve their business model following their presentation and critique.

Students correct the issues identified during the presentations and prepare to present again in class. The second round of presentations gives the students an opportunity to incorporate what they have learned from the first round of presentations and the class discussions into their business model. Typically by the second round of presentations students have learned to critically question assumptions and have become more proficient in identifying the weaknesses of business models. The repetitive process of preparing and critiquing a variety of business models allows students to expand their awareness and understanding of business strategies. Engaging students in the learning process forces them to step outside their comfort zone and make decisions when faced with ambiguity. Students become more critical in the evaluations of their peers during the second round of presentations. This helps prepare them for the panel of judges they will face during the final presentations. The second round of presentations pinpoints remaining inadequacies in the business models and provides students with additional feedback that they can use when preparing their final presentation.

The final presentations are done before a panel of venture capitalists, successful entrepreneurs and faculty in a "shark tank" format. Each panel member is allotted a fictitious $1,000,000 to fund new businesses. Class grades are determined by whether a student's business received funding, the quality of the business model, and the analysis of the risk of the new business. Several students have received real funding from panel members following their presentation. One student received $20,000 from a

successful entrepreneur to file a patent and manufacture demonstration models of the product to be used in marketing the product. Once this milestone is achieved additional funding would be made available to market the product and provide working capital to facilitate sales. The experience has accelerated the development of the student's business from idea to launch. Several venture capitalists on the panel expressed interest in later rounds of financing for the company dependent on achieving a series of milestones including filing patents, manufacturing the product, receiving purchase orders, and becoming cash flow positive. The external validation of student ideas often motivates them to continue to work and develop their businesses after the class is over.

Previously the entrepreneurial finance course was taught using the traditional lecture and exam method. Students were provided lecture material on financial accounting, valuation methods, working capital management, pro-forma cash flow estimates, and sources of capital. This method lacked authenticity and did not adequately prepare students to launch a business. The entrepreneurial students under this approach did not understand the importance of finance and lacked a deep understanding of the concepts. They were unable to apply the concepts to real world applications. Comments from the students indicated that they were not interested in finance and they just wanted to start running their business. They viewed that the finance function was not important for entrepreneurs and could be outsourced to a CPA firm. Following the changes in pedagogy entrepreneurial students appreciate the importance of finance in making business decisions and can apply financial techniques to quantify the benefits and costs associated with each alternative. Business decisions are now more thoroughly analyzed to maximize enterprise value subject to the constraints the entrepreneurs face. The entrepreneurship students now are better prepared to start and run their ventures following the changes in pedagogy.

**NEW VENTURE CAPITAL**

New Venture Capital is a graduate elective course that is focused on investing in early stage, high growth firms from the venture capitalist's (VCs) point of view. Most of the students in this course are interested either in starting their own businesses, becoming an investment banker, or working at a venture capital firm. Lectures on term sheet terminology, deal structuring, and valuation are provided to provide the students the necessary skills to evaluate term sheets critically. Students are then given an "investor friendly" term sheet to evaluate and identify key negotiation items. Students are randomly split into entrepreneurs and venture capitalists and then paired up to negotiate a final term sheet in class. The students are then asked to write a reflection on how the experience achieved the learning objectives. The in class experience provides an authentic experience that demonstrates the complexities of negotiating private equity terms for new business ventures. Students benefit from using critical thinking skills to apply theoretical constructs to real world situations and have a deeper understanding of the nuances of financial decisions.

**Learning Objectives Assessed:**

- Interpret legal terms used in financial documents
- Evaluate impact of alternative capital structures on firm value
- Negotiate term sheet conditions
- Value enterprises using appropriate valuation techniques
- Quantify the financial impact of term sheet conditions

The course begins with a series of lectures aligned with learning objectives and assessment. The lectures are divided into mini-lectures based on learning objectives. The learning objective is stated at the onset of the lecture. The lectures typically span fifteen to twenty minutes followed by a brief student discussion of the appropriateness of the material in achieving the learning objectives. Formative assessment of the learning objective is employed following each min-lecture to provide the students an opportunity to evaluate their understanding of the material. This typically involves providing students current examples from the financial press and asking students to apply the knowledge in analyzing the articles. This approach requires students to use critical thinking skills to apply theoretical constructs to real world settings. The students submit a five minute reflection paper on their analysis. The instructor uses the reflection papers to determine if the learning objectives are achieved and to adjust future pedagogy for continuous improvement.

Following the lecture series the students are given an actual term sheet offered to the management of a new venture. The name of the firm is changed to protect the identity of both the venture capitalist and entrepreneur. The term sheet was written by the venture capitalist's attorney and strongly favors the VC. Students are given one week to analyze the term sheet and prepare a written response analyzing the financial implications of the terms of the offer for both the entrepreneur and the VC. This exercise has two primary goals. The first goal is help students understand term sheets from a real-world perspective. The second is to better prepare students for their potential future as an entrepreneur, investment banker, or a VC. Entrepreneurs often find themselves at a disadvantage when negotiating terms with a venture capital firm. VCs tend to have more experience with term sheets since they negotiate them on a regular basis while this may be the first time that an entrepreneur has seen one. Also, since entrepreneurs are in need of the funding they often feel less able to push for certain terms that are more in their favor for fear the VC

will walk away from the deal. This exercise illustrates this mismatch by putting the students in both the role of VCs and entrepreneurs.

After evaluating the actual term sheet provided in class, the students are split into groups representing a variety of entrepreneurs and venture capital firms. Then venture capital firms and entrepreneurial companies seeking equity financing are divided into groups. The groups may contain an equal number of entrepreneurial companies and venture capital firms, there may be more venture capital firms than entrepreneurial companies (boom time), or there may be more entrepreneurial companies than venture capital firms (bust times). The venture capital firms begin the process by providing a term sheet for the entrepreneur to review. The term sheet includes the terms under which the VC is willing to invest its capital and favors the venture capital firm. It includes key terms such as pre-money valuation of the company, amount of equity the venture capital firm is willing to invest and the proposed ownership percentage following the investment.

This begins the negotiation experience for the students. The task for each group is to agree on the final terms and provide a completed term sheet. Since venture capital firms are often more sophisticated and have more power than the companies seeking capital, the entrepreneurs must carefully evaluate the terms and identify areas that strongly favor the VC. The entrepreneurs must then propose alternate terms that are more favorable to them but that the VC is likely to accept. They must provide a list of proposed changes to the VC along with a defensible rationale for the change. This provides the basis for the negotiations between the entrepreneurs and the venture capitalists. It may be necessary during the negotiating period for the instructor to provide mediation if groups are at a complete standstill. Another remedy to force negotiation is to make the overall grade of the exercise based upon a successful completion of the term sheet. This forces the groups of VCs and entrepreneurs to negotiate terms and work through minor differences. Prior to leaving class the students are required to submit the final agreed upon term sheet.

For the next class period, students provide a written paper examining what they considered while negotiating the term sheet and discuss the biggest issues or pitfalls they had while negotiating. Groups then discuss their final agreements with the class. The presentation of the final term sheets provides a good opportunity to discuss the conflicts of interest that arise when negotiating the term sheet. It also provides insight into how market conditions impact the final outcome of the agreements. Students develop firsthand knowledge of the difficulty in determining the fine details included in a term sheet. They also acquire a better understanding of the negotiation skills required in business. After each group has discussed their negotiated terms, the instructor provides the students with highlights of the actual final terms negotiated for this particular deal if it is based on real companies or expected terms given current market conditions if based on mock companies.

Previously the lectures were provided in the traditional format of lectures spanning the entire class period with a mid-term and final exam for assessment of learning objectives. This method lacked authenticity and did accurately assess the ability of students to apply knowledge to real world settings. Students were not engaged in the learning process and were not required to reflect on their achievement of learning objectives. The new pedagogy encourages students to become engaged learners and facilitates deeper knowledge through reflection. Students perform better on post assessments and are better prepared to apply knowledge in their careers. Comments from students indicate that the experience of negotiating the term sheet enhanced their understanding of the material and forced them to use critical thinking skills.

## APPLIED INVESTMENT MANAGEMENT

Applied Investment Management is an elective for senior finance majors. Students are only admitted by permission of the instructor. Students taking this course manage a real money investment portfolio. Throughout the semester, students consider the financial markets and current and proposed securities investments for the portfolio. They examine investment decisions from the perspective of the investment management team in the context of an integrated, global investment environment.

This course provides students the opportunity to directly apply their finance skills through the hands-on management of a real portfolio. Students are engaged in real-world investment activities that provide valuable skills for their future careers. This course is taught with a decision-making focus that requires students' to use appropriate quantitative analysis to justify their decisions with respect to a variety of investment alternatives. Over the course of the semester students use current prices and transactions, as well as time-proven analysis techniques to make investment recommendations and decisions.

### Learning Objectives Assessed:

Students will:

- Explain and apply investment policy principles to the design of a managed portfolio.
- Discuss the advantages and disadvantages of active versus passive management
- Explain concepts of market efficiency and their implications for investors
- Explain the rationale for international diversification
- Describe the costs and difficulties in international investing
- Explain the various strategies known as "value", "growth" and "momentum"
- Discuss the evidence on the performance of different style portfolios
- Identify the most successful strategies for the past 10 years and longer term

- Explain the CAPM in the context of modern portfolio theory
- Compute and interpret beta, alpha and r-squared

This course emphasizes making investment decisions that are consistent with portfolio objectives in a competitive, efficient-market environment given limited and ambiguous information. Students formulate investment objectives, develop investment policy, and implement investment strategy. Students apply key finance principles that guide the selection of investments, measure portfolio performance, and evaluate the performance of investment managers.

Specifically, students manage a real money portfolio valued at more than $182,000 during the spring semester of 2014. Students take on the role of both a financial analyst and a portfolio manager as they apply the theories and concepts of investments to evaluation and selection of securities for the portfolio. The risk-return paradigm is central to the analysis. Students hone their quantitative and qualitative analysis skills as well as their written and oral presentation skills in an environment that has real consequences in terms of the returns on the portfolio.

In the role of financial analysts, students research and present an analysis of both portfolio firms and new firms for inclusion in the portfolio. Students make recommendations for specific stocks based on valuation measures, risk, attractiveness of the industry, and financial performance.

In the role of portfolio managers, students make decisions about which securities to keep in the portfolio and which securities to add to the portfolio based upon recommendations of the financial analysts and their own individual research. Students must use the appropriate quantitative analysis to justify their decisions with respect to a variety of investment alternatives. Students must also evaluate appropriate asset allocation and the rebalancing of the portfolio through time.

Previously the applied investment management course was taught using the traditional lecture method with periodic exams for assessment of learning objectives. This method lacked authenticity and did not accurately assess the ability of students to apply knowledge in a real world context. The new pedagogy encourages students to engage in real-world investment activities that provide valuable skills for their future careers. The decision-making focus of the course requires students to use critical thinking skills, which ultimately enhances their understanding of the material. The new pedagogy creates opportunities for students to gain real-world experience with investment portfolios and students are better prepared to make investment decisions in their future careers.

**Appendix**

Reuters
http://www.reuters.com

SEC Company Fillings
http://www.sec.gov/edgar/searchedgar/companysearch.html

MSN Money
http://money.msn.com

Yahoo Finance
http://finance.yahoo.com

Bloomberg
http://www.bloomberg.com

Financial Industry Regulatory Authority
http://www.finra.org/Investors/index.htm

Mergent
http://www.mergentonline.com

**REFERENCES**

Margetis, S. (2009) Using Crystal Ball ® Software to Simplify Simulation Analysis in Excel, Journal of Instructional Techniques in Finance, 1(1), 12-14.

Standards and Practice. (n.d.). National Society for Experiential Education. Retrieved February 1, 2014, from www.nsee.org/standards-and-practice

What is Experiential Education?. (n.d.). Association for Experiential Education: A community of progressive educators and practitioners, Retrieved February 1, 2014, from http://www.aee.org/

*Speros Margetis is a Professor of Finance at The University of Tampa.*

*Cheri Etling is an Associate Professor of Finance at The University of Tampa.*

*Nicole Taranto is a finance major at The University of Tampa.*

*Samantha Taranto is a finance major at The University of Tampa.*

# Teaching the Time Value of Money: Advantages of the Continuous Compounding (Exponential) Model

***Douglas Jordan and Torben Thomsen***

*It is vitally important that business students understand the conceptual meaning of the time value of money (TVM) and how to solve TVM related business problems. Most textbooks explain TVM using only discrete compounding. We argue that incorporating continuous (or exponential) compounding into the curriculum can be advantageous. The exponential model allows students to develop a better conceptual understanding of TVM problems. It allows instructors to visually demonstrate a number of important TVM concepts. And finally, the exponential model allows students to understand and solve problems from the natural world. Student reaction to the incorporation of continuous compounding into the curriculum is generally positive.*

## INTRODUCTION

The time value of money (TVM) is central to modern finance. Therefore, TVM is discussed in all introductory finance textbooks. However, the majority of textbook authors only use discrete (annual, monthly, daily etc.) compounding periods when teaching TVM. We believe the incorporation of continuous compounding into TVM pedagogy will improve students' intuitive understanding of important TVM concepts. Introducing continuous compounding into the curriculum allows students to gain insight into TVM problems rather than simply learning the sequence of buttons to push on a financial calculator when faced with a specific TVM problem.

There are a number of areas where taking a continuous compounding view of the situation can aid student understanding. For example, a simple exponential curve to the left and right of the origin can be viewed as an indifference curve intuitively relating past, present, and future values for a particular interest/discount rate. In addition to showing the future value of an annuity, the area under an exponential curve to the right of the origin shows a visually compelling relationship between the amount of money contributed by the investor, the interest earned, and the value of compounding over long time periods. An exponential curve to the left of the origin visually shows the relationship between the amount of money borrowed and the total interest paid on a loan. And finally, there are many problems relating to the natural world (carbon-14 dating problems and intravenous drug dosing, for example) that are easily solved if the student is familiar with continuous compounding. Each of these areas will be described in detail in this paper.

The next section describes how TVM is covered in financial textbooks. There are then four sections describing the advantages of the continuous compounding model in detail. The article concludes with suggestions on how to incorporate continuous compounding into the curriculum and a description of the generally positive reception of students to continuous compounding.

## TEXTBOOK TREATMENT OF TIME VALUE OF MONEY

We did a brief survey of corporate finance textbooks in order to better understand the conventional approach to teaching the time value of money. This was not intended to be a comprehensive survey of the prominent texts in the field. Rather, the intent of the survey was to find out the extent to which continuous compounding and growing annuities are covered in current textbooks. Results of the survey are shown in Table 1.

Table 1 shows that seven of ten texts surveyed do not mention continuous compounding at all. Eight of the ten texts do not discuss how to calculate the future value of a growing annuity. Half the texts surveyed do not include continuous compounding or the future value of growing annuities. The Brealey, Myers, Allen graduate level textbook, Principles of Corporate Finance 8th edition, contains a more extended treatment of continuous compounding than the other texts. Interestingly, Brealey et. al. include two separate tables in an appendix that serve a similar function to Table 3 in this paper.

We believe that the omission of continuous compounding and the future value of growing annuities from most textbooks leaves room for improvement in the TVM pedagogy for most professors. Therefore, the intent of this paper is to explain how including continuous compounding in the TVM pedagogy can improve student comprehension of important TVM concepts.

### The Exponential Curve as an Indifference Curve

If two cash flows occur at different points in time, they must be translated to the same point in time in order to be compared. That point is usually either the present or the future, but it could be any point in time. With discrete compounding, the familiar equation FV = PV*(1 + r)t is

used to do the actual calculation. In this equation r is the discrete interest rate and t is the number of discrete periods.

**Table 1: Textbook Treatment of Continuous Compounding and the Future Value of Growing Annuities**

| Textbook | A | B | C | D |
|---|---|---|---|---|
| Brealey, Myers, Marcus: Fundamentals of Corporate Finance 4th ed. | X | | | |
| Keown, Martin, Petty, Scott: Foundations of Finance 4th ed. | X | | | |
| Brigham and Houston: Fundamentals of Financial Management 8th ed. | X | | | |
| Beck, Demarzo, Harford: Fundamentals of Corporate Finance 1st ed. | X | | | |
| Ross, Westerfield, Jordan: Essentials of Corporate Finance 6th ed. | X | | | |
| Welch: Corporate Finance, An Introduction 1st ed. | | X | | |
| Berk, Demarzo: Corporate Finance: The Core 1st ed. | | X | | |
| Gitman: Principles of Managerial Finance 11th ed. | | | X | |
| Megginson, Smart: Introduction to Corporate Finance 1st ed. | | | X | |
| Brealey, Myers, Allen: Principles of Corporate Finance 8th ed. | | | | X |

A) No mention of continuous compounding or future value of growing annuities.
B) No mention of continuous compounding, gives discrete solution to future value of a growing annuities.
C) Includes a brief section on continuous compounding, no mention of future value of growing annuities.
D) More details on continuous compounding, no mention of future value of growing annuities

With continuous compounding, the equation becomes $FV = PV * e^{it}$, where i is the continuous rate of interest and t is the length of time. When the discrete compounding period is short (daily for instance) the differences between the future values given by the two equations is small. However, the advantage of the continuous compounding version is that it allows us to view an exponential curve as an indifference curve between cash flows past, present, and future. For example, consider the exponential curve for 10% compounded continuously shown in Figure 1.

**Figure 1. Exponential Indifference Curve of one US dollar for r = 10%**

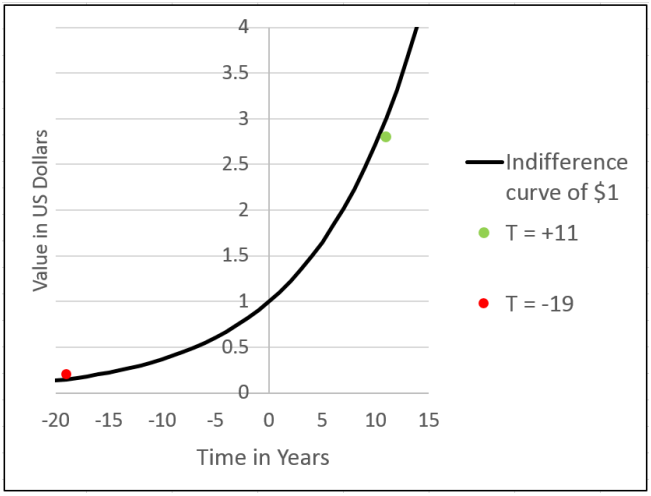



Figure 1 shows that 15 cents 19 years ago [$e^{(-0.1*19)} = e^{-1.9} = 0.15$] is equivalent to $1 today, which is equivalent to $3.00 eleven years in the future [$e^{(.1*11)} = e^{1.1} = 3.0$]. The exponential curve gives us a picture of the bank balance at various points in the past and future that is equivalent to $1 today. Since all these different amounts are equivalent, we can easily compare amounts at different points in time. The exponential curve can be seen as a model of the fact that we expect compensation for any delay, and conversely that an amount of money invested at any point will grow over time. The compensation is the amount of interest that could be earned during the period of the delay. In general, we prefer points above the indifference curve to points below the indifference curve. For example, we would prefer receiving 20 cents 19 years ago to receiving $2.90 eleven years in the future, because 20 cents is above the indifference curve and the $2.90 is below it.

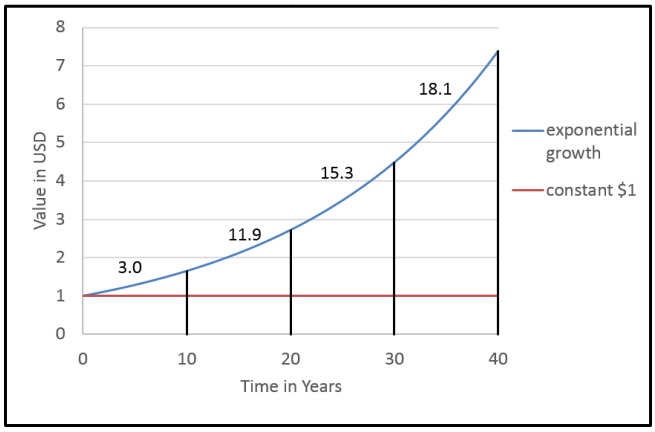
**Annuity Future Value with Continuous Compounding**

Compound interest is an extremely powerful financial concept. The total investment return increases significantly with time when interest is compounded. One practical application related to this concept is that students should begin saving for retirement as soon as they start working. It is vitally important for students to understand that putting off saving for retirement dramatically reduces the future value of their retirement account and their potential post-retirement standard of living. Therefore, it is important for professors who teach the time value of money to be able to drive home to their students that there are big differences between saving for retirement for only twenty years versus saving for thirty or forty years.

The typical example of a problem of this type is the investor who puts money into an Individual Retirement

Account (IRA) annually. The question is how much money will be in the IRA at retirement, given the amount of money invested each year and the annual rate of return. This class of problem involves calculating the future value of an annuity. Although the power of compounding can be demonstrated with discrete compounding examples by calculating annuity future values for varying years of investment, we suggest that the continuous compounding model provides a visually compelling example of the power of compounding over time. For example, Figure 2 shows the exponential curve associated with continuous compounding at 5%.

**Figure 2. Continuously-compounded total value and payment value.**




The area under an exponential curve represents the future value of an annuity. Figure 2 shows that the total area under the curve can be divided into two parts. The rectangle bounded by 0 and 1 on the y-axis and t on the x-axis represents the money put into the account by the investor over a given time period. For example, for the first 10 years at $1 per year, $10 has been put in by the investor. That is the left-most rectangle in Figure 2. The area between the top of that rectangle and the exponential curve represents the interest earned for the first 10 years. In this case, that interest earned is $31. Even without numbers, the picture of the continuous compounding model shown in Figure 2 demonstrates the relationship between the money invested and the interest accumulated over time.

Figure 2 also illustrates the dramatic effect of compounding over time. For example, when the investment period increases from 20 to 30 years, the rectangle between 20 and 30 years represents the $10 put in by the investor over those 10 years. The $25 (below the curve and above the rectangle) represents the interest earned over that ten-year period. The $25 interest earned during this third block of 10 years is more than twice the $11 interest earned during the second block of 10 years. This visualization provides students with a compelling example of the power of compounding over time. If money is allowed to compound over 40 years rather than 30 years the difference between the money contributed and interest earned is even more dramatic. The $48 interest earned from year 30 to year 40 dwarfs the $10 contributed by the investor during those 10 years. Illustrations like Figure 2 can help students more fully comprehend and internalize just how powerful compound interest can be over time.

Another important aspect of compounding is that relatively small changes in interest rates make a dramatic difference in future values, especially over long time periods. The continuous compounding model in Figure 3 shows how much difference a change in the interest rate can make in the future value of an annuity.

**Figure 3: Exponential growth at 5% and 10%**

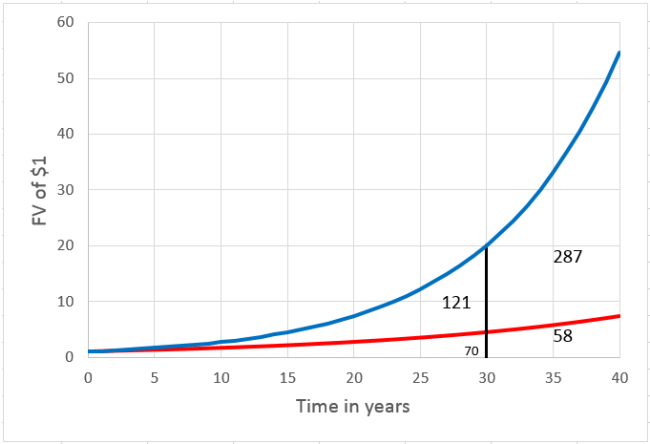



Figure 3 shows the difference in the future value of a $1 per year annuity for interest rates of 5% and 10%. The investor's $40 contribution over the 40 years is not shown because the vertical scale in Figure 3 is so large that the interest earned completely overshadows the $1 per year contributed by the investor. As in Figure 2, the future value of the annuity is the area between the curve and the x-axis from time zero to any given time. The difference in future value between 5% and 10% interest is most striking when the compounding period is more than 20 years. For example, the area between the two curves from 30 to 40 years shows that the same annuity of $1 per year will earn $287 more for those last 10 years at 10% rather than at 5%. In addition, Figure 3 shows that the future value of the annuity at 10% for 40 years consists of four distinct parts:

1) The $70 on hand after 30 years at 5%, plus
2) an additional $121 obtained by raising the interest rate to 10% for the first 30 years, plus
3) an additional $58 obtained by the continuation of the 5% annuity for another 10 years, plus
4) the additional $287 obtained by raising the interest rate to 10% for the final 10 years.

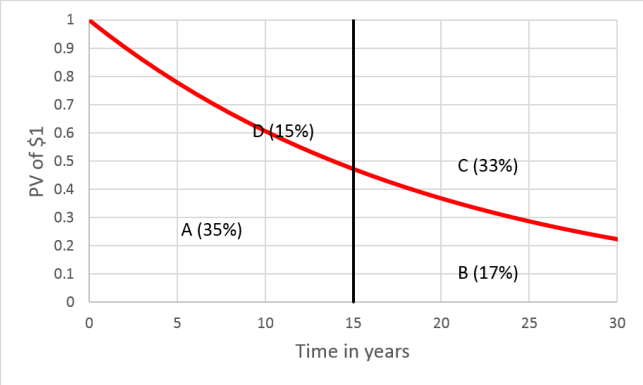
The different areas in Figure 3 are proportional to the dollar amounts. Even if the numbers are not shown, the student will get an intuitive feeling for what happens when the length of time and interest rates are changed, if the instructor uses a figure similar to Figure 3 when teaching annuity future value concepts.

**Annuity Present Value with Continuous Compounding**

Another very common class of TVM problems involves finding the present value of an annuity. Calculating the payment on a loan is typical of this class of problem. For example, most people need a loan to buy a home. Therefore, it is important for students to be able to calculate a monthly payment given the terms of a mortgage. However, the ability to simply calculate a monthly payment and compare it to monthly income does not enable students to fully comprehend several important financial concepts associated with long-term loans such as mortgages. Two aspects of long-term borrowing that are important for students to understand include (1) the relationship between equity [loan principal] and interest paid on the mortgage over the life of the loan, and (2) the relative amount of equity versus interest paid in each monthly payment. Students need to understand these concepts so that they can make wise financial decisions regarding a home purchase. As with future value of annuity problems, the continuous compounding model can be used to visually illustrate these concepts.

For example, Figure 4 shows exponential decay at a 5% rate. This is equivalent to borrowing money at an interest rate of 5% compounded continuously.

**Figure 4: Exponential Decay at 5%**
**(numbers are % of total payments)**




In Figure 4 (as in the future value of an annuity case shown in Figures 2 and 3) the area rectangle, the height of which is 1 and the width of which is time on the horizontal axis, to the right of 1.0 to any given point in time represents the total amount paid on the loan over its life (in this case, $1 per year times 30 years = $30). This means rectangle consists of that areas A+B+C+D. is the amount of money paid by the borrower over a 30- year loan. The area under the exponential curve represents the amount of money borrowed or the loan amount. Therefore, area A+BD is the amount of money borrowed on a 30-year mortgage.

Figure 4 reveals an important aspect of long-term loans. It illustrates the relationship between the amount of money borrowed and the interest paid on the loan. In this 5% example, visual inspection shows that the interest on the loan (area B+C+D) is about roughly equal to the amount of money borrowed (area A+BD). To be precise, Table 3 shows that area B+C+D is 48% of area A+B+C+D. The sobering fact is:, if you borrow money at 5% for 30 years, you buy one house and pay for two. The surprisingly large (to most borrowers) amount of interest paid when borrowing long-term is compellingly illustrated when clearly and simply shown by the relative areas composing in the form of Figure 4. It is useful for professors to demonstrate this concept as shown in Figure 4 because it is important for students to understand just how much interest they will pay when they borrow money for a house.

Figure 4 also dramatically illustrates the advantage of borrowing money for 15 years over borrowing money for 30 years (assuming the borrower can will make the same monthly payments on the higher payments on the 15- year mortgage as on the 30-year mortgage). Area B+C+D is the total interest paid on a 30-year loan and area DB is the interest paid on a 15-year loan. Area D [15] is much smaller than half the area of C [33]. Put another way, the total interest paid on a 15-year loan is much less than the interest paid on a 30-year loan. Area DB is approximately 30% of area A+DB. This means that only 30% of the total amount paid on a 15 year loan goes toward interest as opposed to about half of total payments going toward interest on a 30 year loan. In addition, Area B+C represents all the money the borrower won't have to pay if he or she borrows for 15 years rather than 30 years.

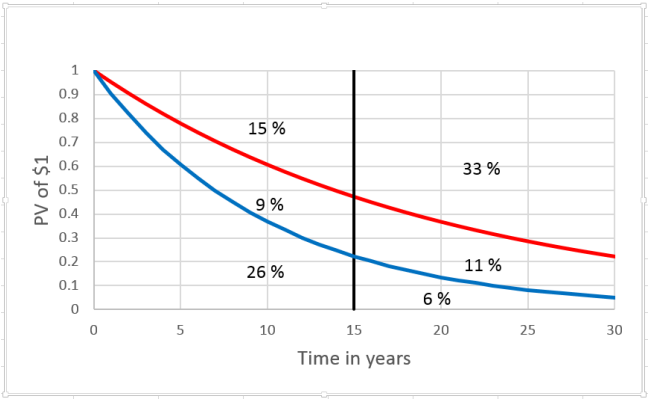
Of course, with the same monthly payments, a 15-year mortgage will not get you as much house as a 30-year mortgage would. You can only buy a house priced at 35/(35+17) = 67% of a house with the 30-year mortgage. But is that not a small price to pay for being free from mortgage payments for the next 15 years after the mortgage is paid off? As an aside, we believe that lenders should be required to show something like Figure 4 to all borrowers when they make a loan. That's really truth in lending, and would probably result in an increased percentage of 15-year rather than 30-year mortgages. Of course, the lending industry would vigorously oppose such a requirement.

Figure 4 also visually shows the relationship between interest paid versus equity paid in each monthly payment. In the 5% loan case, the early payments on the loan are approximately 22% equity and 78% interest. This can be seen by looking at the value of the exponential curve at 30 years. The curve therefore shows what fraction of the payment is interest versus equity over the life of the loan. It takes 16 years of payments before the payment is half interest and half equity. In addition, Figure 4 shows that the interest payments during the first 15 years of the mortgage are 33% of the total payments over the 30 year life of the mortgage, and then decline to 15% in the last 15 years. As before, the advantage of the continuous compounding model is that it shows these relationships visually and therefore makes them easier for students to understand.

A diagram like Figure 4 can also be used to show the dramatic difference that the interest rate can make when

borrowing long-term. Figure 5 shows the exponential decay curves for 5% and 10% interest rates.

**Figure 5: Exponential Decay at 5% and 10% (numbers are % of total payments)**




As in Figure 4, the area under the curves in Figure 5 represents the amount borrowed and the area above the curves represents the interest paid on the loan. Figure 5 shows that the amount of interest paid on a 10% loan is dramatically more than the interest paid on a 5% loan. In fact, the interest paid on a 10% loan is about 68% [33+15+11+9] of the total payments versus 48% [15+33] of the total payments on a 5% loan. In terms we used earlier, when borrowing at 10%, the borrower buys one house and pays for three (versus paying for two when borrowing at 5%). Figure 5 also shows that interest paid on a 15-year mortgage is dramatically smaller than the interest paid on a 30-year mortgage when borrowing at 10%. This shows that the advantage of borrowing for 15 years rather than 30 years increases with increasing interest rates. An important advantage of the continuous compounding model over the discrete compounding model is that the continuous model allows these important concepts to be illustrated visually.

**Non-Business Related Applications of the Exponential Model**

We believe that a major advantage of the exponential growth model is that the model helps students to understand and solve many problems related to the natural world. Students are human beings first and business students second. Therefore, as important as it is for them to be able to understand and solve business-related TVM problems, it is equally important for them to develop an understanding and interest in the natural world that we are all a part of. Teaching them how to solve TVM problems using the continuous compounding model gives them an important tool that will also enable them to conceptually understand and solve many natural world problems.

For example, radioactive decay is one feature of the natural world that can be understood and modeled using an exponential function. To illustrate, strontium-90 is one of the most deadly products of a nuclear explosion. It decays (gives off radioactivity) at a rate of 2.4% per year. A common question concerning radioactive decay is to ask how much of the radioactive material will remain after some period of time. In this case we can ask what percentage of the original strontium is left after 100 years? Although this problem does not appear to be similar to a time value of money problem, it is actually analogous to finding the present value of a future cash flow. In TVM terms, the future value is equal to $e^{100x\ -0.024} = .0907$. Therefore, there will be 9% of the original amount of strontium-90 left in 100 years.

Some radioactive isotopes decay at very low rates. Carbon-14 (famously used for dating samples of old matter) is a good example of a slowly decaying isotope. Scientists prefer to talk about these kinds of isotopes in half-lives rather than very small decay rates. Carbon-14 has a half-life of 5,720 years. The exponential model allows students to understand how scientists use the decay of carbon-14 to date ancient matter. For example, a tiny piece of a Dead Sea scroll was found to have 80% of its original carbon-14 left. How old is the scroll?

In order to answer this question, students need to understand that the term half-life refers to the time it takes for half of the original amount of material to disappear (or half to remain). In this case, since there is more than half left, namely 80%, we know that the scroll is less than 5,720 years old. As in the strontium-90 problem, we recognize this as a decay problem, and solve it in two steps. First we find how fast carbon-14 decays, and then using that information we can find the age of the scroll. In TVM terms, the first step is to calculate the interest rate that yields half the amount in 5,720 years. So we solve as; $0.5 = e^{5,720x\ i}$. Therefore $i = \ln(.5) / 5,720 = -0.0001212$. Given this decay rate, the time it takes to have 80% left is found by; $0.8 = e^{t\ x\ -0.0001212}$. Therefore $t = \ln(.8) / -0.0001212$ which is 1,841. In other words, the scroll is approximately 1,800 years old.

**Implementation in the Classroom**

The previous sections of this paper are primarily concerned with the theory associated with continuous compounding, and theoretical advantages of the continuous model compared with the discrete compounding model. We believe these are interesting topics in themselves, but for educators it is also important to be able to bring the theory into the classroom, and to be able to ascertain if the inclusion of continuous compounding concepts improves student comprehension of TVM principles. Therefore, the practical aspects of using continuous compounding are addressed next. However, it's important to remember that everyone's teaching style is different and what follows is just one possible way to incorporate continuous compounding into the curriculum. It is not necessarily the only way, or the best way, to put these ideas into practice in the classroom.

Our general approach is to use Figures 1-5 as aids to improve the student's understanding of broad TVM principles rather than a way to solve specific TVM problems. We do this primarily because our textbook

addresses TVM in discrete compounding terms, so it would be awkward to show students how to solve problems using the continuous compounding version of the formulas while their textbook uses the discrete compounding version. An additional benefit is that financial calculators are designed to solve problems with discrete compounding, so textbook descriptions of how to use a financial calculator are directly analogous to classroom demonstrations of how to do the problems.

This is how we do it in practice. Following the general textbook practice, we start by showing students how to solve for the present value and future value of single cash flows with annual compounding. The single cash flow problems are then extended to non-annual compounding periods. Multiple cash flow problems with non-constant cash flows are demonstrated next. Then, in contrast to most textbooks, we introduce a growing annuity as a special case of multiple cash flows which can be easily solved for lengthy payment periods using the discrete version of the growing annuity formula. The advantage of this approach is that traditional annuities and perpetuities can then be seen as special cases of a growing annuity. Students are shown and asked to solve all of these types of problems on a financial calculator.

However, just because students can solve for the future value of an annuity or calculate a mortgage payment does not mean that they fully comprehend the power of compounding over time, or how much interest a borrower pays over the life of a 30-year loan. So after the students have mastered how to solve specific TVM problems, we use Figures 1-5 to drive these compounding and interest ideas home. But before showing the diagrams, we have the students calculate the numbers they will see in the diagrams using discrete compounding techniques. In Figure 2, for example, we have the students calculate the interest earned over the first three ten-year periods (the numbers 3, 11, and 25 in the figure), assuming a 5% interest rate with daily compounding. We then show Figure 2 but reveal the figure in ten-year increments starting with the first ten years. This allows the students to see that their calculations of the interest earned each ten year period approximately matches what is shown in the figure. The advantage of this pedagogical technique is that the figure gives an easily understood visual representation of how much the interest earned increases within each ten year period. This is a visually compelling illustration that demonstrates the power of compounding over time. Students may not fully understand the power of compounding if they've just calculated numbers and do not give any thought to their significance. A similar procedure is followed for the other figures.

**Student Reaction**

Immediately after the presentation of the diagrams we asked students in two separate sections to provide written responses to the following question in order to determine if the figures were helpful or not. The question asked was: Please explain how and/or why the continuous compounding diagrams did (or did not) help your understanding of TVM concepts. The results are shown in Table 2.

**Table 2: Student Responses to the Question**, "Please explain how and/or why the continuous compounding diagrams did (or did not) help your understanding of TVM concepts."

| Class section | 1 | 2 |
|---|---|---|
| Class size | 46 | 46 |
| Responses | | |
| Positive | 32 | 13 |
| "Didn't really help me" | 4 | 6 |
| Unclear | 6 | 7 |

Before addressing the results shown in Table 2, a natural question to ask is why is the response rate in Section 2 so much lower than the response rate in Section 1? Section 1 students were asked to write their responses immediately following the presentation and before they left the classroom. There was not enough time at the end of class to do this in Section 2, so Section 2 students were asked to answer the question as a homework assignment. As the responses were not graded or required, Section 2 had a much lower response rate. We've taken this as a lesson learned for future classroom surveys.

All of the student quotes below are unedited in order to avoid misrepresenting what was written. Readers can draw their own conclusions with respect to grammar. Table 2 shows that the majority of students thought the figures were helpful. Many of the positive responses came from students who said they are visual learners. These students argued that the diagrams helped them to better understand the concepts being discussed. The following quotes are typical of this category of response, "The continuous compounding diagrams helped my understanding of TVM concepts because I am a visual learner. The graphs make things much easier for me to conceptualize in my head." Another student wrote, "The continuous compounding diagrams helped me understand the time value of money concept because it gave me a visual representation comparing the different rates side by side rather than just a number. Numbers alone can be harder to digest and visualize so seeing those did help." Some students said they understood TVM concepts before but that the diagrams clarified things for them. For example, another student wrote, "I understood it mostly before but I don't think I fully understood the great effect it had on TVM." A similar point is illustrated by the following quote, "Doubling the interest rate DOES NOT mean doubling interest paid." Two students found the diagrams so compelling that they will implement these ideas in their lives. One said, "For the rest of my life I will try to shorten loans and lengthen investment time, ha ha." Another wrote, "I plan to start investing early and plan to pay off loans early."

Of course, not all of the students thought the figures were helpful. Most of these students said they already knew the concepts or thought it was better to do the calculations themselves. For example, one wrote; "The continuous compounding diagrams didn't really help me at all because I have a pretty firm grasp of TVM concepts and the ability for it to grow." Another said, "They did not help me understand TVM concepts because, although I know how to read a graph, I understand TVM concepts better when I actually perform the problem." Two students found the diagrams confusing and one thought the figures reduced understanding. One said, "They confused me way too much. I thought I understood the concepts before and after those diagrams I feel lost." Unfortunately, this student did not come after class to ask for clarification. Another wrote, "I thought it was confusing. I didn't understand it."

The final category of response in Table 2 is referred to as an unclear response. An unclear response is one that could not be placed in either of the other two categories. A single example will suffice. This student wrote, "I think the diagrams helped in the sense of planning out your work and solving. But to truly understand how to solve the equation, I needed to figure out what the question was asking me. Then put my information in a diagram."

## CONCLUSION

This paper describes how the inclusion of continuous compounding theory into finance pedagogy can improve student comprehension of important time value of money concepts. Student surveys after exposure to the ideas in this paper found that the majority of students thought the continuous compounding concepts described above did increase their understanding of the power of compounding and the very large amount of interest paid on long-term loans. We encourage finance professors to consider incorporating continuous compounding diagrams into their time value of money lesson plans.

## Endnote

1. It is not the purpose of this paper to describe how this $3 interest amount is calculated. All of the numbers in Figures 1-5 are taken from (or can be calculated from) the data in Table 3. Table 3 is presented without explanation but the interested reader can find a complete description of how to do the calculations in Chapter 3 of Thomsen (1991).

## REFERENCE

Thomsen, C. T. (1991). The Accounting Model (2nd ed.). Fresno, CA: BIP

*Douglas Jordan is a Professor of Finance at Sonoma State University.*

*Torben Thomsen is a (retired) Professor of Finance at Sonoma State University.*

# Filling in the Gaps: An Excel Based Integration of Financial Performance and Condition

***Mary Funck and Robert Stretcher***

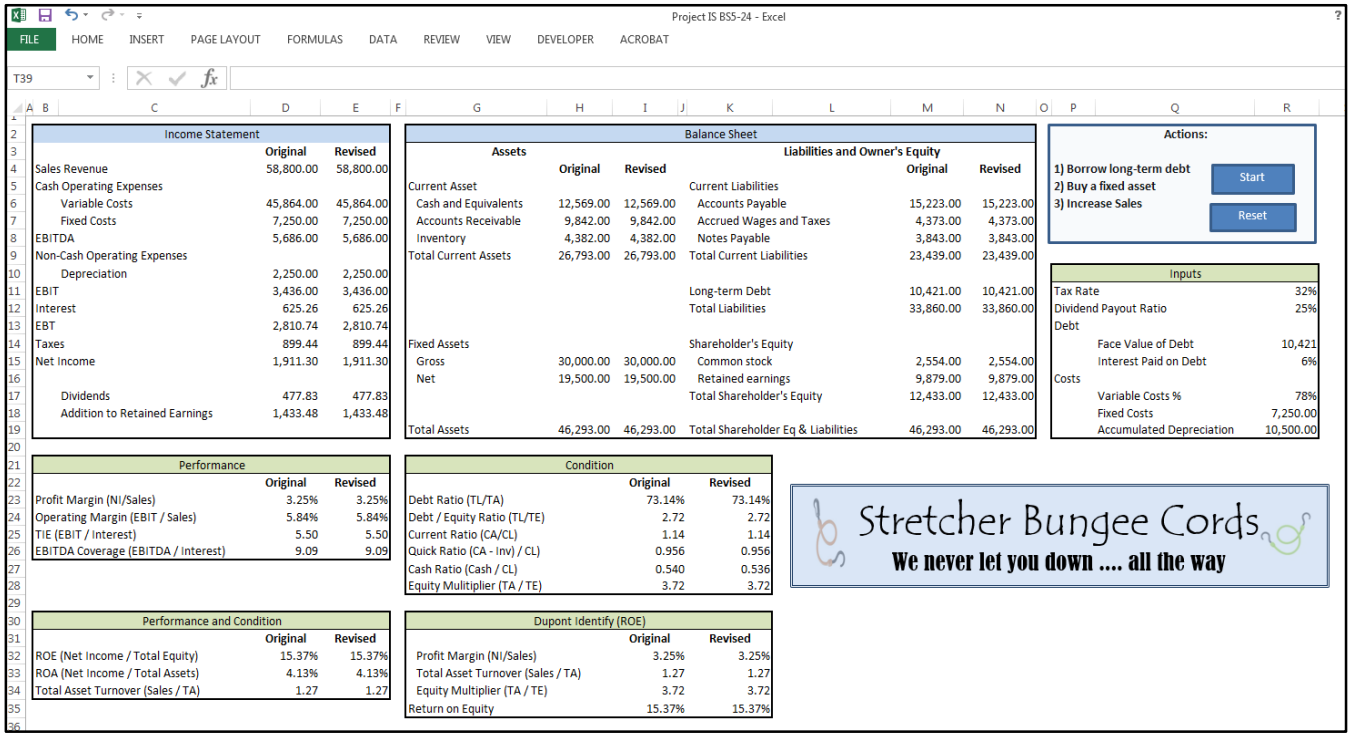
## INTRODUCTION

When teaching introductory financial management courses, professors operate under the assumption that students have gained, through prerequisite courses, a basic understanding of accounting concepts. In principles of accounting courses, however, it is rare to find a curriculum that guides students through financial reporting methodology; one that demonstrates to students how to complete the end-of-cycle closing, adjusting, and reversing entries that allow the hands-on construction of a firm's financial statements. Even if the process is diligently taught, students often do not satisfactorily understand and/or retain this material.

Providing students in financial management courses some basic understanding of the eventual effects of key transactions on the financial statements and common financial ratios helps to solidify an understanding of the integration of these concepts. To specifically address student shortcomings in comprehending this material without entirely re-teaching the accounting course, we have developed, using Visual Basic for Applications (VBA), an Excel application that demonstrates how transactions affect a firm's summary statements. Stepping through the application's macro allows us to lead students through transactional effects one at a time. This application concentrates on transactions that address typical financial management discussion topics: borrowing using long term debt, purchasing fixed assets, and estimating the effects of fixed assets in terms of generating sales revenue (and eventually, profit). This application is used to supplement classroom lectures; we also record a narrated demonstration of the application and post the resulting video online to serve as a review.

Describing a sample company, the application specifies initial values for an income statement, balance sheet, performance (income statement), condition (balance sheet) and combined ratios, as well as the DuPont Analysis, since we believe that it is important to visualize the key components of the return on equity (ROE). Display areas are also included on the spreadsheet for revised financial statement and ratio values, as well as for factors such the tax rate, dividend payout ratio, debt levels, interest rates, and depreciation.

**Exhibit 1. Full Application**



The first step of the application allows the user to designate the amount of long-term debt issued by the company. The application then guides the user through a series of messages that demonstrate the effects of borrowing on the long term debt and cash accounts. The application shows, using the condition ratios, how the fiscal condition of the firm changes: the debt, debt to equity, current, quick, and cash ratios increase, and the equity multiplier rises, because the firm's long term debt and liquidity increases. The effects of the higher debt level on the year-end projected income statement is then presented: higher interest expense, lower Earnings before Taxes (EBT), tax expense (tax shield), and net income, changes in the amount paid out as dividends, and the change in the retained earnings account on the balance sheet. We then revisit the ratio summaries, showing that so far, the profit margin, times interest earned, and EBITDA coverage have suffered, and ROE, Return on Assets (ROA), and asset turnover are all reduced.

**Exhibit 2. Initial Income Statement.**

| Income Statement | | |
|---|---|---|
| | **Original** | **Revised** |
| Sales Revenue | 58,800.00 | 58,800.00 |
| Cash Operating Expenses | | |
| Variable Costs | 45,864.00 | 45,864.00 |
| Fixed Costs | 7,250.00 | 7,250.00 |
| EBITDA | 5,686.00 | 5,686.00 |
| Non-Cash Operating Expenses | | |
| Depreciation | 2,250.00 | 2,250.00 |
| EBIT | 3,436.00 | 3,436.00 |
| Interest | 625.26 | 625.26 |
| EBT | 2,810.74 | 2,810.74 |
| Taxes | 899.44 | 899.44 |
| Net Income | 1,911.30 | 1,911.30 |
| | | |
| Dividends | 477.83 | 477.83 |
| Addition to Retained Earnings | 1,433.48 | 1,433.48 |

**Exhibit 3. Initial Balance Sheet.**

| Balance Sheet | | | | | |
|---|---|---|---|---|---|
| **Assets** | | | **Liabilities and Owner's Equity** | | |
| | **Original** | **Revised** | | **Original** | **Revised** |
| Current Asset | | | Current Liabilities | | |
| Cash and Equivalents | 12,569.00 | 12,569.00 | Accounts Payable | 15,223.00 | 15,223.00 |
| Accounts Receivable | 9,842.00 | 9,842.00 | Accrued Wages and Taxes | 4,373.00 | 4,373.00 |
| Inventory | 4,382.00 | 4,382.00 | Notes Payable | 3,843.00 | 3,843.00 |
| Total Current Assets | 26,793.00 | 26,793.00 | Total Current Liabilities | 23,439.00 | 23,439.00 |
| | | | | | |
| | | | Long-term Debt | 10,421.00 | 10,421.00 |
| | | | Total Liabilities | 33,860.00 | 33,860.00 |
| | | | | | |
| Fixed Assets | | | Shareholder's Equity | | |
| Gross | 30,000.00 | 30,000.00 | Common stock | 2,554.00 | 2,554.00 |
| Net | 19,500.00 | 19,500.00 | Retained earnings | 9,879.00 | 9,879.00 |
| | | | Total Shareholder's Equity | 12,433.00 | 12,433.00 |
| | | | | | |
| Total Assets | 46,293.00 | 46,293.00 | Total Shareholder Eq & Liabilities | 46,293.00 | 46,293.00 |

A question is then posed to students: should the firm keep the borrowed funds in the cash account, or invest them? Some of our more astute students will recognize that firms shouldn't raise long term funding and then simply hold cash, a non-earning asset, so they conclude that investing the cash in productive assets is in order. Posing this question provides us an opportunity to first discuss liquidity and profitability, and then show the progression of effects from investing the cash raised through debt financing. The borrowed funds are invested in a ten-year asset (using straight line depreciation, for simplicity). We demonstrate the decrease in cash and increase in gross fixed assets, the one-year effect on depreciation expense, accumulated depreciation and net fixed assets, and the accompanying decrease in income figures. At this point, we like to point out to students that the firm's profitability has done nothing but suffer- we have borrowed and spent money. But then we discuss the expected results from investment in fixed assets: sales generation and gains in income. We assume an increase in sales in accord with our prior asset turnover ratio, and trace the effects of the revenues throughout the income statement. As the changes are made in the income statement, corresponding changes occur in the firm's ratios, giving us an opportunity to discuss the usefulness of

**Exhibit 4. Initial Performance and Condition Ratios**

| Performance | | |
|---|---|---|
| | **Original** | **Revised** |
| Profit Margin (NI/Sales) | 3.25% | 3.25% |
| Operating Margin (EBIT / Sales) | 5.84% | 5.84% |
| TIE (EBIT / Interest) | 5.50 | 5.50 |
| EBITDA Coverage (EBITDA / Interest) | 9.09 | 9.09 |

| Condition | | |
|---|---|---|
| | **Original** | **Revised** |
| Debt Ratio (TL/TA) | 73.14% | 73.14% |
| Debt / Equity Ratio (TL/TE) | 2.72 | 2.72 |
| Current Ratio (CA/CL) | 1.14 | 1.14 |
| Quick Ratio (CA - Inv) / CL) | 0.956 | 0.956 |
| Cash Ratio (Cash / CL) | 0.540 | 0.536 |
| Equity Mulitiplier (TA / TE) | 3.72 | 3.72 |

**Exhibit 5. Initial Combined and DuPont Ratios.**

| Performance and Condition | | |
|---|---|---|
| | **Original** | **Revised** |
| ROE (Net Income / Total Equity) | 15.37% | 15.37% |
| ROA (Net Income / Total Assets) | 4.13% | 4.13% |
| Total Asset Turnover (Sales / TA) | 1.27 | 1.27 |

| Dupont Identify (ROE) | | |
|---|---|---|
| | **Original** | **Revised** |
| Profit Margin (NI/Sales) | 3.25% | 3.25% |
| Total Asset Turnover (Sales / TA) | 1.27 | 1.27 |
| Equity Multiplier (TA / TE) | 3.72 | 3.72 |
| Return on Equity | 15.37% | 15.37% |

performance ratios in analyzing the firm's income generation capability.

Of particular interest is the effect on the DuPont Analysis. As students observe the changes, we have another opportunity to discuss the three basic elements of the firm's ability to generate return on equity: 1) the ability to generate sales, measured by the asset turnover, 2) the profitability of sales, measured by the net profit margin, and 3) the degree to which the firm uses creditor funding, measured by the equity multiplier.

Attention is then directed to the results reflected on the balance sheet so far; we note that the balance sheet does not yet balance, and pose the question to students about why this may be. The 'unbalanced' state of the balance sheet

**Exhibit 6. Completed Income Statement.**

| Income Statement | | |
|---|---|---|
| | **Original** | **Revised** |
| Sales Revenue | 58,800.00 | 60,300.00 |
| Cash Operating Expenses | | |
| Variable Costs | 45,864.00 | 47,034.00 |
| Fixed Costs | 7,250.00 | 7,250.00 |
| EBITDA | 5,686.00 | 6,016.00 |
| Non-Cash Operating Expenses | | |
| Depreciation | 2,250.00 | 2,350.00 |
| EBIT | 3,436.00 | 3,666.00 |
| Interest | 625.26 | 685.26 |
| EBT | 2,810.74 | 2,980.74 |
| Taxes | 899.44 | 953.84 |
| Net Income | 1,911.30 | 2,026.90 |
| | | |
| Dividends | 477.83 | 506.73 |
| Addition to Retained Earnings | 1,433.48 | 1,520.18 |

**Exhibit 7. Completed Balance Sheet**

| Balance Sheet | | | | | |
|---|---|---|---|---|---|
| **Assets** | | | **Liabilities and Owner's Equity** | | |
| | **Original** | **Revised** | | **Original** | **Revised** |
| Current Asset | | | Current Liabilities | | |
| Cash and Equivalents | 12,569.00 | 12,755.70 | Accounts Payable | 15,223.00 | 15,223.00 |
| Accounts Receivable | 9,842.00 | 9,842.00 | Accrued Wages and Taxes | 4,373.00 | 4,373.00 |
| Inventory | 4,382.00 | 4,382.00 | Notes Payable | 3,843.00 | 3,843.00 |
| Total Current Assets | 26,793.00 | 26,979.70 | Total Current Liabilities | 23,439.00 | 23,439.00 |
| | | | | | |
| | | | Long-term Debt | 10,421.00 | 11,421.00 |
| | | | Total Liabilities | 33,860.00 | 34,860.00 |
| | | | | | |
| Fixed Assets | | | Shareholder's Equity | | |
| Gross | 30,100.00 | 31,000.00 | Common stock | 2,554.00 | 2,554.00 |
| Net | 19,500.00 | 20,400.00 | Retained earnings | 9,879.00 | 9,965.70 |
| | | | Total Shareholder's Equity | 12,433.00 | 12,519.70 |
| | | | | | |
| Total Assets | 46,293.00 | 47,379.70 | Total Shareholder Eq & Liabilities | 46,293.00 | 47,379.70 |

provides us a further opportunity to discuss the conclusion of the accounting cycle and the updates needed in order for the accounts to be finalized. We summarize the cash transactions and update the cash balance, we update the

**Exhibit 8. Completed Performance and Condition Ratios**

| Performance | | |
|---|---|---|
| | **Original** | **Revised** |
| Profit Margin (NI/Sales) | 3.25% | 3.36% |
| Operating Margin (EBIT / Sales) | 5.84% | 6.08% |
| TIE (EBIT / Interest) | 5.50 | 5.35 |
| EBITDA Coverage (EBITDA / Interest) | 9.09 | 8.78 |

| Condition | | |
|---|---|---|
| | **Original** | **Revised** |
| Debt Ratio (TL/TA) | 73.14% | 73.58% |
| Debt / Equity Ratio (TL/TE) | 2.72 | 2.78 |
| Current Ratio (CA/CL) | 1.14 | 1.15 |
| Quick Ratio (CA - Inv) / CL) | 0.956 | 0.964 |
| Cash Ratio (Cash / CL) | 0.540 | 0.544 |
| Equity Mulitiplier (TA / TE) | 3.72 | 3.78 |

retained earnings account based on net income and our fixed payout ratio, and wrap up the tutorial by discussing the changes that have occurred from borrowing money and purchasing and operating the fixed asset for one accounting period.

Throughout the exposition, the application makes use of highlight colors to draw attention to changes in each account. At the end of the discussion, the statements are updated, and the original and revised figures are displayed in the ending income statement and balance sheet, and in the summaries of each category of financial ratios.

**Exhibit 9. Completed Combined and DuPont Ratios**

| Performance and Condition | | |
|---|---|---|
| | **Original** | **Revised** |
| ROE (Net Income / Total Equity) | 15.37% | 16.19% |
| ROA (Net Income / Total Assets) | 4.13% | 4.28% |
| Total Asset Turnover (Sales / TA) | 1.27 | 1.27 |

| Dupont Identify (ROE) | | |
|---|---|---|
| | **Original** | **Revised** |
| Profit Margin (NI/Sales) | 3.25% | 3.36% |
| Total Asset Turnover (Sales / TA) | 1.27 | 1.27 |
| Equity Multiplier (TA / TE) | 3.72 | 3.78 |
| Return on Equity | 15.37% | 16.19% |

Our experience with using this application suggests that students appreciate the view of the forest after studying the trees in their year of accounting principles courses. Since the manual processes for closing out an accounting period are essentially hidden with modern accounting packages, it is important to demonstrate that the transactions involved in managerial decisions have an eventual impact on the summaries of performance and condition. This understanding is helpful in developing competence in financial decision making.

*Mary Funck is an Assistant Professor of Finance at Sam Houston State University.*

*Robert Stretcher is a Professor of Finance at Sam Houston State University*

# Stock Simulations: Game and Group Design to Reduce Risky Behavior and Enhance Learning

***Nancy Lottridge Anderson***

*Stock simulations have been used at all levels of education to teach about the investment process. For college classes, a 15 week semester means the game will be limited to around 12 weeks. The short-term nature of the game may encourage risky behavior, but the educational component of the simulation may be worth the exposure to risk-taking in order to enhance learning through a hands-on experience. I design a simulation and construct various types of student groups. Through observations and a student questionnaire, I determine that simulation complements a traditional lecture. I also find that the design of the game and the design of student groups may reduce risky behavior and enhance learning.*

## INTRODUCTION

Hands-on or experiential learning through simulations, including but not limited to stock market simulations, are commonly used at all levels of education. When studying the impact of such simulations, Siegfried and Fels (1979) find a positive impact in seven key areas: cognitive achievement, student attitudes, retention, and the distribution of benefits between high and low-achieving students. Paden (1980) finds that students involved in simulations spent less time studying while performing better on exams. Joseph (1970) finds that the use of a simulation increases student interest in the course material. When surveying students on a particular game, he finds that 75% of students are more interested in the subject and 90% suggest that the simulation should become a permanent part of the curriculum.

Boehlje and Eidman (2001) point out that the effectiveness of simulations as teaching tools depends on the

integration of simulations with other teaching tools and may produce different results, depending on individual students. Prior to incorporating a simulation, the class consisted of classroom lectures, problem solving, and current events related to weekly topics. Students often ask questions about how to incorporate recently learned material in a practical setting. Many did not know how to open a brokerage account or place a trade. After learning about investing, students want to invest on their own but don't know how to proceed.

In addition, I found that many students struggled to understand derivatives and short selling. Although these concepts are covered in class, and students are assigned problems over these topics, students have no real understanding of the mechanics of investing.

As such, I decide to incorporate a stock simulation to supplement existing lectures. I design the simulation as a group activity. The cost of the online simulator is a factor, but group activities for graduate students are important preparation for team activities in a work setting. In designing the groups, I deliberately create a variety of group types to ascertain the optimal configuration. I design single gender, as well as mixed gender groups. Since international students represent a sizable component in our program, I can observe how different grouping strategies may provide ways to integrate these students more effectively.

Felton et.al. (2003) find some gender effects in investment decision-making. They find that males take more risk in their investment choices but believe this result may be due to a particular subset of males. They call these "optimistic" males and find unusual risk-taking among this group. Atkinson et.al. (2003) find no such gender difference among professional fund managers. Hamacher (2001) says that "The differences within each gender are actually greater than the differences between the genders" (Hamacher, p. 152).

In looking at the security selections of the individual groups, I watch for the tendency to limit choices based on nationality. Kho et.al. (2009) study home bias among U.S. investors over a ten year time period ending in 2004 and find a decline in this bias for foreign countries as a whole. Nieuwerburch and Veldkamp (2009) find access to information does not have an effect on home bias, but Lai and Xiao (2010) suggest this bias may dissipate as investors gain competence and experience. My question concerning group design is, "How do I create groups that offer the best opportunities for students to learn from each other and increase their knowledge of investing?"

## SIMULATION

The online stock simulator, StockTrak, was used for the exercise. StockTrak is a virtual trading platform that allows for the trading of stocks, options, futures, bonds, mutual funds, and currencies. This company has conducted simulations for over twenty years and currently serves about 60,000 students per year. StockTrak accountholders may trade on over 20 global exchanges through this virtual platform. As the professor, I set the parameters of the game for my class by choosing initial account balances, types of securities, available exchanges, and the start and end dates of the game.

No security types were off-limits, but each position was limited to 10% of the entire portfolio. Trading could occur on the following exchanges: U.S., Toronto, Bombay, Hong Kong, Shanghai, Taiwan, and London. The choice of exchanges was related to the composition of the class.

StockTrak offers packages based on the number of weeks in the simulation. One may choose 7 weeks, 10 weeks, 12 weeks, 18 weeks, and 36 weeks. My class lasted 15 weeks, so I chose the 12 week package. This gave me time at the beginning of the semester to prepare students for the simulation and time at the end to conclude the exercise. The 12 week package allowed for 200 trades during the entire exercise. I opted to allow for day trading.

I divided the class into seven groups and assigned students to their groups. Three groups were all male. Two groups were all female, and two groups were mixed in gender. One of the mixed gender groups was all domestic students, and one was a combination of international and domestic students. The single gender groups were either all international or all domestic students.

Each group opened one account, starting with $1 million dollars for trading. Only two student names could be on each account. The cost per account for the 12 week session was $26.95. This nominal fee was paid by each group upon account registration and divided among the members. Students chose who would be listed on the account and who would have trading privileges. In some cases, these roles broke down during the semester.

Guidelines for the simulation are in Exhibit 1. While the exercise lasted 12 weeks, there were interim deadlines for various tasks. These deadlines corresponded to class lectures on each subject. The first task was for students to figure out how to open a brokerage account. They were given time in class to complete an online application. After the lecture on short-selling, they were required to have one short position in the account. An options trade was required after the lecture on options, and a futures contract position was required after a lecture on futures. By week eight, all groups had to be 80% invested and remain so until the end of the simulation.

Each week, we discussed their experiences and addressed problems. When students had problems with a trade or a price, they were required to contact StockTrak directly. I did not intervene but forced them to resolve those issues themselves. Not only did this relieve me of this burden, it was quite instructive for the students. They learned to pay close attention to their accounts and to be proactive when encountering problems.

Students practiced different types of trades by setting up market, limit and stop orders. They researched public companies and looked up stock symbols. Learning about an option or futures contract in class is one thing, but trading in these derivatives and trying to make money in this market brings that lecture to life. It is only when students experience these markets first-hand that they really begin to understand

these securities. Students also learned about the practical side of investing when attempting to place a trade after 3 pm Central Standard Time. Probably the most instructive trade was the short sale. Every group shorted Toyota after an announcement from the company about brake problems.

Each week, results were displayed in class, with groups ranked from highest to lowest in performance. In the interim, students may view current valuations for each group but cannot see individual positions or trades. Group members exchanged contact information, so that they could communicate during the week and conduct trading, as necessary. In addition, I allowed for time at the end of each class for groups to discuss security selections and strategy. At the end of the simulation, the winning group was determined by the highest absolute return. Finally, each group presented a paper at the end of the simulation detailing their experiences.

Students added to their knowledge base in investing, but they also learned more about the group process. Some groups functioned well, but others did not. The presentation at the end of the experience was important to the process. Students had to justify their investment choices and had to face their results. Doing so in front of their classmates was part of the learning experience.

## SURVEY RESULTS

To measure effectiveness and perception of the simulation, I administered a survey. Exhibit 2 lists the questions in the Student Survey. To alleviate stress within groups, students completed a Peer Review. See Exhibit 3. I adjusted scores based on my observations and these Peer Reveiws.

I asked students about the overall benefit of the simulation. On a scale from one to ten, the students gave an average rank of 7.5 to the stock market game. The students rated simulation as helpful in this class. Eleven students, more than sixty percent of the class, had no previous experience investing. Of those with experience, six out of the seven had experience with stock investing, and only two had experience with options. Students' perception of the hands-on experience was positive. My observations confirmed this.

All groups engaged in short-term trading. Each account was allowed a total of 200 trades during the 12 week period. The winning group had 200 trades and reached this limit a few days before the end of the simulation. Average number of trades per group was 71. In most cases, students underestimated the number of trades and did not confirm this by checking the group account. No single group pursued a buy and hold strategy for the entire simulation, but some groups held individual issues for the entire 12 weeks.

Approximately two-thirds of the class pursued a strategy that was more aggressive than conservative. One of the questions on the questionnaire at the end of the semester concerned aggressive versus conservative investment. In my observations, I noted one group with an extremely risky profile. This group regularly traded in naked options. I had expected to see some tens (most aggressive investing) on this question but did not. Apparently, this group's members did not perceive their strategy to be as risky as I did. Interestingly, when asked if they would invest the same if this had been their personal money, about seventy percent said they would not.

Four of the seven groups were comprised of all international students. Two of these were all male, and two were all female. One international student was on a team with two U.S. students. Three female Nepali students were in one group together. Nepal lacks a well-defined financial market, and these students had a steeper learning curve. At the end of the simulation, the group members told me that they would have performed better if they had an American member in their group.

International students, as a whole, appeared to have a greater appreciation for investment opportunities outside the United States. In the group with a mix of American and international, the American students credited their international colleague with the international stock picks, recognizing the importance of her knowledge of other countries and cultures in the simulation.

In addition to accessing foreign exchanges, students could purchase ADRs. Groups with international students tended to buy individual stocks such as Baidu, China Mobile, Guangshen Railway, Sohu, Toyota Motors, New Oriental Education Technology, Home Inns, and Gushan Environmental. The two groups with only U.S. students tended to use exchange traded funds for their exposure to international markets, buying The Malaysia Fund, The South Korea Fund, and The Brazil Fund. Only one group with all U.S. students purchased an individual stock of a foreign country. That stock was Toyota Motors.

Three groups were comprised of all males, and two groups were comprised of all females. The groups that had problems with a domineering member were all male, and the groups that had problems with miscommunication were all male. These groups were also comprised of all international students. I noted no such problems within the all male group of U.S. students.

In observing the closing positions for each group, I note that the all male groups tended to hold larger positions in each security. While the simulation required trading in derivatives during the course of the twelve weeks, most groups simply fulfilled this requirement by trading once, then quickly unwinding that position. The two all male groups comprised of international students continued to trade derivatives in their portfolio beyond what was required.

The two groups with a mixture of male and female members placed in third and fourth for this simulation. While the third place team did not have the highest raw return, they had the highest risk-adjusted return, as measured by Sharpe's ratio. The ending positions for each displayed a more diverse security selection than the single gender groups. In addition, presentations at the end of the class by the mixed teams were, by far, the most polished and cohesive. My observation was that these mixed groups performed better as a group and produced above average results.

## CONCLUSIONS

To supplement existing course materials, I incorporate a simulation for a graduate class and design student groups to determine an optimal investment team. During the activity, I observe student performance and behavior. In addition, students complete a questionnaire at the end of the simulation to measure perceptual benefits.

Students engaged in short-term trading throughout the process. The average trades per group was 70, with one group maximizing the allotted 200 trades. Some groups engaged in naked option writing, and diversification did not appear to be a consideration in security selection. The design of the game could be altered to limit the number of trades per account. StockTrak also allows the administrator to limit day trading on accounts. While short-term stock simulations encourage risky behavior, adjusting these design elements could reduce risk-taking. Per the survey results, students appear to recognize the difference in investor behavior in a simulation versus a real portfolio situation. They indicate they would be more conservative if they were investing their own money.

Ultimately, students perceived the simulation as beneficial to their understanding of the concepts in investing. From my observations, I could see that a hands-on simulation in conjunction with core lectures improved student knowledge and experience. Executing trades helped them understand the benefits of different trading strategies. Trading in derivatives markets through the simulation deepened their understanding of this type of security. Placing a short sale in an account resulted in an "aha" moment for many of my students. When students understood the mechanics of investing, I found they better understood the concepts we explored in class.

Lectures are still critical to the process. Preparatory lectures gave them enough information to venture into various types of securities and trading. Post lectures helped students process their activities and allowed me to fill in knowledge gaps. In other words, the simulation became a type of learning loop.

The mixed gender and mixed cultural groups produced above average results and performed better in the presentation. A mixed gender group may be the best approach in a simulation, and a mixed gender, mixed cultural group may be the best approach within an investment team. International students chose individual issues of companies with which they were familiar. They bought what they knew. U.S. students bought individual issues of U.S. companies and relied on exchange-traded funds for exposure to international markets. Different perspectives may assist students in learning about global investment options, and different genders may lead to a smoother process.

Despite the short-term nature of the simulation, students became educated about the investment process. In addition, I learned how to better use this tool in a classroom setting. Changing the design of the game may reduce risky behavior. Using a risk-adjusted measure of return will reduce risky behavior and encourage a more thoughtful process. Assigning particular investor profiles will encourage students to focus on a more conservative strategy. Placing students in a diverse group should help with the group process and the investment outcome and should expose them to a global perspective and reduce home bias.

The hands-on experience gained from a stock simulation outweighs the pitfalls. Instructors can modify the simulation to discourage risky behavior as much as possible but must understand that risky behavior cannot be completely eliminated. Designing mixed groups should improve the experience and the outcome. We might take comfort in knowing that students will probably be more conservative when it comes time to invest their own money. The opportunity to trade all types of securities and then experience the reward or disappointment of those choices is invaluable.

## REFERENCES

Atkinson, S., Boyce Baird, S., & Frye, M. (2003). Do Female Mutual Fund Managers Manage Differently? The Journal of Financial Research, 26(1), 1-18.

Boehlje, M., & Eidman, V. (1978). Simulation and Gaming Models: Application in Teaching and Extension Programs. American Journal of Agricultural Economics, December, 987-992.

Felton, J., Gibson, B., & Sanbonmatsu, D. (2003). Preference for Risk in Investing as a Function of Trait Optimism and Gender. The Journal of Behavioral Finance, 4(1), 33-40.

Hamacher, T. (2001). He Invests, She Invests. Financial Planning, July, 152.

Joseph, M. (1970). Game and Simulation Experiments. Journal of Economic Education, Spring, 91-96.

Kho, B., Stulz, R., & Warnock, F. (2009). Financial Globalization, Governance, and the Evolution of the Home Bias. Journal of Accounting Research, 47(2), 597-635.

Nieuwerburgh, S., & Veldkamp, L. (2009). Information Immobility and the Home Bias Puzzle. The Journal of Finance, 64(3), 1187-1215.

Lai, C., & Xiao, J. (2010). Consumer Biases and Competences in Company Stock Holdings. The Journal of Consumer Affairs, 44(1), 179-212.

Paden, D., & Barr, M. (1980). Computer-Assisted Instruction in an Elementary College Economics Course. Computers and Education, 4, 259-267.

Siegfried, J.,& Fels, R. (1979). Teaching College Economics: A Survey. Journal of Economic Literature, 17, 923-969.

*Nancy Lottridge Anderson is an Assistant Professor of Finance at Mississippi College.*

**Exhibit 1. Instructions given to graduate students on StockTrak stock market simulation game.**

Overview:

You will be assigned to investment teams. By January 18, 2010, you will receive an e-mail with the team designations. An additional e-mail will be forwarded to you with links and instructions on setting up an account. Each team will have one account. The cost for the account is $26.95 and will be split evenly among the team members. You should be prepared to pay this when opening the account.

The simulation will run for 12 weeks. Class time will be allowed on January 25th for teams to meet and begin the process of opening an account. Only 2 student names will be allowed per account, even though the entire team may be 3 or 4 students.

Each account is funded with a $1 million dollar endowment. Your goal is to maximize the fund's investment. You may use any investment option available within the simulation: stocks, mutual funds, exchange traded funds, bonds, options, futures contracts, short-selling. There is more than one exchange for trading set up for this simulation.

There is a charge for each trade. You may trade online or by calling and placing broker-assisted trades. Broker-assisted trades are more expensive. It is the students' job to determine all costs associated with investing.

Although some class time will be allowed for team meetings, students should expect to spend time outside of class researching, discussing, decision-making, and trading. Each team will track their portfolios week-by-week. Weekly performance should be calculated. All trades during the week should be documented. The professor will be able to view all accounts and account activity and will use investment choices to assign case studies. The team should keep notes on each investment choice.

At the end of the class, each team will present their portfolio. Performance for the full 12-week period should be calculated using a time-weighted, geometrically-linked return. All trading costs incurred during the time period should be documented. A team paper will be turned in to the professor. In addition to the above, it must contain justification for each investment decision.

The grade for the simulation will NOT be based on the performance of the portfolio. Instead, the grade will be determined by the investment decision-making process. Can each trade be justified? Did the team apply sound financial theory? What about the overall risk of the portfolio during the 12-week period?

Below is a list of trading rules:

1. By January 25, 2010, your team should have registered for an account and be familiar with the website.
2. By January 29, the team should have placed at least one trade in the account. The first trade should be for a long position.
3. By February 5, the team should have at least one short position.
4. By February 5, the team should have at least one position in an options contract.
5. By February 12, the team should have at least one position in a futures contract.
6. By March 12, the team should have at least 80% of its assets "at risk " (i.e. invested in something other than cash). This condition must be met throughout the remainder of the trading period. Therefore, proceeds from security sales must be reinvested immediately.
7. All transactions must be well-motivated and may not be arbitrary. If positions cannot be justified to the professor, the team must liquidate.
8. The fund may not engage in insider trading or any illegal or unethical trading. The team must adhere to limits and rules set by Stock Trak.
9. Any trading errors are the responsibility of the team, not the broker. The team must resolve all conflicts or errors with the broker.
10. Please note that, because this is a simulation, there is a 20 minute lag in security pricing.

The objective of this exercise is to learn the mechanics of investing and to apply lessons from class. In your pursuit of good investment ideas, be wise, but not TOO careful. Look for healthy debate within the teams. This usually makes for good decisions. Have fun with the process! When all is said and done, you'll be glad to have this opportunity to do this with "play" money.

**Exhibit 2. Survey given to graduate students on StockTrak stock market simulation game.**

1. Have you ever invested in a security before this simulation?
2. If yes, what types of securities have you purchased before this simulation?
3. How many orders did you place during the simulation?
4. What percentage of your orders were market orders?
5. What percentage of your orders were limit orders?
6. What percentage of your orders were stop loss orders?
7. On a scale of one to ten, with one being the most conservative and ten being the most aggressive, rate the investment philosophy/strategy of the group.
8. On a scale of one to ten rate your personal investment philosophy/strategy.
9. The professor offered a point reward and a prize for the best performing portfolio. Did this cause you to be more aggressive in your selections?
10. At the beginning of the simulation, the professor indicated there would be a penalty for the poorest performing portfolio. When this penalty was removed, did you change your investment style/strategy? If so, did you become more aggressive?
11. Did being part of a group affect your investment choices? How?

12. Would you invest in the same way if this was your account and your money? What would be different?
13. Did you invest in exchanges other than the US?
14. If so, in which exchanges, besides the US, did you buy securities?
15. Are you an international student?
16. Are you a natural born US citizen?
17. If not, what is your nationality?
18. On a scale of one to ten, with one being the least and ten the most, rate how this simulation aided in your knowledge of investments.
19. On a scale of one to ten, with one being the least and ten the most, rate how this simulation aided in your knowledge of derivatives.
20. Case studies were assigned based on activity in group portfolios. On a scale of one to ten, with one being the least and ten the most, rate how the case studies aided in the simulation.
21. If this were an individual exercise, with each person investing their own portfolio, would the cost of the simulation be a problem?
22. Is there anything you would change about the simulation?

**Exhibit 3. Peer Review given to graduate students on StockTrak stock market simulation game.**

List all members in your group (include yourself). Complete a peer review sheet for each member other than yourself.

Member to be reviewed
_____
_____

1. On a scale of one to ten, rate the member's contribution to the exercise.
2. What percentage of the security selections were the idea of this member?
3. Did this member obstruct the simulation in any way? Explain.
4. Did the member do any of the trading in the account?
5. Did the member "take over" the simulation, ignoring the input of other members?
6. If the overall grade for your group was an "A," what grade would you award the member

# Empirical Finance in R: An Introduction

***Omid Sabbaghi***

*This article provides an introduction to the R statistical programming language with teaching applications in finance. R is a statistical software environment for data analysis and graphics. Specific applications presented in this study include the calculation of descriptive statistics for financial returns of 2 stocks and the S&P 500 Index. The R language is useful in today's finance classrooms because of its open-source coding environment, ease of learning, and high number of financial data analysis packages contributed by users worldwide.*

## INTRODUCTION

Empirical finance has attracted much attention in recent years. Modeling financial data and the empirical implementation of financial econometric models provide unique insights in regards to the behavior of securities and financial instruments trading in today's global markets. Research in finance continues to evolve rapidly and new results appear regularly. Importantly, financial time series is an empirical discipline and forms the foundation for making inference. The importance of econometric methods in finance has increased in recent years because of the increase in systematic data collection. That is, our financial markets provide a data-rich environment for the finance student. Thus, modeling financial returns requires knowledge of a programming language that is easy to use.

To date, there has been an absence of research focusing on alternative financial technology applications, thus providing the motivation for the present study. In today's finance classrooms, fewer than 1% of AACSB-accredited business schools offer a dedicated course in financial technology applications (Payne and Tanner 2011). Financial technology courses in business schools' finance curriculum are becoming increasingly important since increases in the availability of financial data and technology have increased the speed at which trades and investment decisions take place. Importantly, business graduates exhibiting a higher competency in technology applications will have a significant comparative advantage in career placement and future success (Truitt forthcoming).

The R software environment emerges as a front runner in teaching finance applications. Specifically, R is a language and environment for statistical computing and graphics that is based on the "S" language developed at Bell Labs. Using R in today's finance classrooms is effective since finance students can implement the commands on their laptops at the same time the instructor is demonstrating the commands in the classroom or finance lab. By having students implement the R commands in real-time, they gain the ability to analyze financial data via learning by doing, a valuable teaching technique. In other words, the R environment allows for experiential learning in financial data analysis.

It is estimated that nearly 250,000 people work with R on a regular basis, and is considered the second language for individuals recently emerging from graduate school (Vance 2009). Additionally, its popularity stems from the ease of using it, its flexibility in coding estimation techniques, and additionally, its unique graphical representation of data. Zeileis and Koenker (2008) argue that the R language provides a rich toolbox for matrix-based computations and that it is attractive for teaching because of its open-source license. In addition, the latter study acknowledges additional benefits of using R, including: (1) the ease by which development efforts can be undertaken; and (2) standards and templates for documentation, version control, and consistency checking. Gaining proficiency with R is useful for finance-related data applications as well as for quantitative methods in related business disciplines, such as accounting, decision sciences, management, and marketing: R is valuable for business undergraduates and MBA students in any field concentration and is an important tool for their future careers.

This study introduces the statistical analysis of financial data in the R computing environment. Using financial returns for 2 companies and the S&P 500 index, we demonstrate how to load the financial returns data in R and calculate sample descriptive statistics, such as sample average returns, medians, and standard deviations.

## THE R ENVIRONMENT

The R statistical environment was developed in the 1990s at the University of Auckland in New Zealand. R is open-source software, meaning that it is free for anyone to use and modify. Its capabilities are extended via user-submitted packages which are collections of R functions, data, and compiled code in well-defined format. These packages massively extend the functionality of R. The base R software may be downloaded freely at R's homepage which is located at http://www.r-project.org/. The contributed user-submitted packages may be downloaded freely from the Comprehensive R Archive Network (CRAN) via the Internet at http://cran.r-project.org/web/packages. CRAN refers to the network of FTP and Web servers around the world. There are currently more than 70 mirror sites that comprise CRAN.

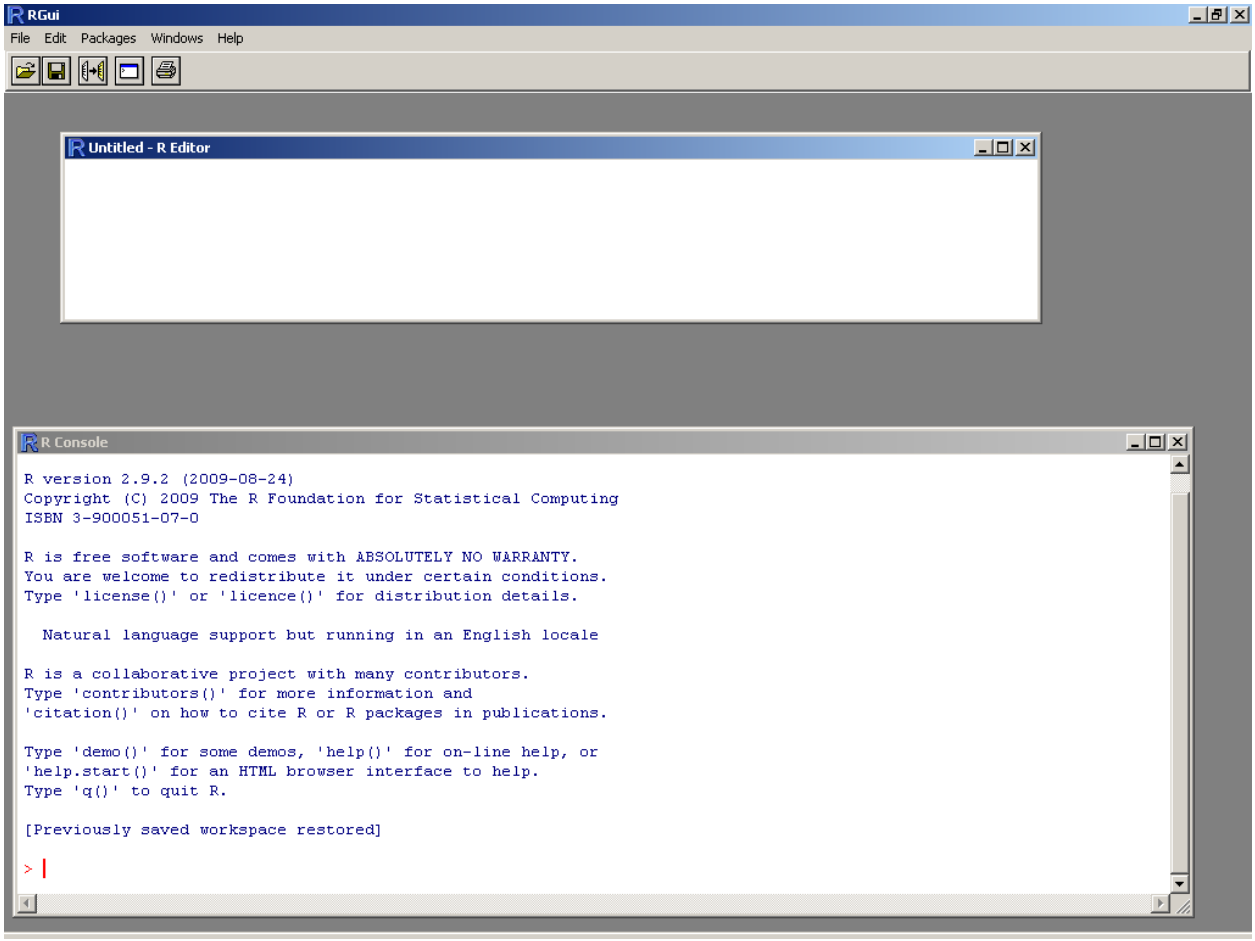
The R environment is attractive for a variety of reasons. R is free and open-source software. Additionally, R exhibits state-of-the-art data analysis and provides a platform for programming new methods. In terms of operating system, R runs on Windows, Linux, as well as Mac OS X. There is an enormous user base and allows for reproducible research.

R can be used directly at the command line or using its inbuilt script editor. Figure 1 presents the graphical user interface when loading R in Microsoft Windows. The first sub screen that appears is the R Console, labeled A in Figure 1. In the R Console, line commands may be manually entered. Statements consist of functions, assignments, and comments. The output is immediately shown in the Console, thus providing an interactive working session. Thus, the R language is interactive and interpreted as well as functional and object oriented. The assignment operator is ← and everything is accomplished through functions operating on objects. An object within R is anything that can be assigned to a variable name and includes: constants, data structures, functions, and even graphs. Objects are kept in memory. However, defined objects in an R session are usually erased from its working memory upon closing the program. Thus, saving commands in an R script file is important for later use. A new script file, labeled B in Figure 1, is initialized using the File menu within R. Commands may be entered in the script file and saved. The commands in the R script file may be implemented by highlighting the command lines or code in the script file and pressing Ctrl + R. The output is then immediately shown in the Console. The R Editor allows for the subsequent revision of the code contained within the R script file.

## SAMPLE DATA & EMPIRICAL METHODOLOGY

We download historical financial data for Google (GOOG), Ford (F), and the S&P 500 index (^GSPC) from Yahoo! Finance. Specifically, we download price level data at the weekly frequency from January 2013 through December 2013 and compute the continuously compounded returns by taking the first difference in log prices. In the present study, we compute several descriptive statistics for the weekly returns data, namely the sample average, median, standard deviation, minimum, maximum, and the t-ratio for the sample average.

**Figure 1. R Graphical User Interface**




## R AND DESCRIPTIVE STATISTICS

We illustrate the value of using R in the classroom by loading the data in R and subsequently calculating descriptive statistics for the returns of our sample companies and the S&P 500 index. The first step in our empirical analysis consists of loading the original downloaded data and computing the weekly returns data in R. Suppose that our original data, downloaded from Yahoo! Finance, resides in an Excel file. One may load this data in R using several steps. The first step is to save the original Excel file as a Text (Tab-Delimited) (*.txt) file within Excel. Following this step, we load the original data for Ford, Google, and the S&P500 Index in R with the following commands, respectively:

```
FORDdata <-
    read.delim("D:\\data\\FORD.txt",header=
    T)

GOOGLEdata <-
    read.delim("D:\\data\\GOOGLE.txt",heade
    r=T)

SP500data <-
    read.delim("D:\\data\\SP500.txt",header
    =T)
```

In the commands above, we are reading in the tab-delimited text data file from its corresponding location on the computer via the `read.delim` command. The `header=T` argument is allowing R to read the first row of the data as column names. By applying the `read.delim` command, we are defining the original data matrices which contain the calendar date in the first column and associated price level and trading volume data in the remaining columns, along with their respective column names in the first row. As a means of visualizing the data, we extract the first five rows of the original data matrix for Ford stock in the R Console via command,

```
FORDdata[1:5,],
```

and report the results in Table 1:

**Table 1. Output from FORData[1:5,] Command**

| | Date | Open | High | Low | Close | Volume | Adj.Close |
|---|---|---|---|---|---|---|---|
| 1 | 1/2/2013 | 13.23 | 13.70 | 13.00 | 13.57 | 83743100 | 13.11 |
| 2 | 1/7/2013 | 13.52 | 14.07 | 13.20 | 14.00 | 55863600 | 13.53 |
| 3 | 1/14/2013 | 14.04 | 14.30 | 13.86 | 14.11 | 48623700 | 13.64 |
| 4 | 1/22/2013 | 14.06 | 14.19 | 13.64 | 13.68 | 47382000 | 13.22 |
| 5 | 1/28/2013 | 13.49 | 13.82 | 12.67 | 13.02 | 70599600 | 12.67 |

The output above confirms the time-series structure of the data matrix, containing the open, high, low, close, and adjusted closing prices as well as trading volume levels. We proceed to calculate continuously compounded returns for Ford stock by calculating the first difference in log adjusted closing prices. The continuously compounded returns for Ford stock are calculated and defined in R via the following command:

```
FORDreturns <-
    diff(log(FORDdata[,"Adj.Close"]))
```

In the command above, we first apply the `log` command to the column containing the adjusted closing prices and then apply the `diff` command in order to take the first difference of the log prices. Importantly, we identify the column containing the adjusted closing prices by referencing the column name in the original data matrix via the command `FORDdata[,"Adj.Close"]`. Generally, the command `data[i,j]` refers to the `i`th row and `j`th column of the defined `data` object in R. Similarly, we calculate the weekly returns for Google stock and the S&P 500 index, respectively, using the following commands:

```
GOOGLEreturns <-
    diff(log(GOOGLEdata[,"Adj.Close"]))

SP500returns <-
    diff(log(SP500data[,"Adj.Close"]))
```

Having defined our returns data within the R computing environment, we proceed to calculate descriptive statistics for our weekly returns data. For illustrative purposes, we calculate the descriptive statistics for Ford's returns data using the following commands in R:

```
mean(FORDreturns)
median(FORDreturns)
sd(FORDreturns)
min(FORDreturns)
max(FORDreturns)
```

The above commands are calculating the sample average, median, standard deviation, minimum, and maximum returns, respectively. A t-test of the null hypothesis that Ford's average returns is equal to zero is conducted with the `t.test` command in R, shown below along with its corresponding output:

```
> t.test(FORDreturns)

        One Sample t-test

data:  FORDreturns
t = 0.6466, df = 51, p-value = 0.5208
alternative hypothesis: true mean is
not equal to 0
95 percent confidence interval:
 -0.006279359  0.012245932
sample estimates:
  mean of x
0.002983287
```

We observe from the output above that the t-ratio is not statistically significant and conclude that the Ford weekly returns are statistically indistinguishable from zero. Note that we are able to extract the t-ratio from the sample output by using double brackets via the command: `t.test(FORDreturns)[[1]]`. Using the mentioned commands above, we calculate descriptive statistics for Google and the S&P500 Index and compile our results in Table 2.

Table 2 reports descriptive statistics for the returns of Ford (F), Google (GOOG), and the S&P 500 index (^GSPC). The sample mean, median, standard deviation (SD), minimum, and maximum are reported. For the sample mean return, t-ratios for testing the null hypothesis of zero average returns are presented in parentheses. The sample period is January 2013 through December 2013. Weekly data is obtained from Yahoo! Finance, accessible via finance.yahoo.com.

In Table 2 one observes that average weekly returns are statistically distinguishable from zero for the case of Google stock and the S&P500 index, suggesting an upward trend in returns over the January 2013 – December 2013 time period. In addition, we observe that there is dispersion present in our returns data. Specifically, we find that the annualized return standard deviations range from 9 percent to 24 percent. Minimum weekly returns range from -2.1 percent through -7.3 percent while maximum weekly returns range from 2.9 percent through 14.8 percent across assets during this time period.

**Table 2. Descriptive Statistics**

| Jan 13 - Dec 13 | Ford | Google | S&P500 |
|---|---|---|---|
| Mean | 0.0030 | 0.0080 | 0.0045 |
| t-ratio | (0.65) | (1.89)* | (2.54)** |
| Median | 0.0028 | 0.0083 | 0.0056 |
| SD | 0.0333 | 0.0306 | 0.0127 |
| Minimum | -0.0731 | -0.0491 | -0.0214 |
| Maximum | 0.0839 | 0.1483 | 0.0292 |

***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 level, respectively.

## CONCLUDING REMARKS

This study investigates the analysis of financial returns data in the R computing environment. Specifically, we provide an overview of the R platform and the importance of its user-friendly programming language in calculating descriptive statistics. The R environment is open source software that is flexible, user-friendly, and allows for a straightforward statistical analysis that is appropriate for the classroom. R is also a very powerful statistical package that students can continue to use in their business careers after graduation as well.

Empirical characteristics of sample financial returns are examined in this study. Specifically, we demonstrate how to calculate sample averages, medians, maximums, minimums, and standard deviations when confronted with returns data. In addition, we show how to conduct a simple t-test when assessing whether returns are statistically indistinguishable from zero.

Several directions lie ahead for teaching finance applications of the R computing environment. Firstly, the R environment can be utilized to conduct asset pricing in the finance classroom. Pricing models such as the Capital Asset Pricing Model (CAPM) and the 3-factor model of Fama and French (1993) can be estimated using historical data. The pricing model estimates can then be utilized to forecast expected returns. Second, the power of the R environment for finance can be extended with user-contributed packages that allow the finance student to predict volatility. In other words, the R computing environment is capable of estimating classical volatility models such as the GARCH model of Bollerslev (1986). We leave these topics for future research.

## REFERENCES

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics*, 31, No. 3, 307-327.

Fama, E.F., and K.R. French (1993). Common Risk Factors in the Returns on Stocks and Bonds. *Journal of Financial Economics*, 33, 3-56.

Payne, J.D., and G. Tanner (2011). Experiential Learning and Finance: A Hands-on-Approach to Financial Modeling. *Journal of Financial Education*, 37, No. 3/4, 82-100.

Truitt, D.L. (forthcoming). The Effect of Training and Development on Employee Attitude as it Related to Training and Work Proficiency. *SAGE Open*.

Vance, A. 2009, January 6. Data Analysts Captivated by R's Power. The New York Times. Retrieved from http://www.nytimes.com

Zeileis, A. and R. Koenker. (2008). Econometrics in R: Past, Present, and Future. *Journal of Statistical Software*, 27, No.1, 1-5.

*Omid Sabbaghi is an Associate Professor of Finance at the University of Detroit Mercy.*

# *Journal of Instructional Techniques in Finance*

## CALL FOR PAPERS

**The *JITF* invites authors to submit manuscripts for publication consideration. The *JITF* is a periodical double-blind refereed journal which began in the Fall of 2008. The *JITF* seeks articles concerning innovative and effective teaching techniques, tools for educators, and especially techniques designed to enhance the student experience in finance courses at the college level. The *JITF* is designed to be useful to finance professors wanting to create better understanding of financial methodologies and analyses among their students. If you have used techniques that have helped you achieve this, please consider formally sharing it through our *JITF* venue.**

**We recommend formatting submissions according to the required *Guidelines for Authors* on our website. While submissions in any format are considered for conferences, the presumption is that journal publication is the ultimate objective of a submission. If formatted correctly, one less editorial requirement stands in the way of effective revisions.**

**A *publication fee* of $57.00 per paper is required upon final acceptance of articles for publication in the *JITF*. If a manuscript is accepted for publication, all listed authors must either be *IFCR* members, or must submit the subscription fee prior to publication. Our operations are supported wholly by membership, subscription, and publication fees. We receive no support from universities or conferences.**

**We sincerely hope the *JITF* can serve your academic publishing needs. Our contact information:**


**Dr. Jose Gutierrez, Editor, Journal of Instructional Techniques in Finance**
**Department of General Business and Finance**
**Sam Houston State University**
**Box 2056, Huntsville, TX 77341**
**(936) 294-3380**
**jag063@shsu.edu**


**The *IFCR* sponsors financial education and financial case research sessions at several conferences. Please consider attending one of our sessions and presenting your case research and instructional techniques.**

***Academy of Economics and Finance, Pensacola, Florida, February 2016***
***www.economics-finance.org***

***Financial Education Association, San Antonio, Texas, September 2015***
***www.jfedweb.org***


**A Publication of the**
***Institute of Finance Case Research***
**www.jfcr.org**