MODULE 3:
TIME VALUE OF MONEY

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OUTLINE

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1. Introduction

The purpose of this module is to introduce you to the math of finance. The focus of this module is on the time value of money – the valuation of cash flows at different points in time. This is an essential tool in financial decision-making because decisions are made considering benefits and costs that occur at different points in time.

Your financial calculator is a wonderful tool that can be used to do the hard work in the calculations. However, mastery of financial math requires understanding the mathematics behind the calculations that your calculator performs. Why bother knowing what’s behind it all? Because not every financial transaction fits neatly into the financial calculator's programs.

The tools that you will learn in this module are necessary to understanding securities' valuation and capital budgeting, which are key topics in financial decision-making. An added benefit to learning financial math is that you will be better prepared for consumer-finance decisions. For example, with the math that you learn in this module you will be able to calculate the true, effective rate of interest on a car loan and the true, effective rate on credit card borrowing.

You may have some experience with financial math from other coursework, but we will be covering the financial math with more depth than most other courses. This is necessary in order to set the stage for the more intense requirements of capital budgeting.
2. Learning outcomes

LO3.1 Apply valuation principles to calculate the future value of lump-sum amount.
LO3.2 Apply valuation principles to calculate the present value of a lump-sum amount.
LO3.3 Distinguish between discrete and continuous compounding of interest.
LO3.4 Calculate the FV and PV of a lump sum for different compounding frequencies, including continuous compounding.
LO3.5 Apply valuation principles to calculate the future value and the present value of a series of cash flows.
LO3.7 Distinguish between an ordinary annuity and an annuity due.
LO3.8 Calculate the present value lump-sum amount for a deferred annuity.
LO3.9 Solve for the deposits or withdrawals in a deferred annuity.
LO3.10 Amortize a loan, breaking out both interest and principal payments, for loans with and without a balloon payment.
LO3.11 Solve for the interest rate for both lump-sum and annuity situations.
LO3.12 Solve for the number of periods for both lump-sum and annuity situations.
LO3.13 Convert an APR into an EAR, and vice-versa.

3. Module 3 tasks

A. Readings
   i) Required reading
      (a) Time value of money: Part 1
      (b) Time value of money: Part II
      (c) Calculating interest rates
   ii) Other resources
      (a) Calculator help. A guide to calculating the problems using a HP, TI or similar calculator.
      (b) Study Finance: Time Value of Money. An overview of the time value of money provided by the University of Arizona.
   iii) Optional reading
      (a) Calculating a future value, a step-by-step approach.
      (b) Fabozzi and Peterson text, Chapter 7 (Mathematics of Finance)

B. Problem sets
   These problems sets are non-graded tasks.
   - Time value of money practice problems and solutions
   - 5-minutes workouts:
     - Future and Present Values
     - Annuities
     - Uneven Cash Flows
     - EAR vs. APR
     - Interpreting Problems
   - Time Value of Money Practice Problems
   - More Time Value of Money Practice Problems
4. Module 3 overview and discussion

A. Introduction

Financial decisions involve dealing with cash flows that occur at different points in time. For example, if a company is considering a new product, the decision depends on the comparison of the cost of the project today with the expected benefits from the new product in the form of future cash flows.

Therefore, the financial manager must be able to translate values through time, either forward or backward, depending on the application. Translating a value or set of values through time requires consideration of both the rate of interest and the number of compound or discount periods.

B. Time value of money: Part I

In this reading, we establish the basic concepts and math of valuation. You are introduced to the basic valuation equation and how it is used to translate a lump-sum monetary amount forward in time - calculating the future value - and backward in time - calculating the present value.

This reading is designed assuming that the reader has never become acquainted with the time value of money principles. You may have seen the time value of money before in another course, but you are encouraged to work through the examples to make sure that you are familiar with the notation and the methods of calculation offered in this reading so that you are prepared for further readings.

Throughout this and other readings, calculator and spreadsheet assistance is provided. The two calculators that are demonstrated are the Texas Instruments (TI) Model 83 (and TI-84, since they have the same programs) and the Hewlett Packard (HP) 10B. The spreadsheet assistance is for Microsoft Excel®.

C. Time value of money: Part II

In this reading, we take a look at valuing a series of cash flows, whether even or uneven. If the series consists of even cash flows (that is, cash flows of the same amount at periodic intervals of time), we can use short-cuts to value these cash flows. We address three annuities: ordinary, annuity due, and deferred annuity. We also take a look at the algebraic manipulations necessary for solving for the unknown number of periods and for solving for the unknown interest rate.

The mathematics of finance can become quite complex, but no matter the complexity, it all harks back to the basic valuation equation.

D. Calculating interest rates

In financial decision-making, we are concerned about how interest rates affect value. The focus of this reading is on making sense of two common methods of stating interest rates: the annual percentage rate (APR) and the effective annual rate (EAR).
Consumer laws require that lenders state the loan arrangement’s APR. However, the APR does not consider compounding, which affects the true cost of the loan. Therefore, we need to understand how to translate a stated rate into a true, effective rate of interest. This is especially important when comparing borrowing opportunities in which the terms of the loans differ.

E. Is a financial calculator necessary?

Do you really need a financial calculator or one with financial programs? Absolutely. Though you may be able to complete all of the financial math problems in this module without a financial calculator (by spending a bit more time on each problem), you will not be able to perform the financial math in the next module without the financial programs. If you have just acquired a financial calculator or have never used the financial programs in your calculator, now is a good time to get used to the programs.

What’s the best calculator? Well, there are actually several good calculators you could acquire. The readings refer to two calculators: The Texas Instruments (TI) TI-83 and the Hewlett-Packard (HP) 10B.

- The TI-83 (and the new model TI-84) is a scientific calculator with excellent financial programs. If you already have one of these from other courses, you will find that this is all you need for this course.
- The Hewlett-Packard 10B is a “best buy” in terms of a good price on a calculator that does everything you need.

There are other good calculators that you can use: some of the other TI scientific calculators have financial applications that can be downloaded from TI’s website and there are imitators of the HP10B that work just as well.\(^1\)\(^2\) When in doubt, as the instructor.

F. What’s next?

The next module focuses on valuation. You’ll notice when you get there that it’s an application of the financial mathematics from Module 3. We use this math to value stocks, bonds, and other investments in Module 4. In Module 5, you’ll see how risk enters the picture and affects valuation.

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\(^1\) Check out the calculator help at the course web site to see if your calculator is supported by the course.

\(^2\) You will notice that I did not mention TI’s BAII+ calculator. This calculator has shown to be a problem for students in the past because it has a very cumbersome cash flow/NPV/IRR programs, as well as confusing registry clearing routines. Use this calculator at your own risk.