M 329F Syllabus

Theory of Interest

Prerequisite and degree relevance: M408D or M408L, with a grade of at least C, or consent of instructor. This course covers the content for the SOA Exam FM. Topics include nominal and effective interest and discount rates, general accumulation functions and force of interest, yield rates, annuities including those with non-level payment patterns, amortization of loans, sinking funds, bonds, spot and forward rates, interest rate swaps, duration, and immunization.

Text: Mathematical Interest Theory, Second Edition, *Vaaler & Daniel*, Mathematical Association of America.

Course Goals: The goal of M329F Theory of Interest is to provide an understanding of the fundamental concepts of financial mathematics, and how those concepts are applied in calculating present and accumulated values for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows.

Learning Objectives:

- The student will understand and be able to perform calculations relating to present value, current value, and accumulated value.
- The student will be able to calculate present value, current value, and accumulated value for sequences of non-contingent payments.
- The student will understand key concepts concerning loans and how to perform related calculations.
- The student will understand key concepts concerning bonds, and how to perform related calculations.
- The student will understand key concepts concerning yield curves, rates of return, and measures of duration and convexity, and how to perform related calculations.
- The student will understand key concepts concerning cash flow matching and immunization, and how to perform related calculations.
- The student will understand key concepts concerning interest rate swaps, and how to perform related calculations.
- The student will understand key concepts concerning the determinants of interest rates, the components of interest, and how to perform related calculations.

Chapter 0 An Introduction to the Texas Instruments BA II Plus (optional)

Chapter 1 The Growth of Money (7 days)

- 1.1 Introduction (optional)
- 1.2 What is interest?
- 1.3 Accumulation and Amount Functions
- 1.4 Simple Interest/Linear Accumulation Functions

- 1.5 Compound Interest (The usual case!)
- 1.6 Interest in Advance/The Effective Discount Rate
- 1.7 Discount Functions/The Time Value of Money
- 1.8 Simple Discount
- 1.9 Compound Discount
- 1.10 Nominal Rates of Interest and Discount
- 1.11 A Friendly Competition (Constant Force of Interest)
- 1.12 Force of Interest
- 1.14 Inflation

Chapter 2 Equations of Value and Yield Rates (4-5 days)

- 2.1 Introduction (optional)
- 2.2 Equations of Value for Investments Involving a Single Deposit made under Compound Interest
- 2.3 Equations of Value for Investments with Multiple Contributions
- 2.4 Investment Return
- 2.5 Reinvestment Considerations
- 2.6 Approximate Dollar Weighted Yield Rates (FM refers to this as Dollar Weighted Yield Rates)
- 2.7 Fund Performance

Chapter 3 Annuities (Annuities Certain) (11-12 days)

- 3.1 Introduction (optional)
- 3.2 Annuities Immediate
- 3.3 Annuities Due
- 3.4 Perpetuities & 7.1 Common and Preferred Stock
- 3.5 Deferred Annuities and Values on any Date
- 3.6 Outstanding Loan Balances
- 3.7 Nonlevel Annuities
- 3.8 Annuities with Payments in Geometric Progression
- 3.9 Annuities with Payments in Arithmetic Progression
- 3.10 Yield Rate Examples Involving Annuities (optional)
- 3.11 Annuity Symbols for Nonintegral Terms (optional)
- 3.12 Annuities Governed by General Accumulation Functions (optional)
- 3.13 The Investment Year Method (exclude investment year method portion)

Chapter 4 Annuities with Different Payment and Conversion Periods (1-2 days)

- 4.1 Introduction (optional)
- 4.2 Level Annuities with Payments Less Frequent Than Each Interest Period (optional)
- 4.3 Level Annuities with Payments More Frequent Than Each Interest Period (optional)

- 4.4 Annuities with Payments Less Frequent Than Each Interest Period and Payments in Arithmetic Progression (optional)
- 4.5 Annuities with Payments More Frequent Than Each Interest Period and Payments in Arithmetic Progression (optional)
- 4.6 Continuously Paying Annuities

Chapter 5 Loan Repayment (2-3 days)

- 5.1 Introduction (optional)
- 5.2 Amortized Loans and Amortization Schedules
- 5.3 The Sinking Fund Method
- 5.4 Loans with Other Repayment Patterns (optional)
- 5.5 Yield Rate Examples and Replacement of Capital (optional)

Chapter 6 Bonds (5-6 days)

- 6.1 Introduction (optional)
- 6.2 Bond Alphabet Soup and the Basic Price Formula
- 6.3 The Premium-Discount Formula
- 6.4 Other Pricing Formulas for Bonds (optional if the entire Bond Alphabet Soup is covered in Section 6.2)
- 6.5 Bond Amortization Schedules
- 6.6 Valuing a Bond After Its Date of Issue (optional)
- 6.9 Callable Bonds

Chapter 7 Stocks and Financial Markets (1 day)

- 7.1 Common and Preferred Stock (cover dividend discount model with §3.4)
- 7.4 Selling Short; Selling Borrowed Stocks (optional)

Chapter 8 Arbitrage, Term Structure of Interest Rates, and Derivatives (1-2 days)

- 8.1 Introduction (optional)
- 8.3 The Term Structure of Interest Rates
- 8.11 Swaps (interest rate swaps only)

Chapter 9 Interest Rate Sensitivity (4-5 days)

- 9.1 Overview
- 9.2 Duration
- 9.3 Convexity
- 9.4 Immunization
- 9.5 Other Types of Duration (optional)

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