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## Spring 2006 - Exam FM (Financial Mathematics)

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### Exam FM Financial Mathematics

The examination for this material consists of two hours of multiple-choice questions and is identical to CAS Exam 2.

The goal of the Financial Mathematics course of reading 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.

The following learning outcomes are presented with the understanding that candidates are allowed to use specified calculators on the exam. The education and examination of candidates should reflect that fact. In particular, such calculators eliminate the need for candidates to learn and be examined on certain mathematical methods of approximation.

### LEARNING OUTCOMES

1. Candidates will know **definitions** of key terms of financial mathematics: inflation; rates of interest [simple, compound (interest and discount), real, nominal, effective, dollar-weighted, time-weighted, spot, forward], term structure of interest rates; force of interest (constant and varying); equivalent measures of interest; yield rate; principal; equation of value; present value; future value; current value; net present value; accumulation function; discount function; annuity certain (immediate and due); perpetuity (immediate and due); stocks (common and preferred); bonds (including zero-coupon bonds); other financial instruments such as mutual funds, and guaranteed investment contracts.

Specifically, candidates are expected to demonstrate the ability to:

- a. Choose the term, given a definition
- b. Define a given term
- c. Determine an equation of value, given a valuation problem involving one or more sets of cash flows at specified times

2. Candidates will understand key procedures of the financial mathematics: determining equivalent measures of interest; discounting; accumulating; determining yield rates; estimating the rate of return on a fund; amortization

Specifically, candidates are expected to demonstrate the ability to:

- a. Calculate the equivalent annual effective rate of interest, given a nominal annual rate and a frequency of interest conversion, discrete or continuous, other than annual.
  - b. Calculate the equivalent effective rate of interest per payment period given a payment period different from the interest conversion period.
  - c. Estimate the interest return on a fund
  - d. Calculate the appropriate equivalent single value (present value, net present value, future (accumulated) value or combination), given a set of cash flows (level or varying), an appropriate term structure of interest rates, the method of crediting interest (e.g., portfolio or investment year) as necessary, an appropriate set of inflation rates as necessary, and accounting for reinvestment interest rates as necessary; for example:
    - i. Calculate the loan amount or outstanding loan balance, given a set of loan payments (level or varying) and the desired yield rate (level or varying)
    - ii. Calculate the price of a bond (callable or non-callable), given the bond coupons, the redemption value, the term of the bond (constant or varying), the coupon interest rate, and the desired yield rate (level or varying)
    - iii. Calculate the value of a stock, given the pattern of dividends and the desired yield rate (level or varying)
    - iv. Calculate the net present value, given a set of investment contributions and investment returns
  - e. Calculate a unique yield rate, when it exists, given a set of investment cash flows
  - f. Calculate the amount(s) of investment contributions, given there is more than one contribution, and given a set of yield rates, the amount(s) and timing of investment return(s), and the desired timing of the investment contributions
  - g. Calculate the amount(s) of investment returns, given there is more than one return, and given a set of yield rates, the amount(s) and timing of investment contribution(s) and the desired timing of the investment returns; for example:
    - i. Calculate loan payments, given the loan amount(s), the term of the loan, and the desired yield rate (level or varying)
    - ii. Calculate the principal and interest portions of a loan payment, given the loan amount, the set of loan payments (level or varying), and a set of interest rates (level or varying)
    - iii. Calculate bond coupons or redemption values, given the bond price, the term of the bond, and the desired yield rate (level or varying)
  - h. Calculate the term of an investment, given a set of cash flows (level or varying), and a set of interest rates (level or varying); for example
    - i. Calculate the length of time required to accumulate a given amount, given the yield rate and an initial amount
    - ii. Calculate the length of time to repay a given loan amount, given the loan payments and the loan interest rate(s)
    - iii. Calculate the time to maturity of a bond, given the price of the bond, the coupon payments, redemption value, and yield rate
3. Candidates will know definitions of key terms of modern financial analysis at an introductory and intuitive level, and be able to complete basic calculations involving such terms: yield curves, spot rates, forward rates, duration, convexity, immunization, and short sales.

Specifically, candidates are expected to demonstrate the ability to:

- a. Choose the term, given a definition
- b. Write the definition, given a term
- c. Perform calculations such as:
  - i. yield rate on a short sale
  - ii. measuring interest rate risk using duration and convexity
  - iii. basic immunization calculations

*Note that probability-based calculations for applications of financial mathematics are in Exam M.*

**Suggested Texts**

The Candidate may use either of the options shown below. Knowledge and understanding of financial mathematics concepts are significantly enhanced through working out problems based on those concepts. Thus in preparing for the Financial Mathematics examination, whichever of the source of textbooks students choose to use, students are encouraged to work out the textbook exercises related to the listed readings.

**OPTION A**

- *Theory of Interest* (Second Edition), 1991, by Kellison, S.G., Chapters 1-2, Chapter 3 (exclude 3.6 and 3.10), Chapter 4, Section 4.1 and the rest of page 95 , Examples 4.1 and 4.2, Sections 4.4–4.8, Chapter 5, Sections 5.1–5.7, Chapter 6, Sections 6.1–6.4 and 6.6, Chapter 7, Sections 7.1–7.7 and 7.10, Chapter 8, Sections 8.7 and 8.8 (exclude Options, Futures, Forwards and Swaps), Chapter 9, Sections 9.4, 9.6, 9.8–9.10, Appendix VIII.

**OPTION B**

- *Mathematics of Investment and Credit* (Third Edition), 2004, by Broverman, S.A., Chapter 1 through section 1.6, Chapter 2 through section 2.4 (excluding 2.4.2 and 2.4.3), Chapter 3 through section 3.3 (excluding pages 188–189), Chapter 4 through section 4.3.1, Chapter 5 through section 5.3 (excluding 5.1.3, 5.1.4 and 5.3.2), Chapter 6 through section 6.3 (excluding 6.2), Chapter 7 through section 7.2, Chapter 8, sections 8.2.1, 8.2.2, 8.2.4, 8.3.1–8.3.3.

**Study Notes**

**SNs for the Preliminary Education examinations and Course 6 are available on the SOA Web site under Exams and Jobs/Candidate and Exam Information/Spring Exam Session/Spring 2006 Basic Education Catalog – Study Notes Information. Hard copies may be purchased by using the Study Note and Published Reference order form in the back of the printed catalog or by downloading the form from the Spring Exam Session Web page.**

| <b>Code</b> | <b>Title</b>  |
|-------------|---|
| FM-05-06#   | <a href="#"><u>FM Introductory Study Note</u></a><br><a href="#"><u>The Theory of Interest, 2nd Edition Errata</u></a>      |
| FM-09-05    | <a href="#"><u>FM Sample Exam Questions (updated 9/19/05)</u></a><br>and <a href="#"><u>Solutions (updated 9/19/05)</u></a> |
| FM-10-05    | <a href="#"><u>May 2005 Exam FM Exam Questions and Solutions</u></a>  |
| FM-12-05#   | <a href="#"><u>November 2005 FM Exam Questions and Solutions</u></a>  |
| FM-22-05    | <a href="#"><u>Review of Calculator Functions for the Texas Instruments BA-35</u></a>                                       |
| FM-23-05    | <a href="#"><u>Review of Calculator Functions</u></a>   |

for the Texas Instruments BA II Plus

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