Study Guide

Exam FM: Financial Mathematics

Society of Actuaries (SOA)

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Preliminary

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Objectives

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Learning outcomes

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Subjects of study

1 Time Value of Money (10%-15%)

Information

Objective

The Candidate will understand and be able to perform calculations relating to present value, current value, and accumulated value.

Learning outcomes

The candidate will be able to :

a) Define and recognize the *definitions* of the following terms :

- Interest rate (rate of interest) ;
- Simple interest ;
- Compound interest ;
- Accumulation function ;
- Future value ;
- Current value ;
- Present value ;
- Net present value ;
- Discount factor ;
- Discount rate (rate of discount) ;
- Convertible m-thly (. . . ?) ;
- Nominal rate ;
- Effective rate ;
- Inflation ;
- Real rate of interest ;
- Force of interest ;
- Equation of value.

b) Given any 3 of :

- Interest rate ;
- Period of time ;
- Present value ;
- Current value ;
- Future value,

calculate the remaining item using *simple* or *compound* interest ;

Solve time value of money equations involving variable force of interest ;

c) Given any 1 of :
   - Effective interest rate ;
   - Nominal interest rate convertible m-thly ;
   - Force of interst,

   calculate any of the other items ;
d) Write the equation of value given a set of cash flows and interest rate.

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2 Topic : Annuities / cash flows with non-contingent payments (exam weight)

Information

Objective

The Candidate will be able to calculate present value, current value, and accumulated value for sequences of non-contingent payments.

Learning outcomes

The candidate will be able to :

a) Define and recognize the *definitions* of the following terms :

- Annuity-immediate ;
- Annuity-due ;
- Perpetuity ;
- Payable m-thly or continously ;
- Level payment annuity ;
- Arithmetic increasing/decreasing annuity ;
- Geometric increasing/decreasing annuity ;
- Term of annuity ;

b) For each of the following types of annuity / cash flows, given sufficient information of :

- Immediate or due ;
- Present value ;
- Futur value ;
- Current value ;
- Interest rate ;
- Payment amount ;
- Term of annuity,

calculate any remaining item.

The types are :

- Level annuity, finite term ;

- Level perpetuity ;
- Non-level annuities / cash flows ;
  - Arithmetic progression, finite term and perpetuity ;
  - Geometric progression, finite term and perpetuity ;
  - Other non-level annuities / cash flows.

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3 Topic : Loans (10%-20%)

Information

Objective

The Candidate will understand key concepts concerning loans and how to perform related calculations.

Learning outcomes

The candidate will be able to :

a) Define and recognize the *definitions* of the following terms :

- Principal ;
- Interest ;
- Term of loan ;
- Outstanding balance ;
- Final payment ;
  - Drop payment ;
  - Baloon payment.
- Amortization.

b) Calculate :

- The missing item given any 4 of :
  - Term of loan ;
  - Interest rate ;
  - Payment amount ;
  - Payment period ;
  - Principal.
- The outstanding balance at any point in time ;
- The amount of interest and principal repayment in a given payment ;
- Similar calculations to the above when refinancing is involved.

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4 Topic : Bonds (10%-20%)

Information

Objective

The Candidate will understand key concepts concerning bonds, and how to perform related calculations.

Learning outcomes

The candidate will be able to :

a) Define and recognize the *definitions* of the following terms :

- Price ;
- Book value ;
- Amortization of premium ;
- Accumulation of discount ;
- Redemption value ;
- Par value / Face value ;
- Yield rate ;
- Coupon ;
- Coupon rate ;
- Term of bond ;
- Callable / Non-callable.

b) Given sufficient partial information about the items listed below, calculate any of the remaining items :

- Price, book value, amortization of premium, accumulation of discount ;
- Redemption value, face value ;
- Yield rate ;
- Coupon, coupon rate ;
- Term of bond, point in time that a bond has a given book value, amortization of premium, or accumulation of discount.

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5 Topic : General Cash Flows and Portfolios (15%-20%)

Information

Objective

The Candidate will understand key concepts concerning yield curves, rates of return, and measures of duration and convexity, and how to perform related calculations.

Learning outcomes

The candidate will be able to :

a) Define and recognize the *definitions* of the following terms :

- Yield rate / rate of return ;
- Dollar-weighted rate of return ;
- Time-weighted rate of return ;
- Current value ;
- Duration (Macaulay and modified) ;
- Convexity (Macaulay and modified) ;
- Portfolio ;
- Spot rate ;
- Forward rate ;
- Yield Curve ;
- Stock price ;
- Stock dividend ;

b) Calculate :

- The dollar-weighted and time-weighted rate of return ;
- The duration and convexity of a set of cash flows ;
- Either Macaulay or modified duration given the other ;
- The approximate change in present value due to a change in interest rate,

- Using 1st-order linear approximation based on modified duration ;
- Using 1st-order approximation based on Macaulay duration.

› The price of a stock using the dividend discount model ;

› The present value of a set of cash flows, using a yield curve developed from forward and spot rates.

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6 Topic : Immunization (10%-15%)

Information

Objective

The Candidate will understand key concepts concerning cash flow matching and immunization, and how to perform related calculations.

Learning outcomes

The candidate will be able to :

a) Define and recognize the *definitions* of the following terms :
   - Cash flow matching ;
   - Immunization (including full immunization) ;
   - Redington immunization.

b) Construct an investment portfolio to :
   - Redington immunize a set of liability cash flows ;
   - Fully immunize a set of liability cash flows ;
   - Exactly match a set of liability cash flows.

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7 Topic : Interest Rate Swaps (0-10%)

Information

Objective

The Candidate will understand key concepts concerning interest rate swaps, and how to perform related calculations.

Learning outcomes

The candidate will be able to :

a) Define and recognize the *definitions* of the following terms :

- Swap rate ;
- Swap term (tenor) ;
- Notional amount ;
- Market value of a swap ;
- Settlement dates ;
- Settlement period ;
- Counterparties ;
- Deferred swap ;
- Amortizing swap ;
- Accreting swap ;
- Interest rate swap net payments.

b) Given sufficient information, calculate :

- The market value ;
- Notional amount ;
- Spot rates or swap rate,

of an interest rate swap

- deferred or otherwise ;
- with either constant or varying notional amount.

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8 Topic : Determinants of Interest Rates (0-10%)

Information

Objective

The Candidate will understand key concepts concerning the determinants of interest rates, the components of interest, and how to perform related calculations.

Learning outcomes

The candidate will be able to :

a)

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