

**Subject CT8
Financial Economics
Core Technical**

Syllabus

for the 2009 Examinations

1 June 2008

**The Faculty of Actuaries and
Institute of Actuaries**

Subject CT8 — Financial Economics Core Technical Syllabus

Aim

The aim of the Financial Economics subject is to develop the necessary skills to construct asset liability models and to value financial derivatives. These skills are also required to communicate with other financial professionals and to critically evaluate modern financial theories.

Links to other subjects

Concepts introduced in Subjects CT1 — Financial Mathematics, CT4 — Models and CT7 — Economics are used in this subject.

Topics introduced in this subject are further developed in Subjects CA1 — Core Applications Concepts and ST6 — Finance and Investment Specialist Technical B. Other Specialist Technical subjects provide an application for some of the hedging and derivative pricing techniques as well as asset-liability modelling.

Objectives

On completion of the subject the trainee actuary will be able to:

- (i) Discuss the advantages and disadvantages of different measures of investment risk.
 1. Define the following measures of investment risk:
 - variance of return
 - downside semi-variance of return
 - shortfall probabilities
 - Value at Risk (VaR) / Tail VaR
 2. Describe how the risk measures listed in (i) 1. above are related to the form of an investor's utility function.
 3. Perform calculations using the risk measures listed above to compare investment opportunities.
 4. Explain how the distribution of returns and the thickness of tails will influence the assessment of risk.

- (ii) Describe and discuss the assumptions of mean-variance portfolio theory and its principal results.
1. Describe and discuss the assumptions of mean-variance portfolio theory.
 2. Discuss the conditions under which application of mean-variance portfolio theory leads to the selection of an optimum portfolio.
 3. Calculate the expected return and risk of a portfolio of many risky assets, given the expected return, variance and covariance of returns of the individual assets, using mean-variance portfolio theory.
 4. Explain the benefits of diversification using mean-variance portfolio theory.
- (iii) Describe and discuss the properties of single and multifactor models of asset returns.
1. Describe the three types of multifactor models of asset returns:
 - macroeconomic models
 - fundamental factor models
 - statistical factor models
 2. Discuss the single index model of asset returns.
 3. Discuss the concepts of diversifiable and non-diversifiable risk.
 4. Discuss the construction of the different types of multifactor models.
 5. Perform calculations using both single and multi-factor models
- (iv) Describe asset pricing models, discussing the principal results and assumptions and limitations of such models.
1. Describe the assumptions and the principal results of the Sharpe-Lintner-Mossin Capital Asset Pricing Model (CAPM).
 2. Discuss the limitations of the basic CAPM and some of the attempts that have been made to develop the theory to overcome these limitations.
 3. Discuss the assumptions, principal results and limitations of the Ross Arbitrage Pricing Theory model (APT).
 4. Perform calculations using the CAPM.

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- (v) Discuss the various forms of the Efficient Markets Hypothesis and discuss the evidence for and against the hypothesis.
1. Discuss the three forms of the Efficient Markets Hypothesis and their consequences for investment management.
 2. Describe briefly the evidence for or against each form of the Efficient Markets Hypothesis.
- (vi) Demonstrate a knowledge and understanding of stochastic models of the behaviour of security prices.
1. Discuss the continuous time log-normal model of security prices and the empirical evidence for or against the model.
 2. Discuss the structure of auto-regressive models of security prices and other economic variables, such as the Wilkie model, and describe the economic justification for such models.
 3. Discuss the main alternatives to the models covered in (vi) 1. and (vi) 2. above and describe their strengths and weaknesses.
 4. Perform simple calculations involving the models described above.
 5. Discuss the main issues involved in estimating parameters for asset pricing models:
 - data availability
 - data errors
 - outliers
 - stationarity of underlying time series
 - the role of economic judgement
- (vii) Define and apply the main concepts of Brownian motion (or Wiener Processes).
1. Explain the definition and basic properties of standard Brownian motion or Wiener process.
 2. Demonstrate a basic understanding of stochastic differential equations, the Ito integral, diffusion and mean-reverting processes.
 3. State Ito's formula and be able to apply it to simple problems.
 4. Write down the stochastic differential equation for geometric Brownian motion and show how to find its solution.

5. Write down the stochastic differential equation for the Ornstein-Uhlenbeck process and show how to find its solution.
- (viii) Demonstrate a knowledge and understanding of the properties of option prices, valuation methods and hedging techniques.
1. State what is meant by arbitrage and a complete market.
 2. Outline the factors that affect option prices.
 3. Derive specific results for options which are not model dependent:
 - Show how to value a forward contract.
 - Develop upper and lower bounds for European and American call and put options.
 - Explain what is meant by put-call parity.
 4. Show how to use binomial trees and lattices in valuing options and solve simple examples.
 5. Derive the risk-neutral pricing measure for a binomial lattice and describe the risk-neutral pricing approach to the pricing of equity options.
 6. Explain the difference between the real-world measure and the risk-neutral measure. Explain why the risk-neutral pricing approach is seen as a computational tool (rather than a realistic representation of price dynamics in the real world).
 7. State the alternative names for the risk-neutral and state-price deflator approaches to pricing.
 8. Demonstrate an understanding of the Black-Scholes derivative-pricing model:
 - Explain what is meant by a complete market.
 - Explain what is meant by risk-neutral pricing and the equivalent martingale measure.
 - Derive the Black-Scholes partial differential equation both in its basic and Garman-Kohlhagen forms.
 - Demonstrate how to price and hedge a simple derivative contract using the martingale approach.
 9. Show how to use the Black-Scholes model in valuing options and solve simple examples.

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10. Discuss the validity of the assumptions underlying the Black-Scholes model.
 11. Describe and apply in simple models, including the binomial model and the Black-Scholes model, the approach to pricing using deflators and demonstrate its equivalence to the risk-neutral pricing approach.
 12. Demonstrate an awareness of the commonly used terminology for the first, and where appropriate second, partial derivatives (the Greeks) of an option price.
- (ix) Demonstrate a knowledge and understanding of models of the term structure of interest rates.
1. Describe the desirable characteristics of a model for the term-structure of interest rates.
 2. Describe, as a computational tool, the risk-neutral approach to the pricing of zero-coupon bonds and interest-rate derivatives for a general one-factor diffusion model for the risk-free rate of interest.
 3. Describe, as a computational tool, the approach using state-price deflators to the pricing of zero-coupon bonds and interest-rate derivatives for a general one-factor diffusion model for the risk-free rate of interest.
 4. Demonstrate an awareness of the Vasicek, Cox-Ingersoll-Ross and Hull-White models for the term-structure of interest rates.
 5. Discuss the limitations of these one-factor models and show an awareness of how these issues can be addressed.
- (x) Demonstrate a knowledge and understanding of simple models for credit risk.
1. Define the terms credit event and recovery rate.
 2. Describe the different approaches to modelling credit risk: structural models, reduced form models, intensity-based models.
 3. Demonstrate a knowledge and understanding of the Merton model.
 4. Demonstrate a knowledge and understanding of a two-state model for credit ratings with a constant transition intensity.
 5. Describe how the two-state model can be generalised to the Jarrow-Lando-Turnbull model for credit ratings.

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6. Describe how the two-state model can be generalised to incorporate a stochastic transition intensity.

End of Syllabus