



Institute of Actuaries of India

Subject
SP6 – Financial Derivatives
Specialist Principles
For 2020 Examinations

SP6 – Financial Derivatives Specialist Principles

Aim

The aim of the Financial Derivatives Principles subject is to instil in successful candidates the ability (at a higher level of detail and ability than in CM2) to understand different types of financial derivatives and their uses, the markets in which they are traded, methods of valuation of financial derivatives, and the assessment and management of risks associated with a portfolio of derivatives.

Competences

On successful completion of this subject, a student will be able to:

- 1 understand the main principles and techniques that are relevant to the use and management of financial derivatives.
- 2 apply these principles to given situations within the context of financial derivative management.
- 3 analyse hypothetical scenarios, including using judgement to assess the implications of possible actions and to develop appropriate proposals or recommendations relating to the management of financial derivatives.

Links to other subjects

CM2 – Financial Engineering and Loss Reserving

CP1 – Actuarial Practice

Syllabus topics

- 1 Derivative markets (5%)
- 2 Derivative types and uses (20%)
- 3 Derivative pricing and valuation methods, including interest rate models (50%)
- 4 Management of derivatives (25%)

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions.

The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as:

- the relative complexity of each topic, and hence the amount of explanation and support required for it.
- the need to provide thorough foundation understanding on which to build the other objectives.
- the extent of prior knowledge which is expected.
- the degree to which each topic area is more knowledge or application based.

Skill levels

The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question which can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document "Command verbs used in the Associate and Fellowship written examinations".

Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations).

In the SP subjects, the approximate split of assessment across these three skill types is 25% Knowledge, 50% Application and 25% Higher Order Skills.

Detailed syllabus objectives

1 Derivative markets (5%)

- 1.1 Demonstrate an awareness of the basic characteristics of the derivatives markets.
- 1.2 Describe the characteristics of exchange traded contracts and over-the-counter contracts.
- 1.3 Describe the uses of forwards, future and options by different types of traders: hedgers, speculators and arbitrageurs.
- 1.4 Demonstrate an understanding of how futures and options markets work.
- 1.5 Describe the operation of central counterparty clearing houses (CCPs) and the related regulatory environment.

2 Derivative types and uses (20%)

- 2.1 Describe the payoffs of forwards and futures, calls and puts (American and European).
- 2.2 Demonstrate an understanding of forward and futures prices.
- 2.3 Explain how to use the futures contracts in 2.2 for hedging.
- 2.4 Describe the following traded derivative contracts:
 - stock options
 - currency options
 - index options
 - options on futures
 - warrants
 - convertibles
- 2.5 Describe different types of property derivatives, including their uses, and property indices.
- 2.6 Describe the following interest rates and interest rate derivatives:
 - Treasury rates
 - LIBOR rates
 - Overnight index swap rates
 - repo rates
 - zero rates
 - forward rates
 - forward rate agreements
 - interest rate futures
 - Treasury bond futures

- interest rate swaps
- European swap options (swaptions)
- caps and caplets
- floors and floorlets
- Bermudan swaptions

2.7 Describe the following exotic equity and foreign exchange derivatives:

- quanto options
- chooser options
- barrier options
- binary options
- lookback options
- Asian options
- exchange options
- basket options

2.8 Describe the following structured securities and over-the-counter (OTC) contracts, including how each can be used to hedge certain types of liability:

- STRIPS
- Interest rate swaps
- Interest rate swaptions
- Index-linked bonds
- Inflation swaps
- Limited Price Indexation (LPI) swaps
- LPI bonds

2.9 Describe how non-economic risks such as longevity risk can be hedged using suitable structured securities and OTC contracts.

2.10 Demonstrate a knowledge and understanding of credit derivatives and their application.

2.10.1 Describe the following types of credit derivative:

- credit default swaps (CDSs)
- collateralised debt obligations (CDOs)
- nth to default baskets
- total return swaps

2.10.2 Explain the relationship between CDSs and corporate bonds, in particular as shown by their relative credit spreads.

2.10.3 Describe the uses of credit derivatives.

3 Derivative pricing and valuation methods, including interest rate models (50%)

3.1 Describe how the following factors affect option prices:

- stock price
- strike price
- term to expiry
- volatility
- risk-free rate
- dividends

3.2 Demonstrate the theory underpinning the determination of derivative prices and hedging strategies using the binomial model, including:

- sample paths.
- filtrations.
- the Binomial Representation Theorem.
- conditional expectations.
- previsible process.
- self-financing portfolio strategies.
- replicating strategies.
- pricing under the martingale measure.

3.3 Demonstrate the theory underpinning the determination of derivative prices and hedging strategies using the Black-Scholes model, including:

- Brownian motion.
- Itô calculus.
- Itô's Lemma.
- statement of the Cameron-Martin-Girsanov Theorem.
- the concept of the Radon-Nikodym derivative.
- change of measure.
- statements of the Martingale Representation Theorem.
- continuous-time portfolio strategies.
- self-financing portfolios in continuous time.
- the Black-Scholes model.
- construction of replicating strategies using the martingale approach.
- the Black-Scholes formula for non-dividend-paying stocks.

3.4 Demonstrate more advanced application of the Black-Scholes model in the determination of derivative prices.

3.4.1 Demonstrate how to adapt the martingale approach to the pricing of foreign-exchange options and options on stock indices paying dividends continuously.

3.4.2 Derive the Black-Scholes-Merton partial differential equation.

- 3.4.3 Explain the role of the market price of risk in the transfer between the real-world and the risk-neutral probability measures.
- 3.4.4 Demonstrate the role of the volatility parameter in the valuation of options, including:
 - calculation of implied volatility from option prices.
 - estimation of volatility from historical time series or other market indices (e.g. the VIX index).
 - the “smile” effect and volatility surfaces.
- 3.4.5 Describe approaches to valuing options on discrete dividend-paying securities.
- 3.5 Demonstrate alternative numerical methods for the determination of derivative prices and hedging strategies.
 - 3.5.1 Describe the following numerical methods for determining equity and foreign exchange derivative prices and hedging strategies:
 - binomial and trinomial trees
 - Monte Carlo techniques
 - finite difference methods
 - 3.5.2 Discuss possible methods for determining prices of American options, including Monte Carlo simulation using the least-squares (Longstaff-Schwartz) approach.
- 3.6 Demonstrate the pricing of interest rate derivatives, including the Black model.
 - 3.6.1 Determine the following:
 - the yield curve, zero rates, forward rates and bond prices
 - the relationship between forward rates and futures rates
 - the value of interest rate swaps
 - 3.6.2 Explain the relationship between swap quotes and LIBOR zero rates.
 - 3.6.3 Demonstrate the use of the Black model for pricing and valuing the following contracts:
 - bond options
 - caps and floors
 - European swap options (swaptions)
 - 3.6.4 Comment on the assumptions underlying Black’s model.

- 3.7 Demonstrate the use of models of the term structure of interest rates.
 - 3.7.1 Explain the difference between equilibrium and no-arbitrage models.
 - 3.7.2 Describe the Hull & White model for the term structure of interest rates.
 - 3.7.3 Contrast the Hull & White model with the Vasicek and Cox-Ingersoll-Ross models.
 - 3.7.4 Describe the numerical techniques that can be used to value an interest rate derivative using the risk-neutral approach to pricing.
 - 3.7.5 Outline a valuation method for an interest rate derivative using an appropriate forward measure and zero-coupon bond.
 - 3.7.6 Explain the role of the market price of risk and changes of numeraire in the dynamics of term structure models.
 - 3.7.7 Describe how interest rate models can be developed in a multifactor setting.
 - 3.7.8 Outline the characteristics of the Heath, Jarrow and Morton (HJM) and LIBOR market models.
 - 3.7.9 Demonstrate how the LIBOR market model can be used to price caps and swaptions.
 - 3.7.10 Discuss the use of Black's model in the calibration of the LIBOR market model, including the problems with this approach.
- 3.8 Outline approaches that can be taken to price property swaps.
- 3.9 Demonstrate an understanding of the pricing of credit derivatives.
 - 3.9.1 Determine the price of a credit default swap.
 - 3.9.2 Explain the role of correlation in pricing credit derivatives.

4 Management of derivatives (25%)

- 4.1 Demonstrate an understanding of how derivatives are used by investors:
 - 4.1.1 Explain how derivatives help investors meet their objectives.
 - 4.1.2 Assess the change in risk profile of a portfolio following the use of derivatives.
 - 4.1.3 Discuss practical issues and limitations arising from derivative use.

- 4.1.4 Compare alternative strategies.
- 4.2 Demonstrate a knowledge and understanding of how to hedge derivatives.
 - 4.2.1 Calculate the partial derivatives (the Greeks).
 - 4.2.2 Describe the use of the Greeks in hedging individual derivatives and portfolios of derivatives.
 - 4.2.3 Explain how option prices and Greeks change in relation to underlying variables.
 - 4.2.4 Describe how to manage portfolios of derivatives using scenario analysis.
 - 4.2.5 Assess the risk management characteristics of a given derivative, including exotic contracts.
 - 4.2.6 Describe the hedging of interest rate derivatives with respect to the underlying parameters (the Greeks).
 - 4.2.7 Describe delta hedging techniques in relation to credit default swaps.
- 4.3 Describe what is meant by basis risk and its impact on hedging strategies.
- 4.4 Discuss the risks that arise in the use of derivatives, and how to manage them.
 - 4.4.1 Define market risk, credit (or counterparty) risk and liquidity risk.
 - 4.4.2 Identify the market, credit (or counterparty), liquidity and other risks that arise in the use of derivatives.
 - 4.4.3 Outline the way in which these risks affect the use of derivatives and how these risks may be handled.
 - 4.4.4 Describe possible methods for establishing Value at Risk (on a portfolio).
 - 4.4.5 Comment on the weaknesses of the Value at Risk measure.
 - 4.4.6 Discuss the use and limitations of credit ratings.
 - 4.4.7 Describe simple techniques for measuring and managing credit (or counterparty) risk on derivatives, including:
 - International Swaps and Derivatives Association (ISDA) agreements.
 - collateral management.
 - 4.4.8 Describe the risks that arise in the use of specific types of derivative.

- 4.5 Describe how special purpose vehicles can be used as part of a mechanism for risk transfer, including the role of a credit enhancement agency.

5 Solving problems

- 5.1 Analyse hypothetical examples and scenarios in relation to the use and management of financial derivatives.
- 5.1.1 Propose solutions and actions that are appropriate to the given context, with justification where required.
 - 5.1.2 Suggest possible reasons why certain actions have been chosen.
 - 5.1.3 Assess the implications of actions within a given scenario.
 - 5.1.4 Discuss the advantages and disadvantages of suggested actions, taking into account different perspectives.
- 5.2 Draw charts to illustrate how attributes of portfolios vary with respect to relevant factors, in the context of derivative use.

Assessment

Three hour fifteen minute written examination.

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