

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

27th October 2009

Subject CT8 – Financial Economics

Time allowed: Three Hours (10.00 – 13.00 Hrs)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

- 1) *Please read the instructions on the front page of answer booklet and instructions to examinees sent along with hall ticket carefully and follow without exception*
- 2) *Mark allocations are shown in brackets.*
- 3) *Attempt all questions, beginning your answer to each question on a separate sheet. However, answers to objective type questions could be written on the same sheet.*
- 4) *In addition to this paper you will be provided with graph paper, if required.*

AT THE END OF THE EXAMINATION

Please return your answer book and this question paper to the supervisor separately.

- Q 1) (a)** What is a state price security and state price? (2)

The price of a volatile stock can be modelled by a two-period recombining binomial model assuming that it will increase or decrease by 25% every month. The continuously compounded monthly risk free rate of interest is 1.5% and the current market price of stock is Rs.200.

Let S_1 , S_2 , S_3 denote the three possible stock prices at the end of the second month. S_1 denotes the stock price resulting from two up-steps, S_2 , the result of an up then down (or down then up) step and S_3 the result of two down steps.

The state price deflators for these states are

State	Price	State Price Deflator
1	S_1	0.7622
2	S_2	1.0089
3	S_3	1.3142

- (b)** Calculate the state prices for the three states. (4)

- (c)** Calculate the monthly rate of return on the stock over the two months. (4)

- (d)** A call option is available in the market at the strike price of Rs.128.60 with the following payoff

$$\begin{aligned} & \text{Max}(S - 128.6, 0) * 0.5, \text{ if } S > 215 \text{ or } S < 175 \\ & \text{Max}(S - 128.6, 0) * 2, \text{ if } 175 \leq S \leq 215 \end{aligned}$$

Where S is price of the stock at after two months.

Calculate the value of this exotic call option at time zero using the state price deflators above. (2)

- (e)** Show that the value of a hedged replicating portfolio at time zero is equal to the value of the call option calculated above. Define all terms used in the calculations. (8)

[20]

- Q 2) (a)** A two year European call option is available for Rs.41 on a share of Reliance Industries at the strike price of Rs.430. The current market price of the share is Rs.350. Calculate the price of a two year European put option with the same strike price if the continuously compounded annual risk free rate of interest is 3%. List down the assumptions you made for this calculation. (4)

- (b)** Calculate the intrinsic value and time value of the put option. (2)

- (c) State the factors that might cause the time value to increase with no change in intrinsic value. (3)
- (d) What is the maximum profit/loss for the writer and holder of the put option? (2)
- [11]**
- Q 3)** (a) What are the desirable characteristics of a term structure model? (4)
- (b) Consider a model of yield curves where the forward yield at term t is:
 Forward yield (s) = $e^{-\alpha s} R + (1 - e^{-\alpha s})L$
 where R is the limiting yield for short bonds
 L is the limiting long forward yield
 α is a positive parameter
- (i) Derive an expression for the price of a zero coupon bond of term T . (3)
- (ii) Derive an expression for the spot yield of term T and hence also an expression for the limiting spot yield. (2)
- [9]**
- Q 4)** (a) Describe various types of models used for modelling the credit risk. (6)
- (b) Why is the two state model with stochastic transition intensity considered better than the JLT (Jarrow, Lando and Turnbull) model for modelling credit risk? (2)
- [8]**
- Q 5)** (a) A particular portfolio comprising equity of high growth companies outperforms the market. Does this indicate that the Efficient Market Hypothesis (EMH) is contradicted? (1)
- (b) One category of tests for the semi-strong form of EMH relates to information efficiency, where studies have shown markets over-react and under-react to certain events.
- (i) What has been the premise for these studies? (1)
- (ii) Give some examples of the over-reaction effects and under-reaction Effects. (5)
- (c) Other than the assumptions made for the mean-variance portfolio theory, what other assumptions are made for deriving the Capital Asset Pricing Model (CAPM)? (3)
- (d) What are the key differences between CAPM and APT? (2)
- [12]**

- Q 6)** A market for risky securities in a CAPM world comprises of three securities and the following information is provided.

Security	Expected return	Market value	Correlation with market	Standard deviation
LoRisk	9.0%	20,000	0.50	24%
MedRisk	13.0%	30,000	1.00	24%
HiRisk	18.0%	45,000	??	28%

The standard deviation of market returns is 30%.

- (a) What are the betas of the three securities? (4)
- (b) LoRisk and MedRisk are priced efficiently as per the CAPM. Determine the risk-free rate and the expected return on the market. (3)
- (c) Based on the information and the calculations performed in parts a) and b); determine if HiRisk is priced correctly as per CAPM? (2)
- (d) If HiRisk is priced incorrectly, how would you exploit the opportunity? (3)

[12]

- Q 7)** You have the following securities available to you for investment for a single period of 1 year. You are allowed unlimited amount of short selling in any of the securities also.

Security	Expected return	Standard deviation of return
A	10%	30%
B	15%	40%
C (Risk free)	5%	0%

The following correlations are also given:

$$\rho_{AB} = 0.50$$

$$\rho_{BC} = 0$$

$$\rho_{CA} = 0$$

- (a) What would be the proportion of A and B in the portfolio to minimise the risk (measured as variance)? (8)
- (b) Your target return from the portfolio is 10% for the year. What is the proportion of A, B and C that will get you the target returns with minimum variance? (2)
- (c) You have invested Rs. 100 in the portfolio in part (b). What is the VaR for your portfolio at a 95% confidence level? State any assumption(s) that you make. (3)

[13]

Q 8) (a) What are the three categories of multi-factor models? (3)

(b) An analyst wants to model the returns on 3 securities using a single factor model? He wants to use market returns as the single factor. What analysis does he need to carry out to find the parameter needed? (1)

(c) The analysis reveals the following for the three securities:

Security	α_i	β_i	SD of the error term
A	3%	1.2	10%
B	2%	0.8	15%
C	5%	0.0	10%

The expected return on the market is 10% and the standard deviation of returns is 20%.

(i) Calculate the expected returns on securities A, B and C (2)

(ii) Calculate the standard deviation of returns for securities A and B (2)

(iii) Calculate the covariance between A and B (1)

(iv) Is C a risk free security? (1)

[10]

Q 9) The bank balance of a young Actuarial student follows the Weiner process with a drift of 100 per month and a variance of 4000 per month.

(i) At the beginning of the year, the bank balance is Rs. 200. What is the probability of the bank balance being greater than zero at the end of the year? (3)

(ii) What should be the starting bank balance so that the probability of a positive bank balance is 99%? (2)

[5]
