INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

16th March 2018

Subject ST6 – Finance and Investment B

Time allowed: Three Hours (10.15* – 13.30 Hours)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

1. ***Please read the instructions inside the cover page of answer booklet and instructions to examinees sent along with hall ticket carefully and follow without exception.***
2. **** You have 15 minutes at the start of the examination in which you are required to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You have then three hours to complete the paper.***
3. ***You must not start writing your answers in the answer sheet unless instructed to do so by the supervisor.***
4. ***The answers are not expected to be any country or jurisdiction specific. However, if Examples/illustrations are required for any answer, the country or jurisdiction from which they are drawn should be mentioned.***
5. ***Attempt all questions, beginning your answer to each question on a separate sheet.***
6. ***Mark allocations are shown in brackets.***
7. ***Please check if you have received complete Question paper and no page is missing. If so, kindly get a new set of Question paper from the Invigilator.***

AT THE END OF THE EXAMINATION

Please return your answer booklet and this question paper to the supervisor separately. You are not allowed to carry the question paper in any form with you.

Q. 1) An Investment firm holds a bond portfolio, the face and book value of which is Rs. 1000 crores. All the bonds in the portfolio are coupon bonds. Each bond in the portfolio carries a coupon rate of 10% per annum with annual compounding. The coupons on all the bonds in the portfolio are paid once in a year. All the bonds in the portfolio have time to maturity of four years. All the bonds in the portfolio have pre-payment options after annual interest payment with pre-payment penalty of 5% (on outstanding principal) and the average pre-payment rate is 5% per year. The average default rate on the portfolio is 4% per year and that the recovery rate is 30% of outstanding principal. Assume that the default takes place at the end of the year and after the payment of annual interest. Further assume that the default takes place before the pre-payment. The current risk-free yield curve is flat at 5% per annum with annual compounding.

i) Estimate the cash flows for the bond portfolio (for the years 1-4) and highlight how default recovery and pre-payment options are treated in terms of timing and order in cash flows determination. Assume that the current time period is '0'. State any assumptions that you make. (8)

ii) Calculate the current value of the bond portfolio and the yield to maturity per annum for the investment firm. (5)

iii) The company is in distress and decides to sell the bond portfolio to raise the capital. The firm is expecting distress market mark up of 5% over and above the risk free rate. The firm estimates if it sells the portfolio, it will have to incur an additional annual servicing expenses of 2% of outstanding principal in the beginning of the year. Re-calculate the cash flows after allowing for the servicing expenses and estimate the sale value of the bond portfolio with distress market mark up. Estimate the loss (in percentage) that will be incurred by the firm if the portfolio is sold. (7)

[20]

Q. 2) Alpha Limited is currently experiencing cash shortage. Alpha owns a mortgage portfolio worth Rs. 100 crores. They are considering the following two options:

- Sell the mortgage portfolio and recover the cash.
- Securitize the mortgage portfolio to raise the cash required for business.

i) Describe the above two options. What are the advantages and disadvantages of each option? (4)

ii) Describe in detail how the structure of the second option (securitization of the mortgage portfolio) would work. What are the various cash flows components and administrative parts of setting up this structure? Who are the various stakeholders involved in this option? Also analyse the risk and reward of this option from the point of view of different stakeholders. (6)

[10]

Q. 3) Describe current and potential credit risk in over the counter derivatives. Suggest approaches to minimise these risks. **[5]**

Q. 4) Suppose that zero interest rates with annual compounding are as follows:

Maturity (Years)	1	2	3	4	5	6	7
Rate (% per annum)	6%	6%	6%	6%	6.25%	6.50%	6.75%

i) What is meant by "forward swap rate"? Calculate the 3-year forward swap rate (at time zero) starting in 4 years. (5)

ii) What is meant by "payer swaption" and how it can be valued? (4)

iii) Using the information in parts (i) and (ii), calculate the value of a swaption that gives the holder the right to pay 6.5% per annum with annual compounding in a 3-year swap starting in 4 years. The volatility of the forward swap rate is 20% per annum. Payments are made annually and the principal is Rs. 100 crores. (6)

[15]

Q. 5) Indian Space Research Organization (ISRO) plans to launch a manned mission to Venus and is expecting to order 100,000 barrels of rocket fuel in three months' time. It is concerned about the risk that fluctuating fuel prices pose to the project's total cost.

ISRO has decided to hedge this risk using ATF futures, for which a contract is available which expires in three months' time.

You are given the following information:

- The spot price of one barrel of ATF is GBP 101.20.
- The relevant futures price for delivery of one barrel of ATF is GBP 106.30.
- The standard deviation of changes in the spot price of a barrel of rocket fuel over the next three months is GBP 4.20.
- The standard deviation of changes in the relevant futures price for ATF over the next three months is GBP2.50.
- The coefficient of correlation between changes in ATF futures prices and rocket fuel spot prices is 0.75.
- One ATF future represents 1,000 barrels of ATF.

i) Define the following terms:

a) Cross hedging (1.5)
b) Hedge ratio (1.5)
c) Minimum variance hedge ratio (1.5)
d) Tailing the hedge (1.5)

ii) Calculate the number of ATF futures that ISRO should buy to minimize the variance of the project's total costs. (5)

iii) Discuss in general terms what can be deduced about ATF storage costs from ATF futures prices. (4)

[15]

Q. 6) **i)** Define Value at Risk (VaR) in the context of a 99% one-day measure? (2)

ii) Explain how the answer of (i) may differ numerically from a 95% VaR calculated over a 5 day horizon. (2)

iii) Describe three different methods of calculating VaR, indicating the situations in which they might best be used. (6)

The treasury department of a fund management firm holds a liquidity portfolio of high grade bonds, mainly from sovereign issuers. A risk manager in this firm uses VaR to calculate the market risk on the portfolio based on an historical observation period of one year.

Credit markets have been stable for many months, but just recently there has been a minor currency crisis and a small country is now in danger of default. Fortunately, the treasury department does not own any bonds issued by this country. However, the firm is concerned about nearby countries, where it does have exposure. In recent weeks credit spreads have already risen for these neighbouring countries. In light of this information,

iv) **a)** Outline the limitations of VaR as a market risk measure in this situation. (2.5)
b) Suggest, with reasons, additional risk measures that would address these limitations. (2.5)
[15]

Q. 7) **i)** Describe the following credit derivatives:

a) A Credit Default Swap (CDS) (2)
b) A Third – to – Default Basket Swap (2)

The "CDS-bond basis" for a particular corporate bond is defined as the CDS spread minus the excess of the bond yield over the risk-free rate. Given this,

ii) Describe the arbitrage opportunity that should theoretically exist if the CDS bond basis is positive and the bond is trading at par. (4)

iii) Suggest reasons why this arbitrage opportunity may not exist in practice. (4)

A corporate bond asset manager has a fund that currently holds ten different corporate bonds in similar proportions, a small amount of cash and no other assets. The manager wishes to introduce credit derivatives into the fund, with the objective of partially reducing credit risk in the portfolio for a limited cost.

The manager has two alternate derivative transactions:
- Purchasing credit default swaps for five of the corporate bonds
- Purchasing a third-to-default basket swap, where the basket comprises the ten holdings

iv) Compare the likely effectiveness of these transactions in meeting the manager's objective. (6)

v) Recommend one of these transactions, with justification. (2)
[20]

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