INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

18th November 2011

Subject ST5 - Finance and Investment A

Time allowed: Three hours (14.45* – 18.00 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. ** You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*

3. *You must not start writing your answers in the answer sheet until 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 new set of Question Paper from the Invigilator.*

AT THE END OF THE EXAMINATION

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

Q. 1) **i)** Describe the operation of a futures margining system of a clearing house and explain why it limits credit risk on exchange traded futures contracts. (4)

You are the manager of a global equity fund valued at US$1 billion. You wish to switch some of the portfolio from the US market to the UK market.

ii) Explain how equity index futures might reduce the costs and problems associated with any physical trades to change the asset allocation on a short term and a long term basis. (5)

One portfolio of US stocks you manage is worth US$50 million and has a beta of 0.87. Since you are concerned about the performance of the market over the next two months, you plan to use a three month futures contract on the S & P 500 to hedge the risk attaching to this portfolio. The current level of the index is 1250 and one contract is on 250 times the index.

iii) Describe the position you should take to eliminate all exposure to the market over the next two months. (2)

iv) You are also looking at using forward contracts to hedge against movements in the $USD/£UK exchange rate, and are seeking quotes for the forward exchange rate.

Derive a formula for the arbitrage-free forward exchange rate ($USD vs £UK). Define any symbols you use. (3)

[14]

Q. 2) **i)** Typically a linear model based on the normality assumption is used for estimating the Value at Risk (VaR) of an investment portfolio. Explain why such a linear model may not provide an accurate estimate of VaR for an investment portfolio containing options. (2)

ii) Explain why many fund managers use financial stress testing and back testing in addition to VaR for assessing the risk of their investment portfolios. (3)

Alpha Investments Limited has a portfolio consisting of two equity funds. In the portfolio, there is a long Rs11m investment in a Domestic Hi-Tech fund, and a short position of Rs 9 m in a Global Fund. The daily volatilities of these funds are given as 5% and 3% respectively and the coefficient of correlation between their returns is -0.2.

iii) Derive the impact of diversification on the 10 day 95% VaR of this portfolio, and explain how this can be improved by altering the position in the Global fund. State any assumptions made. (5)

You are a risk management actuary at Megalife Insurance, a large composite insurer, and have been asked to assess how it controls its credit risks.

iv) Outline the controls on credit risk that you would expect to see in place, and the possible corrective actions that may be required if the controls indicated any deficiency in the credit risk management. (5)

You have also been asked to calculate the economic capital which needs to be held for credit migration for a corporate bond portfolio.The economic capital for credit migration is defined to be the 99.9% one-year VaR of the change in the value of the bond portfolio due to movements between credit ratings of the component bonds. A particular bond portfolio at Megalife has two assets:

- One A rated bond with Rs 1.5 million face value, 6% annual coupon, and 4 years to maturity.
- One BB rated bond with Rs 2 million face value, 8% annual coupon, and 4 years to maturity.

You have been given these statistics about these bonds:

- The bond recovery rate is 35% of the face value
- The 1 year transition matrix between rating categories is shown in the table below

	AAA	**AA**	**A**	**BBB**	**BB**	**Default**
AAA	89%	5%	6%	0%	0%	0%
AA	3%	90%	6%	1%	0%	0%
A	2%	9%	71%	17%	1%	0%
BBB	0%	5%	11%	77%	4%	3%
BB	0%	0%	4%	12%	74%	10%

- The zero coupon curves which would apply (i.e the 1 year forward curves) for each rating category are shown in the table below:

Category	**Year 1**	**Year 2**	**Year 3**
AAA	4.25%	5.00%	5.25%
AA	4.60%	5.25%	5.55%
A	4.65%	5.35%	5.75%
BBB	5.00%	5.80%	6.30%
BB	5.45%	6.15%	6.95%

v) Use this information to estimate the economic capital which needs to be held in respect of credit migration for this portfolio. State any assumptions you make. (5)

vi) Explain how a suitable instrument could be used to significantly reduce the economic capital calculated in part (v). (2)

Megalife is considering making a private loan to a utility company. You have been asked to derive a model to assess the credit risk on this loan, and have been given the data below on the company.

- Risk-free rate: 5% per annum compounded continuously
- Market value of company's assets today: Rs21 billion
- Market value of company's equity today: Rs5 billion
- Total debt due to be repaid by the company including interest one year from now: $17 billion
- Volatility of equity returns: 80%
- Volatility of asset returns: 20%

vii) Calculate the risk neutral probability that the utility company will default on its obligations, stating any assumptions you make. (3)

[25]

Q. 3) **i)** Outline briefly the possible risks incurred when investing in options. (2)

ii) Describe the key ways in which a structured product can be used by a defined benefit pension fund when managing its assets and liabilities. (4)

You are a structured products specialist at an investment house, primarily involved in structuring products which meet the needs of your clients. In addition, you are also involved in the firm's proprietary trading activity, and therefore structure appropriate hedging and speculative trades.

Amco's stock price is currently Rs 110. One of your clients has a Rs 11 million portfolio of Amco stock which they must hold for 3 years. The client requires a product which ensures that their portfolio value (net of any hedging costs paid at the outset) will lie between Rs 12 million and Rs 14 million at the end of 3 years.

You will structure a suitable product for the client using only the 3 year options on Amco stock listed in the table below.

Strike Price (Rs)	**Put Option Premium (Rs)**	**Call Option Premium (Rs)**
135	50	40
145	58	37
155	67	35

iii) Using only these options, construct a suitable product for your client, and calculate the premium which your client should pay for this product. State any assumptions. (5)

The stock price of IMP Enterprises is currently Rs89. Some 1 year call options on IMP stock are listed in the table below.

Call option	**Strike (Rs)**	**Premium (Rs)**
A	91	2
B	88	3
C	80	10

You wish to speculate on the stock. You have decided to structure a trade where you will sell 1 of each of the call options listed in the table above.

iv) Draw a diagram showing your payoff at expiry allowing for the initial net credit received from the trade. Ignore all other transaction costs.

Explain the main reason why you may wish to undertake such a trade. (4)

[15]

Q. 4) **i)** Describe the economic functions of commodity futures and briefly describe their investment characteristics. (2)

ii) One approach that investors can use to gain exposure to commodities is to invest in shares of a company where the company's fortunes are strongly linked to commodity prices. Outline the key advantages and disadvantages of this approach compared to more direct methods of investing in commodities. (2)

iii) A large company called Resolver has expanded the size of its group holdings by acquiring two local subsidiaries: Cot- co (a producer of cotton) and Cloth-co (a company which uses cotton to make and sell T-shirts).

The contribution from each subsidary to the group's profit is linearly related to the price of cotton. As the unit price of cotton increases by Rs1, Cot-co's contribution to profit increases by Rs 20 whereas Cloth-co's contribution decreases by Rs 10.

A forward contract based on the underlying cotton price is available in this market for hedging. There is a transaction cost incurred when buying or selling a unit of the hedging contract.

Both Cot-co and Cloth-co have fully hedged their individual exposures by taking appropriate positions in the forward contract and both hedges will expire in 1 month. Although the Chief Risk Officer of Resolver wishes to fully hedge the group's exposure to the price of cotton, he has recommended that neither subsidiary should roll their existing hedge.

Explain the basis of the chief risk officer's recommendation, and outline a possible hedging recommendation which is consistent with his objective. (3)

[7]

Q. 5) A fixed interest swap market has a term structure defined by the following discount factors (i.e. the values in decimal of a zero coupon bond of that maturity). Assume annual compounding.

Year	Discount Factor
0	1.000
1	0.960
2	0.920
3	0.879
4	0.840
5	0.804

Based on this information:

i) Calculate the first three annual forward rates that apply in this market. (2)

ii) a) Calculate the fixed coupon on a 3-year annual coupon fixed-to-floating swap. (2)

b) A swap dealer enters into the swap in (ii) (a) and chooses to receive fixed payments on a three-year Rs100 million annual coupon fixed-floating interest rate swap.

Calculate the impact on the mark-to-market value of the swap if the "Time 2 to 3" forward rate (only) falls immediately by 0.25% i.e. (a reduction of 25 basis points). (2)

iii) a) Calculate the fixed coupon on a 3-year annual coupon fixed-to floating swap that commences in 2 years time. (2)

b) A financial institution is committed to a forward agreement whereby it will pay 4.75% per annum interest on a nominal amount of Rs1million invested for three years from the end of year 2, with the interest being paid annually in arrears at the end of years 3, 4 and 5. Explain whether the forward agreement currently has a positive or negative value to the financial institution. (2)

[10]

Q. 6) **i)** Give three reasons why the CFO [Chief Financial Officer] of a company might not hedge the company's exposure to a particular risk. (3)

ii) In the context of a shareholder owned company which is run by appointed managers, define the term "Agency Costs" and briefly explain why such costs arise (3)

The board of a company is reviewing the following three alternative senior management compensation structures:

a) Salary of Rs 2.25Cr and 1,250,000 stock options exercisable after one year and for up to ten years with an exercise price of Rs 25

b) Flat Salary of Rs 2.50 Cr

c) Base salary of Rs1.95 Cr and 250,000 shares of stock vesting at the end of one year

The company's share price at the end of one year is expected to lie between Rs 20 and Rs 30, but the company has the ability to hedge earnings volatility and stabilize the company's share price at Rs 27 per share.

iii) Describe how the different compensation structures may impact the risk management decisions taken by the company's managers with regard to managing the company's earnings and share price. (4)

[10]

Q. 7) **i)** Describe the main types of regulatory regimes? (4)

ii) In the current economic climate, explain the type of regulation that would be appropriate for each of:

a) State Governments in India
b) Indian insurance industry
c) Professionals like Actuaries and Chartered Accountants. (5)

[9]

Q. 8) Provident Fund is a Defined Contribution (DC) social security mandatory scheme in India wherein every month both employers and employees each contribute 12% of employee basic salary to a fund. The fund can be managed through two mechanisms:

1) By EPFO, a government body which manages funds on multi-employer basis.

2) Through Trusts set-up by employers. An employer can operate only one Trust and an employer can choose either to contribute to EPFO or manage the fund through the Trust. Currently, 95% of the employers contribute to EPFO.

Every year (at the end of financial year) EPFO declares a rate of return that is to be accrued to individual accounts which is based on previous year's earnings of the fund managed by EPFO. As per the governing Act, Trusts need to at-least match the return declared by EPFO, otherwise the employer makes up the difference. In case of excess return in a Trust, the employer cannot withdraw the excess return from the Trust.

The Act prescribes the investment pattern by EPFO wherein EPFO has to invest the Fund in fixed interest (FI) central government securities, FI state government securities, FI PSU bonds and FI corporate bonds, all in 25% proportion. Employer Trusts have been provided with the freedom to invest the contributions according to the trustees' wishes.

The accounting policy governing EPFO and Trusts values fixed interest securities at book value but equities and other similar real assets are valued at market value.

The accumulated money is paid to the employee only at prescribed times which are at retirement, early retirement due to illness, unemployed for certain period and some others. Therefore, an employee who has been contributing to an employer's Trust at the time of changing jobs needs to transfer his individual account either to a new Trust (if new employer operates a Trust) or to EPFO.

You are investment advisor to ABC Provident Fund Trust which is the Provident Fund Trust of ABC Ltd, a company engaged in gold mining. ABC Ltd was making losses until three years ago, but is now making huge profits due to steep increase in the price of gold. Its share price has grown by a CAGR of 50% in last three years.

One of the trustees proposes to invest the whole of the ABC Provident Fund Trust in equities and property. He is of the view that since real assets provide higher long term returns, equities and properties are better investments. The higher returns will benefit the members. He also mentioned that gold is a perfect hedge for economic uncertainty and a major portion of the equity investments should be made in the shares of ABC Ltd.

As investment advisor to the ABC Provident Fund Trust, draft your reply to the proposal.

[10]

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