INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

30th May 2012

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.*

5. *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*

Q. 1) **a)** Describe the properties of multifactor model of asset returns. You should define all the notations that you use.

(2)

b) Suppose that two factors have been identified for the Indian economy: the growth rate in industrial production (IP) and the inflation rate (IR). Suppose also that there are three portfolios X, Y, and Z, characterized by the following data

Portfolio	Expected Return	Beta on IP	Beta on IR
X	15	1	0.6
Y	14	0.5	1
Z	10	0.3	0.2

What is the equilibrium expected-return beta relationship in the Indian economy?

(3)

c) Suppose that another portfolio, Portfolio D, is created by investing equal amount in portfolios X, Y and Z. What is the expected return on the portfolio D? Further assume that there exists Portfolio E with an expected return of 15%, beta on IP of 0.6 and beta on IR of 0.6. Would an arbitrage opportunity exist? If so, what would be the arbitrage strategy?

(5)
[10]

Q. 2) Consider the following utility function:

$$U(w) = -\frac{1}{\sqrt{w}}$$

Where

U: Utility

w: wealth

a) Derive the expression for the absolute risk aversion and relative risk aversion measures.

(2)

b) Assuming that the wealth of the investor increases, interpret the values of the coefficients of absolute risk version and relative risk aversion (as computed in part a) in terms of investment in risky assets.

(2)

c) Suppose that the investor (with an initial wealth of Rs. 6.5 million) is offered the following four investment portfolios with a payoff in year 1 as described below.

Investment A		Investment B		Investment C		Investment D	
Payoff	Probability	Payoff	Probability	Payoff	Probability	Payoff	Probability
5	1/3	4	1/4	1	1/5	1	4/10
6	1/3	7	1/2	9	3/5	6.5	5/10
7	1/3	10	1/4	18	1/5	31.8	1/10

Which is the most preferred investment portfolio (if any) of the investor given the above utility function? (5)

[9]

Q. 3) **a)** What is the main advantage and disadvantage of using Variance as a measure of return? (2)

b) Investment returns (% pa), X , on a particular asset are modelled using the probability distribution:

X	Probability
-10	0.1
5.5	0.9

For a portfolio consisting of INR 20 crores invested in the asset, calculate the following

(i) Mean (1)

(ii) Variance (1)

(iii) 95% VaR over one year (2)

(iv) 95% TailVaR over one year. (3)

[9]

Q. 4) Let X be a stochastic process satisfying the stochastic differential equation

$$dX_t = -r X_t \, dt + d B_t$$

where B_t is a standard Brownian motion , r is constant and

$$X_o = 0.$$

i) Identify the stochastic process defined by the above equation. (1)

ii) Find the solution of the stochastic differential equation given above. (2)

iii) Prove that $X_t e^{rt}$ is a martingale. (1)

iv)   Find a,b and c such that

$(X^2_t - a) \, e^{2rt}$ and $(X^4_t - bX^2_t + c) \, e^{4rt}$ are martingales. (3)

v) Find var(X_t), var(X_s) and cov(X_t, X_s), where t and s are fixed times and 0<t<s. (5)

[12]

Q. 5)   Investors expect that return on NSE Nifty index (proxy for market portfolio) in the current year to be 18%. The Treasury bill rate (proxy for risk-free rate) is 6%. Infosys stock has a beta (with respect to NSE Nifty index) of 1.2. The market value of its outstanding equity is Rs. 900 million.

   a)   What is your best guess currently as to the expected rate of return on Infosys stock? You believe that the stock is fairly priced.   (1)

   b)   If the market return in the coming year actually turns out to be 16%, what is your best guess as to the rate of return that will be earned on Infosys stock?   (1)

   c)   Suppose now that Infosys wins a major lawsuit during the year. The settlement is Rs. 45 million. Infosys stock return during the year turns out to be 21%. What is your best guess as to the settlement the market previously expected Infosys to receive from the law suit? (Continue to assume that the market return in the year turned out to be 16 %.) The magnitude of the settlement is the only firm-specific event during the year.   (3)

                                                                                                              [5]

Q. 6)   Which of the following phenomena would be either consistent with or violation of the efficient market hypothesis? Explain briefly.

   a)   Nearly half of all professionally managed mutual funds are able to outperform the BSE Sensex in a typical year.   (1)

   b)   Fund managers (that outperform the market (on a risk adjusted basis) in one year are likely to outperform in the following year.   (1)

   c)   Stock prices tend to be predictably more volatile in April than in other months.   (1)

   d)   Stock prices of companies that announce increased earnings in April tend to outperform the market in May.   (1)

   e)   Stock that performs well in one month poorly performs in the following month.   (1)

                                                                                                              [5]

Q. 7)   List the desirable characteristics of a model for the term structure of interest rates.

                                                                                                              [4]

Q. 8)   Consider an agriculture based developing country. You strongly believe that in such countries economic situation (inflation in particular) is influenced by the climate in the preceding year. You choose annual rainfall during the preceding year as a measurement of climatic conditions (good or bad).

You fit a standard normal curve to the annual rainfall statistic and estimate the following parameters:

Mean: 1150 millimeters; Standard deviation: 110 millimeters

A given year is considered to be a "Good" year if the annual rainfall in the preceding year was within one standard deviation of mean. Otherwise it is considered to be a "Bad" year.

i)   Calculate the probability that a given year in the future would be a good year.   (2)

ii)   State Wilkie's updating equation for the force of inflation and describe all the terms used.   (3)

In a "Good" year the force of inflation follows Wilkie's updating equation. Using historical data you estimate the following values of the parameter:

Mean parameter: 5%; Standard deviation of error terms: 2%; Autoregressive parameter: 0.9

In a "Bad" year the force inflation is very unpredictable. You assume the following updating equation for the force of inflation in a "Bad year".

$I(t) = 10\% + 10\%*Z(t)$
where $Z(t)$'s are independent and identically distributed standard normal variables.

You are given that the force of inflation was 8% and annual rainfall was 1200 mm for the year 2011.

iii)   Calculate the probability that inflation in 2012 would be less than 10%.   (3)

iv)   Calculate the probability of deflation in 2014?   (9)

                                                                                                                                              [17]

Q. 9)   **i)**   Define Intrinsic Value, Time Value and Theta of a put option.   (4)

You are given that the prevailing risk free force of interest for all terms to maturity is 5%.

Current price of a non-dividend paying share is 100 and corresponding volatility is 15%. You create the following portfolio hoping to benefit from time decay.

Sell 3 month at-the-money put option and buy 6 month at-the-money put option on the share.

ii) Assuming all other economic variables remain the same, estimate the profit/loss you would expect if you settle/unwind this portfolio in three month's time. (7)

iii) Explain the emergence of profit or loss in words. (2)

[13]

Q. 10) A company has the following three sources of capital on its balance sheet at time 0.

Source	Face Value	Maturity	Interest/dividend
Equity	20 million	Undated	None
Subordinated debt	8 million	5 years	None
Senior debt	5 million	5 years	None

In case of liquidation Senior debt takes priority over Subordinated debt and Subordinated debt takes priority over Equity.

i) Use the Merton's model to express the value of the Senior Debt in terms of a European put option. (3)

ii) Similarly, express the value of Subordinated Debt in terms of European put options. (5)

iii) Estimate the fair price per 100 face value of the three securities if the value of assets is 17 million at time 0. Assume that the risk free force of interest is 5% for all terms and annualized volatility of the value of company's asset is 30%. (5)

iv) Estimate the credit spread as suggested by the price of both the forms of debt. (3)

[16]

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