Mid-Semester Exam – ECON-F354/ FIN F311
Derivative & Risk Management (DRM)
Session – 2021-22 (II)
Closed Book

Maximum Marks: 105

Dated: 12/March/2022

Time Duration: 90 Minutes (Max)

Instructions:

- Do not forget to write your Name and ID number on the answer sheet
- You need to write the answers in the separate answer booklet provided to you and submit to the invigilator before leaving the examination room. Failing to do so will result in zero marks in this evaluative component
- All questions are compulsory and there is no negative marking for the wrong answers
- Read question specific instructions before giving your answers
- **To get the full score, you need to show all the steps required to arrive at the final answer with proper interpretation**
- Calculator is allowed

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1. Sourav has invested in four securities M, N, O, and P, the particulars of which are as follows-

Security	M	N	O	P
Amount Invested (Rs.)	1,25,000	1, 50,000	80,000	1, 45,000
Beta (β)	0.60	1.50	0.90	1.30

(7.5)

If T-Bill carries an interest rate of 8% and NIFTY yields 14%, what is the expected return of the portfolio? If investment in Security O is replaced by investment in T-Bill, what is the corresponding change in Portfolio Beta and expected return? [Hint: Use CAPM model] **[15 Marks]**

2. Suppose you buy a stock index futures contract at the opening price of $452.25 on July 1. The lot size is 500, so the price is $452.25x500= $226,125. You hold the position until selling it on July 16 at the opening price of $435.50. The initial margin requirement is $9000, and the maintenance margin requirement is $6000. Assume that you deposit the initial margin and do not withdraw the excess on any given day. Construct a table showing the charges and credits to a margin account. The daily prices in the intervening days are as follows:

(15)

Day	Settlement Price
7/1	453.95
7/2	454.50
7/3	452.00
7/7	443.55
7/8	441.65
7/9	442.85
7/10	444.15
7/11	442.25
7/14	438.30
7/15	435.05
7/16	435.50

[15 Marks]

3. An investor is considering two investment opportunities with the following risk and return characteristics.

Security	P	Q
Expected return	15%	22%
Risk	3%	7%

The investor plans to invest 80% of its available funds in share P and 20% in Q. the directors believe that the correlation coefficient between the returns of the shares is +1.0.

Required— [15 Marks]

   a. Calculate the returns from the proposed portfolio of shares P and Q.
   b. Calculate the risk of the portfolio.
   c. If the correlation coefficient between P and Q was -1 (minus one). Calculate the expected return and risk of the proposed portfolio.

4. A stock is expected to pay a dividend of $1 per share in two months and in five months. The stock price is $50, and the risk-free rate of interest is 8% per annum with monthly compounding for all maturities. An investor has just taken a short position in a six-month forward contract on the stock.
[20 Marks]

   a) What are the forward price and the initial value of the forward contract?
   b) Three months later, the price of the stock is $48, and the risk-free rate of interest is still 8% per annum. What are the forward price and the value of the short position in the forward contract?

5.
(i) You are saving for the college education of your two children. They are two years apart in age; one will begin college 15 years from today and the other will begin 17 years from today. You estimate your children's college expenses to be $45,000 per year per child, payable at the beginning of each school year. The annual interest rate is 7.5 percent. How much money must you deposit in an account each year to fund your children's education? Your deposits begin one year from today. You will make your last deposit when your oldest child enters college. Assume four years of college. **[20 Marks]**

(iii) Tom Adams has received a job offer from a large investment bank as a clerk to an associate banker. His base salary will be $55,000. He will receive his first annual salary payment one year from the day he begins to work. In addition, he will get an immediate $10,000 bonus for joining the company. His salary will grow at 3.5 percent each year. Each year he will receive a bonus equal to 10 percent of his salary. Mr. Adams is expected to work for 25 years. What is the present value of the offer if the discount rate is 9 percent? **[20 Marks]**

Solution

Solution-1

A. Computation of Expected Return on Portfolio (Under CAPM)

(i) Computation of Weighted Beta (Beta of the Portfolio)

Security	Amount Invested (Rs.)	The proportion of Investment to Total Investment	Beta of Investment	Weighted Beta
(1)	(2)	(3) = (2) ÷ 5,00,000	(4)	(5) = (3) × (4)
M	1,25,000	0.25	0.60	0.150
N	1,50,000	0.30	1.50	0.450
O	80,000	0.16	0.90	0.144
P	1,45,000	0.29	1.30	0.377
Total	5,00,000	1.00		1.121

(ii) Computation of Expected Return on Portfolio

Expected Return [E (Rp)]   = Rf + βp X (Rm – Rf)]
= 8% + [1.121 x (14% - 8%)]
= 8% + [1.121 x 6%] = 8% + 6.726% = 14.726%

B. Computation of Expected Return [Investment in O, replaced by T-Bill] (CAPM)

(i) Computation of Weighted Beta (Beta of the Portfolio)

Security	Amount Invested	The proportion of Investment to Total Investment	Beta of Investment	Weighted Beta
(1)	(2)	(3) = (2) 4- 5,00,000	(4)	(5) = (3) X (4)
M	1,25,000	0.25	0.60	0.150
N	1,50,000	0.30	1.50	0.450
RBI Bonds	80,000	0.16	0.00	0.000
P	1,45,000	0.29	1.30	0.377
Total	5,00,000	1.00		0.977

(ii) Computation of Expected Return on Portfolio

Expected Return [E(RP)]
= Rf + βpx (Rm – Rf)]
= 8% + [0.977 x (14% - 8%)]
= 8% + [0.977 x 6%] = 8% + 5.862% = 13.862%

2. (Daily Settlement)

Date	Settlement Price	Settlement Price ($)	Mark-to-Market	Other Entries	Account Balance
7/1	453.95	226,975	850	9,000	9,850
7/2	454.50	227,250	275		10,125
7/3	452.00	226,000	–1,250		8,875
7/7	443.55	221,775	–4,225		4,650
7/8	441.65	220,825	–950	+4,350	8,050
7/9	442.85	221,425	600		8,650
7/10	444.15	222,075	650		9,300
7/11	442.25	221,125	–950		8,350
7/14	438.30	219,150	–1,975		6,375
7/15	435.05	217,525	–1,625		4,750
7/16	435.50	217,750	225	4,250	9,225

Explanation of Other Entries:

7/1:   Initial margin deposit of $9,000

7/8:   Balance on 7/7 was $4,650, which is below the $6,000 maintenance margin. Required to deposit $4,350 to bring balance up to the initial margin of $9,000

7/16:   Balance on 7/15 was $4,750, which is below the $6,000 maintenance margin. Required to deposit $4,250 to bring balance up to the initial margin of $9,000

3.

a. Return of the Portfolio

Securities	Expected return	Proportion	Return from portfolio
(1)	(2)	(3)	(4) = (2) x (3)
P	15	0.8	12
Q	22	0.2	4.4
Return of the Portfolio			**16.4**

b. Basic Values of Factors for Determination of Portfolio Risk

Particulars	Notation	Value
Standard deviation of Security P	σ_P	3%
Standard deviation of Security Q	σ_Q	7%
Correlation co-efficient of Securities P and Q	ρ_{PQ}	+ 1
Weight of Security P	W_P	0.80
Weight of Security Q	W_Q	0.20

Risk of Portfolio i.e. Standard deviation of Portfolio of P and Q [80% : 20% Ratio]

$$\sigma_p^2 = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\left(r_{12}\sigma_1\sigma_2\right)$$

$= [(0.\,80^2)\,(3^2)] + [(0.20^2)\,(7^2)] + [(2*0.80)\,(0.20)]\,[(1)\,(3)\,(7)]$

$= (0.64*9) + (0.04*49) + (0.32)\,(21)$

$= 5.76 + 1.96 + 6.72$

Variance $= 14.44$

Therefore, risk or Standard deviation of portfolio is $= \sqrt{Variance} = \sqrt{14.44} = 3.80\,\%$

c. If the correlation coefficient between P and Q was -1 (minus one)

$= [(0.\,80^2)\,(3^2)] + [(0.20^2)\,(7^2)] + [(2*0.80)\,(0.20)]\,[(-1)\,(3)\,(7)]$

$= (0.64*9) + (0.04*49) + (0.32)\,(-21)$

$= 5.76 + 1.96 - 6.72$

Variance $= 1$

Therefore, risk or Standard deviation of portfolio is $= \sqrt{Variance} = \sqrt{1} = 1\%$

4.

Convert the monthly compounding interest rate to continuous compounding, which comes out to be 7.97% per annum.

    a) The present value, I , of the income from the security is given by:
$$I = 1 \times e^{-0.0797 \times 2/12} + 1 \times e^{-0.0797 \times 5/12} = 1.9541$$

From equation (5.2) the forward price, F_0, is given by:
$$F_0 = (50 - 1.9541)e^{0.07973 \times 0.5} = 50.00 \text{ (approximately)}$$
or $50.00. The initial value of the forward contract is (by design) zero. The fact that the forward price is very close to the spot price should come as no surprise. When the compounding frequency is ignored the dividend yield on the stock equals the risk-free rate of interest.

    b) In three months:
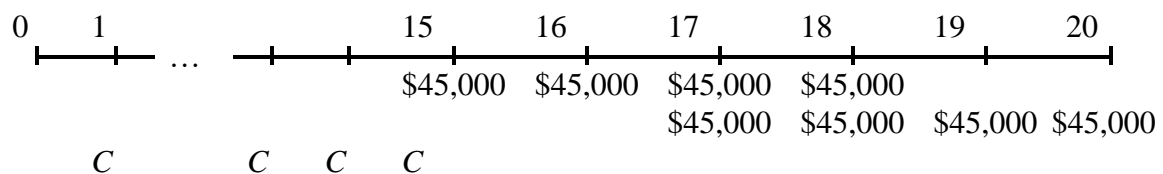$$I = e^{-0.07973 \times 2/12} = 0.9868$$

The delivery price, K , is 50.00. the value of the short forward contract, f , is given by
$$f = -(48 - 0.9868 - 50.00e^{-0.07973 \times 3/12}) = 2.00$$
and the forward price is
$$(48 - 0.9868)e^{0.07973 \times 3/12} = 47.95$$

5(i).   The timeline is:

     First, we will calculate the present value of the college expenses for each child. The expenses are an annuity, so the present value of the college expenses is:

PVA = $C(\{1 - [1 / (1 + r)]^t \} / r)$
PVA = $45,000(\{1 - [1 / (1 + .075)]^4 \} / .075)$
PVA = $150719.7

     This is the cost of each child's college expenses one year before they enter college. So, the cost of the oldest child's college expenses today will be:

PV = FV / $(1 + r)^t$
PV = $150719.7 / $(1 + .075)^{14}$
PV = $54758.79

     And the cost of the youngest child's college expenses today will be:

PV = FV / $(1 + r)^t$
PV = $150719.7 / $(1 + .075)^{16}$
PV = $47384.31

     Therefore, the total cost today of your children's college expenses is:

Cost today = $54758.79+ 47384.31
Cost today = $102142.8

This is the present value of your annual savings, which are an annuity. So, the amount you must save each year will be:

PVA = C ({1 − [1 / (1 + r)]^t } / r)
$102142.8= C$ ({1 − [1 / (1 + .075)]^{15} } / .075)
C = $11571.48

5(ii). The salary is a growing annuity, so we use the equation for the present value of a growing annuity. The salary growth rate is 3.5 percent, and the discount rate is 9 percent, so the value of the salary offer today is:

PV = C {[1 / (r − g)] − [1 / (r − g)] × [(1 + g) / (1 + r)]^t}
PV = $55,000{[1 / (.09 − .035)] − [1 / (.09 − .035)] × [(1 + .035) / (1 + .09)]^{25}}
PV = $725939.6

The yearly bonuses are 10 percent of the annual salary. This means that next year's bonus will be:

Next year's bonus = .10($55,000)
Next year's bonus = $5500

Since the salary grows at 3.5 percent, the bonus will grow at 3.8 percent as well. Using the growing annuity equation, with a 3.5 percent growth rate and an 8.5 percent discount rate, the present value of the annual bonuses is:

PV = C {[1 / (r − g)] − [1 / (r − g)] × [(1 + g) / (1 + r)]^t}
PV = $5500{[1 / (.09 − .035)] − [1 / (.09 − .035)] × [(1 + .035) / (1 + .09)]^{25}}
PV = $72593.96

Notice the present value of the bonus is 10 percent of the present value of the salary. The present value of the bonus will always be the same percentage of the present value of the salary as the bonus percentage. So, the total value of the offer is:

PV = PV(Salary) + PV(Bonus) + Bonus paid today
PV = $725939.6+72593.96+ 10,000
PV = $808533.55