

Question number	Subpart	Marks available	Marks awarded	Comment
Q1	i	3	3	<i>Perfect</i>
	ii(a)	1	0	<i>wrong subpart mentioned, it must be ii(a)</i>
	ii(b)	2	0	<i>wrong subpart mentioned, it must be ii(b)</i>
	ii (c)	2	0	<i>wrong subpart mentioned, it must be ii(c)</i>
Q2	i(a)	1	1	<i>well defined</i>
	i(b)	1	1	<i>well defined</i>
	ii	3	3	<i>well explained, just mention that whether you are writing the formula for time 0 or at time t.</i>
Q3	i	3	3	<i>perfect</i>
	ii	2	1	<i>incorrect observation provided, make sure to check it out once with the original answer</i>
	iii	2	1	<i>only provided one theory, limited points, also present answers in points rather than para</i>
Q4	i	3	2	<i>wrong formula used for xA calculation, it must be VB in the numerator not VA, awarding you bonus marks due to error in question's hint), but in cases like this you must always go with the correct formula you studied in material. Additionally the formula used for expected return calculation is also wrong, it requires no allowance for amount invested or share price. Make sure to chekc out the original answer once</i>
	ii	2	1.5	<i>correct points metioned, but framing should be improved, your first point should actually be second and vice versa.</i>
	iii	1	0.5	<i>you did not undertand the question, they did not ask you to advise but acc to the advise given above they asked you to comment over risk appetite, so your valid points for score should be non satitation and risk averse</i>
Q5	i	2	2	<i>Perfecft differences mentioned, the third para was actually not required.</i>
	ii	5	4.5	<i>well derived, can check out the original answer once for further understanding</i>
Q6	i	2	2	<i>bonus marks</i>
	ii	6	6	<i>bonus marks</i>
Q7	i	2.5	1.75	<i>Correct definition, portfolio changes correctly explained, final equation contains a little error, there should not be d phi(t) but phi (t) only ad same for psi (t)</i>
	ii	2.5	2.5	<i>correct</i>
Q8	a	1	1	<i>perfect</i>
	b(i)	5	5	<i>perfect</i>
	b(ii)	6	6	<i>perfect</i>
Q9	i	1	1	<i>could have presented mathematical distribution notation alongwith</i>
	ii	4	0	<i>unattempted</i>
	iii	3	0	<i>unattempted</i>

	iv	3	0	unattempted
	v	4	0	unattempted
Q10		10	7.5	final answer for o/s claims not presented, the amount of projected loss is correct though. Also only 1-2 table are explained, not all
Q11	i	1	1	perfect
	ii	2	2	perfect
	iii	4	4	perfect
Q12	i	1	1	correct
	ii	1	0	wrong, no formula presented, direct substitution is there, thus cannot award step marks as well
	iii	2	0.5	wrong formula for covariances used hence wrong beta values
	iv	1	1	correct formula but wrong answer due to wrong value in above part
	v	2	1.5	one more limitation required to score full marks
		97	67.25	Give enough spaces between the subparts, currently the sheet looks messy. Avoid silly mistakes of wrong numbering, you are losing marks even though full/partial credits could have been awarded. Maintain the alignment of the sheet. Need to work over accuracy a little. wishing you best of luck!!

CM2A MOCK TEST

ANSWER 1)

(i) Sigma m = 20%

We have to calculate the variance of securities A,B and C.

$$R_i = \alpha_i + \beta_i R_M + e_i$$

Taking variance on both sides we get

$$V(R_i) = \beta_i^2 V(R_M) + V(e_i)$$

Taking the values from the question we get

For security A we have

$$V(A) = 0.8^2 (20\%)^2 + (25\%)^2$$

$$V(A) = 0.0881 = 881\%$$

For security B we have

$$V(B) = 1^2 (20\%)^2 + (10\%)^2$$

$$V(B) = 0.05 = 500\%$$

For security C we have

$$V(C) = 1.2^2 \cdot (20\%)^2 + (20\%)^2$$

$$V(C) = 0.0976 = 976\%.$$

(ii) Mean of portfolio if we the only asset is security A

$$E(R_p) = E(R_A) = 10\%$$

$$V(R_p) = V(A) = 881\%.$$

(iii) 55% of type B and 45% of Type C

$$E(R_p) = E(R_B) \cdot 0.55 + E(R_C) \cdot 0.45 = 12\% \cdot 0.55 + 14\% \cdot 0.45 = 0.129 = 12.9\%$$

$$V(R_p) = V(B) \cdot 0.55^2 + V(C) \cdot 0.45^2 + 2 \cdot 0.55 \cdot 0.45 \cdot \sigma_B \cdot \sigma_C$$

$$V(R_p) = 0.0694 = 694\%.$$

(iv) Security A has expected return = 10% and variance = 0.0881.

A portfolio consisting of 55% B and 45% C has expected return = 12.9% and variance = 0.0694.

Therefore, the B,C portfolio provides a higher expected return with lower risk than Security A.

An investor could short-sell Security A and invest the proceeds in the 55% B and 45% C portfolio.

This gives an opportunity to obtain higher return for lower risk.

Hence, Security A is inefficiently priced relative to the B–C portfolio.

Strictly, this is not a pure arbitrage unless the difference produces a risk-free profit.

ANSWER 2)

- (i) Credit risk is the risk that a borrower or issuer of debt fails to make the required interest or principal payments when they are due. For example, if you buy a company's bond, there is a risk that the company defaults and you don't receive all your promised payments.
- (ii) A credit spread is the difference between the yield on a risky debt instrument and the yield on a comparable risk-free debt instrument.
- (iii) The Merton model is a model used to assess the credit risk of a company and value its debt by treating the company's equity as a call option on its assets.

The Merton model treats the company's equity as a European call option on the company's assets, with the debt's face value D acting as the strike price.

Let

V_0 = current value of company assets

D = face value of debt

T = time to maturity

r = risk-free interest rate

σV = volatility of company assets

At maturity, the company defaults if the value of its assets is less than the debt:

$$V_t < D$$

Under the risk-neutral measure, the asset value follows a lognormal distribution.

Calculate:

$$d_1 = \frac{\ln(V_0/D) + \left(r + \frac{1}{2} \sigma^2\right) T}{\sigma \sqrt{T}}$$

and

$$d_2 = d_1 - \sigma \sqrt{T}$$

Therefore, the risk neutral probability is $N(-d_2)$.

ANSWER 3)

- (i) If the efficient market hypothesis is assumed to be true B's actions are not consistent with his statements

According to B the market is efficient and the stock price reflects all the available information made public and yet to be made public. So, no amount of public information and insider information can help B generate excess risk adjusted returns.

According to B the market is strong form efficient as insider information cannot help generate extra risk adjusted returns.

B believes that the market is strong form efficient yet is trying to get extra risk adjusted return with the help of historic price charts and patterns. This action is inconsistent with the statements they made.

If a market is strong form, it is also possessing the characteristics of weak form market meaning the price history and the patterns of stocks won't lead to extra risk adjusted returns.

Since the market is strong form efficient according to B the price history and patterns won't help him generate extra returns.

- (ii) Stocks did rally the next day after the quarter end results were publicly announced so this means that the insider information from A was true and could have helped in generating extra adjusted returns.

The level of market efficiency this market exhibit is semi-strong form.

The semi-strong form of market efficiency states that security prices fully and rapidly reflect all publicly available information, meaning that investors cannot consistently earn abnormal returns using publicly available information.

Since the information was not publicly available the investor was able to generate extra risk adjusted returns.

- (iii) B's approach can be explained using the following behavioural finance theory:

Loss aversion: B is more concerned about the potential loss from selling the stock and then seeing it rise than about the potential gain from buying it back cheaper. Investors tend to feel losses more strongly than equivalent gains.

ANSWER 4)

(i) $x_A = (V_A - C_{AB}) / (V_A + V_B - 2C_{AB})$

the correlation coefficient is -0.6

$$\rho = C_{AB} / (\sigma_A \sigma_B)$$

$$-0.6 \cdot 0.1 \cdot 0.25 = -0.015 = C_{AB}$$

$$x_A = (0.01 + 0.015) / (0.01 + 0.0625 + 2 \cdot 0.015) = 2/7$$

2/7 is the proportion of shares to be invested in the portfolio so the variance is minimized.

The expected return of the portfolio is

$$E(R_p) = 2/7 \cdot (10000/100) \cdot 10\% + 5/7 \cdot (10000/200) \cdot 12\% = 50/7 = 7.14\%$$

- (ii) with the correlation coefficient as +0.6

x_A would be -2/17 and since short selling is not allowed the portfolio with the minimum variance would not be reached.

With negative correlation, diversification is strong, so you can hold positive amounts of both assets. With positive correlation, diversification is weaker, and the minimum-variance portfolio may require short-selling one asset.

- (iii) The investor appears to be relatively risk averse, as they prioritise minimising portfolio variance, even though this results in a relatively low expected return. So, I would advise them on diversifying their portfolio.

ANSWER 5)

- (i) CML relates expected return to total risk, measured by standard deviation (sigma).

SML relates expected return to systematic risk, measured by beta.

CML applies only to efficient portfolios, whereas SML applies to individual securities and portfolios.

The CML is based on the market portfolio and risk-free asset, while the SML is based on the CAPM relationship between beta and expected return.

- (ii)

Since portfolio P lies on the Security Market Line (SML),

$$E(R_p) = R_f + \beta_p[E(R_M) - R_f]$$

Consider a portfolio Q consisting of the risk-free asset and the market portfolio, with proportion β_{qp} invested in the market.

Its expected return is:

$$E(R_Q) = R_f + \beta_P[E(R_M) - R_f]$$

Hence,

$$E(R_Q) = E(R_P)$$

The standard deviation of Q is:

$$\sigma_Q = \beta_P \sigma_M$$

But:

$$\beta_P = \frac{\text{Cov}(R_P, R_M)}{\sigma_M^2} = \frac{\rho_{PM} \sigma_P \sigma_M}{\sigma_M^2}$$

Therefore,

$$\sigma_Q = \sigma_P \rho_{PM}$$

Since correlation coefficient is less than 1 σ_Q is less than σ_P . Thus, Q has the same expected return but lower risk than P.

Therefore, P is not an efficient combination of the risk-free asset and the market portfolio.

ANSWER 6)

(i) The probability that a credit event occurs till the maturity of the bond

$$0 + 0.1 + 0.4 = 0.5.$$

ANSWER 7)

- (i) A trading strategy is self-financing if, after the initial investment, no additional money needs to be added or withdrawn from outside the portfolio.

For a strategy with holdings ϕ_t units of stocks and ψ_t units of cash.

- Any changes in the holdings are financed entirely by the portfolio itself.
- The value of the portfolio changes only because of gains/losses and returns on the assets held.
- There are no external cash inflows or outflows after the initial investment.
- Mathematically:

$$dV_t = \phi_t dS_t + \psi_t dC_t$$

where V_t is the value of portfolio at time t

ϕ_t unit of stocks

S_t is the stock

sait unit of cash

Bt is the cash

- (ii) A replicating strategy is a portfolio of the underlying asset and risk-free asset that produces exactly the same payoff as the derivative at maturity.

To price the derivative at time 0:

Identify the derivative payoff at maturity, example V_t

Construct a portfolio of the underlying and risk-free asset whose payoff equal V_t in every possible state.

Let the portfolio contain:

Delta units of the underlying risky asset

B invested in the risk-free asset.

Since the portfolio and derivative have identical future payoffs, they must have the same price today, otherwise there would be an arbitrage opportunity.

$$V_0 = \Delta S_0 + B$$

ANSWER 8

- (a) Arbitrage-free means there is no way to make a riskless profit without investing any money of your own.
- (b) 2/3 probability to go up and 1/3 probability to go down
- (i) Mean 10% and standard deviation is 10%

Let the up return be u and down return be d

$$\frac{2}{3}u + \frac{1}{3}d = 1 + 0.1$$

$$2u + d = 3.3 \quad \text{equation 1}$$

The probability of stock price going up and down are independent to each other so

$$\frac{2}{3}(u-1.1)^2 + \frac{1}{3}(d-1.1)^2 = 0.1^2$$

From equation 1 we get

$$d = 3.3 - 2u$$

solving both the equations we get

$$u = 1.1707$$

$d = 0.9586$.

(ii) Risk free rate of return is 7.5%

Strike price is 275 for call option and 300 for put option with the current share price being 250

The share price at time 1 will be

292.675

250

239.65

The risk neutral probability is

$$q = (e^{r-d}) / (u-d) = 0.5625, 1-q = 0.4375$$

the value of call option is

$$e^{-0.075} * 0.5625 * (292.675 - 275) = 9.2238$$

the value of put option is

$$e^{-0.075} * 0.5625 * (300 - 292.675) + e^{-0.075} * 0.4375 * (300 - 239.65) = 28.318$$

ANSWER 9)

(i) The portfolio of insurance follows a poisson process so the waiting period between two different time periods follows exponential distribution .

The distribution of the time until the first claim T_1 follows exponential distribution.

(ii) The question is not very visible.

ANSWER 10)

the number of claims settled

accident year	development year		
	0	1	2
2006	442	151	50
2007	623	111	
2008	681		

the cost of settled claims during each year

accident year	development year		
	0	1	2
2006	6321	1901	701
2007	7012	2237	
2008	7278		

Converting them into cumulative claims

the cumulative number of claims settled

accident year	development year		
	0	1	2

2006	442	593	643
2007	623	734	
2008	681		

the cumulative cost of settled claims during each year

accident year	development year		
	0	1	2
2006	6321	8222	8923
2007	7012	9249	
2008	7278		

Dividing each cell in the second table by the corresponding cell in the first table gives the accumulated average incurred cost per claim.

accident year	development year		
	0	1	2
2006	14.3009	13.865	13.877
2007	11.255	12.6008	
2008	10.687		

Calculating the average claim amounts

accident year	development year			Ult
	0	1	2	
2006	14.3009	13.865	13.877	13.877
	103.05%	99.91%	100.00%	
2007	11.255	12.6008		
	89.24%	99.91%		12.612
2008	10.687			
	96.145%			11.1155

The same for the claim numbers

accident year	development year			Ult
	0	1	2	
2006	442	593	643	643
	68.74%	92.22%	100.00%	
2007	623	734		796
	78.277%	92.22%		
2008	681			926
	73.51%			

the total ultimate loss

accident year	Avg.cost per claim	claim numbers	project loss estimate
2006	13.877	643	8922.911
2007	12.612	796	10037.75
2008	11.1155	926	10297.62
	total project loss		29258.28

ANSWER 11)

(i) Market price of risk is 10% per annum

Risk free rate (r) of return is 3.3% per annum

The expected annual return on the market portfolio is 5.3% per annum. (EM)

Calculating σ_M

Using market price of risk, we get

$$(EM - r) / \sigma_M = 10\%$$

$$(0.053 - 0.033) / \sigma_M = 0.1$$

$$\sigma_M = 0.2 = 20\%.$$

(ii) Calculating r_B

$$EM = 100/500 * 0.04 + 150/500 * r_B + 250/500 * 0.06 = 0.053$$

$$0.053 = 0.008 + 0.3 * r_B + 0.03$$

$$0.015 / 0.3 = r_B = 0.05 = 5\%$$

(iii) calculating the covariances of the annual returns on each asset with the annual return on the market portfolio

Covariance between asset A and the market portfolio

$$\text{Cov}(R_A, R_M) = V(R_M) \cdot \beta_A$$

$$\beta_A = (E_A - r) / (E_M - r) = (0.04 - 0.033) / (0.053 - 0.033) = 0.35$$

$$\text{Cov}(R_A, R_M) = 0.35 \cdot 0.2^2 = 0.014$$

Similarly for asset B

$$\beta_B = (E_B - r) / (E_M - r) = (0.05 - 0.033) / (0.053 - 0.033) = 0.85$$

$$\text{Cov}(R_B, R_M) = 0.85 \cdot 0.2^2 = 0.034$$

Similarly for asset c

$$\beta_C = (E_C - r) / (E_M - r) = (0.06 - 0.033) / (0.053 - 0.033) = 1.35$$

$$\text{Cov}(R_C, R_M) = 1.35 \cdot 0.2^2 = 0.054$$

ANSWER 12)

(i) The expected return on market portfolio is

The total market value of shares is $200 \cdot 3 + 300 \cdot 4 = 1800$

$$E_M = 600/1800 \cdot 0.16 + 1200/1800 \cdot 0.1 = 0.12 = 12\%$$

(ii) Volatility of the market portfolio

$$\begin{aligned} V_M &= (1/3)^2 \cdot 0.3^2 + (2/3)^2 \cdot 0.1^2 + 2 \cdot (1/3) \cdot (2/3) \cdot 0.3 \cdot 0.1 \cdot 0.4 \\ &= 0.019778 = 1.9778\% \end{aligned}$$

(iii) Beta of each stock

$$\beta_A = \text{Cov}(R_A, R_M) / V_M$$

$$\text{Cov}(R_A, R_M) = 1/3 \cdot V_A + 2/3 \cdot \text{Cov}(A, B)$$

$$= 1/3 \cdot 0.09 + 2/3 \cdot 0.012 = 0.03 + 0.008 = 0.038.$$

$$\beta_A = 0.038 / 0.019778 = 1.92$$

Similarly for asset B

$$\text{Cov}(R_B, R_M) = 1/3 * \text{Cov}(A, B) + 2/3 * V_B$$

$$= 1/3 * 0.012 + 2/3 * 0.01 = 0.004 + 0.00667 = 0.010667.$$

$$\text{Beta}_B = 0.010667 / 0.019778 = 0.54$$

(iv) The risk free rate of return

$$E_A - r = \text{Beta}_A * (E_M - r)$$

$$0.16 - r = 1.92 * (0.12 - r)$$

$$r = 7.65\%$$

(v) Unrealistic assumptions: CAPM assumes investors are rational, markets are perfect, and there are no taxes or transaction costs.

Single-factor model: It assumes that beta is the only measure of risk, ignoring other factors that may affect returns.

Beta is unstable: A security's beta can change over time, so historical beta may not be a reliable measure of future risk.