



Institute  
and Faculty  
of Actuaries

# EXAMINERS' REPORT

SP6 - Financial Derivatives

Specialist Principles

April 2023

## Introduction

The Examiners' Report is written by the Chief Examiner with the aim of helping candidates, both those who are sitting the examination for the first time and using past papers as a revision aid and also those who have previously failed the subject.

The Examiners are charged by Council with examining the published syllabus. The Examiners have access to the Core Reading, which is designed to interpret the syllabus, and will generally base questions around it but are not required to examine the content of Core Reading specifically or exclusively.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report; other valid approaches are given appropriate credit. For essay-style questions, particularly the open-ended questions in the later subjects, the report may contain more points than the Examiners will expect from a solution that scores full marks.

For some candidates, this may be their first attempt at answering an examination using open books and online. The Examiners expect all candidates to have a good level of knowledge and understanding of the topics and therefore candidates should not be overly dependent on open book materials. In our experience, candidates that spend too long researching answers in their materials will not be successful either because of time management issues or because they do not properly answer the questions.

Many candidates rely on past exam papers and examiner reports. Great caution must be exercised in doing so because each exam question is unique. As with all professional examinations, it is insufficient to repeat points of principle, formula or other text book works. The examinations are designed to test "higher order" thinking including candidates' ability to apply their knowledge to the facts presented in detail, synthesise and analyse their findings, and present conclusions or advice. Successful candidates concentrate on answering the questions asked rather than repeating their knowledge without application.

The report is written based on the legislative and regulatory context pertaining to the date that the examination was set. Candidates should take into account the possibility that circumstances may have changed if using these reports for revision.

Sarah Hutchinson  
Chair of the Board of Examiners  
July 2023

### **A. General comments on the *aims of this subject and how it is marked***

The aim of Financial Derivatives Principles (SP6) is to develop a candidate's ability to understand different types of financial derivatives and their uses, the markets in which they are traded, methods of valuation of financial derivatives, and the assessment and management of risks associated with a portfolio of derivatives. It builds on material covered in earlier subjects, particularly Loss Reserving and Financial Engineering (CM2).

Candidates are reminded to ensure that their answers are sufficiently detailed to demonstrate their understanding, as well as to make sure that more obvious points are still made to be awarded full marks. The model solutions are intended to reflect the level of detail that a well-prepared candidate might be able to produce. For many questions there are more marks available than the question requires to achieve full marks. This reflects that the examiners will give credit for valid alternative solutions, particularly in questions focussed on higher level skills.

Candidates who give well-reasoned points, not in the marking schedule, are awarded marks for doing so.

### **B. Comments on *candidate performance in this diet of the examination.***

Most candidates were able to make a decent attempt at most questions. In general, candidates demonstrated good knowledge of the core reading material and its application to a range of situations.

To achieve a good pass mark, candidates must not only state points of principle and make a basic analysis. Candidates are also required to synthesise their application into advice which considers best options, pros and cons, and otherwise demonstrate the higher order thinking skills as required by the questions. Such higher order thinking skills were required for parts of Questions 1, 2, 6 and 7, which proved to be more challenging. Additional comments are provided after each question below.

### **C. Pass Mark**

The Pass Mark for this exam was 60.  
45 presented themselves and 24 passed.

## Solutions for Subject SP6 - April 2023

### Q1

(i)

It would be inappropriate to price derivatives using a real-world probability measure  $P$  as this would violate the principle of no-arbitrage [1]

(ii)

Node 1:  $F_1 = 1$  or  $F_1 = \{100\}$  [1]

Node 4:  $F_2 = 1, 2, 4$  or  $F_2 = \{100, 120, 130\}$  [1]

(iii)

At node 1

$$q * 120 + (1-q) * 80 = 102$$

$$40q = 22$$

$$q = 22/40 \text{ or } 0.55 \text{ or } 55\% \quad [1]$$

At node 2

$$q * 130 + (1-q) * 110 = 120 * 104 / 102$$

$$q * 20 = 120 * 104 / 102 - 110$$

$$q = 0.6176 \text{ or } 61.76\% \quad [1]$$

At node 3

$$q * 90 + (1-q) * 70 = 80 * 104 / 102$$

$$q * 20 = 80 * 104 / 102 - 70$$

$$q = 0.5784 \text{ or } 57.84\% \quad [1]$$

(iv)

At node 2

The final payoff will be  $X = 50$  at each node 4 and 5, so the delta is zero

Derive the stock holding strategy  $\phi$  is therefore 0 [1]

The bond holding strategy  $\psi$  is simply the discounted value of 50, of  $50 * 102/104 = 49.0385$  [1]

At node 3

The final payoff will be  $X = 0$  at each node 6 and 7, so the delta is zero

Derive the stock holding strategy  $\phi$  is therefore 0 [1]

The bond holding strategy  $\psi$  is also 0 [1]

(v)

Without doing the calculation, the delta / stock holding strategy will be high at node 1 as the difference in value of the stock between nodes 2 and 3 is 40, whereas the delta of the claim  $X$  is close to 50, so stock holding strategy will be higher than 100% [1]

Then at nodes 2 and 3 the stock holding strategy will be 0 [1]

This is quite sudden change, which means that the stock holding strategy will need a large adjustment [1]

This sudden change in stock holding strategy can be explained by the binary nature of the option [1]

[Total marks available 4, maximum 3]

[Total 13]

*The question was reasonably well answered with many candidates achieved full marks on parts (ii) and (iii).*

*Only better prepared candidates were able to achieve full marks with the higher order skills part (v), which was more challenging given the unusual nature of the claim X.*

**Q2**

(i)

Using continuous compounding and assuming a Brownian motion with parameter  $\mu = 0.1$

$$S_1 = S_0 * \exp [(\mu - \sigma^2 / 2) + \sigma * Z] \quad [1]$$

z value	Simulated stock price
-0.4568	46.06
-1.7246	31.49
0.1320	54.96
-0.1802	50.05

[2]

Alternatively, using continuous compounding and assuming the following lognormal model:

$$S_1 = S_0 * \exp [ \mu + \sigma * Z ] \quad [1]$$

z value	Simulated stock price
-0.4568	48.18
-1.7246	32.94
0.1319	57.49
-0.1801	52.35

[2]

Alternatively, using a discrete time model with one (2 marks maximum)

$$S_1 = S_0 * [1 + \mu + \sigma * Z] \quad [1]$$

z value	Simulated stock price
-0.4568	48.15
-1.7246	29.13
0.1319	56.98
-0.1801	52.30

[1]

[Total marks available 8, maximum 3]

- (ii)  
 For a process to follow a Markov process the future behaviour should only depend on its current value [1]  
 and not the path it has followed in the past, so no mean reversion or trend behaviour [1]
- (iii)  
 The daily volatility is  $30\% / \sqrt{250} = 1.8974\%$  [1]
- (iv)  
 This observation indicates trend behaviour of daily stock prices [1]  
 This means that daily rises are more likely to be followed by subsequent rises and vice versa [1]  
 This behaviour explains daily volatility to be lower than expected when looking at annual volatility [1]  
 With mean reverting prices we would expect the opposite observation [1]  
 [Total marks available 4, maximum 3]
- (v)  
 The investor could buy the stock after a recent rise in stock prices [1]  
 And sell or short the stock after recent falls in the stock price [1]  
 The investor could use option-based strategies that seek to benefit from the apparent anomaly [1]  
 There are many reasons why these trading rules might not work, such as transaction costs, the observation that markets were trending does not mean they continue to be, the competitive nature of investment markets when such a trading rule has been found it generally gets arbitrated away [1]  
 [Total marks available 4 maximum 2]  
**[Total 11]**

*The question did not specifically prescribe how to derive four random values for part (i) and therefore marks were awarded for a range of methods.*

*Overall, this question was the most challenging on the paper, with only a small number of candidates achieving full marks on the last two parts (iv) and (v).*

### Q3

- (i)  
 Monte Carlo can be used for payoffs that are path dependent [1]  
 Monte Carlo is widely used [1]  
 With Monte Carlo it is not necessary to find a closed form solution [1]  
 [Total marks available 3 maximum 2]
- (ii)  
 From DDUU and UDDD we observe that steps up and steps down cancel each other as both trails end at 100, which seems to be the current stock price  
 UUUU gives 121.55 which indicates up move =  $121.55^{(1/4)} - 1 = 5\%$

DDDD gives 82.27 which indicates down move =  $82.27^{(1/4)} - 1 = 4.7762\%$  (or  $1/1.05 - 1$ )

Hence the trail to fill in which is UUDU gives  $100 * 1.05^2$  [½]

Gives 110.25 as final stock price [½]

and the following path

U	105
UU	110.25
UUD	105
UUDU	110.25

[1]

Giving an average stock price of 107.625 [½]

and hence an option pay off of 7.625 [½]

*(There are a variety of ways to approach this, here is just one way of solving this. Candidates need to show their workings for full marks)*

(iii)

The 95% confidence interval is found around the mean of 3.61 plus or minus  $1.96 * \text{standard deviation of payoffs} / \sqrt{M}$  [½]

where M is the number of trails or 10 in this case

st.dev of payoffs is given 5.08

giving 3.61 plus or minus  $5.08 * 1.96 / \sqrt{10}$  [½]

or the 95% confidence interval from 0.47 to 6.76 [1]

(iv)

These simulations could be used to estimate vega

By first simulating on current values and then simulating again using a small difference for the volatility [1]

The change in value of derivative gives an estimate for vega [1]

In order to minimize the standard error of the estimate the same random / seed values [1]

and number of trails, time intervals should be used [1]

Given the small number of simulations and the nature of the derivative the estimate of vega might not be particularly accurate [1]

[Total marks available 5, maximum 3]

**[Total 10]**

*This question was well answered, and candidates showed a range of creative ways of finding the missing values under question (ii).*

*For part (iii) a common mistake was to omit  $\sqrt{M}$  from the formula for the confidence interval.*

**Q4**

(i)

The SPV allows the energy company to raise capital on a bankruptcy remote basis [1/2]  
 i.e.. the debt is only secured against the assets in the SPV and not against any of the energy company's other assets [1/2]

[Total marks available 1½, maximum 1]

(ii)

The super senior bonds will offer the lowest returns but with the greatest certainty of repayment [1/2]  
 They may be attractive for investors who wish to generate some additional return relative to risk-free assets but without significant risk e.g. pension schemes, insurance companies [1/2]  
 Senior bonds will offer a return higher than super senior bonds but with increased risk of default [1/2]  
 They will similarly be attractive to investors who would like a relatively safe investment such as pension schemes and insurance companies [1/2]  
 Junior bonds are ranked below the two senior tranches and therefore are more at risk of default [1/2]  
 As such, they will have a higher coupon rate [1/2]  
 They will therefore be attractive to investors looking for a higher risk vs return profile e.g. hedge funds [1/2]  
 The equity tranche is retained by the energy company. It is therefore liable for any initial losses incurred as part of the project [1/2]  
 However, it will be the benefactor of any upside returns [1/2]  
 This ensures the energy company has "skin in the game" i.e. its interests are aligned to those of other investors [1]

[Total marks available 5½, maximum 3]

(iii)

A rating is a single generic indicator that reflects the issuer's creditworthiness [1/2]  
 Credit rating agencies (CRAs) give a rating between AAA and C for rated bonds [1/2]  
 The CRA assesses the probability of default (PD) over a given time horizon [1/2]  
 They then typically estimate the loss given default (LGD) by estimating the recovery rates that would occur given default [1/2]

The CRA will assess the ability of the SPV to repay the bonds and hence their PD, dependent on the:

Delivery of the project i.e. will the wind farm be constructed within budget [1/2]  
 The cashflows generated by the windfarm [1/2]  
 Timing of the cashflows generated by the windfarm [1/2]  
 Management of the windfarm [1/2]  
 The amount of leverage in the SPV [1/2]  
 (Other reasonable suggestions should be accepted)

[Total marks available 4½, maximum 3]

(iv)

The guarantee should provide market-competitive rates for the electricity and therefore increase the creditworthiness of the bonds in general [1/2]  
 [1]

- given that there will be a minimum amount of expected income from the windfarm [½]  
 The guarantee may impact the different tranches of debt differently depending on the structure of the debt and the SPV [½]  
 i.e. it may increase the credit rating of the senior bonds, given these will be repaid first but without significant impact on the junior bonds [½]  
 If the guarantee does not provide market rates, then it is unlikely to be valuable and will have little effect on the credit rating of the bonds [½]  
 The guarantee only provides a price for the energy, it does not guarantee there will be wind. If there were doubts about the ability of the windfarm to generate power, then the guarantee may not be very valuable [½]  
 However, we can safely assume the energy company has tested the wind availability in the area where they propose to build the windfarm [½]  
 The govt guarantee is for 10 years - the impact of the guarantee may diminish if the bonds are of a greater term than 10 years [½]  
 (*Other reasonable suggestions should be accepted*)

[Total marks available 5½, maximum 3]

**[Total 10]**

*This question was overall well answered, across the four parts. Candidates that scored higher marks were able to provide complete answers, including stating obvious points.*

**Q5**

(i)(a)

The delta of an option is the change in the option value for a given small change in the value of the underlying stock. Therefore, by hedging the delta, the bank will be able to offset changes in the value of the portfolio due to small changes in the value of the underlying [1]

(b)

The gamma of an option is the rate of change of delta of the option. Therefore, hedging gamma reduces the risk of portfolio changes arising from changes in delta [1]

(ii)

The delta and gamma of a portfolios of derivatives is calculated using the weighted sum of the individual exposures [1]

(iii)

	Delta	Gamma	Reason
Stock	✓	✗	Stocks have delta of 1 by definition and a gamma of 0
Corporate bonds	✗	✗	Corporate bonds will have delta of 0 and gamma of 0 as they are not based on stock

			prices
Exchange-traded options	✓	✓	Exchange-traded options will have a non-zero delta. They will also have a gamma due to their non-linearity.
OTC options	✓	✓	OTC options will have a non-zero delta. They will also have a gamma due to their non-linearity.
Single stock futures	✓	✗	Single stock futures have delta of 1 and a gamma of 0

(1 mark for correctly identifying which instruments can hedge delta, 1 mark for gamma instruments and 1 mark for explanations) [3]

(iv)

Garman-Kohlhagen equations:

$$p = K \exp(-rT) \Phi(-d2) - S \exp(-qT) \Phi(-d1)$$

$$d1 = [\log(S/K) + (r - q + 0.5\sigma^2)T] / (\sigma \sqrt{T})$$

$$d2 = d1 - \sigma \sqrt{T}$$

[1/2]

$$dd1/ds = dd2/ds$$

[1/2]

Then calculate  $\Delta$

$$\Delta = dp/ds = K \exp(-rT) (d\Phi(-d2)/ds) - s \exp(-qT) (d\Phi(-d1)/ds) - \exp(-qT) \Phi(-d1) \quad [1]$$

$$= K \exp(-rT) (d\Phi(-d2)/dd2) * (-dd2/ds) - S \exp(-qT) (d\Phi(-d1)/dd1) * (-dd1/ds) - \exp(-qT) \Phi(-d1) \quad [1]$$

$$= - \exp(-qT) \Phi(-d1) + ((K \exp(-rT) * \phi(-d2)) / (s * \sigma * \sqrt{T})) - s \exp(-qT) * \phi(-d1) / (s * \sigma * \sqrt{T}) \quad [1/2]$$

We are given that  $S * \exp(-qT) \phi(-d1) = K * \exp(-rT) * \phi(-d2)$ , therefore the expression in the bracket reduces to 0 [1/2]

Therefore:

$$\Delta = - \exp(-qT) \Phi(-d1) \quad [1/2]$$

[Total marks available 4 1/2, maximum 4]

(v)

The bank sold the put spread, it is therefore short the \$900 option and long the \$750 option:

$$S = 925$$

$$q = 0.03$$

$$u = 0.5$$

$$r = 0.02$$

$$\sigma = 0.25$$

[1/2]

\$900 option:

$$d1 = (\log(925/900) + (0.02 - 0.03 + 0.5 * 0.25^2) * 0.5) / (0.25 * \sqrt{0.5}) = 0.215 \quad [1/2]$$

$$\text{Gamma} = \exp(-0.03 \cdot 0.5) \cdot \phi(d1) / (925 \cdot 0.25 \cdot 0.5^{0.5}) = 0.0024 \quad [1/2]$$

\$750 option:

$$d1 = (\log(925/750) + (0.02 - 0.03 + 0.5 \cdot 0.25^2) \cdot 0.5) / (0.25 \cdot \sqrt{0.5}) = 1.246 \quad [1/2]$$

$$\text{Gamma} = \exp(-0.03 \cdot 0.5) \cdot \phi(d1) / (925 \cdot 0.25 \cdot 0.5^{0.5}) = 0.0011 \quad [1/2]$$

$$\text{Gamma of bear spread} = -0.0024 + 0.0011 = -0.0013 \quad [1/2]$$

(vi)

For out of the money options, the gamma will typically tend to zero as time to maturity decreases. [1/2]

However, for at the money options, the gamma will typically increase as time to maturity decreases [1/2]

The lower leg of the bear spread (i.e. the \$750 option) is currently out of the money but the upper leg is near the money [1/2]

Therefore, if there is no change in the stock price, there will be an increased need to rebalance as the gammas of the two options move in opposite direction [1]

However, it is also possible that the relationships between gamma and time stated above will behave differently at certain times to maturity [1/2]

which may influence the frequency of rebalancing needed [1/2]

[Total marks available 3½, maximum 2]

**[Total 15]**

*This question was overall well answered with most candidates scoring well across the question parts. Parts (iv) and (v) were good differentiators where better prepared candidates were able to score full marks.*

## Q6

(i)

$$\lambda = (\mu - r) / \sigma \quad [1]$$

$\mu$  = expected return

$\sigma$  = volatility of the stock price

$r$  = risk free rate [1]

(ii)

$$\lambda = (5 - 0.5) / 0.15 = 30 \quad [1]$$

$$\sigma \lambda + 0.5\% = \mu_g \quad [1/2]$$

$$\mu_g = 30 \cdot 37.5\% + 0.5\% = 11.75\% \quad [1/2]$$

(iii)

The numeraire is the reference asset which is used to measure the value of other assets [1]

For the ratio  $\omega$ , the asset g is the numeraire [1/2]

the price of asset f is measured relative to the price of asset g and therefore gives the value of asset f in units of asset g [1/2]

[Total marks available 2, maximum 1]

(iv)

The value of the derivative will be the same regardless of which numeraire is used to value the derivative [1]

Choosing a suitable numeraire can therefore simplify the calculation of the valuation of the derivative [1]

It enables/facilitates the extension of the risk neutral valuation framework to the situation where interest rates are stochastic [1]

For example, it can extend Black's model to stochastic interest rates [½]

[Total marks available 3½, maximum 2]

(v)

Let  $s(t)$  be the swap rate at time  $t$

The payment from the fixed side of a fixed-for-floating  $n$ -year swap can be written

As:

$A \cdot s(t)$ , where  $A$  is a  $n$ -year annuity factor [½]

The floating side can be written as  $P(t, T_0) - P(t, T_N)$  [½]

Equating both sides gives:  $A \cdot s(t) = P(t, T_0) - P(t, T_N)$  [½]

$S(t) = (P(t, T_0) - P(t, T_N)) / A$  [½]

Setting  $f = P(t, T_0) - P(t, T_N)$  and  $g = A$ , the equivalent martingale measure gives that  $s(t)$  is a martingale, when the market price of risk is  $\sigma_A$  [½]

Therefore,  $s(t) = E(s(T))$ , as required [½]

[Total 10]

*The first three parts of this question were well answered, but only best prepared candidates were able to achieve full marks in parts (iv) and (v).*

## Q7

(i)

If a company knows that it has to purchase an item at a specific time in the future

Then it may take a long position [1]

A company will be able to lock-in a certain price for the item it needs to purchase [½]

subject to basis risk [½]

In this way the company can reduce, or remove in some cases, the risk of unexpected losses or expenses [1]

[Total marks available 3, maximum 2]

(ii)

Overview

By hedging in an appropriate way using futures the farm may be able to protect itself from fluctuations in the price of wheat in 12 months [1]

An example of such a hedge may be by shorting some suitable wheat futures [½]

In this way if the price of wheat falls, compared to the current price of 7.50, then it would make less income from the contract with the bakery [½]

but it would make a gain on the short futures it had purchased [½]

In the scenario where the price of wheat increases, compared to the current price of 7.50, it would make more income from the contract with the bakery [½]

but it would make a loss on the short futures it had purchased [½]  
 In general hedging using futures does not improve the financial outcome of the contract in 12 months [½]  
 Instead suitable hedging using futures can make the financial outcome of the contract in 12 months more certain [1]

Basis risk:

Wheat futures are available on many exchanges [½]  
 This may mean the basis risk is relatively low, but it will depend on: [½]  
 The contract size of the available futures; wheat futures may be significantly different from the size of this bakery contract [½]  
 In the case of the wheat future contracts being much larger then there will be significant basis risk. [½]  
 In the case of the wheat futures contracts being much smaller then it would require multiple futures to be bought [½]  
 The liquidity of the market for wheat futures [½]  
 Greater liquidity will reduce the basis risk, particularly if the farm has to close out its future's position early [½]  
 The futures price relative to the spot price of wheat, the underlying wheat price may be different relative to the spot price of wheat used in the bakery contract, increasing basis risk [½]  
 The maturity dates of the futures relative to the bakery contract [½]  
 as it may be the case that the farm has to close out a futures position well before the maturity of the future [½]  
 Any rollover risk, this is likely to be low given the hedging period is only going to be a maximum of 12 months [½]  
 Any uncertainty in the risk-free risk will increase basis risk [½]

Operational risk:

The farm will require sufficient liquidity to enable it to meet any margin payments over the period of the hedge [½]  
 There is likely to be limited counter-party risk using futures [½]  
 The farm has no experience in using derivatives which may increase the risk of the hedge been set-up incorrectly [½]  
 The volume of futures contract that minimises risk in the hedge is difficult to determine and may be beyond the skills of the farm employees [½]  
 In addition, due to the lack of experience the farm may require third party advice which will incur additional costs to the hedging [½]

Summary:

Overall, the use of futures is likely to increase the certainty of the financial position in 12 months [½]  
 It will not completely eliminate the risk of a fall in the spot price of wheat in 12 months [½]

[Total marks available 14½, maximum 4]

(iii)

Assume the farm is able to satisfy the contract [½]  
 and receives full payment from the supermarket [½]  
 In addition, it is also assumed that the 25,000 present value can be considered

Certain with no probability of changing [½]  
 Let  $w$  be the market price of wheat in 12 months where the farm makes neither a profit nor loss  
 In 12 months the cashflow from the contract is  $4,000 \times w$  [½]  
 Discounting to the current time gives a present value of  $4,000 \times w \times e^{-0.04}$  [½]  
 Solving the equation of value:  $4,000 \times w \times e^{-0.04} = 25,000$  gives  $w = 6.51$  [½]  
 [Total marks available 3, maximum 2]

(iv)  
 The cost to set-up the hedge =  $-4,000 \times 0.37 + 4,000 \times 0.02$  [½]  
 This is equal to an initial income of 1,400, so there is no cost [½]

It is assumed there are no other fees relating to the purchase of the derivatives, for example:  
 transaction costs [½]  
 consulting fees; or [½]  
 bid/offer spreads relating to the market prices of the options [½]  
 [Total marks available 2½, maximum 2]

(v)  
 Assuming no transaction costs or taxes [½]

Let  $w$  be the market price of wheat in 12 months where the farm makes neither a profit nor loss. In 12 months the cashflow from the contract is  $4,000 \times w$  [½]  
 Discounting to the current time gives a present value of  $4,000 \times w \times e^{-0.04}$  [½]  
 The cost at the current time of setting up the hedge is -1,400 (using part (iii) and the present value of production is an outflow of 25,000 [½]

In 12 months the cashflows from the hedge will be:  
 $4000 \max(6 - w, 0)$  for the put options; and [½]  
 $4000 \min(w - 8, 0)$  for the call options [½]

Discounting this to the current time and combining with the cashflows above gives an equation of value to solve of:  
 $4,000we^{-0.04} + 1,400 - 25,000 + 4000e^{-0.04} (\max(6 - w, 0) + \min(8 - w, 0)) = 0$  [½]  
 Rearranging:  $w + \max(6 - w, 0) + \min(8 - w, 0) = 6.14078$ . [½]

To solve this equation consider the following cases:  
 Case 1:  $w < 6$ :  
 The equation becomes:  $w + (6 - w) + (0) = 6.14078$   
 This has no solution [½]  
 Case 2:  $w > 8$ :  
 The equation becomes:  $w + (0) + (8 - w) = 6.14078$ .  
 This has no solution [½]

Case 3:  $6 \leq w \leq 8$  :

The equation becomes:  $w + (0) + (0) = 6.14078$

This has the unique solution:  $w = 6.14078$  [½]

[Total marks available 5½, maximum 5]

(vi)

Using this hedge the market price of wheat at which the whole contract becomes profitable is 6.14078 compared to an unhedged market price of 6.51 [1]

This means that there is some profitable protection against a fall in the market price of wheat over the next 12 months [½]

This is exactly the risk from which the farmer was seeking protection [½]

Due to the use of options the amount of profit is capped above 8, so upside Potential is limited [½]

Similarly, deep losses are also reduced below the market price of wheat being below 6 [½]

This hedge does not protect against any changes to the cost of production over the period [½]

For example, the 25,000 cost may change over the year due to rising prices of labour or seed prices [½]

[Total marks available 4, maximum 2]

**[Total 17]**

*Question 7 was generally well answered, except for parts (v) and (vi).*

*Only better prepared candidates were able to work through the calculations required for part (v) and provide comments on the appropriateness of the hedge for part (vi).*

## Q8

(i)

A margin call is a request for additional funds to be deposited in the margin account as a result of the balance in the margin account falling below the maintenance margin level [½]

The additional funds should ensure the margin account is topped up to the initial margin level [½]

within a certain timeframe, depending on the contract [½]

The settlement price for any given day is the average of the prices that a futures contract trades for [½]

immediately before the end of trading [½]

It is used for calculating daily gains and losses [½]

and margin requirements. [½]

For liquid futures the close price may be the settlement price [½]

but for illiquid futures the averaging is important [½]

[Total marks available 5, maximum 3]

(ii)

The broker acts as a communication link between the client and the exchange [½]

They will take instructions from a client and execute them in the futures market	[½]
The brokers also deal with margin transactions with the exchange on behalf of the client	[½]
A broker must be a member of a clearing house, or use a member of a clearing House in order to post margin	[1]
The client will maintain a margin account with a broker	[½]
The broker may decide to pay interest on the margin account to a client	[½]
In order to satisfy initial margin requirements some brokers may accept securities in lieu of cash	[½]
Some brokers may require greater margin from clients than required by the exchange in order to manage the broker's credit risks	[½]
Brokers help maintain liquidity in the markets, and they can help with support an efficient market through providing market news and research	[½]
	[Total marks available 5½, maximum 3]

(iii)

*(It should be noted that there was an error in the initial introduction to the question and in the actual question)*

The introductory part of the question which read: *A trader whose base currency is the US Dollar currently has a long position in one futures contract on a US Dollar/Euro foreign exchange future. Under this contract, the trader agrees to buy €125,000 for \$105,550 in 90 days.*

Should have read:

*A trader whose base currency is the US Dollar currently has a **short** position in one futures contract on a US Dollar/Euro foreign exchange future. Under this contract, the trader agrees to **sell €105,550 for \$125,000** in 90 days.*

Question 8(iii) should have read:

Show that the margin call at the close of the market on Wednesday 3 June is **\$454.51**, stating any assumptions made.

The following solution reflects the corrected question as described above.

Monday 1 June

Using the information in the question the trader entered the futures contract at a trade price of:  $125,000 / 105,550 = \$1.18427 / \text{Euro}$ . [½]

It is assumed this is also the settlement price of this future for Monday 1 June. [½]

At the market close the margin account is equal to the initial margin of \$10,000.00.

Tuesday 2 June

Overnight interest =  $\$10,000 \times 0.01\% = \$1.00$ , resulting in an opening margin account of \$10,001.00. [½]

The settlement price of \$1.179/Euro means that the cost to sell €105,550 is now  $105,550 * 1.179 = \$124,443.45$  [½]

This results in a change of margin of  $\$125,000.00 - \$124,443.45 = \$556.55$ . [½]

At close, the value of the margin account is  $\$10,001.00 - \$556.55 = \$9,444.45$  (the margin is reduced as the trader is selling the futures contract). [½]

Wednesday 3 June

Overnight interest =  $\$9,444.45 \times 0.01\% = \$0.94$ , resulting in an opening margin account of  $\$9,445.39$  [½]

The settlement price of  $\$1.161/\text{Euro}$  means that the cost to sell  $\text{€}105,550$  is now  $105,550 \times 1.161 = \$122,543.55$  [½]

This results in a change of margin of  $\$124,443.45 - \$122,543.55 = \$1,899.90$  [½]

At close, the value of the margin account is  $\$9,445.39 - \$1,899.90 = \$7,545.49$  [½]

The value of the margin account is below the maintenance margin of  $\$8,000$ . [½]

It is assumed the margin call is based on the value of the margin account at the close and not at opening the next day (which would allow for interest). [½]

The margin call is therefore:  $\$8,000.00 - \$7,545.49 = \$454.51$  [½]

[Total marks available 6½, maximum 6]

(iv)

If a margin call is not made then it is reasonable to expect that the broker will attempt to make contact with the trader to explain the situation and consequences [½]

If the trader still fails provide sufficient funds to the broker then the broker may close out the open position of the future the trader has [½]

This would be to reduce the credit risk of the broker [½]

In addition, the broker may close out any other open positions that the trader has to generate sufficient income to cover the margin call [½]

The broker has client management considerations in deciding what to do regarding the margin call not being made [½]

For example, if the broker decides to escalate the matter with the trader then there could be a risk to the relationship, and potentially future business [½]

There is a reputational risk to the trader in not meeting a margin call [½]

If the purchase of the future relates to FX hedging then there is an increased currency risk to the trader [½]

[Total marks available 4, maximum 2]

**[Total 14]**

*This question was well answered on average. Most candidates were able to gain points on parts (i) and (ii) which were more bookwork.*

*Part (iii) had an error where the currency was inverted and candidates were awarded suitable marks and full marks were available for a wide range of reasonable responses.*

*Examiners have ensured that no candidates were penalised due to the error in this part of the question. Part (iv) was most challenging.*

**[Paper Total 100]**

## END OF EXAMINERS' REPORT





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