ACCA

Paper P4

Advanced Financial Management

December 2017

Mock B – Answers

To gain maximum benefit, do not refer to these answers until you have completed the revision mock questions and submitted them for marking.

Some of these answers are longer than the examiner would have expected from students in the time available. See the marking schemes to assess how many points were needed to achieve a pass.

1 PLAISTOW, BILLERICAY AND SGV

(a) Billericay's cost of equity should reflect Billericay's operating risk and its financial risk. Therefore we need to derive a suitable equity beta for Billericay so that we can use CAPM to compute its cost of equity.

We are told that Billericay and Plaistow have equal asset betas, so we first derive Plaistow's asset beta then re gear it for Billericay's gearing, using the formula:

$$\beta_a = \frac{V_e}{V_e + V_d(1-T)}\beta_e + \frac{V_d(1-T)}{V_e + V_d(1-T)}\beta_d$$

Starting with Plaistow:

$$\beta_a = \frac{(420m \times 3.57)}{(420m \times 3.57) + (750m \times 0.70)} \times 1.1 + \frac{(750m \times 0.70)}{(420m \times 3.57) + (750m \times 0.70)} \times 0.20 = 0.867$$

Now we re-gear this asset beta to reflect Billericay's gearing: (N.B. Book values of equity and debt have been used in the formula, as required.)

$$0.867 = \frac{900m}{900m + (300m \times 0.70)} \times \beta_e + \frac{(300m \times 0.70)}{900m + (300m \times 0.70)} \times 0.20$$

0.867 = 0.811 β_e + 0.038

$\therefore \beta_e$ = 1.022

Using CAPM: $k_e = R_f + \beta_e(R_m - R_f)$

k_e = 3% + 1.022 (5%) = 8.11%

To derive WACC, we need to find Billericay's cost of debt. Debt is not risk free here (it has a beta of 0.2) so we can use CAPM to find the required return to the debt holders, as follows:

$k_d = R_f + \beta_d(R_m - R_f)$

k_d = 3% + 0.2(5%) = 4%

$\therefore$ kd (1–T) = 4% x 0.70 = 2.8%

Hence, the WACC of Billericay is:

$$\text{WACC} = \left(\frac{V_e}{V_e + V_d}\right) K_e + \left(\frac{V_d}{V_e + V_d}\right) K_d(1-T)$$

$$= \left(\frac{900}{900+300}\right) \times 8.11\% + \left(\frac{300}{900+300}\right) \times 2.8\%$$

= 6.78%

Use of cost of equity and WACC in business valuation:

Theoretically, the value of a business can be derived by discounting its cash flows back to present value, using an appropriate cost of capital.

Cost of equity – this can be used for discounting income flows, such as dividends or free cash flow to equity, which go directly to the equity investor. This gives the value of equity.

WACC – this should be used for discounting cash flows attributable to the whole business entity, such as project cash flows or overall free cash flows. This gives a valuation of the whole entity.

(b) The likely growth rate of Billericay can be estimated using Gordon's Growth Model (from the formula sheet):

$g = b \times r_e$

where, according to the information in the requirement,

b = current rate of retention of free cash flow to equity

r_e = required rate of return on equity

From part (a) above, $r_e = 8.11\%$

Rate of retention of free cash flow to equity (FCFE):

In the most recent year (20X5) the capital expenditure was €22.4m out of FCFE (before investment) of €72.1m. Hence the rate of retention is estimated to be:

$$b = \frac{22.4m}{72.1m} = 31.1\%$$

Thus, g = 31.1% x 8.11% = 2.52%

It appears that the estimate provided by Billericay's directors is indeed over-stated at 4%.

The following assumptions have been made:

- the current figures for cash generation and reinvestment are expected to be maintained in the future
- the cost of equity has been calculated correctly (e.g. we have assumed that the given beta figure for Plaistow can accurately be applied to Billericay)
- growth will only be generated by retaining and reinvesting cash flow – if the company raises finance from other sources in the future, or is able to achieve cost efficiencies, this will increase the likelihood of growth.

(c) **Report to the directors of Plaistow Co**

From: Financial Manager

Subject: The proposed takeover of Billericay

Date: Today

Introduction

Plaistow Co is considering taking over a competitor in the same industry, Billericay. My report covers a suggested valuation of Billericay, a bidding strategy, and a proposal of what consideration should be used.

Valuation

I have presented detailed valuation calculations in the Appendix.

Three different methods of valuing Billericay have been used, and various valuation figures have been derived:

Value per share (€)	*Basic value (excluding synergy)*	*Value incorporating likely synergy*
Net assets method	2.05	2.50
P/E method	1.90	2.36
Discounted FCFE method	2.07	2.53

Bidding strategy

Let us consider these figures from the point of view of both groups of shareholders.

Plaistow's shareholders should devise a bidding strategy where they make a low opening bid, which is sufficient to interest the Billericay shareholders, but would keep most of the value added from the take-over for the benefit of Plaistow.

Plaistow could start with an opening bid of, say, €2.10 per share. This is greater than Billericay's net asset value, so is enough to bring Billericay into play, but would mean that the Plaistow shareholders would enjoy the synergies created.

Plaistow should then be prepared to negotiate up to approximately €2.36 per share. There is no guarantee that Billericay's earnings forecasts are accurate, or that the synergies will be realised as planned, so it would be dangerous to go much above €2.36 per share without risking a negative NPV transaction for Plaistow.

Suitability of different methods

The net assets method is useful to Plaistow in setting a level below which Billericay will not be interested in the deal.

The FCFE method is of questionable relevance since, after the take-over, Plaistow will be able to impose whatever reinvestment ratio it wishes for Billericay, so calculations using the previous ratio are not set in stone.

The P/E method is potentially the most relevant to Plaistow if it can be verified that the proxy P/E ratio used is actually appropriate to Billericay. In this case, the P/E method gives a value lower than the net assets method. Perhaps this implies that the P/E used is too low, or perhaps it is an indication that the level of goodwill in Billericay is low. These values suggest that Billericay could be a target for asset stripping.

Looking from the point of view of Billericay's shareholders, they will be prepared to sell if the considerations they are offered exceeds the present value of the cash flows that they will receive from owning their shares. Here the FCFE is relevant. Any bid in excess of €2.07 should be enough in theory to be worth considering. In practice, Billericay's directors have already indicated that they would be prepared to recommend a sale of the company, so a massive premium in fair value is unlikely to be achieved. Any bid of around €2.36 per share is likely to command a favourable response from the Billericay shareholders.

Type of consideration – cash or share exchange?

Plaistow must choose whether to offer the consideration for purchasing Billericay in the form of shares or in cash. The following points can be made:

- Cash has a certain value, while the value of shares issued is uncertain. If Billericay's shareholders are strongly risk-averse, they will want to take cash rather than shares.
- By accepting cash for their shares, the old Billericay shareholders will become liable to capital gains tax immediately on their profit from the sale. By accepting shares, the CGT liability can be deferred. Billericay's shareholders must therefore consider their tax situation when making their decision.
- What is the status of the Billericay shareholders? If, for example, the shares are all held by pension funds that are exempt from tax, then the above tax point will not be relevant.
- What are the current liquidity positions of the two companies? Plaistow is looking to pay around €1 billion to acquire Billericay. If the consideration is to be in cash, then the cash must be raised. Plaistow has current cash holdings of €250m so will need to raise a further €750m to fund the purchase. If this is not possible, then issuing shares is the best option.
- The effect on Plaistow's gearing ratio. Issuing new shares will reduce the gearing ratio. Issuing new debt to fund a cash consideration will increase the gearing ratio. If Plaistow's shareholders are strongly risk-averse, they will not want to issue new debt and thereby increase their financial risk.
- Issuing a large amount of new equity will require Plaistow to gain shareholder approval before the shares are issued. If the shareholders seem unwilling to give their approval, a cash consideration could be offered.

Conclusion

In the current circumstances it might be possible to please all categories of Billericay shareholders by offering shares but with an offer of a cash alternative.

If this is not possible, then a dialogue should be started with the Plaistow shareholders to test their willingness to approve the issue of new shares. Plaistow's gearing ratio is already at a moderate level (Debt: Equity ratio of 33% at book values) so a further €750m debt should be avoided if possible. My recommendation would be for the consideration to be offered in shares.

Only if this is not going to be approved by the current shareholders of Plaistow should the consideration be offered in cash. A bid of around €2.36 per share would probably be acceptable to the Billericay shareholders.

Appendix – Valuation calculations

Net assets method

As at 30 June 20X5 the net assets of Billericay have a book value of €900m. This suggests a value per share of:

$\frac{900m}{440m\ shares}$ = €2.05 per share

If the expected value of the synergies is recognised, the value per share would be:

$\frac{900m + 200m}{440m\ shares}$ = €2.50 per share

This shows that the synergy is effectively worth £0.45 per share.

P/E method

Billericay has no quoted P/E ratio (unquoted company) but it operates in the same industry as Plaistow, so we shall use Plaistow's P/E ratio as an approximation to the industry average.

Plaistow's P/E ratio = $\frac{€3.57}{€128.5m / 420m\ shares}$ = 11.7

∴ Billericay's earnings are worth 11.7 × €71.5m = €836.55m, or €1.90 per share. Including the value of the expected synergies would bring this up to €1.036.55m, or €2.36 per share.

Discounted value of Free Cash Flow to Equity

The basic formula is:

Value of equity = $\frac{FCFE_0(1+g)}{k_e - g}$

so, using the calculations of g and ke prepared earlier [parts (a) and (b)],

Value of equity = $\frac{(72.1 - 22.4) \times 1.0252}{0.0811 - 0.0252} = €911.5m$, or €2.07 per share.

[Alternatively, if we assume that the 4% quoted growth rate is accurate,

Value of equity = $\frac{(72.1 - 22.4) \times 1.04}{0.0811 - 0.04} = €1{,}257.6m$, or €2.86 per share.

This is much higher than the other estimated valuations, suggesting once again that the 4% growth rate is likely to be over-stated.]

If the expected value of the synergies is recognised, the value per share would be:

$\frac{911.5m + 200m}{440m\ shares}$ = €2.53 per share

(d) (i) There are various factors that should be considered when seeking to implement risk management processes within a company. These include:

Scope and time available

The scope of the processes to be implemented and a feasible time period for implementation must be clearly determined at the outset. In addition, key stages in the implementation process should also be identified and the availability of appropriate resources must be confirmed to ensure that the implementation process is successfully carried out.

Senior management support

When implementing any major process of change within a company, it is vital that the senior managers demonstrate their commitment to the process. Whilst the chief risk officer may be most heavily involved in implementing the new processes, other senior managers should also be encouraged to contribute. It is important that employees recognise that the implementation process has the full support of top management.

Employee support

Successful risk management processes will ultimately depend on the support of employees. They should, therefore, become involved in developing the new processes, insofar as possible, to ensure a greater sense of ownership. This involvement should also help them to gain a better understanding of the processes.

Recognising the existing culture

Introducing new risk management processes may have a significant impact on the existing culture of the company. Failure to recognise this, may lead to resistance to change or to staff turnover. Where it is necessary to change the culture, employees should be provided with appropriate support, reassurance and training.

The nature of existing systems

It is often helpful to 'go with the grain' when implementing new systems. Thus where existing systems have proved to be useful, this should be acknowledged and new systems should build on, rather than replace, these systems. By so doing, greater support for the new systems may be achieved.

Corporate strategy and the ability to embed risk management into it

The risk management processes introduced should be linked to the strategic objectives of the company and reporting processes should be developed to ensure that management can monitor their effectiveness. To ensure that the processes are carried out, they should become an integral part of the tasks and routines undertaken by employees and managers.

(ii) If shareholders can see that the objectives of the business are likely to be achieved because risks are being managed properly, it should lead to greater confidence in the future of the company which, in turn, should lead to a higher share price. In particular, risk management processes should help to increase shareholder value in the following ways:

- aligning the processes to the strategic objectives of the business can help to ensure that the risk appetite of the business is reflected in the decisions and actions of managers

- investing in new ventures can take explicit account of risk. This should help ensure that an appropriate response to risk is developed and that the required returns from new ventures are commensurate with the risks involved
- risk-transfer policies can be developed to achieve the required balance between risk and return
- managers will become more skilful in forecasting and managing risks, which should help to avoid 'surprises' that result in large losses or reputation damage.

Marking scheme			
			Marks
(a)	Plaistow's asset beta		2
	Billericay's equity beta		1
	Cost of equity		1
	Cost of debt		2
	WACC		1
	Use of ke and WACC – 1 each		2
	Total part (a)		**9**
(b)	Rate of retention of FCFE		2
	Deriving g as bxre		1
	Assumptions – 1 per sensible point		Max 2
	Total part (b)		**5**
(c)	(i)	Valuations – net assets (with and without synergy)	1
		P/E method – deriving Plaistow's P/E	1
		Valuation (with and without synergy)	1
		FCFE method – with and without synergy	2
		Comments on suitability	Max 5
		Bidding strategy discussion	Max 5
		(1 mark per sensible point throughout)	
	(ii)	Discussion of share exchange v cash offer – 1 per sensible point	Max 6
		Report layout (1), Intro and conclusion (1 each), use of appendix (1)	Max 4
	Total part (c)		**25**
(d)	(i)	One mark for each valid point throughout	Max 7
	(ii)	One mark for each valid point throughout	Max 4
	Total part (d)		**11**
Total			**50**

2 MAC CO

(a) The yield on a bond is the IRR of the market value, the annual interest payments and the redemption amount. Therefore, in the case of Echo Co:

Year	*Cash flow*	*Discount rate*	*Present value*	*Discount rate*	*Present value*
	$	5%	$	3%	$
0 Market Value	(105.10)	1	(105.10)	1	(105.10)
1–4 Interest	5.00	3.546	17.73	3.717	18.59
4 Capital repayment	100.00	0.823	82.30	0.888	88.80
			(5.07)		2.29

Tutorial note: Any two rates could have been used to discount the cash flows here. Since the yield on a bond is usually fairly low, 3% and 5% were used here to try to achieve an accurate estimate.

The approximate yield is therefore:

3% + [2.29/(2.29+5.07)]2% = 3.62%

It seems fair to assume that the Bunnymen Co bonds will have the same yield as the Echo Co bonds, since the bonds have the same term to maturity and the two companies have the same credit rating.

Therefore the theoretical value of the Bunnymen Co bonds will be equal to the investor's expected returns (interest and redemption amount) discounted at the yield (3.62% calculated above) i.e.

[$110 × 4-year discount factor @ 3.62%] + [$2 × 4-year annuity factor @ 3.62%]

$$= \left[\$110 \times \frac{1}{1.0362^4}\right] + \left[\$2 \times \frac{1-(1.0362)^{-4}}{0.0362}\right]$$

= ($110 × 0.867) + ($2 × 3.663)

= $102.70

(b) Duration is found by taking the the sum of (time to maturity × PV of receipts) for the bond, and then dividing by the theoretical bond price.

Echo Co bond (PV of receipts)

$5 \times 1.0362^{-1} + 5 \times 1.0362^{-2} + 5 \times 1.0362^{-3} + 105 \times 1.0362^{-4}$

So PV of cash flows (years 1 to 4) = 4.83 + 4.68 + 4.49 + 91.10 = $105.10

(i.e. market price)

Duration = [4.83 × 1 + 4.68 × 2 + 4.49 × 3 + 91.10 × 4]/105.10 = 3.73 years

Bunnymen Co bond (PV of receipts)

$2 \times 1.0362^{-1} + 2 \times 1.0362^{-2} + 2 \times 1.0362^{-3} + 112 \times 1.0362^{-4}$

So PV of cash flows (years 1 to 4) = 1.93 + 1.83 + 1.79 + 97.15 = $102.70

(i.e. theoretical market price)

Duration = [1.93 × 1 + 1.83 × 2 + 1.79 × 3 + 97.15 × 4]/102.70 = 3.89 years

(c) **Risk v return**

The main consideration for any investment is the trade-off between risk and return.

The risk associated with a corporate bond is reflected by the issuing company's credit rating. In this case both Echo Co and Bunnymen Co have an A credit rating, so the expected return (yield) from the two bonds is the same (3.62% – see workings in part (a) above).

Note that another contributing factor to this identical yield is that the term to maturity of the two bonds is the same. If the two bonds had had different terms to maturity, the longer dated bond would most probably have had a higher yield. This is because the yield curve for bonds is generally upward sloping.

If Mac Co wants a higher yield from its bonds, it has to be prepared to take on an increased level of risk, either by investing in a lower rated company, or by investing in longer dated bonds (which are inherently more risky because of the longer time to redemption).

Pattern of receipts and Macauley duration

Another consideration is the split of the return on the bond between its coupon return and its redemption payment. In this case, even though the two bonds have identical yields, the higher coupon on the Echo Co bonds means that Mac Co would receive its return from the Echo Co bonds sooner than the return from the Bunnymen Co bonds (where the bulk of the return comes at the end, in the large redemption payment). This issue is what the Macauley duration attempts to measure.

Duration measures the average time it takes for a bond to pay its coupons and principal and therefore measures the redemption period of a bond. It recognises that bonds which pay higher coupons effectively mature 'sooner' compared to bonds which pay lower coupons, even if the redemption dates of the bonds are the same. This is because a higher proportion of the higher coupon bonds' income is received sooner. Therefore these bonds are less sensitive to interest rate changes and will have a lower duration.

As calculated in part (b) above, the Echo Co bonds (with the higher coupon rate) have a lower duration. This is indicative of lower risk, so note that even though we were told to assume that the yields on the two companies' bonds were identical, in reality the yield on the Bunnymen Co bonds may be slightly higher to reflect this higher risk.

(d) Industry risk measures the resilience of the company's industrial sector to changes in the economy. In order to measure or assess this, the following factors could be used:

- Impact of economic changes on the industry in terms of how successfully the firms in the industry operate under differing economic outcomes
- How cyclical the industry is and how large the peaks and troughs are
- How the demand shifts in the industry as the economy changes.

Earnings protection measures how well the company will be able to maintain or protect its earnings in changing circumstances. In order to assess this, the following factors could be used:

- Differing range of sources of earnings growth
- Diversity of customer base
- Profit margins and return on capital.

Financial flexibility measures how easily the company is able to raise the finance it needs to pursue its investment goals. In order to assess this, the following factors could be used:

- Evaluation of plans for financing needs and range of alternatives available
- Relationships with finance providers, e.g. banks
- Operating restrictions that currently exist, such as debt covenants.

Evaluation of the company's management considers how well the managers are managing and planning for the future of the company. In order to assess this, the following factors could be used:

- The company's planning and control policies, and its financial strategies
- Management succession planning
- The qualifications and experience of the managers
- Performance in achieving financial and non-financial targets.

Marking scheme		
		Marks
(a)	IRR method – correct use of MV, Int and Redemption amount	1
	IRR calculation	1
	Bond value – correct method (discounted value of interest stream and redemption amount at YTM)	1
	Correct value calculation	1
	Total part (a) **Maximum**	**4**
(b)	Correct formula/method used	1
	Echo Co calculation	2
	Bunnymen Co calculation	2
	Total part (b) **Maximum**	**5**
(c)	1-2 marks per sensible point throughout	Max 8
	Total part (c) **Maximum**	**8**
(d)	For each of the four criteria – 2 marks for explanation and suggestion of any sensible factors	Max 8
	Total part (d) **Maximum**	**8**
Total		**25**

3 PERIGUEUX CO

Tutorial note

This answer contains lots of detailed workings, in order to show different ways of presenting the answer. The answer is therefore longer than a good student's answer in the real exam would have been.

(a) Perigueux Co can borrow at LIBOR + 0.75 (currently 7.25%).

Using a futures hedge the company will attempt to make a futures gain in order to offset a possible cash market loss if interest rates rise. As the primary concern is an interest rate rise (because the company is borrowing money), the company will **sell futures contracts**.

Cash market

Current cost of borrowing for 4 months is:

£18,000,000 × 7.25% × 4/12 = £435,000

If interest rates increase by 150 basis points, or 1.5%, the new cost of borrowing will be:

£18,000,000 × 8.75% × 4/12 = £525,000

This represents a cash market 'loss' of £90,000.

Futures market

Sell March futures contracts (as March is the nearest expiry after the borrowing commences).

In order to hedge a 4-month risk:

$$\frac{£18{,}000{,}000}{£500{,}000} \times \frac{4}{3} = 48 \text{ contracts are required}$$

Basis is (100 – Spot rate of interest (e.g. the current LIBOR rate)) – futures price.

i.e. (100 – 6.50%) – 93.10 = 0.40%

At maturity of the futures contract at the end of March, the basis will be zero. Assuming basis falls at a constant rate, the expected basis when the loan is taken at the start of February will be 0.20% or 20 basis points. (The contract matures in four months' time, and the loan is taken out in two months' time, so basis will be 2/4 × 40 = 20 basis points.)

Interest rates rise by 1.5%

The expected futures price in 2 months will be 93.10 – 1.50 + 0.20 = 91.80.

The futures position will be closed by buying 48 contracts at 91.80. The gain on closing out will be (93.10 – 91.80) = 1.30 or 130 points.

The total expected futures gain if the 48 contracts are closed out in 2 months' time is:

48 × 130 × £12.50 per point = £78,000.

The overall cost of the loan is expected to be:

	£
Cost of borrowing at 8.75%	525,000
Gain on futures hedge	78,000
	447,000

£447,000 represents an effective interest rate on borrowing £18 million for four months of:

(£447,000/£18 million) × (12/4) × 100% = 7.45%.

Tutorial note

This 'lock in rate' of 7.45% could alternatively been calculated as:

100 – (current futures price + unexpired basis on the transaction date)

i.e. 100 – (93.10 + 0.20) = 6.70%

adjusted for Perigueux Co's own credit spread of 0.75% (above the LIBOR rate)

i.e. 6.70% + 0.75% = 7.45%

Interest rates fall by 0.5%

If interest rates fall by 50 basis points, the new cost of borrowing will be:

£18,000,000 × 6.75% × 4/12 = £405,000.

This is a cash market 'gain' of £30,000 on the cost of borrowing at the current interest rate (which is £435,000, see above).

The same futures contract will have been used to hedge the risk, and the expected basis at the start of February will still be 0.20%.

The expected futures price in 2 months is therefore 93.1 + 0.50 + 0.20 = 93.80.

The futures position will be closed by buying 48 contracts at 93.80. The expected futures loss if the 48 contracts are closed out in 2 months' time is (93.10 – 93.80) = 0.70 or 70 points. The total loss on the futures position will be:

48 contracts × 70 × £12.50 = £42,000.

The overall cost of the loan is expected to be:

	£
Cost of borrowing at 6.75%	405,000
Loss on futures hedge	42,000
	447,000

This is the same as if interest rates went up by 1.5%, and represents an effective interest rate of 7.45% per annum.

No matter how interest rates move the futures hedge should keep the cost of borrowing below the desired 7.50% maximum.

However, note that in reality any futures gains or losses would occur on a daily basis, not at the end of the period, and basis may not fall at a constant rate.

Options

March put options are required. (The company would want to exercise the right to sell futures contracts, so it should buy put options.) Perigueux Co will buy 48 put options on March futures.

The worst case scenario for Perigueux Co is if interest rates rise and the options have to be exercised.

Cash market

If interest rates increase by 150 basis points, or 1.5%, the new cost of borrowing will be £525,000 (calculation shown earlier).

Options market

Using the 93.00 exercise price

Buy 48 March put options contracts, at a cost of £18m × 0.20% p.a. × 4/12 = £12,000.

If interest rates increase by 1.5%, the options will be exercised and 48 futures contracts will be sold at the exercise price of 93.00. (Note: It might be possible to sell the options themselves at a better rate as they still have some time value.)

Expected profit = 93.00 – 91.80 (the expected futures price in 2 months) = 120 points per contract.

The total expected gain is 48 contracts × 120 × £12.50 = £72,000.

The overall cost of the loan is expected to be:

	£
Cost of borrowing at 8.75%	525,000
Cost of option premiums	12,000
Gain on options hedge	(72,000)
	465,000

This represents an effective interest rate on a four-month loan of £18 million of:

(£465,000/£18 million) × (12/4) × 100% = 7.75% p.a.

Using the 93.50 exercise price

Buy 48 March put options contracts, at a cost of £18m × 0.60% p.a. × 4/12 = £36,000.

The expected profit is 93.50 – 91.80 (the expected futures price in 2 months) = 170 points.

The expected total gain is 48 × 170 × £12.50 = £102,000.

The overall cost of the loan is expected to be:

	£
Cost of borrowing at 8.75%	525,000
Cost of option premiums	36,000
Gain on options hedge	(102,000)
	459,000

A net cost of £459,000 represents an effective interest rate on a four-month loan of £18 million of:

(£459,000/£18 million) × (12/4) × 100% = 7.65% p.a.

Using the 94.00 exercise price

Buy 48 March put options contracts, at a cost of £18m × 1.35% p.a. × 4/12 = £81,000.

The expected profit is 94.00 – 91.80 (the expected futures price in 2 months) = 220 points.

The expected gain is 48 × £12.50 × 220 × 100 = £132,000.

The overall cost of the loan is expected to be:

	£
Cost of borrowing at 8.75%	525,000
Cost of option premiums	81,000
Gain on options hedge	(132,000)
	474,000

A net cost of £474,000 represents an effective interest rate on a four-month loan of £18 million of:

(£474,000/£18 million) × (12/4) × 100% = 7.90% p.a.

Tutorial note

The cheapest of these three options could have been calculated as:

Exercise price	*Interest rate*	*Plus put premium*	*Total cost*
93.00	*7.00%*	*0.20%*	*7.20%*
93.50	*6.50%*	*0.60%*	*7.10%*
94.00	*6.00%*	*1.35%*	*7.35%*

Which shows that the 93.50 option is the cheapest of the three.

Using this approach to identify the cheapest alternative and then showing the results at just that rate would have scored the majority of the marks and would have saved time.

If interest rates fall by 50 basis points, the new cost of borrowing will be:

£18m × 6.75% × 4/12 = £405,000.

The expected futures price will be 93.80 (see earlier).

The 93.00 and 93.50 options will not be exercised and the overall cost will be:

(1) 93.00 exercise price: £405,000 + £12,000 = £417,000 or 6.95%

(2) 93.50 exercise price: £405,000 + £36,000 = £441,000 or 7.35%

The 94.00 contract will be exercised giving an expected profit of 94.00 – 93.80 (the expected futures price in 2 months) = 20 points.

The expected total gain is 48 × 20 × £12.50 = £12,000.

The overall cost of the loan is expected to be:

	£
Cost of borrowing at 6.75%	405,000
Cost of option premiums	81,000
Gain on options hedge	(12,000)
	474,000

A net cost of £474,000 represents an effective interest rate on a four-month loan of £18 million of 7.90% p.a.

Conclusion

If basis is expected to fall to 0.20%, none of the option contracts has a maximum expected interest rate (including option premium) of 7.50%, although the 93.50 exercise price is close to it. If the finance director does not wish to pay more than 7.5%, hedging with futures should be selected.

An **option collar** might also be possible in this situation, if Perigueux Co is prepared to limit the benefit from any fall in interest rates.

(b) Market traded interest rate options have several advantages over OTC options:

(i) There is greater price transparency, with current prices on the market immediately available and widely disseminated, which facilitates the management of option positions.

(ii) Exchange traded options offer greater liquidity, with easy sale or purchase of options of a known standard quality.

(iii) There is a central marketplace, with quick access to large numbers of buyers and sellers.

(iv) Lower counterparty risk. Contracts are marked to market on a daily basis, and a central clearing house monitors the ability of all counterparties to meet their obligations.

(v) Better regulation. Most options exchanges are subject to stringent regulation by government authorities.

(vi) Market traded options are normally American style and may be exercised at any time. OTC options are often European style, and can only be exercised at their maturity date.

Advantages of OTC options include:

(i) OTC options offer a much larger choice of contract size, maturity, and type of interest option which allows the purchaser of the option to tailor the option much more specifically to individual needs.

(ii) Option sizes are typically much larger on the OTC market.

(iii) Options may be arranged for longer periods than is possible on traded options markets.

(c) Option prices are influenced by the following factors:

(i) The price of the underlying security, in this case a specific interest bearing instrument.

(ii) The exercise price of the option.

(iii) The time until expiry of the option.

(iv) The risk of the option, as normally measured by the historic volatility of a similar option.

(v) The level of interest rates within the economy.

(vi) Whether the option is European style or American style, the American style being more flexible and slightly more expensive.

Whether or not the option is expensive will depend upon whether it has been correctly priced, which will itself largely depend upon what assumptions have been made by the seller of the OTC option about the volatility of the option.

OTC options often are expensive because they are tailored to the exact requirements of the company purchasing the option.

OTC options are not very price transparent, but there is a competitive market in such options, and reputable banks and other sellers of options have little to gain in the long run by overpricing options. There is, however, evidence that some forms of options have been substantially more expensive than would be expected from option pricing models.

Marking scheme		
		Marks
(a)	**Futures**	
	Set up hedge: – **sell** futures and **March** futures (1 mark for both)	1
	– 48 contracts	1
	Current basis	1
	Expected basis on 1 February	1
	Interest rates rise by 1.5%	
	Expected futures price on 1 February, and gain on futures	1
	Overall cost of borrowing (borrowing cost net of futures gain), and effective interest rate	1
	Interest rates fall by 0.5%	
	Expected futures price on 1 February, and loss on futures	1
	Overall cost of borrowing (inc. futures loss), and effective interest rate	1
	Futures lock in rate	3
	Options	
	Use 48 March put options	1
	Identification of the 93.50 option as the cheapest	1
	Premium payable for options	1
	Interest rates rise by 1.5%	
	Cost of options if exercised – 1 mark for each exercise price	Max 3
	Interest rates fall by 0.5%	
	Identification of the fact that 93.00 and 93.50 would not be exercised	1
	Cost of 94.00 options if exercised	1
	Advice/comments/assumptions throughout – 1 mark per sensible point	Max 5
	Total part (a) **Maximum**	**16**
(b)	1 mark per sensible, well-explained point throughout	Max 4
	Total part (b) **Maximum**	**4**
(c)	List of factors impacting option price (max 3 marks for all 5 key BSOP variables – Pa, Pe, r, s, t)	Max 3
	Comments on OTC options being expensive – 1 mark per sensible point	Max 3
	Total part (c) **Maximum**	**5**
Total		**25**

4 LAKEMAN

(a) Both Directors are correct to a point but are failing to see the whole picture.

The Marketing Director is correct in her interpretation of the calculated NPV. The NPV can normally be interpreted as showing the impact of a project on shareholder wealth so a negative NPV would indicate that the investment would erode shareholder value and should thus be rejected.

The Finance Director (FD) is correct to point out a weakness of conventional NPV analysis. High uncertainty is usually reflected in a higher discount rate and hence a lower NPV. However, greater uncertainty will usually result in higher option values, so the FD is correct to suggest that option values must be incorporated and that Lakeman has an option to delay investment, giving a call option.

The FD is wrong to suggest that ignoring options is the only weakness of NPV. A more complete analysis would also try to incorporate non-financial factors such as the possible implications for Lakeman's image of being so closely connected with military research laboratories. Some investors and customers may object to this link and hence future sales would be compromised.

(b) Using the Black-Scholes model for European call options:

(1) Time, t = 1

(2) Pa = PV of future cash flows assuming the project is delayed for 1 year

= \$180 million x 0.909 = \$163.6 million

(3) The exercise price, Pe = cost of investment = \$190 million

(4) The interest rate, r = 0.05

(5) Volatility, s = 0.35

These values can now be applied to the Black-Scholes formula values.

Call price for a European option = $c = P_aN(d_1) – P_eN(d_2)e^{-rt}$, where

$$d_1 = \frac{\ln(P_a/P_e) + (r + 0.5s^2)t}{s\sqrt{t}} \text{ and } d_2 = d_1 - s\sqrt{t}$$

$$d_1 = \frac{\ln\left(163.6/190\right) + \left(0.05 + 0.5 \times 0.35^2\right) \times 1}{0.35 \times \sqrt{1}}$$

$$= \frac{-0.1496 + 0.1113}{0.35} = -0.1094 \text{ (–0.11 to 2 decimal places)}$$

$d_2 = d_1 - s\sqrt{t}$ = –0.1094 – 0.35= – 0.4594 (–0.46 to 2 decimal places)

From normal distribution tables:

$N(d_1) = N(-0.11) = 0.5 – 0.0438 = 0.4562$

$N(d_2) = N(-0.46) = 0.5 – 0.1772 = 0.3228$

Inputting data into call price = $c = PaN(d_1) – PeN(d_2)e^{-rt}$

Call price = 163.6 (0.4562) – [190 (0.3228)x $e^{-0.05x1}$]

= 74.63 – 58.34

= \$16.29 million

Recommendation

The high value of the call option would suggest that the offer of a licence should be accepted.

(c) The Black-Scholes model was developed for European, financial options.

In this scenario we have a real option not a financial option, which means that using the model is not wholly appropriate. In particular, with real options there is a problem identifying input factors such as the value of the underlying asset and the interest rate.

Furthermore, as production could commence at any time during the 1 year period the option is an American option rather than a European option.

It can be argued that, where there is no dividend payable and where time value still exists, it is worthwhile holding an American option to expiry and thus the valuation as a European call is valid.

In this case, however, it is likely that investment would be commenced (i.e. the call option exercised) as soon as the forecast NPV became positive due to revised forecasts. The valuation as a European call would thus give a lower limit on the value of the option to delay.

(d) 95% confidence level requires the value at risk (VAR) to be within 1.645 standard deviations from the mean, based on a single tail measure.

Annual VAR = 1.645 × $1 million = $1.645 million

Six year VAR = $1.645 million × $6^{½}$ approx. = $4.029 million

Tutorial note

Alternative approach:

For the 6 years of the project, the mean of the normal distribution is simply

6 x the annual mean of $5 million = $30 million

However, the standard deviation (SD) for the 6 years of the project is found by calculating:

$(6 \times (\text{Annual SD})^2)^{½}$

i.e. $(6 \times 1 \text{ million}^2)^{½} = \$2.449$ million

Then, the VAR figure for 6 years is still 1.645 SD from the mean, so

1.645 × $2.449 million = $4.029 million (approx)

The figures mean that Lakeman can be 95% confident that the cash flows will not fall by more than $1.645 million in any one year and $4.029 million in total over six years from the average returns.

Therefore the company can be 95% certain that the returns will be $3.355 million or more every year [$5 million – $1.645 million].

And it can be 95% certain that the returns will be \$25.971 million or more in total over the five-year period [(6 × \$5 million) – \$4.029 million].

There is a 5% chance that the returns will be less than \$3.355 million each year or \$25.971 million over the five-year period.

Marking scheme			
			Marks
(a)	Link between NPV and s/h wealth		1
	Negative NPV – usually reject		1
	Explanation of real options		2
	Other issues		2
	Total part (a)	**Maximum**	**6**
(b)	Identification of 5 input factors (1 mark for Pa, ½ each for others)		3
	N(d1)		2
	N(d2)		2
	Call option price		2
	Recommendation		1
	Total part (b)	**Maximum**	**10**
(c)	European v American options – 1 per sensible point		4
	Total part (c)	**Maximum**	**4**
(d)	Pick up 1.645 SD		1
	Annual VAR of \$1.645 million		1
	6 yearly VAR of \$4.029 million		1
	Explanation		2
	Total part (d)	**Maximum**	**5**
Total		**Maximum**	**25**