Faculty of Actuaries **Institute of Actuaries**

ADVANCED CERTIFICATE IN DERIVATIVES: THE MATHEMATICS, PRINCIPLES AND PRACTICE

Examination Paper

April 1998

Paper One

Time allowed: Three hours

INSTRUCTIONS TO THE CANDIDATE

1. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only but notes may be made.*

2. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*

3. *Write your surname in full, the initials of your other names and your Candidate's Number on the front of the answer booklet.*

4. *Mark allocations are shown in brackets.*

5. *Attempt all 12 questions leaving sufficient space between each answer.*

AT THE END OF THE EXAMINATION

Hand in BOTH your answer booklet and this question paper.

> *In addition to this paper you should have available actuarial tables, derivatives formula sheet and an electronic calculator.*

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1 You are a UK equity market speculator. The equity market outlook is for falling prices.

(i) Discuss the potential for profit and loss and the risk of each of the following option trading strategies:

(a) long put on the FTSE 100 index and
(b) bear spread on the FTSE 100 index. 5]

(ii) What volatility outlook are you expecting in order to profit from strategy (a) above? [1]
[Total 6]

2 On the 16 March 1998, the closing prices of the first six 90-day Eurodollar futures traded on the Chicago Mercantile Exchange were as follows:

June 1998	94.40
Sept 1998	94.60
Dec 1998	94.50
Mar 1999	94.40
June 1999	94.30
Sept 1999	94.20

On the same day the Eurodollar cash deposit mid rates were:

3 month	5.375%
6-month	5.500%
9-month	5.625%
12-month	5.750%

All contracts expire on the 16th of the relevant month.

(i) Calculate the 12-month Eurodollar money rate implied by the futures contracts. [3]

(ii) Describe how a large US bank could theoretically arbitrage the anomaly between the Eurodollar futures and cash markets? [2]

(iii) Why in practice might this bank be unable or unwilling to undertake such an arbitrage? [2]
[Total 7]

3 Discuss the issues that need to be considered by a futures exchange when deciding whether and how to develop a new futures contract. [11]

4 Company A has just entered an n-year plain vanilla sterling interest rate swap under which it will receive an annual fixed coupon of x% and pay an annual floating coupon based on sterling 12-month LIBOR.

(i) Write down a formula for the current value of the swap to Company A and demonstrate that the value of this swap may also be considered as the difference in value between a fixed rate bond and a floating rate bond.

Assume 365 days in each year and explain any extra symbols you use. [6]

(ii) Six months ago, a 5-year sterling swap was set up for zero cost when the yield curve was level at 7%.

Describe the effect of (a) and (b) below on the value of the swap to the party receiving the fixed rate and indicate which has the greater effect:

(a) the yield curve pivots such that 1-year rates rise to 8% and 5-year rates remain at 7%; and

(b) the yield curve pivots such that 1-year rates remain at 7% and 5-year rates fall to 6.5%.

A descriptive treatment will be adequate - calculations are not required. [4]
[Total 10]

5 Discuss the three main reasons why hedging exposure to an asset using futures contracts works less than perfectly in practice. [6]

6 You are the risk manager of a fund which invests exclusively in UK equities and which uses a "value-at-risk" (VaR) measure of market risk for the portfolio.
VaR is the maximum loss which the portfolio might sustain on any one day with 98% confidence based on a normal distribution of price movements and the variance and covariance of the portfolio constituents.

(i) Discuss the relative advantages and disadvantages of

(a) compiling a complete variance-covariance matrix based on historical movements of each sector of the equity market and
(b) recalculating the profit and loss on the equity portfolio using historical prices of the individual equities in the construction of the VaR model.

[4]

(ii) The portfolio contains a number of long-dated plain vanilla and exotic options on several individual UK equities.

Explain briefly the features of this part of the portfolio which make it inappropriate to use a simple model of calculating VaR and outline a better procedure using scenario analysis and method (b) above. [6]

[Total 10]

7 (i) Describe briefly the main assumptions and the computational method underlying the binomial tree numerical procedure for pricing a plain vanilla American option.

[5]

(ii) Discuss whether the basic binomial tree numerical procedure can be used to value an option where the payoff is the amount by which the final stock price exceeds the minimum stock price achieved during the life of the option.

[1]

(iii) List the hedge parameters which can be estimated from a single binomial tree for the calculation of a plain vanilla American option and discuss the method by which the remaining hedge parameters can be estimated.

[4]

[Total 10]

8 With reference to the Black Scholes formula and using the notation of the examination handbook and the formula sheet:

(i) Derive an expression for $N'(x)$. [1]

(ii) Show that $SN'(d_1) = Xe^{-r(T-t)}N'(d_2)$. [3]

(iii) Show that $\frac{\partial d_1}{\partial S} = \frac{\partial d_2}{\partial S}$ and that $\frac{\partial c}{\partial S} = N(d_1)$. [2]

(iv) Show that $\frac{\partial c}{\partial t} = -rXe^{-r(T-t)}N(d_2) - SN'(d_1)\frac{\sigma}{2\sqrt{T-t}}$

where c is the price of a European call option. [2]

[Total 8]

9 (i) Describe interest rate caps and interest rate floors and write down a formula for the payoff on one of the caplets making up a cap. [4]

(ii) A bond pays a semi-annual floating coupon based on 6-month LIBOR plus a margin of 0.40%. On each reset date, the coupon can never fall below the last coupon level (even if LIBOR falls), but also can only rise by a maximum of 0.65%.

(a) Describe the option features embedded in the structure of the bond.

(b) Describe the yield curve environment which would make this product a better or worse investment than a regular floating rate bond paying LIBOR and comment in particular on the yield curve environment which allows it to pay the extra margin of 0.40%.

[7]

[Total 11]

10 An options trader has just entered into the following portfolio of options on the June 1998 LIFFE Bund future (contract size DM250,000):

Option position	*Current option price*	*Option delta*
Sold 500 Calls strike 106	0.42	+38%
Sold 500 Puts strike 104	0.15	−17%

The options all expire on 21st May 1998, and the current price of the future is 105.50.

(i) Sketch a diagram of the profit and loss on the portfolio at expiry of the options against a suitable range of futures prices (assuming no futures hedge), and add to this graph a line indicating approximately the current profit and loss over the same range. [3]

(ii) What futures position would the trader require to delta hedge his portfolio at the current market level? [3]

(iii) Discuss the effect on the trader's profit and loss of the market falling sharply in the next few days suggesting the likely action he would take (assume the trader has hedged his position as suggested in part (ii)). Would your answer be any different if the fall took place a week before expiry?

[5]
[Total 11]

11 Discuss the two main methods of accounting for derivatives in the financial statements of a pension fund. [8]

12 Describe the main reason why portfolio insurance using synthetic put options is relatively ineffective in protecting portfolios against the type of falls seen by markets in the October 1987 crash. [2]

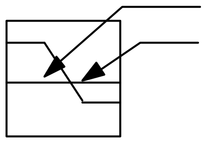
Q1

Long put

Profit is unlimited[1] as the FTSE 100 index falls beyond the strike price minus the premium paid.

Risk is limited to the premium paid.

Bear spread



A bear spread can be created from a short call (strike A) and a long call (strike B) or a short put (strike A) and a long put (strike B). In both cases the two options have the same expiry date and B > A. Using calls one receives the net premium using puts one pays the net premium at the outset.

Profit is limited to the net premium received if the FTSE 100 index is at or below A at expiration.

The downside risk is limited to the difference between the strike prices minus the net premium received.

(ii) The greater the actual volatility the greater the profit potential on the put option; one would expect rising volatility when executing this strategy.

Q2

(i)

Only require the first three contracts and the 3-month money rate.

Calculate following table (question implies $f = 0.25$ for all contracts):

Contract	Future	Implied rate r	YearFrac f	Roll-up (= $1 + rf$)
3-month depo		5.375 %	0.25	1.013438
Jun-98	94.40	5.6 %	0.25	1.014
Sep-98	94.60	5.4 %	0.25	1.0135
Dec-98	94.50	5.5 %	0.25	1.01375

[1] The profit is limited to that associated with the index falling from its current level to zero.

Take product of right hand column and subtract 1 to give implied 12 month rate = 5.5819%.

(ii)

Bank could borrow at the rate implied by the futures contracts (sell the group of futures contracts) above and lend at the deposit rate of 5.750% for 12-months.

Therefore sell the group of futures contracts in same nominal as deposit (e.g. $100 million = 100 futures).

Borrow nominal value (say $100 million) for 3 months at 5.375% and lend for 12 months at 5.75%.

As each future settles, borrow nominal amount at the settlement rate - settles on LIBOR so no bid-offer spread problems.

(iii)

The rates quoted in the question are mid rates; the futures contract settles on offer rates. The bank would need to look at the bid & offer rates before making a decision.

To do the arbitrage the bank would have to borrow four lots of 3-month money and lend 12-month money; the transaction costs involved may be too high. The transaction costs may be about 0.125%.

Borrowing and lending in the cash market ties up capital.

The number of open positions that a bank can have at the futures exchange may be limited by the clearing house.

Futures are effectively closed out & settled each day; there will be a cash mismatch if the market moves well from its current level.

Futures are effectively closed out & settled each day rather than at the end of the contract; thus there may be a convexity difference.

The rates quoted for the cash deposits are not offer rates; they are bid rates.

Q3

The exchange must

- consider the likely trading volumes in the contract and competition from other exchanges;
- consider its ability to operate trading in an additional contract;
- specify the exact nature of the agreement between the parties.

If, by introducing a new contract, an exchange disturbs the status quo in the OTM market where the major investment banks operate, the banks may not support the new contract. To gain support for trading in the contract, it is essential that the contract is attractive to speculators.

Issues include: (1) likely trading volumes which will be influenced by the need for hedgers to use the contract to hedge positions in the underlying asset; (2) competition from other exchanges and global 24 hour screen based trading systems, (3) the attractiveness of the contract to hedgers (in particular how closely does the futures contract match the typical hedger's underlying asset) and (4) such issues as the amount of the asset to be delivered under one contract (contract size).

This latter issue is important as if the contract size is too large, many investors who wish to hedge relatively small exposures or who wish to take relatively small speculative positions will be unable to use the exchange.

On the other hand if the contract size is too small, the cost of trading may become too expensive as trading costs are per contract charges.

The ability of the exchange to precisely define the asset and in the case of commodities to define the quality of the asset.

It is also important that there is sufficient quantity of the quality of the asset available for delivery; for example, not all silver would meet the strict quality definition required for physical delivery under a silver futures contract.

The type of settlement will have to be decided; physical and cash delivery are the two main types.

Cash delivery is preferable when physical delivery would impose obvious costs on traders (warehouse expenses, insurance costs, possibly transportation costs and brokerage fees).

Cash delivery is suitable when the nature of the underlying does not make physical delivery feasible (stock indices and live cattle are two examples) and has the advantage of preventing traders from manipulating futures prices by causing artificial shortages in deliverable stock.

Cash delivery does have the disadvantage that parties with long positions cannot use the futures contract to acquire the asset.

The place(s) where delivery can take place will have to be specified by the exchange.

Delivery months will need to be chosen for the contract.

Price quotations will need to be specified.

The need for daily price movement limits and position limits will need to be considered.

Initial and variation margin levels will need to be specified and these are related to the volatility of the price of the underlying; initial margin levels are usually chosen so that there is only a very small probability that daily changes in the value of the futures contract will exceed the initial margin.

Regulation: to organise a futures contract on, say, UK government bonds, it would be necessary to get the agreement of the Bank of England and consult with the exchnage's regulator.

Q4

(i)

Assumption of 365 days in year means we don't have to worry about day count conventions.

Use f_k = 12-month LIBOR floating rate from year k-1 to year k and d_k = discount function for year k; M is the notional principal. Discount function is value of zero coupon bond maturing at time k. Swap is n years long. The symbol P represents the present value of the cash flows under the notional fixed rate or floating rate bond as indicated. The symbol x is the coupon rate on the notional fixed rate bond.

Annual fixed:

$$P_{fixed} = M\sum_{k=1}^{n} xd_k$$

Annual floating:

$$P_{floating} = M\sum_{k=1}^{n} f_k d_k$$

The value of the swap is the value of the notional fixed rate bond minus the value of the notional floating rate bond.

Add M.d_n to both fixed and floating values without changing their difference. Then both become bonds as required.

(ii)

Since it is six months after setting up, the swap is effectively 4½ years long and can be valued as the difference between two 4.5 year bonds.

(a) The floating side is not so important, but will show a tiny profit; (a) has very little effect but there is a small loss of value due to the slight rise in rates at all points along the yield curve relevant to the swap.

(b) The floating side is not so important; (b) has a big effect since the 4- to 5-year area has improved considerably (45bp), so the swap to the fixed receiver is more valuable. (b) has the greater effect.

Q5

The asset whose price is to be hedged may not be exactly the same as the asset underlying the futures contract.

For example, there are no futures contracts on jet oil. Jet oil prices are usually hedged using heating oil futures contracts. The prices of jet oil and heating oil are not perfectly correlated and this is a major reason why the hedge works less than perfectly in practice.

Frequently hedgers are uncertain as to the exact date when an asset will be bought or sold. For example, a UK exporter who will be paid in Yen may be unsure as to the exact date he will be paid.

As futures contracts have fixed maturity dates and convergence of spot and futures only occurs at the expiry of a futures contract uncertainty to the exact date of sale or purchase is a key reason why hedging using futures contracts works less perfectly in practice.

The hedge may require the futures contract to be closed out well before its expiry date.

Again this means that the spot and futures prices will not have converged and the hedge is less than perfect.

There may also be uncertainty as to the exact quantity of an asset that will be bought or sold. For example, a UK fund manager hedging his exposure to currency movements on a portfolio of German equities will not know the exact value of his portfolio at the end of say a three month holding period.

Sometimes the expiry of the hedge is later than the availability of the longest maturity futures contract. Hedging requires the futures contracts to be rolled over thus introducing further basis risk.

Q6

(i)

VaR is calculated by taking into account:

- future price movements (volatility)
- the interdependencies of the portfolio constituents (correlations).

(a)

<u>Advantages</u>

Standard method - statistically sound;
Normal model is the only practical one because of its theoretical advantages;
Easy to calculate based on benchmarks like the FTSE 100 index although not so easy for individual equities.

<u>Disadvantages</u>

If too few factors are used, VaR is not precise;
If too many are used, the matrix becomes too big and it takes a long time to calculate VaR;
Correlations are not stable over time nor are they entirely accurate;
Correlations are based on past performance and may not be a guide to the future;
The classic problem with the parameters is choosing the correct amount of history to compute volatilities and correlations - if the data set goes back too far it may not be relevant;
Normal model is not realistic for outliers (Kurtosis effect)
Hence VaR does not really give the extremes which is a bit of a problem if it is supposed to be a guide to the amount of a firm's risk capital.

(b)

<u>Advantages</u>

Fast to compute;
Easy to obtain distribution of losses from the data without relying on normal model (this may be a weakness as the distribution is implicit);
No problem with correlation assessment - all implicit which again may be a weakness;
Allows for specific risk as well as sectoral risk

<u>Disadvantages</u>

Not forward looking
Seriously affected by particular major events e.g. the 1987 stock market crash;
Problem in knowing how far back to go as in (a)
Difficult to cope with new issues since price history not available

For new issuses, mergers & takeovers one has to use sectors and hence thrown back on correlation problem/specific versus index.

(ii)

Essentially VaR is a linear measure of risk, i.e. it assumes loss is always proportional to exposure, which is true except for option-type instruments.

At the linear level, one could use option delta to give exposure at current level and enter this into the VaR model.

Non-linear characteristic of options (gamma) make VaR's linear approximations only work for small range about current market level – hence no use for capital on extreme move.

The pricing of exotic options is often very difficult and hence it is more complicated to fit them into a model.

Exotic options also have very variable gamma and vega (volatility) profiles so risk profile at current level is misleading.

Some exotics are virtually riskless at current levels, but "blow up" somewhere far away (e.g. barrier options or cancellation options).

Scenario testing takes a range of prices (say from –50% to +50% of current price in steps of 10%) and a range of implied volatilities (say from –20% to +20% of current volatility in steps of 10%) to give a grid of option values. …

This can then be used as a pricing tool in the backtesting model, so whatever price level was reached in the historical simulation can be translated into a portfolio P&L distribution.

The advantage of such a method is it allows for non-linearity and also uses real values in the scenario – the problem otherwise is to assign appropriate probabilities to the grid elements.

Some candidates mentioned Monte Carlo simulation but this was not appropritate as it is a way of creating observations from a distribution. In this case the distibution is available from the history of past prices.

Q7

(i)

Binomial trees are a discrete time representation of the continuous time model for stock prices.

Bimomial trees divide the life of an option up into a number of short intervals of time, Δt, and assume that in each such time interval a stock price either moves up by a proportional amount, u, or down by a proportional amount, d.

Thus there are n+1 alternative stock prices at the end of n time intervals.

The mean and the standard deviation of the change in the stock price in the risk neutral world drive the values of u, d and their associated probabilities.

The parameters u and d allow a recombining tree of stock prices to be developed from which option prices can be calculated.

Option prices are calculated by starting at the end of the tree and working backwards. For an American option, the value of the option at each node is

$$\text{MAX}\{\text{discounted expected value if held for a further period } \Delta t, \text{ the value if exercised immediately}\}.$$

(ii)

A standard binomial tree cannot be used to value this option as the payoff depends on the path followed by the stock price as well as its final value.

As the payoff at the final nodes of the tree cannot be determined with certainty, the option cannot be valued by starting at the end of the tree and working backwards

A very sophisticated binomial tree approach can be used to solve this problem but it is beyond the scope of the syllabus. Any candidate who outlined the approach got full marks.

(iii)

Delta, theta and gamma can be determined from the simple binomial tree.

Vega can be determined by making a small change to volatility and recomputing the option price using a new tree but with the same value of Δt.

Vega is then given by the formula

$$(f_1 - f)/\Delta s$$

where f_1 is the estimate of the option price from the new tree and f the estimate from the old tree; Δs, is the change in volatility.

Rho can be calculated similarly.

Q8

(i)

$N(x)$ is the cumulative probability that a standard normal variable will be less than x.

$N'(x)$ is the corresponding p.d.f. for x.

$$N'(x) = \frac{1}{\sqrt{2\Pi}} e^{-\frac{x^2}{2}}$$

(ii)

$$d_1 = \frac{1n\left(\frac{s}{x}\right) + \left(r + \frac{s^2}{2}\right)(T-t)}{s\sqrt{T-t}}$$

$$d_1 s\sqrt{T-t} = 1n\left(\frac{S}{x}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)$$

$$e^{d_1 s\sqrt{T-t}} = \frac{S}{x} e^{\left(r+\frac{s^2}{2}\right)(T-t)}$$

x both sides by $e^{\frac{d_1^2}{2}}$

$$e^{-\frac{1}{2}\left\{d_1^2 - 2d_1 s\sqrt{T-t}\right\}} = \frac{S}{x} e^{-\frac{d_1^2}{2} + \left(S + \frac{s^2}{2}\right)(T-t)}$$

Complete the square on the LHS and it becomes

$$e^{-\frac{1}{2}\left\{d_1^2 - 2d_1 s\sqrt{T-t} + s^2(T-t) - s^2(T-t)\right\}}$$

$$= e^{-\frac{1}{2}\left(d_1 - s\sqrt{T-t}\right)^2 + \frac{s^2}{2}(T-t)} = e^{-\frac{d_2^2}{2}} . e^{\frac{s^2}{2}(T-t)}$$

$$= N'(d_2) e^{\frac{s^2}{2}(T-t)}$$

$$\frac{RHS}{\frac{S}{x} e^{-\frac{d_1^2}{2}} e^{\left(r+\frac{s^2}{2}\right)(T-t)}}$$

$$= \frac{S}{x} N'(d_1) e^{r(T-t)} e^{\frac{s^2}{2}(T-t)}$$

equating the revised LHS and RHS we get

$$SN'(d_1) \quad = \quad xe^{-r(T-t)}N'(d_2)$$

(iii)

$$d_1 - d_2 \quad = \quad s\sqrt{T-t}$$

$$\frac{\P d_1}{\P S}\,\frac{\P d_2}{\P S} \quad = \quad 0$$

$$\Rightarrow \frac{\P d_1}{\P S} = \frac{\P d_2}{\P S}$$

(iv)

$$c \quad = \quad SN(d_1) - Xe^{-r(T-t)}\,N(d_2)$$

$$\frac{\P c}{\P t} \quad = \quad \frac{S\P N(d_1)}{\P t} - x\left\{re^{-r(T-t))}N(d_2) + e^{-r(T-t)}\,\frac{\P N(d_2)}{\P t}\right\}$$

$$= \quad SN'(d_1)\frac{\P d_1}{\P t} - xre^{-r(T-t)}N(d_2) - xe^{-r(T-t)}N'(d_2)\frac{\P d_2}{\P t}$$

$$\frac{\P d_1}{\P t} - \frac{\P d_2}{\P t} = \frac{-s}{2(T-t)^{\frac{1}{2}}}$$

$$\frac{\P c}{\P t} \quad = \quad -SN'(d_1)\frac{s}{2\sqrt{T-t}} - xre^{-r(T-t)}N(d_2)$$

$$c \quad = \quad SN(d_1) - Xe^{-r(T-t)}N(d_2)$$

$$\frac{\partial c}{\partial S} \quad = \quad N(d_1) - SN'(d_1)\frac{\partial d_1}{\partial S} - xe^{-r(T-t)}N'(d_2)\frac{\partial d_2}{\partial S}$$

$$= \quad N(d_1)$$

Q9

(i)

A cap is an option which guarantees that the rate of borrowing on a particular loan amount does not exceed a certain level (the "cap rate") during the option period, which usually extends for several **years**.

The borrowing rate is based on a particular index such as £ 6-month LIBOR.

As the cap usually lasts for several interest rate resetting periods, the cap is in effect a series of options (or "caplets") on a particular interest rate.

The payoff at expiry of each caplet is the positive difference between the interest which would have been payable on the loan for the next period at the current market rate less the same interest at the cap rate.

If the payoff is at expiry of the caplet period then discounting is not applied; if it is at the start of the caplet period then discounting is applied.

A suitable formula for the caplet payoff would be: $f \, . \, M \, . \, \max(R - K, 0)$, where M = nominal, R = current rate, K = cap rate and f is the year fraction applicable to the caplet frequency (e.g. $f = 0.5$ if the caplets are half-yearly, which they would be if the cap were based on 6-month LIBOR).

A floor is likewise but guarantees that the rate of lending does not fall below a certain level.

(ii)

(a)

It is not necessary to know exactly how exotics work to answer this part - only to apply some basic options sense. Marks were given for a good sense of what is happening and an attempt to link up with part (i), which gave a valuable clue.

The bond's coupon can never fall, but if rates rise sharply it will pay a coupon less than the market rate, at least for a while (it may catch up).

Thus the floater has good downside protection on coupons in exchange for being less "greedy" on the upside.

The option effect here is that the holder of the bond has bought a series of floorlets and sold a series of caplets based on rising strikes.

Each floorlet strike is at the same level as the previous coupon, and the corresponding caplet strike is 0.65% above it.

The extra margin clearly means that overall the caplets are worth more than the floorlets.

The instrument needs a rising yield curve to achieve this.

In a rising yield curve, the expected forward rates are rising and each caplet strike is nearer the forward rate than the corresponding floorlet strike (or at least they are overall).

This means that the cap on the increase is worth more than the ratchet effect - not an obvious result at first glance.

(b)

The yield curve environment in which the bond is better than a normal floater are:

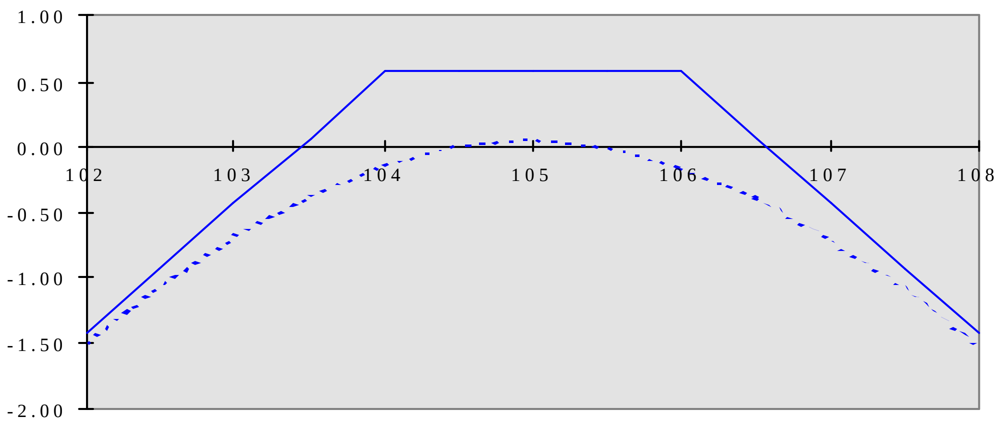
- an upward sloping yield curve to give the extra margin
- high cap volatilities which might decline in favour of the holder
- rates rising less than that implied in the yield curve
- a flattening of the yield curve would alter the balance of the cap/floor in favour of the holder.

The last two would help the ratchet even in the absence of an extra margin.
The opposite conditions would benefit the normal floater.
The bond is better than the floater if interest rates are falling.

Q10

(i)

An approximate "strangle" diagram such as the one below is required.
Vertical axis is profit on strategy; horizontal is price of Bund future.
The expiry lines must have 45^0 angles on the sides, through points shown (which should be marked).
The dotted line is the current time curve: this should pass through P&L zero at the points 105.50 and 104.5.
The maximum profit at expiry is 0.57 if the underlying lies in the range 104-106. Unlimited loss.



(ii)

Delta position = -500 (38% + -17%) = -105 contracts (i.e. 105 contracts short).
Therefore delta hedge is to buy 105 contracts of June 1998 Bund future.

(iii)

If the market falls sharply, the call will be worthless and the put will become almost identical to a future (all intrinsic value).

Hence the option position will be equivalent to being long 500 futures contracts.

What actually happens to the trader's P&L depends on his next action, but he will almost certainly make a loss, since the volatility outcome is considerably higher than that assumed in the prices.

The trader will also lose because the options will increase in volatility.

The correct action for a delta hedger is to sell contracts until the position is neutral.

This could mean selling up to 500 futures, plus any ones he had bought as an earlier delta hedge.

A week before expiry will exacerbate the gamma effect.

Hence:

- the final loss will be greater because the options will have little time value and hence little protection against sudden moves
- there will be no loss due to volatility, since the time remaining is too small to allow any meaningful vega exposure.

Q11

There are two types of accounting 'accruals' accounting and 'mark-to-market' accounting:

Accruals

Method: record only realised gains and losses on derivatives (options, swap etc) and does not record values at market value. The 'balance sheet' is not affected by market movements.

Advantages:

- good for long term holding: stable, not subject to unexpected swings due to short term movements
- good for close hedges and arbitraged positions
- simple to understand, doesn't need complicated accounting system
- appropriate if pension fund values assets by discounting cash flows rather than at market prices
- loans and deposits (even where traded) are accounted for under accruals

Disadvantages:

- can give misleading picture if market prices move
- does not reflect market sensitivities, so can easily disguise trading losses

Mark-to-market (MTM)

Method: takes prices and other rates from market sources and apply to value positions at regular intervals. The balance sheet is affected by market movements.

Advantages:

- objective assessment of "true" position
- indicating close-out value for solvency
- less room for manipulation of accounts
- consistent with G30 recommended practice for banks
- generally accepted as correct method for trading operations

Disadvantages:

- if holding derivative to maturity, required to have intermediate values which may lead to inappropriate action (e.g. if an interim loss is revealed)
- many parts of valuations are subjective, such as liquidity assessment where prices are often the result of marginal decisions rather than true valuations
- can't always find a price for some types of derivative, and may have to purchase a valuation if it's complex
- need a more advanced accounting system to cope with valuation requirements (e.g. to calculate swap values).

Q12

Insuring a portfolio against falls in market value by creating synthetic put options assumes that as soon as the portfolio's value declines by a small amount the portfolio manager rebalances his position by either selling part of the portfolio or selling some index futures.

In October 1987, the market declined so quickly that the sort of rebalancing expected in these kinds of portfolio insurance schemes could not be achieved.