Financial Risk Management Exam
Sample Questions/Answers

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Example 1-1: FRM Exam 1999-Question 17/Quantitative Analysis
b) This is derived from by $(1 + y^S/2)^2 = (1 + y)$, or $(1 + 0.08/2)^2 = 1.0816$, which gives 8.16%. This makes sense since the annual rate, with less frequent compounding, is higher.

Example 1-2: FRM Exam 1998-Question 28/Quantitative Techniques
a) This is derived from by $(1 + y^S/2)^2 = exp(y)$, or $(1 + y^S)^2 = 1.10$, which gives 10.25%. This makes sense since the semi-annual rate, with less frequent compounding, is higher.

Example 1-3: FRM Exam 1998-Question 12/Quantitative Techniques
d) We need to find $y$ such that $4/(1 + y/2) + 104/(1 + y/2)^2 = 102.9$. Solving, we find $y = 5\%$. (This can be computed on a HP-12C calculator, for example).

Another method is as follows. This bond has a duration of about one year, implying that, approximately, $\Delta P = -1 \times \$100 \times \Delta y$. If the yield was 8%, the price would be par. Instead, we have $\Delta P = 102.9 - 100 = 2.9$. Solving for $\Delta y$, the change in yield must be about $-3\%$, leading to $8 - 3 = 5\%$.

Example 1-4: FRM Exam 1999-Question 9/Quantitative Analysis
c) First derivatives involve modified duration and delta. Second derivatives involve convexity and gamma.

Example 1-5: FRM Exam 1998-Question 17/Quantitative Techniques
c) To compute the modified duration, we should consider both sides, or a price move of $-0.045$ if the yield changes by 0.0001, say. The modified duration is then $-(dP/dy)/P = (0.045/0.0001)/100 = 4.5$. 

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Example 1-6: FRM Exam 1998-Question 22/Quantitative Techniques

c) We assume that the initial market price is 100 and compute \( \Delta P = -D^*P\Delta y + (1/2)CP(\Delta y)^2 = -7\%100(0.001) + (1/2)50\%100(0.001)^2 = -0.70 + 0.0025 = -0.6975 \).

As expected, the price falls but by not as much as predicted by duration.

Example 1-7: FRM Exam 2000-Question 19/Capital Markets

d) All that is required is the computation of duration since the convexity numbers are all different. This is given by:

<table>
<thead>
<tr>
<th>Year</th>
<th>CF</th>
<th>PV</th>
<th>t*PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>87.7</td>
<td>87.7</td>
</tr>
<tr>
<td>2</td>
<td>1100</td>
<td>846.4</td>
<td>1692.8</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>934.1</td>
<td>1780.5</td>
</tr>
</tbody>
</table>

Duration is then 1780.5/934.1 = 1.906 years. Similarly, convexity is 4.328.

Example 1-8: FRM Exam 1998-Question 20/Quantitative Techniques

b) We associate the price of 92 to an up move of \( \Delta y = 0.01 \), and 96.5 to a down move. The effective modified duration is then \( D^E = (P_+ - P_-)/(2\Delta yP_0) = (96.5 - 92)/(2 \times 0.01 \times 94) = 2.394 \).

Example 1-9: FRM Exam 1998-Question 21/Quantitative Techniques

a) As before, we compute the modified duration for a down move in \( y \) as \( D_- = (P_- - P_0)/(\Delta yP_0) = (96.5 - 94)/(0.01 \times 94) = 2.6596 \). Similarly, the modified duration for an up move is \( D_+ = (P_0 - P_+)/(\Delta yP_0) = (94 - 92)/(0.01 \times 94) = 2.1277 \). Convexity is \( C^E = (D_- - D_+)//(\Delta y) = (2.6596 - 2.1277)/0.01 = 53.19 \). This is positive since modified duration is higher for a down move than for an up move in yields.

Example 1-10: FRM Exam 1998-Question 29/Quantitative Techniques

c) Going back to the duration equation for the consol, (1.23), we see that it does not depend on the coupon but only on the yield. Hence, the durations must be the same.
Example 1-11: FRM Exam 1997-Question 24/Market Risk

c) Duration usually increases as the time to maturity increases (Figure 1-4), so (d) is correct. Macaulay duration is also equal to maturity for zero-coupon bonds, so (a) is correct. Figure 1-4 shows that duration decreases with the coupon, so (b) is correct. As the yield increases, the weight of the payments further into the future decreases, which decreases (not increases) the duration. So, (c) is false.

Example 1-12: FRM Exam 1999-Question 75/Market Risk

a) Bond B has a higher coupon and hence a slightly lower duration than for Bond A. Hence it will react less strongly than Bond A to a given change in yields.

Example 1-13: FRM Exam 2000-Question 106/Quantitative Analysis

a) The 9-year bond (number 5) has shorter duration since the maturity is shortest, at 9 years, among comparable bonds. Next, we have to decide between bonds 1 and 2, which only differ in the payment frequency. The semi-annual bond (number 2) has a first payment in 6 months and has shorter duration than the annual bond. Next, we have to decide between bonds 1 and 4, which only differ in the yield. With lower yield, the cash flows further in the future have a higher weight, so that bond 4 has greater duration. Finally, the zero-coupon bond has the longest duration. So, the order is 5-2-1-4-3.

Example 1-14: FRM Exam 1998-Question 18/Quantitative Techniques

d) The dollar duration of the portfolio must be equal to the sum of the dollar durations for the individual positions, as in (1.27). First, we need to compute the market value of the bonds by multiplying the notional by the ratio of the market price to the face value. This gives for the first bond $\$100M(101/100) \times 1.7 = \$171.7M$ and for the
second $50M(99/100) \times 4.1 = -5202.95M$ for a total dollar duration of $-831.25M$. We compute the value of the portfolio as $P = \$101M - \$49.5M = \$51.50M$. The duration is then $DD/P \times 0.61$ year. Note that duration is negative due to the short position. We also assumed that the denominator $(1 + y)$ was the same for all bonds, using duration instead of modified duration.

**Example 1-15: FRM Exam 2000-Question 110/Quantitative Analysis**

c) Convexity is driven by cash flows with long maturities. Answer I is correct since the 10-year zero has only one cash flow, whereas the coupon bond has several others that reduce convexity. Answer II is false since the 6% bond with 10-year duration must have cash flows much further into the future, say in 30 years, which will create greater convexity. Answer III is false since convexity grows with the square of time. Answer IV is false since some bonds, e.g. MBS or callable bonds, can have negative convexity. Answer V is correct since convexity must be positive for coupon-paying bonds.

**Example 2-1: FRM Exam 1999-Question 21/Quantitative Analysis**

c) From Equation(2.19), we have $\sigma_B = \text{Cov}(A, B)/(\rho \sigma_A) = 5/(0.5 \sqrt{12}) = 2.89$, for a variance of $\sigma_B^2 = 8.33$. 
b) Correlation is a measure of linear association. Independence implies zero correlation but the reverse is not always true.

Example 2-3: FRM Exam 1999-Question 12/Quantitative Analysis
b) See Figure 2-5.

Example 2-4: FRM Exam 1999-Question 11/Quantitative Analysis
d) Each variable is standardized, so that its variance is unity. Using (2.26), we have
\[ V(5X + 2Y) = 25V(X) + 4V(Y) + 2 \times 5 \times 2 \times \text{Cov}(X, Y) = 25 + 4 + 8 = 37. \]

Example 2-5: FRM Exam 1999-Question 13/Quantitative Analysis
d) Note that (b) is not correct since the kurtosis involves \( \sigma^4 \) in the denominator and is hence scale-free.

Example 2-6: FRM Exam 2000-Question 108/Quantitative Analysis
b) We compute the standard variate for each cutoff point \( z_1 = (43 - 45)/16 = -0.125 \) and \( z_2 = (39 - 45)/16 = -0.375 \). Then we compute the cumulative distribution function for each \( F(z_1) = 0.450 \) and \( F(z_2) = 0.354 \). Hence the difference is \( P = 0.096 \).

Example 2-7: FRM Exam 1999-Question 16/Quantitative Analysis
a) As before, the kurtosis adjusts for \( \sigma \). Greater kurtosis than for the normal implies fatter tails.

Example 2-8: FRM Exam 1999-Question 5/Quantitative Analysis
c) \( Y \) is said to be lognormally distributed if its logarithm \( X = \ln(Y) \) is itself normally distributed.

Example 2-9: FRM Exam 1998-Question 10/Quantitative Techniques
c) Using Equation (2.45),
\[ E[X] = \exp[\mu + \frac{1}{2} \sigma^2] = \exp[0 + 0.5 \times 0.2^2] = 1.02. \]
Chapter 3 – Fundamentals of Statistics

Example 2-10: FRM Exam 1998-Question 16/Quantitative Techniques

d) Normal variables are stable under addition, so that (I) is true. For lognormal variables \( Y_1 \) and \( Y_2 \), we know that their logs, \( X_1 = \ln(Y_1) \) \( X_2 = \ln(Y_2) \) are normally distributed. Hence the sum of their logs, or \( \ln(Y_1) + \ln(Y_2) = \ln(Y_1Y_2) \) must also be normally distributed. The product is itself lognormal, so that (IV) is true.

Example 2-11: FRM Exam 2000-Question 128/Quantitative Analysis

\( c) \) Using Equation (2.45), we have \( E[X] = e^{\mu + 0.5\sigma^2} = e^{0 + 0.5 \times 0.5^2} = 1.1331 \). Assuming there is no error in the listed answers, it is sufficient to find the correct answer for the expected value.

Example 2-12: FRM Exam 1999-Question 22/Quantitative Analysis

\( c) \) The lognormal distribution has a long right tail (since the left tail is cut off at zero). We will later see that long positions in options have limited downside but large potential upside, hence a positive skew.

Example 2-13: FRM Exam 1999-Question 3/Quantitative Analysis

\( b) \) Leptokurtic refers to a distribution with fatter tails than the normal, or greater kurtosis.

FRM-99, Question 4
Random walk assumes that returns from one time period are statistically independent from another period. This implies:
A. Returns on 2 time periods cannot be equal.
B. Returns on 2 time periods are uncorrelated.
C. Knowledge of the returns from one period does not help in predicting returns from another period
D. Both b and c.

FRM-99, Question 14
Suppose returns are uncorrelated over time. You are given that the volatility over 2 days is 1.2%. What is the volatility over 20 days?
A. 0.38%
B. 1.2%
C. 3.79%
D. 12.0%

\( \sigma(R_{20}) = \sqrt{10}\sigma(R_{10}) \)

FRM-98, Question 7
Assume an asset price variance increases linearly with time. Suppose the expected asset price volatility for the next 2 months is 15% (annualized), and for the 1 month that follows, the expected volatility is 35% (annualized). What is the average expected volatility over the next 3 months?

A. 22%
B. 24%
C. 25%
D. 35%

\[
\sigma_{av} = \frac{\sigma_{13}}{\sqrt{3}} = \frac{\sqrt{\sigma_1^2 + \sigma_2^2 + \sigma_3^2}}{\sqrt{3}} = \sqrt{0.15^2 + 0.15^2 + 0.35^2} \\
= 0.236 \approx 24\%
\]

FRM-97, Question 15
The standard VaR calculation for extension to multiple periods assumes that returns are serially uncorrelated. If prices display trend, the true VaR will be:
A. the same as standard VaR
B. greater than the standard VaR
C. less than the standard VaR
D. unable to be determined

Bad Question!!!
“answer” is b. Positive trend assumes positive correlation between returns, thus increasing the longer period variance.

Correct answer is that the trend will change mean, thus d.

FRM-99, Question 2
Under what circumstances could the explanatory power of regression analysis be overstated?
A. The explanatory variables are not correlated with one another.
B. The variance of the error term decreases as the value of the dependent variable increases.
C. The error term is normally distributed.
D. An important explanatory variable is excluded.
D. If the true regression includes a third variable z that influences both x and y, the error term will not be conditionally independent of x, which violates one of the assumptions of the OLS model. This will artificially increase the explanatory power of the regression.

FRM-99, Question 20
What is the covariance between populations a and b:
\[
\begin{align*}
\text{a} & & 17 & & 14 & & 12 & & 13 \\
\text{b} & & 22 & & 26 & & 31 & & 29 \\
\end{align*}
\]
A. -6.25
B. 6.50
C. -3.61
D. 3.61

\[
\begin{align*}
\mu_a = 14, & \quad \mu_b = 27 \\
\text{a-14} & \quad \text{b-27} & \quad (a-14)(b-27) \\
3 & \quad -5 & \quad -15 \\
0 & \quad -1 & \quad 0 \\
-2 & \quad 4 & \quad -8 \\
-1 & \quad 2 & \quad -2 \\
\text{sum} = & \quad -25 \\
\end{align*}
\]
\[
\text{Cov}(a,b) = \frac{-25}{4} = -6.25
\]
FRM-99, Question 6
Daily returns on spot positions of the Euro against USD are highly correlated with returns on spot holdings of Yen against USD. This implies that:
A. When Euro strengthens against USD, the yen also tends to strengthens, but returns are not necessarily equal.
B. The two sets of returns tend to be almost equal
C. The two sets of returns tend to be almost equal in magnitude but opposite in sign.
D. None of the above.

FRM-99, Question 10
You want to estimate correlation between stocks in Frankfurt and Tokyo. You have prices of selected securities. How will time discrepancy bias the computed volatilities for individual stocks and correlations between these two markets?
A. Increased volatility with correlation unchanged.
B. Lower volatility with lower correlation.
C. Volatility unchanged with lower correlation.
D. Volatility unchanged with correlation unchanged.

The non-synchronicity of prices does not affect the volatility, but will induce some error in the correlation coefficient across series. Intuitively, this is similar to the effect of errors in the variables, which biased downward the slope coefficient and the correlation.

FRM-00, Question 125
If the F-test shows that the set of X variables explains a significant amount of variation in the Y variable, then:
A. Another linear regression model should be tried.
B. A t-test should be used to test which of the individual X variables can be discarded.
C. A transformation of Y should be made.
D. Another test could be done using an indicator variable to test significance of the model.

The F-test applies to the group of variables but does not say which one is most significant. To identify which particular variable is significant or not, we use a t-test and discard the variables that do not display individual significance.

FRM-00, Question 112
Positive autocorrelation of prices can be defined as:
A. An upward movement in price is more likely to be followed by another upward movement in price.
B. A downward movement in price is more likely to be followed by another downward movement.
C. Both A and B.
D. Historic prices have no correlation with future prices.

Answer C: both A and B
Example 4-1: FRM Exam 1999-Question 18/Quantitative Analysis
b) Both S1 and S2 are lognormally distributed since $d\ln(S1)$ and $d\ln(S2)$ are normally distributed. Since the logarithm of (S1*S2) is also its sum, it is also normally distributed and the variable S1*S2 is lognormally distributed.

Example 4-2: FRM Exam 1999-Question 19/Quantitative Analysis
d) Both models include mean reversion but different variance coefficients. None includes jumps.

Example 4-3: FRM Exam 1999-Question 25/Quantitative Analysis
b) This model postulates only one source of risk in the fixed-income market
This is a single factor term structure model.

Example 4-4: FRM Exam 1999-Question 26/Quantitative Analysis
c) This represents the expected return with mean reversion.

Example 4-5: FRM Exam 1999-Question 30/Quantitative Analysis
b) *(This requires some knowledge of markets).* Currently, yen interest rates are very low, the lowest of the group. This makes it important to choose a model that, starting from current rates, does not allow negative interest rates, such as the lognormal model.

Example 4-6: FRM Exam 1998-Question 23/Quantitative Techniques
a) This is also Equation (4.7), assuming all parameters are positive.

Example 4-7: FRM Exam 1998-Question 24/Quantitative Techniques
b) The model assumes that prices follow a random walk with a constant trend, which is not consistent with the fact that the price of a bond will tend to par.

Example 4-8: FRM Exam 2000-Question 118/Quantitative Analysis
a) These are no-arbitrage models of the term structure, implemented as either one-factor or two-factor models.
Example 4-9: FRM Exam 2000-Question 119/Quantitative Analysis
b) Both the Vasicek and CIR models are one-factor equilibrium models with mean reversion. The Hull-White model is a no-arbitrage model with mean reversion. The Ho and Lee model is an early no-arbitrage model without mean-reversion.

Example 4-10: FRM Exam 1999-Question 8/Quantitative Analysis
b) Accuracy with independent draws increases with the square root of $K$. Thus multiplying by a factor of 10 will shrink the standard errors from 100,000 to $100,000 / \sqrt{10}$, or about 30,000.

Example 4-11: FRM Exam 1998-Question 34/Quantitative Techniques
b) (Requires knowledge of derivative products) Asian options create a payoff that depends on the average value of $S$ during the life of the options. Hence, they are “path-dependent” and do not involve early exercise. Such options must be evaluated using simulation methods.

Example 4-12: FRM Exam 1997-Question 17/Quantitative Techniques
b) Sampling variability (or imprecision) increases with (i) fewer observations and (ii) greater confidence levels. To show (i), we can refer to the formula for the precision of the sample mean, which varies inversely with the square root of the number of data points. A similar reasoning applies to (ii). A greater confidence level involves fewer observations in the left tails, from which VAR is computed.
Example 4-13: FRM Exam 1999-Question 29/Quantitative Analysis

c) (Data-intensive) This involves a Cholesky decomposition. We have $XX' = \begin{bmatrix} x_{11} & 0 & 0 \\ x_{12} & x_{22} & 0 \\ x_{13} & x_{23} & x_{33} \end{bmatrix} \begin{bmatrix} x_{11} & x_{12} & x_{13} \\ 0 & x_{22} & x_{23} \\ 0 & 0 & x_{33} \end{bmatrix} = \begin{bmatrix} x_{11}^2 & x_{11}x_{12} & x_{11}x_{13} \\ x_{12}^2 + x_{22} & x_{12}x_{23} + x_{12}x_{23} \\ x_{13}^2 + x_{23}^2 + x_{33}^2 \end{bmatrix} = \Sigma$

$$\Sigma = \begin{bmatrix} 0.09\% & 0.06\% & 0.03\% \\ 0.06\% & 0.05\% & 0.04\% \\ 0.03\% & 0.04\% & 0.06\% \end{bmatrix}$$

We then laboriously match each term, $x_{11}^2 = 0.0009$, or $x_{11} = 0.03$, $x_{21} = 0$ (since this is in the upper right corner, $x_{11}x_{12} = 0.0006$, or $x_{12} = 0.02$, $x_{12}^2 + x_{22}^2 = 0.0005$, or $x_{12} = 0.01$.


d) The theoretical forward/futures rate is given by $F = \text{Se}^{rT} = 378.83 \times \exp(0.0528 \times 180/365) = \$388.84$ assuming continuous compounding. This is consistent with the observation that futures rates must be greater than spot rates when there is no income on the underlying asset. The profit is then $100 \times (388.84 - 387.85) = 164.4$.


a) We need first to compute the PV of the dividend payment, which is $PV(D) = 1.8\exp(-0.04 \times 4/12) = \$1.776$. The valuation is $F\exp(-rT) = S - PV(D)$. Hence, $F = (\$98 - \$1.776)\exp(0.045 \times 8/12) = \$99.15$.

Example 5-3: FRM Exam 1999-Question 49/Capital Mkt.

a) Using continuous compounding, $e^{-rT} = \exp(-0.055 \times 1) = 0.9465$ and $e^{-r\tau} = \exp(-0.025 \times 1) = 0.9753$. We have $F = S\exp(-r\tau)/e^{-r\tau} = 1.05 \times 0.9753/0.9465 = \$1.0820$. 

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Example 5-4: FRM Exam 1999-Question 41/Capital Mkts.

a) The forward price is too high relative to the fair rate, so we need to sell the forward contract short. In exchange, we need to buy the asset. To ensure a zero initial cash flow, we need to borrow the present value of the asset.


b) The convexity effect is important for long-dated contracts, so that (d) is wrong. This positive correlation makes it more beneficial to have a futures position since profits can be reinvested at higher rates. Hence the futures price must be higher than the forward price.
Example 6-1: FRM Exam 1999-Question 34/Capital Mkts.
b) The call lower bound, when there is no income, is $S_t - Ke^{-rt} = \$90 - \$80e^{\left(-0.05 \times 1\right)} = \$90 - \$76.10 = \$13.90.$

Example 6-2: FRM Exam 1999-Question 52/Capital Mkts.
b) An American call will not be exercised early when there is no income payment on the underlying asset.

Example 6-3: FRM Exam 1999-Question 35/Capital Mkts.
b) A short put position is equivalent to a long asset position plus shorting a call. To fund the purchase of the asset, we need to borrow. This is because the value of the call and puts are small relative to the value of the asset.

Example 6-4: FRM Exam 2000-Question 15/Capital Mkts.
d) By put-call parity, $p = c - (S - Ke^{-rt}) = 30 - (100 - 120e^{\left(-0.5 \times 0.5\right)}) = 30 + 17.04 = 47.04.$

d) Futures have an “implied” income stream equal to the risk-free rate. As a result, and American call may be exercised early. Similarly, the American put may be exercised early. As a result, put-call parity does not hold strictly for such American options.

Example 6-6: FRM Exam 1999-Question 50/Capital Mkts.
b) A covered call is long the asset plus a short call. This preserves the downside but eliminates the upside, which is equivalent to a short put.
Example 6-7: FRM Exam 1999-Question 33/Capital Mkts.
a) A bull spread involves the same options but with different strike prices. It can be achieved with calls or puts. Above 55, none of the puts is exercised and we collect a high premium. To get the downside just below 55, we need to sell a put with $K_2 = 55$ and buy a put with $K_1 = 50$. We verify that selling the put with the higher strike price will create a net cash inflow.

a) The proceeds from exercise are $(42 - 30) - (42 - 40) = 10$. From this should be deducted the net cost of the options, which is $3 - 1.5 = 1.5$, ignoring the time value of money. This adds up to a net profit of $8.50$.

c) Any income payment should be reinvested in the asset.

Example 6-10: FRM Exam 1998-Question 2/Quantitative Techniques
d) This is the term multiplying the present value of the strike price, by equation (6.16).

c) Knock-in or knock-out options involve discontinuities, and are harder to hedge when the spot price is close to the barrier.

Example 6-12: FRM Exam 1997-Question 10/Derivatives
b) Knockouts are no different from regular options in terms of maturity or underlying volatility but are cheaper than the equivalent European option since they involve a lower probability of final exercise.

b) As interest rates increase, the coupon decreases. In addition, the discount factor increases. Hence the value of the note must decrease even more than a regular fixed-coupon bond.


d) With a callable bond the issuer has the option to call the bond early. Hence the investor is short an option. A long position in a callable bond is equivalent to a long position in a non-callable bond plus a short position in a put option (on the bond price).


a) \( DR = \frac{(\text{Face} - \text{Price})}{\text{Face}} \times \frac{360}{t} = \frac{\$100,000 - \$97,569}{\$100,000} \times \frac{360}{100} = 8.75\% \). Note that the yield is 9.09\%, which is higher.


b) Using Equation (7.8), we have \( D^* = -\frac{(dP/P)}{dy} = \frac{[(135.85 - 132.99)/134.41]/[0.001 \times 2]} = 10.63 \). This is also a measure of effective duration.
c) Since this is a zero-coupon bond, it will always trade below par, and the call should
never be exercised. Hence its duration is the maturity, 10 years.

Example 7-6: FRM Exam 1999-Question 91/Market Risk
a) By Equation (7.8).

Example 7-7: FRM Exam 1997-Question 49/Market Risk
d) Duration is not related to maturity when coupons are not fixed over the life of the
investment. We know that at the next reset, the coupon on the FRN will be set at
the prevailing rate. Hence, the market value of the note will be equal to par at that
time. The duration or price risk is only related to the time to the next reset, which
is 1 week here.

d) Discount factors need to be below one, as interest rates need to be positive, but in
addition forward rates also need to be positive.

Example 7-9: FRM Exam 1997-Question 1/Quantitative Techniques
b) If the par curve is rising, it must be below the spot curve. As a result, the selected
par rate will be too low, thereby over-estimating the bond value.

Example 7-10: FRM Exam 1999-Question 1/Quantitative Analysis
a) See the graph in the text. The coupon yield curve is an average of the spot,
zero-coupon curve, hence has to lie below the spot curve. The forward curve can be
interpreted as the spot curve plus the slope of the spot curve. If the latter is upward
sloping, the forward curve has to be above the spot curve.

a) Using \((1 - 6%) = (1 - SMM)^{12}\), we find SMM = 0.51%.
Example 7-12: FRM Exam 1999-Question 44/Capital Mkts.
a) The factor influencing most the decision to repay early (the option feature) is, from this list, refinancing incentives.

b) As \((1 - SMM)^{12} = (1 - CPR)\).

Example 7-14: FRM Exam 1999-Question 87/Market Risk
b) Discounted cash flows are not useful for CMOs since they are uncertain. We have \((dP/P) = D'dy = 50 \times 1\% = 50\%\).

c) MBS are subject to I, II, III (either homeowner or agency default). Brady bonds are subject to I, III, IV. None is exposed to currency risk.

Example 7-16: FRM Exam 1999-Question 40/Capital Mkts.
c) All attributes are reasons for using effective convexity, except that the price risk decreases as maturity gets close since this would hold for a regular bond anyway.

Example 7-17: FRM Exam 2000-Question 13/Capital Mkts.
c) Like a CMO, a CLO represents a set of tradable securities backed by some collateral, in this case a loan portfolio.

Example 7-18: FRM Exam 2000-Question 121/Quantitative Analysis
d) Risk is measured by duration. Treasury bills and floaters have very small duration. A 10-year fixed-rate note will have a duration of perhaps 8 years. In contrast, an inverse (or reverse) floater has twice the duration.

c) The duration is normally about 14 years. Note that if the current coupon is zero,
the inverse floater behaves like a zero-coupon bond with duration of 10 years.

**Example 7-20: FRM Exam 1999-Question 79/Market Risk**

c) Following the same reasoning as above, we must divide the fixed-rate bonds into 2/3 FRN and 1/3 inverse floater. This will ensure that the inverse floater payment is related to twice LIBOR. As a result, the duration of the inverse floater must be 3 times that of the bond.

**Example 7-21: FRM Exam 2000-Question 3/Capital Mkts.**

d) MBSs are unlike regular bonds, Treasuries or corporates, due to their negative convexity. When rates fall, homeowners prepay early, which means that the price appreciation is less than that of comparable duration regular bonds.

c) The duration is $5 - 2 = 3$ months. If rates go up, the position generates a profit. So, the DV01 must be positive and $100 \times 0.01\% \times 0.25 = 2.500$.


d) FRAs are OTC contracts; Eurodollar futures are exchange-traded with standard contract sizes and high liquidity.


d) We need to short Eurodollars in an amount that accounts for the notional and durations of the inventory and hedge: $(V_p/V_T) \times (D_p/D_T) = (100M/1M) \times (1/0.25) = 400$.


a) The fair futures price is $100 - 5.7 = 94.30$. Given that the actual futures price is higher, one should short the futures and lock in a high 5.7% investment rate by investing to time $T + 3$ and borrowing to $T$.


a) The goal of the CF is to equalize differences between various deliverable bonds. In the extreme, if we discounted all bonds using the current term structure, the CF would provide an exact offset to all bond prices, making all of the deliverable bonds equivalent. This reduction from 8% to 6% notional reflects more closely recent interest rates. It will lead to more instability in the CTD, which is exactly the effect intended. Also, a lower coupon increases the duration of the contract, so that (c) is not correct.

a) Receiving float on the swap will offset the payment on the note, leaving a net obligation in fixed.

Example 8-6: FRM Exam 1999-Question 59/Capital Mkts.

a) The futures rate should be corrected downward. Otherwise, the forward rate will be too high, implying a high fixed payment. This risk can be offset by going short futures.


d) Paying fixed on the swap is the same as being short a fixed-rate note.

Example 8-8: FRM Exam 1999-Question 54/Capital Mkts.

a) With the same strike price, a short cap/long floor loses money if rates increase, which is equivalent to a long position in a fixed rate bond.

Example 8-9: FRM Exam 1999-Question 60/Capital Mkts.

a) In a downward-sloping rate environment, forward rates are higher for short maturities. Caplets involves the right to buy at the same fixed rate for all caplets. Hence short maturities are ITM.

Example 8-10: FRM Exam 1997-Question 18/ Derivatives

c) The value of a call increases with the maturity of the call and the volatility of the underlying asset value (which here also increases with the maturity of the swap contract). So, (a) and (d) are wrong. In contrast, the value of the right to receive an asset at $K$ decreases as $K$ increases.


c) A swaption is a one-time option that can be exercised either at one point in time
(European), at any point during the exercise period (American), or on a discrete set of dates during the exercise period (Bermudan). As such the Bermudan option must be more valuable than the European option, ceteris paribus. Also, a cap is a series of options. As such, it must be more valuable than any option that is exercisable only once.


(c) The fund borrows 200M and invest 300M, which creates a yield of $300 \times 14\% = $42M. Borrowing costs are $200 \times 8\% = $16M, for a difference of $26M on equity of $100M, or 26\%. Note that this is a yield, not expected rate of return if we expect some losses from default. This higher yield also implies higher risk.


(b) The convertible includes a warrant, which is basically a call option on the firm’s stock. This must have positive delta and gamma.

Example 9-3: FRM Exam 1997-Question 52/Market Risk

(c) Abstracting from the convertible feature, the value of the fixed-coupon bond will fall if rates increase; also, the value of the convertible feature falls as the stock price decreases.


(c) The rate of inflation is not in the cash-and-carry formula, although it is embedded in the nominal interest rate.


(a) This is simply put-call parity, solved for S. We have $S_t e^{-\nu T} = F_t e^{-r T}$, or $S = 552.3 \times \exp(-7.5/200)/\exp(-4.2/200) = 543.26$. We verify that the forward rate is greater than the spot since the dividend yield is less than the risk-free rate.
Example 10-1: FRM Exam 1999-Question 37/Capital Mkts.

b) A company can only have a comparative advantage in one currency, that with the greatest difference in capital cost, 2% for pounds versus 1% for yen.


c) If hedgers are not short, they are selling corn futures even if it involves a risk premium such that the selling price is lower than the expected future spot price. Thus the expected spot price of corn is higher than the futures price. Note that the current spot price is totally irrelevant.


b) First, forward prices are only at a discount vs. spot prices in a backwardation market. The high spot price represents a convenience yield to the consumer of the product, who holds the physical.


b) Backwardation means that the spot is greater than futures prices.

Example 10-5: FRM Exam 1997-Question 45/Market Risk

a) Shorting the cash exposes the position to increasing cash prices, assuming for instance fixed futures prices, hence increasing backwardation.


a) MG was selling oil forward to clients, hence had to hedge by buying short-dated futures oil contracts. In theory, price declines in one market were to be offset by gains in another. In futures markets, however, losses are realized immediately, which may lead to liquidity problems (and did so). Hence, the expectation was that oil prices would stay constant.
Example 11-1: FRM Exam 1999-Question 89/Market Risk

c) There will be a loss worse than VAR in, on average, \( n = 1\% \times 100 = 1 \) day out of 100.


d) This is the correct answer given the "always" requirement and the fact that VAR is not always sub-additive. Otherwise, (b) is not a bad answer, but it requires some additional distributional assumptions.

Example 11-3: FRM Exam 1997-Question 7/Risk Measurement

b) Square root of 10 is 3.16.

Example 11-4: FRM Exam 1997-Question 16/Regulatory

c) The Capital Accord requires a minimum historical observation period of one year.

Example 11-5: FRM Exam 1997-Question 23/Regulatory

c) Less than calculated. Loss limits cut down the positions as losses accumulate. This is similar to a long position in an option, where the delta increases as the price increases, and vice versa. Long positions in options have shortened left tails, and hence less risk than an unprotected position.

Example 11-6: FRM Exam 1997-Question 9/Regulatory

b) Callable interest rate swaps involve options, for which there is no limit. Also note that back-to-back options are perfectly hedged and have no market risk.

Example 11-7: FRM Exam 1997-Question 4/Risk Measurement

a) Stress-testing evaluates the portfolio under large moves in financial variables.
Example 11-8: FRM Exam 1998-Question 20/Regulatory

a) The goal of stress-testing is to identify losses that go beyond the “normal” losses measured by VAR.


d) Stress testing identifies low-probability losses beyond the usual VAR measures. It does not, however, provide a maximum loss.

Example 12-1: FRM Exam 1997-Question 16/Market Risk

d) Specific risk.

Example 12-2: FRM Exam 1998-Question 7/Credit Risk

c) (This requires some knowledge of markets). Ranking these assets in decreasing order of asset liquidity, we have (a), (b), (d) and (e). Floating rate notes are typically issued in smaller amounts and have customized payment schedules. As a result, they are typically less liquid than the other securities.

Example 12-3: FRM Exam 1997-Question 54/Market Risk

a) Illiquid instruments are ones that do not trade actively. Answers (b) and (d) are not correct as OTC products, which do not trade on exchanges, such as Treasuries, can be quite liquid. The lack of easy hedging alternatives does not imply the instrument itself is illiquid.
c) Managing balance sheet liquidity risk involves the ability to meet cash flow needs as required. This can be met by keeping liquid assets or being able to raise fresh funds easily. Answer (a) is not correct as it substitutes cash for marketable securities, which is not an improvement. Hedging with Eurodollar futures does not decrease potential cash flow needs. Setting up a reserve is simply an accounting entry.

b) In a crash, bid offer spreads widen, as do liquidity spreads. Answer I is incorrect as Treasuries usually rally, which lead to greater losses for portfolio short Treasuries than swaps.

d) Answer (a) refers to asset liquidity risk; answers (b) and (c) to funding liquidity risk. Answer (d) is incorrect since exchange traded derivatives are marked to market daily and hence could be terminated at any time without additional cash flow needs.
Example 13-1: FRM Exam 1997-Question 10/Market Risk
b) From the table. Note that by now, the ITL and DEM have disappeared.

Example 13-2: FRM Exam 1997-Question 14/Market Risk
d) The logs of JPY/DEM and DEM/USD add up to that of JPY/USD:
\[ \ln[JPY/USD] = \ln[JPY/DEM] + \ln[DEM/USD] \]. So, \( \sigma^2(\text{JPY/USD}) = \sigma^2(\text{JPY/DEM}) + \sigma^2(\text{DEM/USD}) + 2\rho\sigma(\text{JPY/DEM})\sigma(\text{DEM/USD}) \), or
\[ 8^2 = 10^2 + 6^2 + 2\rho \times 6 \times 6 \text{ or } 2\rho \times 6 = -72 \text{ or } \rho = -0.60. \]

Example 13-3: FRM Exam 1999-Question 86/Market Risk
d) Historical yield volatility is more stable than price risk for a specific bond.

Example 13-4: FRM Exam 1999-Question 80/Market Risk
c) (Lengthy.) Assuming normally distributed returns, the 95% worst loss for the bond can be found from the yield volatility and Equation (13.6). First, we compute the gross market value of the position, which is \( P = 820,000,000 \times (98 + 8/32 + 1.43)/100 = $19,936,000. \) Next, we compute the daily yield volatility, which is \( \sigma(\Delta y) = ye^{\text{ANNUAL}(\Delta y/y)}\sqrt{250} = 0.06509 \times 0.12/\sqrt{250} = 0.000494. \) The bond's VAR is then \( \text{VAR} = D^* \times P \times 1.645 \times \sigma(\Delta y) \), or \( \text{VAR} = 12.719 \times 19,936,000 \times 1.645 \times 0.000494 = 8205,055, \) which is close to (c).

d) Most of the movements in yields can be explained by a single-factor model, or parallel moves. Once this effect is taken into account, short-term yields move more than long-term yields, so that (a) and (b) are wrong.

Example 13-6: FRM Exam 1997-Question 42/Market Risk
d) The yield on the inflation-protected bond is a real yield, or nominal yield minus expected inflation.
Example 13-7: FRM Exam 1999-Question 71/Market Risk
b) If most of the term structure is unaffected, the hedge will not change in value. There will be little change in refinancing. For the IO, the slight decrease in the short-term discount rate will increase the present value of cash flows, but the effect is small.

Example 13-8: FRM Exam 1999-Question 73/Market Risk
c) The TR swap will eliminate all market risk; shorting Treasuries protects against interest rate risk; since the ARM is already short options, the manager should be buying caps, not selling them.

Example 13-9: FRM Exam 1997-Question 43/Market Risk
a) The “smile” effect represents different implied vols for the same maturity. Otherwise, the index is computed using market values not prices, for a sample of 500 stocks, not necessarily the largest, that are regularly changed.

Example 13-10 FRM Exam 1997-Question 44/Market Risk
c) The futures price is a function of the spot price, interest rate and dividend yield.

d) The CAPM assumes that returns are normally distributed and that markets are in equilibrium. In other words, the demand from mean-variance optimizers must be equal to the supply. In contrast, the APT simply that returns are driven by a factor model with a small number of factors, whose risk can be eliminated through arbitrage. So, the APT is less restrictive, does not assume that returns are normally distributed and does not rely on the identification of the true market portfolio.

Example 13-12: FRM Exam 1997-Question 12/Market Risk

c) There is no spot risk since the two contracts have offsetting exposure to the spot rate. There is, however, basis risk and liquidity risk.
Example 14-1: FRM Exam 2000-Question 78/Market Risk Mgt.
c) Hedging is made possible by the fact that cash and futures prices usually move in
the same direction and by the same amount.

Example 14-2: FRM Exam 2000-Question 17/Capital Markets
b) Answer (a) is wrong since we need to hedge by selling futures. Answer (b) is wrong
since futures hedging creates some basis risk. Answer (d) is wrong since cross hedging
involves different assets. Speculators do serve some social function, which is to create
liquidity for others.

d) Basis risk occurs if movements in the value of the cash and hedged positions do
not offset each other perfectly. This can happen if the instruments are dissimilar, or
if the correlation is not unity. Even with similar instruments, if the hedge is lifted
before the maturity of the underlying, there is some basis risk.

Example 14-4: FRM Exam 1999-Question 66/Market Risk
c) See equation (14.6).

d) The hedge ratio is $\rho_f \sigma_s / \sigma_f = 0.3876 \times 0.57 / 0.85 = 0.2599$.

Example 14-6: FRM Exam 1999-Question 67/Market Risk
b) MG was long futures to offset the promised forward sales to clients. It lost money
as oil futures prices fell.

Example 14-7: FRM Exam 2000-Question 73/Market Risk Mgt.
b) The assumption is that of (1) parallel and (2) small moves in the yield curve.
Answers (a) and (c) are the same, and omit the size of the move. Answer (d) would
require perfect, not high correlation, plus small moves.
Example 14-8: FRM Exam 1999-Question 61/Market Risk
a) The DVBP of the portfolio is $1100. That of the futures is $25. Hence the ratio is $1100/25 = 44$.

Example 14-9: FRM Exam 1999-Question 109/Market Risk
b) The dollar duration of a 5-year 6% par bond is about 4.3 years. Hence the DVBP of the position is about $200m \times 4.3 \times 0.0001 = 86,000$. That of the futures is $25$. Hence the ratio is $86000/25 = 3440$.

b) The hedging instrument has a market beta that is not unity, but instead 0.623. The optimal hedge ratio is $N = -(1.8 \times 50,000,000)/(0.623 \times 500,000) = 288.9$.

b) Answer (a) is wrong since we need to sell the contract, not buy it. Answer (c) is wrong since hedging does involve basis risk. Answer (d) is also wrong since basis risk arises when the cash and futures are not the same.

Example 15-1: FRM Exam 1999-Question 65/Market Risk
a) The delta-gamma approximation is reasonably good for vanilla options (especially not too close to maturity).

Example 15-2: FRM Exam 1999-Question 88/Market Risk
c) Non-linearities cause distributions to be non-normal. Note that for long-term vanilla options, the delta-normal method may be appropriate.

Example 15-3: FRM Exam 1997-Question 28/Market Risk
a) An ATM option has about 50% delta and is long gamma, so the VAR is $0.50 \times 0.078 \times $1M = $39M$ minus the long gamma effect.

Example 15-4: FRM Exam 1999-Question 69/Market Risk
a) The volatility of the hedged portfolio must be proportional to $\sigma$. It must also be inversely related to the number of rebalancings $N$. 
a) Theta is deterministic. Gamma actually lowers risk for this position.

c) Gamma now creates risk.

b) The position is now delta-neutral and has positive gamma.

c) See Figure 15-7 describing the option theta.

c) Time decay describes the loss of option value, which is greatest for at-the-money option with short maturities.

b) An otherwise identical call and put have the same gamma and vega. Theta is different, even though the formula contains the same first term, due to the differential effect of time on \( r \) and \( y \). Rho is totally different, positive for the call and negative for the put.

c) The investor is long the option and has already paid the premium. Therefore, there is credit risk as counterparty could default when the contracts have positive value. The position is also exposed to decreases in volatility (vega risk) and the passage of time (theta risk). There is no gamma risk as the position has positive gamma.

c) Note that Gamma is negative. Using the Taylor approximation, the worst loss is obtained as the price move of 
\[
\Delta(-dS) + \frac{1}{2}\Gamma(dS)^2 = 100,000 \times -82 + \frac{1}{2}(-50,000)(-2)^2 = -200,000 - 100,000 = -300,000.
\]

b) This is the reverse of the previous position. There is no credit risk as the investor can only lose money, not the dealer. Now there is gamma risk. The position is also exposed to increases in volatility (vega risk).


a) Long positions in options have positive gamma and vega. Gamma (or instability in delta) increases near maturity; vega decreases near maturity. So, to obtain positive gamma and negative vega, we need to be long short-maturity options and short long-maturity options.

Example 15-15: FRM Exam 1999-Question 94/Market Risk

d) As Figure 15-11 shows, the distribution profile changes as the horizon changes. This makes it difficult to extrapolate short-horizon VAR to longer-horizons. In other words, VAR assumes that the portfolio is frozen over the horizon; positions in options involve automatic dynamic trading.

Example 15-16: FRM Exam 1997-Question 51/Market Risk

b) Relative to a bullet bond, the investor is long an option, due to fact that it can “put” back the bond to the issuer. This will create positive gamma, or lower VAR than otherwise.

Example 15-17: FRM Exam 2000-Question 97/Market Risk Mgt.

d) An important aspect of the question is the fact that the option is held to maturity. Answer (a) is incorrect as changes in the implied volatility would change the value of the option but this has no effect when holding to maturity. The profit from the dynamic portfolio will depend on whether the actual volatility differs from the initial implied volatility. It does not depend on whether the option ends up in-the-money or not, so answers (b) and (c) are incorrect. The portfolio will be profitable if the actual volatility is small, which implies small moves around the strike price.
Example 16-1: FRM Exam 1999-Question 64/Market Risk

d) The presence of either mean reversion or trend (or time variation in risk) implies a different distribution of returns for different holding periods.


c) Knowing that the variance is $V(2 - \text{day}) = V(1 - \text{day})[2 + 2\rho]$, we find $\text{VAR}(2 - \text{day}) = \text{VAR}(1 - \text{day})\sqrt{2} + 2\rho = 1M\sqrt{2} + 0.2 = 1.483M$, assuming the same distribution for the different horizons.

Example 16-3: FRM Exam 1999-Question 83/Market Risk

a) With fat tails, the normal VAR would underestimate the true VAR.

Example 16-4: FRM Exam 1999-Question 103/Market Risk

a) The updated volatility is from Equation (16.14) the square root of

$$h_t = \lambda(\text{current vol.})^2 + (1 - \lambda)(\text{current return})^2$$

Using log-returns, we find $R = 1.653\%$ and $\sigma_t = 1.5096\%$. With discrete-returns, we find $R = 1.667\%$ and $\sigma_t = 1.5105\%$.

Example 16-5: FRM Exam 1999-Question 72/Market Risk

b) The EWMA puts a weight of 0.06 on the latest observation, which is higher than the weight of 0.0167 for the 60-day MA and 0.004 for the 250-day MA.
Example 17-1: FRM Exam 1997-Question 13/Regulatory

c) Delta-normal is appropriate for the fixed-income desk, unless it contains many MBSs. For the option desk, at least the second derivatives should be considered; so, the delta-gamma method is adequate.

Example 17-2: FRM Exam 1997-Question 12/Risk Measurement

c) In finite samples, the simulation methods will be in general different from the delta-normal method, and from each other. As the sample size increases, however, the Monte Carlo VAR should converge to the delta-normal VAR when returns are normally distributed.

Example 17-3: FRM Exam 1998-Question 6/Regulatory

a) The variance/covariance approach does not take into account second-order curvature effects.

Example 17-4: FRM Exam 1999-Questions 82/Market Risk

d) $VAR = \sqrt{40^2 + 50^2 - 2 \times 40 \times 50 \times 0.89} = 23.24$.

Example 17-5: FRM Exam 1999-Questions 15 and 90/Market Risk

c) $VAR = \sqrt{300^2 + 500^2 + 2 \times 300 \times 500 \times 1/15} = $600.
Example 18-1: FRM Exam 2000-Question 36/Credit Risk
a) Settlement risk is due to the exchange of notional principal in different currencies at different points in time, which exposes one counterparty to default after it has made payment. There would be less risk with netted payments.

b) Answers (c) and (d) are both correct. Answers (a) and (b) are contradictory, so one is false. A Multilateral netting system concentrates the credit risk into one institution. This could potentially create much damage if this institution fails.

Example 18-3: FRM Exam 2000-Question 46/Credit Risk
c) The expected loss is $\sum_i p_i \times CE_i \times (1 - f_i) = 20 \times 0.02 (1 - 0.60) + 30 \times 0.04 (1 - 0.40) = \$0.880m.$

Example 18-4: FRM Exam 1998-Question 38/Credit Risk
b) Since the subsidiary defaults when the parent defaults, the joint probability is simply that of the parent defaulting.

Example 18-5: FRM Exam 1998-Question 16/Credit Risk
a) If defaults of A and B are highly correlated, the default of one implies a greater probability of a second default. Hence the fee must be higher.

Example 18-6: FRM Exam 1998-Question 42/Credit Risk
c) The probability of losing money is driven by (i) a fall in the value of the collateral and (ii) default by the Russian bank. If the two events are independent, the joint probability is $5\% \times 1\% = 0.05\%$. In contrast, if the value of securities always drops at the same time the Russian bank defaults, the probability is simply that of the Russian bank's default, or 5\%.
Example 18-7: FRM Exam 1998-Question 51/Credit Risk
a) The three loss events are: (i) default by the first, with probability $0.1 \times (1 - 0.2)$
(ii) default by the second, with probability $0.2 \times (1 - 0.1)$ (iii) default by both, with
probability 0.03. The loss in the first case is £100 \times (1 - 0.4) \times 0.08 = 4.8, and so on.
The expected loss is then $4.8 + 10.8 + 3.6 = 19.2$.

Example 18-8: FRM Exam 1997-Question 11/Credit Risk
a) With independence, this probability is $10\% \times 10\% = 1\%$.

Example 18-9: FRM Exam 1997-Question 12/Credit Risk
\(c\) This is $(1 - 5\%)^{10} = 60\%$.

Example 18-10: FRM Exam 1998-Question 30/Credit Risk
b) The probability that none will default is $0.94 \times 0.94 = 88.4\%$.
Example 19-1: FRM Exam 1998-Question 5/Credit Risk
b) Calling back a bond simply occurs when the borrower wants to refinance at a lower cost, which is not a credit event.

Example 19-2: FRM Exam 1999-Question 128/Credit Risk
d) Losses I and II are due to market risk. Loss III is a credit event, due to restructuring. Loss IV is a tax event.

Example 19-3: FRM Exam 1997-Question 8/Credit Risk
d) Ba2 is the lowest rating.

Example 19-4: FRM Exam 1998-Question 37/Credit Risk
a) The cutoff point for pre-tax interest coverage ratio in Table 19-4 is 4.1 for BBB credits, which is similar to the ratio of 3.75 for company X. More importantly, the LT debt/equity ratio of 35% for company X translates into a LT debt/capital ratio of 26% (obtained as 35%/(1 + 35%) = 26%). As this is well below the cutoff point of 40.8% for BBB-credits in Table 19-4, it corresponds to an AAA-rating.

Example 19-5: FRM Exam 1997-Question 28/Credit Risk
c) From Table 19-4.

Example 19-6: FRM Exam 1998-Question 29/Credit Risk
a) From Table 19-4, the ratio of B to BBB defaults for a 1-year horizon is 5.82/0.22 = 26, which is higher than the 16 ratio in the first part of the question. The numbers may be different due to differences in sample periods, or methodology. The ratio at 10-year horizon is 42.88/5.23 = 8, which adjusted down gives a ratio of 5.

Example 19-7: FRM Exam 1997-Question 2/Credit Risk
a) Using $(1 - d_M)^4 = (1 - 0.06\%)$, we find an average rate of $d_M = 0.015\%$. For the next quarter, however, the marginal default rate will be lower due to the fact that $d$ increases with maturity for high credit ratings.
Example 19-8: FRM Exam 2000-Question 37/Credit Risk

c) The probability of surviving is \( (1 - \delta)^3 = 0.343 \). Hence the probability of default at any point during the next three years is 66%.

Example 19-9: FRM Exam 2000-Question 31/Credit Risk

d) The numbers are clearly hypothetical, as a BB credit has a 5-year cumulative default rate of about 12%. Under the assumed conditions, the cumulative 6-year default rate would be: 
\[
C_6(R) = C_5(R) + k_6 = C_5(R) + S_5 \times d_6 = 0.15 + (1 - 0.15) \times 0.10 = 0.235.
\]
This is closest to solution (d).

Example 19-10: FRM Exam 1997-Question 10/Credit Risk

a) The question could refer to the cumulative or marginal probabilities. Using the cumulative probabilities in Table 19-4, we have, for 1 year, a ratio of \( 0.01/5.82 = 0.002 \) and, for 10 years, a ratio of \( 2.02/42.88 = 0.047 \). This increases with maturity. Similarly, the marginal default probability increases with time for high credits and decreases for low credits.

Example 19-11: FRM Exam 2000-Question 43/Credit Risk

b) This is one minus the survival rate over 3 years: 
\[
S_3(R) = (1 - d_1)(1 - d_2)(1 - d_3) = (1 - 0.03)(1 - 0.04)(1 - 0.05) = 0.8856
\]
Hence, the cumulative default rate is 0.1154.

Example 19-12: FRM Exam 2000-Question 34/Credit Risk

a) The marginal default rate is the probability of defaulting over the next year, conditional on having survived to the beginning of the year.

Example 19-13: FRM Exam 2000-Question 50/Credit Risk

d) The transition matrix represents the conditional probability of moving from one rating to another over a fixed period, typically a year.

Example 19-14: FRM Exam 2000-Question 58/Credit Risk

a) The recovery rate on loans is typically higher than that on bonds. Hence the credit rating, if it involves both probability of default and recovery, should be higher for loans than for bonds.
Example 19-15: FRM Exam 1998-Question 8/Credit Risk

c) The rating of the collateral must be between that of the offered securities and the residual. Say that the collateral is rated B (with 5% EDF) and that the offered securities represent 80% of the total market value. These are more highly rated than the collateral since the equity absorbs the default risk. If they are rated BB (with 1% EDF), the equity must be such that 80% \times 0.01 + 20\% \times x = 0.05, which yields an EDF of 21\% for the equity, close to a CCC rating.

Example 19-16: FRM Exam 1997-Question 27/Credit Risk

b) The empirical evidence is that bond prices lead changes in credit ratings.

Example 19-17: FRM Exam 1999-Question 121/Credit Risk

d) Empirically, the ratio of debt to exports seems to be the most important factor driving sovereign ratings (see the Handbook of Emerging Markets, pp. 10-11).

Example 19-18: FRM Exam 1998-Question 36/Credit Risk

a) Countries cannot be forced into bankruptcy. There is no enforcement mechanism for payment to creditors such as for private companies. Recent history has shown that a country can simply decide to reneg on its debt.

Example 20-1: FRM Exam 1998-Question 3/Credit Risk

b) Using Equation (20.3), we have

\[
(1 - \pi) = \frac{(1 + y/200)^2}{(1 + y^s/200)^2}
\]

which gives

\[
\pi = 1 - \frac{(1 + 5/200)^2}{(1 + 5.5/200)^2} = 0.49\%
\]

Example 20-2: FRM Exam 1997-Question 23/Credit Risk

b) Using Equation (20.3), the annual probability of default is \( \pi = 1 - \frac{(1 + 0.055)}{(1 + 0.06)} = 0.47\% \), which gives 0.1% quarterly.
Example 20-3: FRM Exam 1997-Question 24/Credit Risk
a) We add 50% of 1% to the risk-free rate, which gives 6.0%.

Example 20-4: FRM Exam 1998-Question 11/Credit Risk
c) Credit spreads widen considerably for lower rated credits.

Example 20-5: FRM Exam 1999-Question 136/Credit Risk
a) A quick answer can be obtained as follows. First, we compute the current yield on the 6-month bond, which is selling at a discount. This is about 10% (from \( y \) such that \( 99 = 104/(1 + y/200)^1 \)). Thus the yield spread for the first bond is roughly \( 8 + 2 - 5.5 = 4.5\% \), which implies an annual default rate of \( 4.5\%/0.50 = 9\% \), or semi-annual of 4.5% over the coming six months. The spread for the second bond is 3%, which implies an annual default rate of \( 3%/0.50 = 6\% \). So the default rate for the second six-month period is only 1.5%, much less than the first. For more precision, one would have to set the price of the two risky bonds equal to their expected cash flows and use the first period default rate to compute the second period default rate.

Example 20-6: FRM Exam 1998-Question 22/Credit Risk
c) Equity price risk.

Example 20-7: FRM Exam 1999-Question 155/Credit Risk
a) The cost of equity is generally higher than that of debt since it is riskier. Otherwise, all of the other arguments (a), (b), (c) are true. Equity will not cause default. It does not mature and provides a cushion for debtholders as stockholders should lose money before debtholders.
Example 21-1: FRM Exam 1999-Question 130/Credit Risk
a) There is no credit risk from selling options if the premium is received upfront.

Example 21-2: FRM Exam 1999-Question 151/Credit Risk
d) The maximum exposure is potentially very large since this is a long position in an option, certainly larger than the initial premium. At a minimum, the exposure is the current exposure of EUR 10,000.

b) A putable bond is long a put option. This skews the distribution to the right, creating less market risk. In effect, if rates fall, the investor can put the bond back to the company. This increases the value of the bond, hence increasing credit exposure.

Example 21-4: FRM Exam 2000-Question 35/Credit Risk Mgt.
a) To have a credit loss, we need a combination of positive exposure and default. The swaps with Universal Tools have negative exposure, so do not create credit risk. Answer (a) is the best since it combines positive exposure and default risk.

Example 21-5: FRM Exam 1999-Question 111/Credit Risk
d) For a loan, the principal is at risk and the payments depend on the level of rates; the swap needs to be in-the-money for a credit loss to occur.

Example 21-6: FRM Exam 1999-Question 133/Credit Risk
b) MTM and notionals alone do not measure the potential exposure. We need a combination of current MTM plus an add-on for potential exposure.

Example 21-7: FRM Exam 2000-Question 55/Credit Risk Mgt.
c) Using Equation (21.11) for three remaining periods, we have the discounted value of the net interest payment, or \( (8\% - 7\%) \times 100m = 1m \), discounted at 7%, which is $934,579 + 873,439 + 816,298 = 2,624,316.$
Example 21-8: FRM Exam 1999-Question 118/Credit Risk

(c) The value of the swap must be positive to the dealer to have some exposure. This will happen if current rates are less than the fixed coupon.

Example 21-9: FRM Exam 1999-Question 148/Credit Risk

(b) See Equation (21.15).

Example 21-10: FRM Exam 2000-Question 29/Credit Risk Mgt.

(a) This question alters the variance profile in (21.12). Taking now the variance instead of the volatility, we have

\[ \sigma^2 = k(T - t)^4 \times t \]

where \( k \) is a constant. Differentiating with respect to \( t \),

\[ \frac{d\sigma^2}{dt} = k[(-1)4(T - t)^3] + k[(T - t)^4] = k(T - t)^3[-4t + T - t] \]

Setting this to zero, we have \( t = T/5 \). Intuitively, since the exposure profile drops off faster than in (21.12), we must have earlier peak exposure.

Example 21-11: FRM Exam 1999-Question 149/Credit Risk

(c) We know from the previous question that the maximum is at \( t = T/3 \). We then plug into \( \sigma_{\text{MAX}}(V) = |k(T-t)|\sigma \sqrt{t} \). This is also \( [kT(2/3)] \sigma \sqrt{T/3} = [4,000 \times 2] \times 5 \times \sqrt{250} = 632,456 \). Multiplying by 2.33, we get 1,473,621.

Example 21-12: FRM Exam 1999-Question 127/Credit Risk

(c) The exposure of a currency swap is greater than that of interest rate swap and increases with maturity.


d) The CD has the whole notional at risk. Otherwise, the next greatest exposure is for the forward currency contract and the interest rate swap. The short cap position has no exposure if the premium has been collected. Note that the question eliminates settlement risk for the forward contract.
Example 21-14: FRM Exam 1999-Question 153/Credit Risk
b) All items have an effect on exposure, except (I) which is default risk.

Example 21-15: FRM Exam 1998-Question 33/Credit Risk
c) The credit quality is not involved in the calculation of the potential exposure. It is only taken into account for the computation of the Basel risk weights, or for the distribution of credit losses.

Example 21-16: FRM Exam 1998-Question 34/Credit Risk
d) Without additional information and no netting agreement, it is not possible to determine the exposure from the net amount only.

Example 21-17: FRM Exam 1999-Question 131/Credit Risk
d) Credit risk will be decreased with netting, more positions and counterparties.

Example 21-18: FRM Exam 1999-Question 154/Credit Risk
c) Define $X$ and $Y$ as the absolute values of the positive and negative positions. The net value is $X - Y = 20m$. The absolute gross value is $X + Y = 80$. Solving, we get $X = 50m$. This is the positive part of the positions, or exposure.

Example 21-19: FRM Exam 1999-Question 123/Credit Risk
b) The haircut on equity repos is greater due to the greater price volatility of the collateral.
Example 22-1: FRM Exam 2000-Question 33/Credit Risk
b) Answer (a) is not correct since payment is simply a function of market variables. Answer (c) is incorrect since the default event is the first default. Answer (d) is incorrect since the credit event is more general than simply bankruptcy. Answer (b) says that a risky bond is the sum of a risk-free bond plus a short position in a credit default swap.

Example 22-2: FRM Exam 1999-Question 113/Credit Risk
c) Payment from the protection seller is contingent upon a credit event for a credit swap and a combination of payment tied to a reference rate and the asset depreciation for a TRS.

Example 22-3: FRM Exam 1999-Question 114/Credit Risk
a) The default event is triggered when there is a first default on necessarily any of the assets in the basket.

Example 22-4: FRM Exam 1999-Question 122/Credit Risk
b) This is an interesting question that demonstrates that the credit risk of the underlying asset is exchange for that of the swap counterparty. The swap is now worthless as if the underlying credit defaults, the counterparty will default as well (since it is the same).

c) The only state of the world with a loss is a default on the asset jointly with a default of the guarantor. The expected loss is then $100m \times 0.03 \times (1 - 40\%) = 3.18m.$
Example 22-6: FRM Exam 1999-Question 144/Credit Risk

a) An option on a T-bond has no credit component.

Example 22-7: FRM Exam 1998-Question 26/Credit Risk

d) The first three instruments have a major credit component. Callable FRN, on the other hand, primarily contain an interest-rate option.

Example 22-8: FRM Exam 1998-Question 44/Credit Risk

c) A credit derivatives certainly will not prevent the default event from happening.

Example 22-9: FRM Exam 1998-Question 46/Credit Risk

a) The payments are linked to the total return on bond X.

Example 22-10: FRM Exam 2000-Question 61/Credit Risk

c) We need to value the bond with remaining semi-annual payments for 9 years using two yields, \( y + S = 6.30 + 1.50 = 7.80\% \) and \( y + K = 6.30 + 1.30 = 7.60\% \). This gives $948.95 and $961.40, respectively. The total payout is then $50,000,000 \times \left[\frac{961.40 - 948.95}{1000}\right] = $622,424.


a) The net payment is: outflow of 12% - 3% minus inflow of 11% + 0.4%, which is a net receipt of -2.4%. Applied to the notional of $200 million, this gives a receipt of $4.8 million.

Example 22-12: FRM Exam 1999-Question 147/Credit Risk

d) As a first approximation, the reference credit spread curve may be enough. To be complete, however, we also need information about the credit risk of the swap counterparty, the treasury curve (for discounting) and correlations. The correlation
structure enters the pricing through the expectation of the product of the default and LGD.

**Example 22-13: FRM Exam 1999-Question 135/Credit Risk**
a) Since all bonds rank equally, all default at the same time and have the same loss given default. Therefore the cash flow on the 1-year credit swap can be replicated (including any risk premium) by going long the 1-year Widget bond and short the 1-year T-Bond.

**Example 22-14: FRM Exam 2000-Question 30/Credit Risk Mgt.**
d) Credit derivatives are used to reduce regulatory capital usage and counterparty concentrations, and to manage the risk profile of the loan portfolio. Private banking deposits are bank liabilities and do not require the same type of protection.

**Example 23-1: FRM Exam 1998-Question 41/Credit Risk**
c) Credit provisions should be made for actual and expected losses. Capital, however, is supposed to provide a cushion against unexpected losses.

**Example 23-2: FRM Exam 1998-Question 39/Credit Risk**
b) The expected loss is $100m \times 0.06 \times (1 - 0.4) = 3.6m$.

**Example 23-3: FRM Exam 1999-Question 120/Credit Risk**
c) The exposure times the loss given default is, respectively, $500,000$, $1,000,000$, $2,400,000$, and $1,600,000$. Loan (c) has the most to lose.

**Example 23-4: FRM Exam 1999-Question 112/Credit Risk**
a) Answer (a) is correct. Answer (b) should be “less”, not more. Answer (c) deals with exposure, not default.
Example 23-5: FRM Exam 1998-Question 13/Credit Risk

c) First, we have to transform the annual default probability into a monthly probability. Using \((1 - 2\%) = (1 - d)^{12}\), we find \(d = 0.00168\), which assumes a constant probability of default during the year. The expected credit loss is \(d \times \$1M = \$1,682\). Since \(d = 0.168\%\) is more than \(1 - 99.9\% = 0.1\%\), the WCL is $1M, and the CVAR is $998,318.

Example 23-6: FRM Exam 1998-Question 10/Credit Risk

d) As in the previous question, the monthly default probability is 0.0168. The following table shows how to compute the expected loss.

<table>
<thead>
<tr>
<th>Default</th>
<th>Probability</th>
<th>Loss</th>
<th>(p_iL_i)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 bonds</td>
<td>(d^2 = 0.00000282)</td>
<td>$500,000</td>
<td>$1.4</td>
</tr>
<tr>
<td>1 bond</td>
<td>(2d(1 - d) = 0.00335862)</td>
<td>$250,000</td>
<td>$839.7</td>
</tr>
<tr>
<td>0 bond</td>
<td>((1 - d)^2 = 0.99663854)</td>
<td>$0</td>
<td>$0.0</td>
</tr>
</tbody>
</table>

which gives an expected loss of $841. Next, $500,000 is the WCL at a minimum 99.9% confidence level. Subtracting from $500,000, we get d).

Example 23-7: FRM Exam 1999-Question 146/Credit Risk

b) KMV uses information about the market value of the stock plus the book value of debt.

Example 23-8: FRM Exam 1999-Question 145/Credit Risk

b) CreditMetrics infers the default correlation from equity correlations.

Example 23-9: FRM Exam 1998-Question 21/Credit Risk

d) CM uses equity correlations.

Example 23-10: FRM Exam 2000-Question 60/Credit Risk

c) The distance between the current value of assets and that of liabilities is $200m, which corresponds to twice the standard deviation of $100m. Hence the probability of default is 2.3%, or about 0.020.
Example 23-11: FRM Exam 2000-Question 44/Credit Risk

d) Answer (d) is most correct. Answer (a) is wrong as CreditRisk+ assumes fixed exposures. Answer (b) is also wrong as CreditMetrics is a simulation, not analytical model. Finally, KMV uses the current stock price and not the historical default rate.

Example 24-1: FRM Exam 1998-Question 3/Oper.&Integr.Risk

b) Fluctuations in market prices reflect market risk.

Example 24-2: FRM Exam 1999-Question 173/Oper.&Integr.Risk

d) All the three definitions have been used and highlight a different aspect of operational risk.

Example 24-3: FRM Exam 1997-Question 32/Regulatory

c) Model risk includes model assumptions that are too rigid (a), that are only understood by a small group of people (b) or not understood by risk managers (d). Having the models validated by independent reviewers decreases model risk.
b) Answers (a), (c), and (d) all describe pure market risk.

Example 24-5: FRM Exam 1998-Question 5/Oper.&Integr.Risk
b) Automatic filtering of outliers may weed out bad data points but also reject real observations, which may bias downward forward-looking measures of risk. Also, changing a spreadsheet’s calculation mode from automatic to manual can create operational risk.

Example 24-6: FRM Exam 1998-Question 6/Oper.&Integr.Risk
c) We need to identify risk before measuring, controlling and managing them.

Example 24-7: FRM Exam 2000-Question 64/Operational Risk Mgt.
a) Constructing the operational loss requires the probability, or frequency of event as well as estimates of potential loss sizes. Answer (b) is wrong as measurement of op risk is still developing. Answer (c) is wrong as the business unit is also responsible for controlling operational risk. Answer (d) is wrong as losses can occur as a combination of operational and market or credit risks.

Example 24-8: FRM Exam 1999-Question 166/Oper.&Integr.Risk
d) The distribution of losses due to operational risk results from the combination of loss frequencies and loss severities.

Example 24-9: FRM Exam 1999-Question 167/Oper.&Integr.Risk
c) The expected loss severity is, with a uniform distribution from 80m to 100m, 90m. The frequency of this happening would be once every 200 years times the ratio of the [80m, 100m] range to the total range [25m, 100m], which is (20/75)/200 = 0.001333. The expected loss is 90m × 0.001333 = HKD120,000.
Example 24-10: FRM Exam 1999-Question 169/Oper.&Integr.Risk

c) The distribution of losses due to operational risk is derived from the loss frequency (I) and loss severity distributions (III).

Example 24-11: FRM Exam 1999-Question 170/Oper.&Integr.Risk

b) Capital can only provide protection against unexpected losses at a high confidence level. Above that, insurance can pick up the risk.

Example 24-12: FRM Exam 1998-Question 4/Oper.&Integr.Risk

d) As seen in the example of the effect of a failure to record the terms of the swap correctly, operational risk can create both market and credit risk.

Example 25-1: FRM Exam 1999-Question 159/Oper.&Integr.Risk

c) Bankers RAROC computes the risk capital using the quantitative parameters in (a) plus a tax factor. So, the answer is both (a) and (b).


c) VAR is $100m \times 0.2 \times 2.33 = $46.6m$. hence RAPM is $10/46 = 21.46\%$.

Example 26-1: FRM Exam 1997-Question 4/Regulatory

a) The G-30 developed best-practice risk management principles.
Example 27-1: FRM Exam 1999-Question 160/Oper.&Integr.Risk
a) This also belongs to the credit risk category.

Example 27-2: FRM Exam 1998-Question 10/Oper.&Integr.Risk
d) Integrated risk management is driven by linkages between products, markets, as well as correlations.

d) Policies are derived from business strategies, and include risk tolerance and disclosure.

Example 27-4: FRM Exam 1999-Question 171/Oper.&Integr.Risk
c) To have integrated management of market, credit, and operational risk, all three managers should report to the Chief Risk Officer, who then reports to the CEO.

Example 27-5: FRM Exam 1999-Question 164/Oper.&Integr.Risk
a) As one risk manager has said, this is one of the few instances where “never” means “absolutely never”. Allowing traders to tabulate their profit and losses themselves is a recipe for disaster.

Example 27-6: FRM Exam 1998-Question 7/Oper.&Integr.Risk
d) The credit risk manager goes through all the steps in the risk management process; he participates in approving standards, sets and monitors risk limits.

Example 27-7: FRM Exam 1998-Question 9/Oper.&Integr.Risk
d) The board must approve policies, be able to evaluate and maintain oversight of risk management.

c) Answers (a), (b), and (d) are all reasonable. Answer (c) violate the separation of trading and back office functions.

Example 27-9: FRM Exam 1997-Question 3/Regulatory

c) The G-30 recommends an independent risk control function for market and credit risk. As a result, the head of risk management should report directly to the board of directors, or senior management, but certainly not to the head of trading.

Example 27-10: FRM Exam 1999-Question 165/Oper.&Integr.Risk

c) Linking compensation to revenues provides incentives for better performance but unfortunately for avoiding controls as well.

Example 27-11: FRM Exam 1999-Question 163/Oper.&Integr.Risk

c) Tying the compensation to the trading or customer revenues only creates incentives to take on additional risk.

Example 27-12: FRM Exam 1999-Question 162/Oper.&Integr.Risk

c) Having too many exceptions indicates that the control function is not working properly (a); risk managers cannot report to the head of trading (b); reducing personnel requirement is not an end in itself (d). The goal is to create an environment that is conducive to controlled risk-taking.

c) Risk management cannot implement any trading activity, due to the potential conflict of interest, even for hedging.

Example 27-14: FRM Exam 1997-Question 33/Regulatory

b) As (a), (c), (d) attempt to align the traders's interests with those of the institution, or try to give feedback for risk. In contrast, (b) is purely based on historical information and will have no effect on current behavior.


b) Answer I violates the principle of separation of functions. Answer III may create problems of traders taking too much risk. Answer II advises to use external sources for valuing positions, as traders may affect internal price data.

Example 31-1: FRM Exam 1997-Question 17/Regulatory

b) In addition to all the risks in the trading book (interest rate, equity, forex, com-
modity), the market capital charges also include forex and commodity risks in the bank book.

**Example 31-2: FRM Exam 1999-Question 189/Regulation**
c) Allowable capital includes equity (book equity), perpetual securities and subordinated debt with maturity greater than 5 years.

**Example 31-3: FRM Exam 2000-Question 139/Regulation**
a) Tier 1 capital includes common stock, disclosed reserves, and noncumulative preferred shares.

**Example 31-4: FRM Exam 2000-Question 134/Regulation**
a) Unfunded commitments are off-balance-sheet items (unlike funded commitments, which are loans). Below a year, the credit conversion factor is zero, which means zero BIS weight.

**Example 31-5: FRM Exam 2000-Question 137/Regulation**
b) Unfunded commitments with maturities greater than a year (and irrevocable) have a 50% conversion factor, or 4% BIS weight instead of the usual 8%.

**Example 31-6: FRM Exam 1999-Question 134/Credit Risk**
b) The BIS method does not take into account the credit rating of the counterparty. The add-on already incorporates the type of instrument and maturity. The analyst only needs items II and III.

**Example 31-7: FRM Exam 2000-Question 135/Regulation**
c) The capital charges for the trading portfolio do not follow the 8% credit risk charges, so that (a) and (b) does not apply. An investment in a Venture Capital fund, however, is typically not marked to market and as a result will be classified into the banking book with the usual 8% risk charge.
Example 31-8: FRM Exam 2000-Question 131/Regulation
a) The 1999 and revised 2001 proposals differentiate more finely across credit ratings, using external or internal ratings. Internal portfolio credit risk, or VAR, models are still not allowed across all risk categories.

Example 31-9: FRM Exam 1998-Question 21/Regulatory
d) By now there is some consensus on measuring market and credit risk. Operational risk is more difficult to measure because of the lack of data and standardized methodology.

Example 32-1: FRM Exam 1999-Question 184/Regulation
a) Assuming normally and independently distributed returns, the RM VAR needs to be adjusted from 95% to 99% confidence and from 1 day to 10 days. This gives $1,000,000 \times (2.33/1.65) \times \sqrt{10} = 4.5m.$

Example 32-2: FRM Exam 1999-Question 196/Regulation
b) Under the IMA, VAR must be computed at the 99 percent confidence level, either over a 10 day period or over a 1-day period with appropriate time scaling.

Example 32-3: FRM Exam 1999-Question 190/Regulation
c) Answer (b) is correct if the bank uses fixed weights only. Otherwise, the average time lag of the observations cannot be less than 6 months.

Example 32-4: FRM Exam 1999-Question 197/Regulation
c) See Equation (32.9).

a) An 8% capital charge applies to this bond. We buy $100 worth of the bond, which
is funded at the bank rate, for a net dollar return of $100[(L+0.15\%) - (L-0.05\%)] = $0.20. We need to keep $8 in capital, which we assume is not invested. The rate of return is then $0.20/$8 = 2.5\%. (Also note that the capital adequacy rules are from the Basel Committee on Banking Supervision, not the BIS).

**Example 32-6: FRM Exam 1998-Question 4/Regulatory**

c) This is obtained as $3 \times \sqrt{200^2 + 15^2 + 50^2} = 3 \times 207 = 620$. If this was a banking book only, the charge would apply to the currency component only, or $150M.

**Example 32-7: FRM Exam 1998-Question 18/Regulatory**

d) The total MRC is $3 \times $100 \times \sqrt{10} + $30 = $949 + $30 = $979.

**Example 32-8: FRM Exam 1999-Question 194/Regulation**

d) Note that the original January 1996 text has been amended in September 1997. Banks can use their internal models if they satisfy a list of criteria; otherwise, they have to use the standardized approach. Even so, if they do not account for default and event risk, a prudential surcharge applies.

**Example 32-9: FRM Exam 1998-Question 19/Regulatory**

c) Specific risk includes (i) idiosyncratic risk plus (ii) default/event risk.

**Example 32-10: FRM Exam 1999-Question 195/Regulation**

c) Stress test results should be reported to senior management and the board, who have control over traders. So, (II) and (III) are correct. (V) is also correct, as it describes a situation where the stress-test exercise leads to a reduction in the position. (IV) is wrong. The loss indicated by stress tests is too large to establish stop-loss limits; it would then be too late to save the bank.

**Example 32-11: FRM Exam 1998-Question 20/Regulatory**

a) VAR only gives an indication of the worst loss under normal conditions (e.g. 95%
It does not address the behavior in the tails. Stress test results are certainly not precise.

**Example 32-12: FRM Exam 1997-Question 15/Regulatory**

d) Scenario analysis is not a probabilistic description of potential losses, unlike the covariance matrix approach or historical or Monte Carlo simulations.

**Example 32-13: FRM Exam 1999-Question 192/Regulation**

c) Both measures are informative.

**Example 32-14: FRM Exam 1999-Question 193/Regulation**

b) See Table 32-7.

**Example 32-15: FRM Exam 1999-Question 191/Regulation**

a) Backtesting is based on daily data at the one-tail 99 percent level.

**Example 32-16: FRM Exam 1998-Question 1/Regulatory**

d) The power is also one minus the type 2 error rate, which implies a 13% probability of not rejecting an incorrect model.