

CPD Spotlight Quiz - Solutions (October 2007)

Value at Risk

Question 1

Answer

The right answer is (b) £56.5 million.

The confidence level of 95% indicates that the potential loss of £40 million is 1.65 standard deviations for the portfolio away from the mean portfolio value at present. In order to increase the confidence level we have to increase the potential deviation from 1.65 to 2.33 standard deviations. So, if £40 million represents 1.65 standard deviations then 1 standard deviation must be £40 million / 1.65 = £24.2424 million. The new Value at Risk, where we are 99% confident that our losses over one year will not exceed the stated amount, is therefore 2.33 times this figure, i.e. £24.2424 million × 2.33 = £56.4848 million.

Question 2

Answer

The right answer is (c) £138,675

The methodology for transforming time periods is to multiply by “the square root of time”. In other words, as the time interval increases Value at Risk will increase by the square root of the proportional time increase. When the time decreases, Value at Risk will decrease by the square root of the proportional reduction in time interval. So, in this case, the time reduces from 13 weeks to 1 week so the reducing factor is $\sqrt{1/13} = 0.27735$.

In full, the calculation is $500,000 \times \sqrt{1/13} = 138,675$

Question 3

Answer

The right answer is (d) £38.7 million

The methodology for combining VaR values to determine the portfolio VaR is similar to combining standard deviations of portfolio components to determine the portfolio standard deviation. Not surprising as Value at Risk is really an expression of the monetary value of a periodic standard deviation scaled for a confidence level and the size of the exposure.

So the calculation is:

$$\begin{aligned}\text{VaR Portfolio} &= \sqrt{\{\text{VaR}_{\text{Assets}}^2 + \text{VaR}_{\text{Liabilities}}^2 + (2 \times \text{correlation} \times \text{VaR}_{\text{Assets}} \times \text{VaR}_{\text{Liabilities}})\}} \\ &= \sqrt{\{50^2 + (-50)^2 + (2 \times 0.7 \times 50 \times (-50))\}} \\ &= \sqrt{\{2500 + 2500 - 3500\}} \\ &= \sqrt{1500} \\ &= \text{£38.7298 million Value at Risk of the portfolio.}\end{aligned}$$

The implication of this is that when the portfolio combines assets and liabilities, low variability is generated by a high correlation coefficient, i.e. the well known hedging methodology of matching a risky outcome with another risky outcome which is highly correlated – but opposite in effect, such as an asset and a liability.

Question 4

Answer

The right answer is (b) the NZD position is concerning.

The VaR can be calculated for each position as GBP equivalent as follows.

You can be 95% confident that the next month will see a change in the value of each position that is no more than 1.65 standard deviations less than the current value. Volatility is quoted as a percentage standard deviation – often it is an annualized figure but here it is stated to be monthly.

So the maximum loss to be expected, with 95% confidence, is given by:

For NZD $\text{VaR} = \text{Exposure} \times 1.65 \times \text{volatility} = £42.6 \times 1.65 \times .0417 = £2.93 \text{ million}$
For EUR $\text{VaR} = \text{Exposure} \times 1.65 \times \text{volatility} = £104 \times 1.65 \times .0140 = £2.40 \text{ million}$

The EUR exposure is 20% below the maximum permitted by the policy whereas the NZD exposure is around 2.3% below the maximum. The NZD exposure is therefore of concern.

Question 5

Answer

The right answer is (c) that each time period is independent, i.e. there are no trends.

The implicit assumption leading to the use of the “square root of time” is that of a random walk: that the outcome from each time period is independent of the previous outcome. The assumptions regarding normal or lognormal distributions are necessary in the development of the theory backing the concept of VaR, but not the annualizing of volatility.

One further assumption that is implicit is that volatility remains constant over the longer period. The events of the markets in recent weeks shows that this cannot always be relied upon!

Question 6

Answer

The right answer is (d) Leptokurtic distribution.

This is the name for the fat-tailed distribution, where the low-probability ends of the distribution have a higher probability than would be expected. It has been proposed that this is a naturally-occurring phenomenon. In financial markets it has also been proposed that it is due to the reaction of market participants. As a price falls, then holders of the asset rush to sell before the price falls further – precipitating further price falls. Another outcome of this leptokurtism is the ‘volatility smile’. It has been proposed that this is due to miscalculation or mis-estimation of low-probability outcome frequency, again at the extreme ends of the normal distribution.

For further reading on VaR see:

Value at Risk – Uses and Abuses by Christopher Culp, Merton Miller and Andrea Neves at Chapter 12 in ‘Financial Strategy, edited by Rutterford, Upton and Kodwani, published by John Wiley & Sons’ reproduced from ‘Joel Stern and Donald Chew, The revolution in Corporate Finance Fourth Edition (2003)’ pp416-29