IAQS | INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

Subject: Risk Management & Investment Management II

Chapter: Unit 1

Category: Practice Questions Solutions

1. :

VAR describes the quantile of the projected distribution of gains and losses over the target horizon. Intuitively, it summaries the worst loss over a target horizon with a given level of confidence. VAR is measured in currency units (e.g., dollar, euro, yen), which makes it more intuitive to understand. VAR is also based on the current positions, so is a forward-looking measure of risk.

2. :

Relative risk is the risk of a dollar loss in a fund relative to its benchmark. It is defined as the dollar difference between the fund return and that of a like amount invested in the benchmark. Relative risk is important for managers because their performance is compared to that of a passive index.

3. :

The manager should choose the asset with the lowest marginal VAR. This would help him lower the overall risk of the portfolio.

4. :

Marginal VAR describes the largest effect on the portfolio VAR for an equal change in the positions on the risk factors. This is the appropriate risk measure for this purpose.

5. Risk budgeting is a top-down process that involves choosing and managing exposures to risk. The main idea is that the risk manager establishes a risk budget for the entire portfolio and then allocates risk to individual positions based on a predetermined fund risk level. This concept is equivalent to a top-down allocation of economic risk capital starting from the asset classes down to the choice of the active manager and even to the level of individual securities.

6. :

   i. Absolute or asset risk refers to the total possible losses over a horizon. It is simply measured by the return over the horizon.

   ii. Relative risk is measured by excess return, which is the dollar loss relative to a benchmark. The

shortfall is measured as the difference between the fund return and that of a benchmark in dollar terms.

iii. Marginal VaR applies to a particular position in a portfolio, and it is the per unit change in a portfolio VaR that occurs from an additional investment in that position.
To measure the effect of changing positions on portfolio risk, individual VARs are not sufficient. Volatility measures the uncertainty in the return of an asset, taken in isolation.

iv. Diversified VaR is simply the VaR of the portfolio where the calculation takes into account the diversification effects.
The portfolio VAR, taking into account diversification benefits between components.

v. Incremental VAR is the change in VAR owing to a new position. It differs from the marginal VAR in that the amount added or subtracted can be large, in which case VAR changes in a nonlinear fashion.
Incremental VaR is the change in VaR from the addition of a new position in a portfolio. Since it applies to an entire position, it is generally larger than marginal VaR and may include nonlinear relationships, which marginal VaR generally assumes away.

7. A portfolio can be characterized by positions on a certain number of constituent assets, expressed in the base currency, say, dollars. If the positions are fixed over the selected horizon, the portfolio rate of return is a linear combination of the returns on underlying assets, where the weights are given by the relative amounts invested at the beginning of the period.
A manager can lower a portfolio VaR by lowering allocations to the positions with the highest marginal VaR. If the manager keeps the total invested capital constant, this would mean increasing allocations to positions with lower marginal VaR. Portfolio risk will be at a global minimum where all the marginal VaRs are equal for all *i* and *j*: $VaR_i = MVaR_j$

8. Distinguishing policy mix from active risk is important when an investment firm allocates funds to different managers in various asset classes. This breaks down the risk of the total portfolio into that associated with the target policy (i.e., the weights assigned to the various funds in the policy) and the risk from the fact that managers may make decisions which lead to deviations from the designated weights.
Often, active management risk is not much of a problem for several reasons. For well-managed funds, it is usually fairly small for each of the individual funds. There will be diversification effects across the deviations. There can be diversification effects with the policy mix VaR to actually lower the total portfolio VaR.

9. :

i. VaR can help move away from the ad hoc nature and overemphasis on notionals and sensitivities that characterize the guidelines many managers now use.
ii. Clearly, ad hoc procedures will generally be inferior to formal guidelines using established principles. Also, limits on notionals and sensitivities have proven insufficient when leverage and positions in

derivatives exist.

iii. The limits do not account for variations in risk nor correlations. VaR limits include all of these factors.

iv. The problem with controlling positions and not risk is that there are many rules and restrictions, which in the end may not achieve the main goal. There is no measure of the possible losses that can occur in a given time period–a good quantity to identify in order to know how much capital to have on hand to meet liquidity needs.

v. Furthermore, simple restrictions on certain positions can be easily evaded with the many instruments that are now available.

vi. As a wider range of products develop, obviously, the traditional and cumbersome position-by-position guidelines will become even less effective.

10. When there is an increase in the overall risk of a portfolio, top management would want to investigate the increase by asking the following questions:

Has the manager exceeded her risk budget?
VaR procedures and risk management can allocate a risk budget to each manager. The procedures should give an indication if and why the manager exceeds the risk budget. Is it a temporary change from changes in the market? Has the manager unintentionally let the weights of the portfolio drift so as to increase risk? Or, more seriously, has the manager engaged in unauthorized trades?

Are managers taking too many of the same style bets?
If the managers are acting independently, it is possible that they all start pursuing strategies with the same risk exposures. This would drastically increase the interest rate risk of the overall portfolio.

Have markets become more volatile?
If the risk characteristics of the entire market have changed, top management will have to decide if it is worth accepting the volatility or make decisions to reduce it by changing the target portfolio weights.

11. Risk budgeting should be a top down process.
The first step is to determine the total amount of risk, as measured by VaR, that the firm is willing to accept. The next step is to choose the optimal allocation of assets for that risk exposure. The goal will be to choose assets for the fund that keep VaR less than this value. Unless the asset classes are perfectly correlated, the sum of the VaRs of the individual assets will be greater than the actual VaR of the portfolio.
Thus, the budgeting of risk across asset classes should take into account the diversification effects. Such effects can be carried down to the next level when selecting the individual assets for the different classes.

12. :

UNIT 1

PRACTICE QUESTIONS SOLUTIONS

$$\text{VAR} = \alpha(\sigma\dot{W}) = 2.326(0.0157 \times \$10) = \$0.365 \text{ million.}$$

13. :

Scenarios (a), (c), and (d) increase risk. Increasing the number of assets decreases risk.

14. :

(a) The portfolio variance is obtained from $x'\Sigma x$, or

$$[\$100,000 \quad \$100,000] \begin{bmatrix} 0.05^2 & -0.50 \times 0.05 \times 0.2 \\ -0.50 \times 0.05 \times 0.2 & 0.2^2 \end{bmatrix} \begin{bmatrix} \$100,000 \\ \$100,000 \end{bmatrix}$$

which gives $325,000,000$. Taking the square root, we get a volatility of \$18,028 and diversified VAR of \$29,656. Note that the individual VARs are \$8,225 and \$32,900, for a total undiversified VAR of \$41,125.

(b) The marginal VARs are obtained from

$$\Delta\text{VAR} = \frac{\text{VAR}}{x'\Sigma x}\Sigma x = \frac{\$29,656}{325,000,000} \begin{bmatrix} 0.0025 & -0.0050 \\ -0.0050 & 0.0400 \end{bmatrix} \begin{bmatrix} \$100,000 \\ \$100,000 \end{bmatrix} = \begin{bmatrix} -0.0228123 \\ +0.3193715 \end{bmatrix}$$

The component VARs are obtained by multiplying these by the size of the positions. This gives -\$2,281 and \$31,937, which indeed add up to \$29,656. The component VAR for CGB is negative, indicating that it lowers the portfolio risk.

(c) When the CGB position is set to zero, the risk becomes the individual VAR for the other asset, or $1.645 \times 20\% \times \$100,000 = \$32,900$. The incremental VAR is therefore $\$32,900 - \$29,656 = \$3,244$. Note that decreasing the position in CGB leads to higher risk.

15. :

The variance is $0.17^2 + 0.17^2 + 2 \times 0.7 \times 0.17 \times 0.17 = 0.0983$. This gives a total VAR of $2.33 \times 0.313 \times \$100 = \$36.52$ million.