Value-at-Risk Model

Parametric (Analytical) Value-at-Risk

Value at risk (VaR), as the name suggests, is a measure of risk of loss for a particular asset or portfolio. The probability level is one minus the probability of a VaR break (extremely risky scenario); for example, if the confidence level is the extreme leftmost 1%, the specified confidence level is 100%-1% or 99% confidence level.

Assumptions:

- The returns from the asset/portfolio are normally distributed. This allows the use of the two parameters from the normal mean and standard deviation.
- We choose a level of confidence. If the confidence is 95% sure the worst case is not going to happen, choose z-value = -1.645. If the confidence is 99% sure the worst case is not going to happen, choose z-value = -2.33. The z-value represents the number of standard deviations away from the mean.
- The returns are assumed to be serially independent so no prior return should influence the current return.

Steps required to Get VaR

1. Find (log) returns from financial data (keep things as percentages).
2. Calculate mean (percentage).
3. Calculate standard deviation of means (percentage).
4. Choose a confidence level (we assume z=1.645).
5. Calculate the dollar loss associated with your investment as a money manager. Assume you invested $10m in a security.

Example:

Choose a 95% confidence level, meaning we wish to have 5% of the observations in the left-hand tail of the normal distribution. That means that the observations in that area are 1.645 standard deviations away from the mean (assume to be zero for short period-of-time return data).

The following are data for a security investment:

- amount of dollars invested: $10 million
- standard deviation: 1.99% or 0.0199

The VaR at the 95% confidence level is 1.645 x 0.0199 or 0.032736. The portfolio has a market value of £10 million, so the VaR of the portfolio is 0.032736 x 10,000,000 = $327,360.

Relationship of Correlation and VaR

Covariance VaR changes linearly as the underlying model or factor variable instantaneous correlations change. Likewise, nonlinear VaR will change nonlinearly as the instantaneous correlations change. Dynamic hedging costs should properly reflect the VaR cost of cap.