$\sigma_p^2 \; V$

$$^2 = \begin{bmatrix} 4 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} w_1 & \dots & w_N \end{bmatrix} \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_N \end{bmatrix}$$

$$= \begin{bmatrix} 4 & 2 \end{bmatrix} \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} 4 \\ 2 \end{bmatrix}$$

$$= (4 \times 0.06^2) + 2 \times 0$$
$$= 0.0144$$
$$= 4 \times 0 + 2 \times 0.14^2 = 0.0392$$

$= 0.0144 \times 4 = 0.0576$

$0.0392 \times 2 = 0.0784$

$= 0.0576 + 0.0784 = 0.136$ m

$VaR = \alpha \sqrt{x_i' \Sigma x_i}$

$\sigma^2 p V^2 = x_i' \Sigma x_i$

$VaR = 1.65 \times \boxed{\sqrt{0.136m}}$

$= 0.136$

$VaR = 1.65 \times 368.78$

$= \underline{608.49}$

Diversified VaR

$$VaR_p = Z_c \times \sigma_p \times P$$

σ_p = S.D of the portfolio Returns

P = Nominal Amount invested in a portfolio

Z_c → The Z Score associated with level of confidence c

Marginal VaR:

- Per unit change in a Portfolio VaR that occurs from an add. investment in that portfolio.

Mathematically, P.D of the portfolio VaR w.r.t that position

Marginal VaR = MVaRi =

$$\frac{\partial VaR_p}{\partial (\text{Monetary in investment in } i)}$$

$$= Z_c \frac{\sigma_p}{\partial W_i} = \boxed{Z_c \frac{Cov(R_i, R_p)}{\sigma_p}}$$

$$\beta = \frac{Cov(R_i, R_p)}{\sigma^2 p}$$

$$\boxed{\text{Marginal VaR} = \frac{VaR_p}{\text{Portfolio Value}} \times \beta_i}$$

Portfolio X → VaR = 400,000

A, B, C, & D → Assets are

Each asset valued at 1,000,000

β_A

$\beta_A = 1.2$ → Marginal VaR of Asset A?

Ans:

$$\text{Marginal } VaR_A = \frac{VaR_p}{\text{Portfolio Value}} \times \beta_A$$

$$= \frac{\cancel{400,000}^{\,1}}{{}_{10}\,\cancel{4,000,000}} \times 1.2$$

$= 0.12$

Thus, portfolio VaR will change by 0.12 for each change in Asset A.

Incremental VaR

- Change in VaR from the addition of a new position in a portfolio

Step 1:- Estimate the risk factors of new position and include them in vector (n).

Step 2:- For the portfolio, estimate the vector of marginal VaR for the risk factor (MVaRj)

Step 3:- Take the cross product

Incremental VaR =

$$VaR_{p+\alpha} - VaR_p$$

portfolio

additional position

Managing portfolios using VaR

→ Investor ↓ Portfolio VaR

→ ~~Reduce position by fixed amt~~

$= W_1 = 4, \ W_2 = 2m$

$= W_1 = 5m, \ W_2 = 1m$

VaR =

$$\begin{bmatrix} 5 & 1 \end{bmatrix} \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} 5 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 5 \times 0.06^2 + 1 \times 0 & 5 \times 0 + 1 \times 0.1 \end{bmatrix} \begin{bmatrix} 5 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0.018 & 0.0196 \end{bmatrix} \begin{bmatrix} 5 \\ 1 \end{bmatrix}$$

$$= 0.018 \times 5 + 1 \times 0.0196$$

$$= 0.1096$$

$$VaR_p = 1.65 \times \sqrt{0.1096m}$$

$$= 546.247$$

Example 1 → 608.48

Ex 2 → 546.247

Marginal VaR:

$Cov(R_1, R_p)$

$Cov(R_1, R_p) = \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} 5 \\ 1 \end{bmatrix}$

$Cov(R_2, R_p)$

$= \begin{bmatrix} 0.06^2 \times 5 \\ \end{bmatrix}$

$$= \left[\frac{0.05^2 \times 5}{0.14^2 \times 1} \right]$$

$$= \left[\frac{0.018}{0.0196} \right]$$

$$MVAR_i = \overset{Z_C}{1.65} \times \frac{Cov(R_i, R_p)}{\sigma_p}$$

$$MVAR_A = 1.65 \times \frac{0.018}{\sqrt{0.1096}}$$

$$= 0.0897$$

$$MVaR_B = 1.65 \times \frac{0.0196}{\sqrt{0.1096}} =$$

$$= 0.0977$$

MVaR		Exp	Exp2
A	= 0.08971	4/6	5/6
B	= 0.0977	2/6	1/6

VaR =	608.48	546.25

Sharpe's Ratio ->