



## P2.T8. Risk Management & Investment Management

### Bionic Turtle FRM Practice Questions

#### Global Topic Drill

By David Harper, CFA FRM CIPM  
[www.bionicturtle.com](http://www.bionicturtle.com)

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## Global Topic Drill: Risk Management & Investment Management

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### P2.T8.400. Diversified portfolio Value at Risk (VaR)

400.1. A portfolio with a value of \$800.0 million contains two positions: the first position has a value of \$520.0 million (65% weight) and a 99.0% individual VaR of \$242.0 million; the second position has a value of \$280.0 million (35% weight) and an individual VaR of \$195.0 million. The positions are uncorrelated (correlation equals zero) with returns that are normally distributed. Which is nearest to the **DIFFERENCE** between the diversified and undiversified VaR at the 99.0% confidence level?

- a) Zero; i.e., no difference due to zero correlation
- b) \$48.5 million
- c) \$93.0 million
- d) \$126.2 million

400.2. Consider a \$1.0 billion portfolio with the following two positions:

- Asset A has a value of \$700.0 million (70% weight) with volatility of 22.0% per annum
- Asset B has a value of \$300.0 million (30% weight) with volatility of 45.0% per annum
- Their returns are normally distributed with a correlation of +0.60

Which is **nearest** to the 95.0% incremental VaR of Asset B?

- a) \$50.0 million
- b) \$91.7 million
- c) \$172.1 million
- d) \$203.6 million

400.3. Consider a \$100.0 million Portfolio (P) which holds the following two positions:

- Asset A has a value of \$50.0 million (50% weight) with volatility of 13.0% per annum; and the beta of Asset A with respect to the portfolio,  $\beta(A, P)$ , equals 0.520.
- Asset B has a value of \$50.0 million (50% weight) with volatility of 26.0% per annum; and the beta of Asset B with respect to the portfolio,  $\beta(B, P)$ , equals 1.480.
- The correlation between asset returns,  $\rho(A)$ , is 0.30. The correlation between Asset A and the portfolio,  $\rho(A, P)$ , is equal to  $0.647 = 0.520 \times \text{volatility}[\text{Portfolio}] / 13.0\%$ . The correlation between Asset B and the portfolio,  $\rho(B, P)$ , is equal to  $0.9213 = \text{volatility}[\text{Portfolio}] / 26.0\%$ .
- As the portfolio volatility is 16.18%, the 95.0% portfolio VaR = \$26.6 million (returns are normally distributed)

Which is **nearest** to the component VaR of Asset B?

- a) \$10.8 million
- b) \$16.5 million
- c) \$19.7 million
- d) \$21.4 million

**Answers:**

**400.1. D. \$126.2 million**

Undiversified VaR = \$242.0 + \$195.0 = \$437 million.

Diversified VaR =  $\text{SQRT}(242.0^2 + 195.0^2 + 2 \cdot 242.0 \cdot 195.0 \cdot 0) = \text{SQRT}(242.0^2 + 195.0^2) = \text{SQRT}(242.0^2 + 195.0^2 + 2 \cdot 242.0 \cdot 195.0 \cdot 0) = \$310.79$

Undiversified VaR - Diversified VaR = \$126.21 million

Please note: we do not require the confidence level (it is already implicit in the given VaRs).

**400.2. C. \$172.1 million**

Incremental VaR [Asset B] = Diversified Portfolio VaR - Individual VaR [Asset A]; i.e., the increase in Portfolio VaR due to the addition of Asset B.

Incremental VaR [Asset B] = \$425.41 - \$253.31 = \$172.10

**400.3. C. \$19.7 million**

Component VaR = Portfolio VaR \* position weight \* beta(B,P) = \$26.6 \* 50% \* 1.48 = \$19.6840; or,

Component VaR = Position VaR \* correlation(B,P) = [\$50 \* 26% \* 1.645] \* 0.9213 = \$19.70, or could also calculate marginal VaR (0.3937) and use:

Component VaR = marginal VaR (B, P) \* Position = 0.3937 \* \$50 = \$19.685.

Please note Component VaR[A] ≈ \$6.9 such that sum of Component VaRs is equal to Portfolio VaR of \$26.6 million.

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