

Assignment of Session 4:

1. Consider a portfolio of options on a single asset. Suppose that the delta of the portfolio is 10, the gamma of the portfolio is -2, the value of the asset is \$12, and the daily volatility of the asset is 1%. Derive a quadratic relationship between the change in the portfolio value and the percentage change in the underlying asset price in one day.

- Calculate the first three moments of the change in the portfolio value.
- Using the first two moments and assuming that the change in the portfolio is normally distributed, calculate the 1-day 95% VaR for the portfolio.
- Use the third moment and the Cornish-Fisher expansion to revise your answer to b).

2. A company has a long position in a 2-year bond and a 3-year bond as well as a short position in a 5-year bond. Each bond has a principal of \$100 and pays a 5% coupon annually. Calculate the company's exposure to the 1-year, 2-year, 3-year, 4-year and 5-year rate. Use the data on Page 12 of Handout 4 to calculate a 20-day 95% VaR on the assumption that rate changes are explained by (a) one factor, (b) two factors, and (c) three factors. Assume that the current zero-coupon yield curve is flat at 5% with continuous compounding, i.e., the zero rate now is 5% for all maturities. (Hint: First find the delta of the portfolio with respect to the 1-year, 2-year, 3-year, 4-year and 5-year rate, like the one on Page 13 of Handout 4)

3. The calculations in Section II of Handout 4 assume that the investments in the DJIA, FTSE 100, CAC 40, and Nikkei 225 are \$4 million, \$3 million, \$1 million, and \$2 million, respectively. How do the VaR and ES change if the investments are \$3million, \$3 million, \$1 million, and \$3 million, respectively? Carry out calculations when

- volatilities and correlations are estimated using the equally weighted model and
- when they are estimated using the EWMA model.

What is the effect of changing λ from 0.94 to 0.90 in the EWMA calculations? Please explain the effect with one sentence.

Use the spreadsheets named "HW4Q3_VaRExampleRMFI4eModelBuilding.xls".