Vrije Universiteit Amsterdam De Boelelaan 1105
FEWEB 1081 HV Amsterdam

**Examination Quantitative Financial Risk Management QF 4.5,
June 27, 2011.**

Please provide motivated, concise and clear answers, in readable writing. Results of the exam will be announced on July 1, 2011. Questions regarding your grades can be addressed to me by email or by appointment after that date.

1. You have 1 mln US dollar and you borrow the Euro equivalent of additional 1 mln dollars against 1-year Dutch Treasury certificates rate. You invest your total into emerging markets (Morgan Stanley Capital International Emerging Markets Index) and into Goldman Sachs Commodity Index (both quoted in US dollars) in equal proportion.

   a) Identity your risk factors. Write down the loss operator, which maps the risk factor changes into losses.

   b) Calculate a first-order approximation of the loss operator (i.e. write down the *linearized loss operator*), and express the portfolio loss as a linear function of the risk factor changes.

   c) Calculate the portfolio weights in b) if MSCI EM today was at $ 1107, GSCI at $ 674, Eurodollar exchange rate is at 1.41 and US treasury bond rate at 2%. Calculate also the coefficients of the linear approximation b) of your portfolio loss.

2. A 2-mln US dollars portfolio consists of an emerging market index MSCI EM, commodity index GSCI and a US treasury bond, in proportions (1/3, 1/3, 1/3). The yearly average return is 15% for the emerging market index, 20% for commodity index and 2% for a bond. The yearly volatilities are resp. 60% for emerging markets index, 30% for commodities and 10% for the bond. The correlations are: -0.15 between emerging market and commodities index, 0.15 between emerging market and bond, and 0.2 between commodities and bond.

   a) Compute the the average yearly portfolio return and the yearly volatility of your portfolio.

   b) Give the estimates of *monetary* (so no in %) Value-at-Risk(0.95, 1 day) and VaR(0.99, 1 day), for your portfolio, assuming normality of the returns and also assuming the returns have Student-t distribution with 4 degrees of freedom (the corresponding quantilies are 1.645 and 2.326 for Normal (0,1) and 2.132 and 3.747 for Student-t(4)).

   c) Under the assumption of Normal distribution, compute also the VaR(0.95, 1 week), VaR(0.95, 1 month) and VaR(0.95, 1 year).

3. Assume that GSCI at the close of trading yesterday was $ 668 and the latest estimate of the yearly volatility of the index was 30% per year. The parameters in GARCH(1,1) model for daily volatility are w=0.000003, a=0.1 and b=0.8. The index was at $ 674 today.

   a) What is the daily volatility corresponding to annual 30 % per year? What is the long-run average yearly volatility following from this GARCH model?

   b) What is the new volatility estimate following from this GARCH model (yearly and daily)?

   c) If we use the standard EWMA method for updating the volatility, what is then the new volatility estimate?

4. a) Use Merton's model to explain why there exists a conflict of interest between bond and share holders.

   b) Give two advantages of the KMV model compared to Merton's approach.

5. Consider a portfolio of 3 credit risks and assume a one factor Gaussian model. Assume that the probability of default of company k, conditional on a realization of the common factor Y, is given by $p_k(y)$ with $k = 1, 2$ or 3. Model the default of company k by a latent variable $V(k)$ which has a standard normal distribution. Assume that the common factor Y has a standard normal distribution.

   a) Describe the one-factor model.

   b) Give the probability of two defaults conditional on $Y = y$.

   c) Give the formula for the probability of two defaults.

d) Explain how rating migrations can be incorporated in the factor model.

e) Explain what happens to the price of a first-to-default swap if we increase the asset correlations.