Exam Financial Risk Management QF 4.2,
December 19, 2006, 18:30-21:15.

Please provide motivated, concise and clear answers, in readable writing.
The exam grade is worth 55% of your final grade. Other 45% are composed equally of two assignments and the presentation.
Results of the exam, assignments and the final grades will be announced on January 12, 2007 at 18:00.
Questions regarding your grades can be asked on Monday, January 15, 2007 between 14:00 and 15:00.

1. You have V mln US dollars in cash. In addition to that, you borrow exactly the same amount against the current 1-year US Treasury interest rate (i.e. by selling short 1-year zero-coupon US Treasury bonds). The proportion λ ($\lambda \in (0,1)$) of the total money are then invested in NIKKEI 225 index (quoted in Yen) and $1 - \lambda$ in Dow Jones Industrial Average (quoted in US dollars).

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

2. The next table gives twenty-one latest daily *values* of the 1-year US interest rate, NIKKEI 225 index, Dow Jones Industrial Average and USD/JPY exchange rate.

Date	1 yr ir (%)	NIKKEI 225	DJInd Av	USD/JPY
15/12/06	4.49	16829	12318	117.6
14/12/06	4.55	16693	12307	117.4
13/12/06	4.57	16638	12278	117.2
12/12/06	4.48	16418	12309	117.0
11/12/06	4.43	16371	12331	116.2
8/12/06	4.52	16266	12284	115.1
7/12/06	4.58	16321	12194	114.9
6/12/06	4.62	16076	12222	115.3
5/12/06	4.65	15855	12122	115.6
4/12/06	4.67	15734	12280	116.3
1/12/06	4.75	16163	12327	116.1
30/11/06	4.69	16289	12343	115.9
29/11/06	4.63	16022	12252	116.6
28/11/06	4.74	16198	12132	118
27/11/06	4.60	16393	12108	117.7
24/11/06	4.56	16350	12177	118.2
23/11/06	4.62	16399	12106	117.4
22/11/06	4.68	16811	11986	117.9
21/11/06	4.74	16700	12090	118.4
20/11/06	4.79	16788	12163	119.1
17/11/06	4.84	16506	12002	118.5

   Consider the portfolio from the previous question. Take V=1 mln US dollars, λ=0.7. From the above historical data, construct a set of possible daily losses of your portfolio. Using these historically simulated losses, give the estimate of Value-at-Risk(0.95, 1 day).

   Describe (briefly) how you would complement such a historical simulation method by stress testing (i.e. scenario simulation).

3. Consider a portfolio of 3 credit risks and assume a 2 factor model. Assume that the probability of default of company i, with $i = 1, 2$ or 3 is given by $p(i)$ and model the default of company i by a latent variable $X(i)$ which has a standard normal distribution. Assume that the two factors $Y(1)$ and $Y(2)$ have independent standard normal distributions.

a) Describe the two factor model.

b) What are the asset correlations in your model?

c) What are the default correlations in your model?

d) Give the probability of two defaults conditional on $Y(1)$ and $Y(2)$.

4. a) Give the definition of a Bernouilli mixture model for calculating the loss distribution of a portfolio of credit risks.

b) For pricing of CDO tranches one might use different probabilities of default for the same underlying company as one might use in calculating the loss distribution of a portfolio of credits. Explain why there is such a difference.

c) Explain the concept of importance sampling by a simple example based on a binomial or normal distribution.

5. **The last question: you can choose to answer ONE of the following four questions**:

• Give the definition of copula. Which fundamental theorem lies in the foundation of modelling dependence by copulas? Formulate this theorem, if you remember it (*bonus point*). What is a very useful property of copulas? Explain what are the advantages of using copulas for modelling dependencies between risk factors over the traditional joint-distribution or the correlation approach.

• What is a coherent risk measure? Which is the main property that such a measure should satisfy? Why is this such an important property? Formulate all four axioms of coherent risk measures, if you remember them (*bonus point*). Is VaR coherent? If not, what would be an alternative risk measure? What are possible implications of using a non-coherent risk measure for a bank-wide risk management?

• Give the definition of operational risk. Give examples of operational losses and of recent financial disasters that happened due to operational risk. Describe the three approaches allowed by Basel II to operational risk measurement. What are the regulatory capital requirements for each approach under Basel II? What are the main challenges in modelling operational risk loss data and what are possible quantitative solutions?