Delft University of Technology Mekelweg 4
EWI Faculty 2628 CD Delft

Risk Management WI3421TU
Final Exam
January 25th 2013, 14.00-17.00

The language of this exam is English.
Please only use the paper sheets here provided.
You can make use of a non-programmable calculator and of a cheat-sheet (A4 only front) containing formulas. No definition, no exercises on it. I will pass and sign it during the exam.
Please provide your student card on the table, ready for inspection.
Mobiles, tablets and similar objects must be switched off.
During the first hour you cannot leave the room, even if you decide not to hand your exam in.
After the first hour, if you need to go to the toilet (max one person at a time) you have to temporarily hand your exam in.
The exam is invalidated if you cheat, use your mobile, etc.
Please write with a pen. Pencils are not accepted.
Please write your name, surname and student number.
Good Luck!

Name: ..... **Surname:** ..... **Student Number:** .....

Part 1: Multiple Choice Questions [2.5]

Please notice: Each question may have more than one correct answer. Each correctly answered question is worth 0.25 points.

1. We have two assets: X and Y. Their covariance is $\sigma(X, Y) = 0$. Then we can say that:

A. X and Y are independent.

B. X and Y are uncorrelated.

C. $Y \geq X$.

D. $X = Y$.

E. X and Y are non-linearly dependent.

2. Consider the following portfolio based on a Delta-neutral asset:

	Delta	Gamma	Vega
Portfolio	0	-2000	-5000
Option A	0.6	0.5	2.0
Option B	0.5	0.8	1.2

The options in the portfolio can be traded.
In order to make the portfolio both gamma and vega neutral we need to add:

A. 1600 units of Option A only.

B. 1400 units of Option B only.

C. 1600 units of Option A and 1500 units of Option B.

D. 1400 units of Option A and 2100 units of Option B.

E. Nothing, because the portfolio is already Gamma and Vega neutral.

3. The Gamma of a Delta-neutral portfolio of options on an asset is -4500. Suppose that, in an infinitesimal time interval tending to 0, there is a change of +4 in the price of the asset. What is the unexpected decrease in the value of the portfolio?

A. 0, since the portfolio is Delta-neutral.

B. 0, since the portfolio is linear.

C. -36000.

D. 18000.

E. ± 9000.

F. None of the previous answers.

4. Consider a 3-year bond with a par value of 200 euros that pays 2 euros every three months. The market price of the bond is 194.2893. Then the yield is more or less:

A. It is not possible to say, because of a lack of data.

B. 0.05.

C. 0.5.

D. 0.06.

E. 6%.

F. 5%.

G. None of the previous answers.

5. Portfolio A consists of a one-year zero-coupon bond with a face value of 2,000 CHF and a 10-year zero-coupon bond with a face value of 6,000 CHF. Portfolio B consists of a 5.95-year zero-coupon bond with a face value of 5,000 CHF. The current yield on all bonds is 10% per annum continuously compounded. What can we say about the durations of the portfolio?

A. The duration of A is 5.95.

B. The duration of B is 5.95.

C. A and B have the same duration.

D. The duration of B is 6.

E. The duration of A is 7.8.

F. The duration of B is larger than that of A.

6. Suppose that each of two investments has a 4% chance of a loss of 10 million, a 2% chance of a loss of 1 million, and a 94% chance of a profit of 1 million. They are independent of each other. What about the 95% VaR and ES?

A. They are both equal to 5 million.

B. The 95% VaR is 1 million and the expected shortfall is 8.2 million.

C. The 95% VaR is 10 million.

D. The 95% ES is 2.5 million.

E. The 95% VaR is not subadditive.

F. In this case both the VaR and the ES are coherent.

7. Daily changes for a portfolio have first-order correlation equal to 0.12. The basic 15-day VaR, under the normality assumption, is estimated to be equal to 3 million euros. If we correct the VaR using the information about correlation we obtain the following 10-day VaR:

A. 25.

B. 2.96.

C. 3.36.

D. 2.20.

E. 3.07.

F. None of the previous answers.

8. The VaR is a coherent measure of risk

A. Always.

B. Never.

C. Under elliptically distributed risks.

D. Under spherically distributed risks.

E. Under comonotonic risks.

F. In association with the Expected Shortfall.

9. We have two assets: X and Y. Each of them is normally distributed. What can we say about their joint distribution, i.e. the distribution of (X, Y)?

A. It is a bivariate normal.

B. It is a bivariate normal if X and Y are independent.

C. It may belong to different distribution families.

D. It is a Gaussian copula.

E. It cannot be a bivariate normal.

10. Operational risk, according to the definition of the BCBS (Basel Committee on Banking Supervision), includes:

A. Process risk.

B. Reputational Risk.

C. People Risk.

D. External risks such as terrorism and calamities.

E. Strategic risk.

F. Default risk.

Part 2: Open Questions [2.5]

Please: Write clearly and try to be as complete as possible without useless digressions. Open questions are "open" but rather precise. The given space should be sufficient.
Open questions give different points. You can find the actual values in the brackets.

1. In the Market Risk framework, what are the main differences between the Historical and the Model-building approaches? [1 Point]

2. Describe the basic characteristics of the Merton model, showing how we obtain the very convenient representation of equity and debt in terms of European options. [1 Point]

3. If we compare KMV and Credit Migration models, what are their points of strength and their points of weakness when dealing with business cycles? [0.5 Points]

Part 3: Exercises [5]

Please: Write clearly and provide the computations you have used to obtain the results. Missing computations may halve the points.
To speed up corrections, please write your results here below on the dotted lines. Computations (that you have to provide) can be in a separate sheet. The actual value of each exercise is in the brackets.
Statistical tables are provided.

1. We have two independent investments. Each of them may have a 1% chance of a loss of 10 million euros, a 2% chance of a loss of 5 million, a 3% chance of a loss of 1 million, and a 94% chance of a profit of 1 million.

a. What are the VaR and the ES for one of the investments when the confidence level is 95%?

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b. What are the VaR and the ES for a portfolio P consisting of the two investments when the confidence level is 98%?

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c. We now want to back-test the $VaR_{0.99}$ of a portfolio consisting of the two investments. We have 1200 days of data and we observe 19 exceedances. We set the significance level for the test to be 2%. Should we reject the VaR?

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Here is a table that could be useful for you.
The table contains $P(X \leq n)$ for $X \sim Binomial(n, 1200, p)$.

Table 1: Distribution function of a $Binomial(n, 1200, p)$ random variable.

$P(X \leq n)$	$p = 0.01$	$p = 0.02$	$p = 0.03$
n=16	0.8998	0.0545	0.0001
n=17	0.9380	0.0849	0.0002
n=18	0.9633	0.1258	0.0006
n=19	0.9793	0.1776	0.0012
n=20	0.9888	0.2401	0.0024

[3 Points]

2. We have a Delta-neutral portfolio in euros with Gamma 50 and Vega 25.

a. What happens to the total value of the portfolio if there is a shock on the markets such that the underlying asset price decreases by 6 euros and its volatility increases by 5%?

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b. What happens to the total value of the portfolio if Delta-neutrality does not hold?

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[2 Points]