1. Consider a portfolio consisting of 20 AB Inbev stocks and 30 Kinepolis stocks. The current stock prices of AB Inbev and Kinepolis are respectively €64 and €49. The daily volatility of the AB Inbev stock returns is 2% and of the Kinepolis stock returns is 2,5%. The two stocks have a return correlation of 0.45. Assume that the stock returns are multivariate normally distributed and that a year has 250 trading days.

.

   i. What is the 99% 10-day relative VaR of the portfolio? Interpret.
   ii. Does this portfolio satisfy the subadditivity rule? If so, calculate the diversification effect. If not, explain why.
   iii. Assume that the estimates of the volatility are based on 250 observations. Compute a 95% confidence bound around the VaR estimate of the portfolio.

2. Assume the following simplified 1-year credit rating transition matrix.

		To Rating (1 year)			
		AAA	**BBB**	**CCC**	**Default**
From Rating	**AAA**	0.96	0.04	0.00	0.00
	BBB	0.03	0.90	0.04	0.03
	CCC	0.01	0.10	0.75	0.14
	Default	0.00	0.00	0.00	1

   i. What is the 2-year cumulative probability of default for a AAA-bond (assuming constant transition rates)?
   ii. Consider a portfolio of 2 bonds. The first bond is a 3-year BBB bond with face of value of € 100.000, annual coupon of 3%, and recovery rate of 80%. The second bond is a 3-year CCC bond with face of value of € 50.000, annual coupon of 5%, and recovery rate of 40%. Assume a default correlation of 5%. (Assume that both bonds repay at par.) What is the 1 year credit VaR for this portfolio, without allowing for credit loss because of rating migration?
   iii. When allowing for credit rating migration, calculate the 99%-Credit VaR for the BBB bond above.

To calculate the 1 year forward value, use the following 1-year forward pricing rates (in % per annum). The credit VaR calculations needs to be computed just before the first coupons are received. Explain all your calculations.

Rating	Year1	Year2	Year3	Year4	Year5
AAA	3.60	4.17	4.73	5.12	5.35
BBB	4.10	4.67	5.25	5.63	6.11
CCC	8.10	9.05	9.84	10.55	11.21

3. Assume the following cumulative default probabilities for given credit rating classes.

Rating	Default 1 year	Default 2 years	Default 3 years
AAA	0.00%	0.00%	0.09%
AA	0.03%	0.08%	0.14%
A	0.06%	0.20%	0.34%
BBB	0.24%	0.68%	1.17%
BB	1.06%	2.88%	5.07%
B	4.51%	9.87%	14.43%
CCC/C	25.67%	34.10%	39.25%

i. Calculate the marginal probability of a BB rated bond to default in year 3.

Consider an investment in two bonds *X* and *Y* of € 10 mln each (1 year forward market value). Assume that *X* has an A-rating and that *Y* has a BB-rating. Assume a default correlation of 20%. Assume no recovery and that recovery and credit exposure are deterministic.

ii. Calculate the 99% 1-year credit VaR.
iii. Does this portfolio satisfy the subadditivity rule?

4. Suppose a financial institution has the following simplified balance sheet:

<table>
<tr><th>Assets</th><th>Liabilities</th></tr>
<tr><td rowspan="2">Bond investment A</td><td>Own Funds (Equity capital)</td></tr>
<tr><td>Liabilities to clients B</td></tr>
</table>

- Assume that the bond investment *A* has a fixed annual coupon of 5%, remaining maturity of 5 years and a notional of € 100 mln.
- Assume that the liabilities *B* have also a fixed annual coupon of 5%, remaining maturity of 5 years and a notional of € 90 mln. (Assume that their cash flow pattern can be assumed to be equal to a bond cash flow pattern.)
- Assume a fixed annual market interest rate over all maturities of 4%.
- Assume that the annual volatility of changes in the interest rate equals 1,5%.
- Assume 250 trading days in a year.

i) Calculate the present value and Macaulay duration of both investment *A* and liabilities *B*. For the next subquestions assume that the value on the balance sheet is given by this present value.

ii) What is the duration mismatch between *A* and *B* (in terms of Macaulay duration)? If you allow for the (Euro) size of investment, what is then the mismatch in Macaulay duration (you can express it in Euro terms)?

iii) Suppose that annual market interest rate increases to 5% (over all maturities), approximate the impact on the balance sheet using the duration. Assume no impact on the Own Funds. Interpret the obtained result.

iv) Calculate the 10-day relative 95% market VaR for this portfolio of *A* and *B* assuming a delta normal model.

v) Assume that the full volatility of the asset side is generated by the interest rate volatility, what is the (1-year) PD of this firm using the Merton model? (Hint: first transform the volatility of changes in the interest rate to a volatility of the asset using the duration of the asset. For this subquestion (alone) also disregard any potential volatility coming from the liability side, and assume that the value of B after 1 year would be € 90 mln.)

True or false? Motivate your answer.

1. In their risk management, financial institutions should focus mostly on black swan events as they are most difficult to predict and have a big impact.

2. The risk appetite for all insurance companies is very alike as they are subject to the same regulation.

3. When investing a fixed amount in a portfolio of two investments with correlation, not all combinations of those investments are rationally defendable.

4. Without loss of quality of the model, in the EMWA model it can happen that the decay parameter λ equals 1.

5. For a Zero Coupon Bond, the Macaulay duration equals the remaining maturity of the bond.

6. Assume that in 100 observations you observe 3 breaches of a 99% VaR. We can consider this to be acceptable.

7. If two banks active in trading markets have a lot of trading with each other, they can typically have a lot of credit risk towards each other as well.

8. The basis point value calculation can be considered as an example of a unidimensional stress test.

9. Liquidity risk is an important risk for a bank and the Liquidity Coverage Ratio ensures that short term liabilities can effectively be paid, even in stressed conditions.

10. Returns and logreturns are often used interchangeable, but logreturns have some nice properties.

11. It is logical that the decay parameter of the EMWA model for monthly returns is higher than for daily returns.

12. A positive or negative duration mismatch is the result of the balance sheet positions of the financial institutions and is a pure coincidence of the assets and liabilities it could attract, rather than an explicit choice.

13. In order to allow for kurtosis, either delta normal VaR and historical VaR can be used on an equal setting.

14. If the credit rating of a government bond and of a corporate loan does not differ, one would assume that also the Loss Given Default does not differ.

15. To overcome certain drawbacks of the VaR estimates, stress testing can be helpful.