Exam: Finansiell Risk, MVE 220/MSA400
Wednesday, Januari 9, 14.00-18.00
Jour: Edvin Wedin ankn 5325

Allowed material: List of Formulas, Chalmers allowed calculator.

Problems 1-4: Multiple choice, only hand in table with answers
Only one correct answer. Correct answer gives 5 points, no answer ("don't know") gives 0 points and wrong answer gives -1 point (more than one answer automatically gives -1 point).

Uppgift	a	b	c	d	e	f (Don't know)	Points
1	☐	☐	☐	☐	☐	☐	
2	☐	☐	☐	☐	☐	☐	
3	☐	☐	☐	☐	☐	☐	
4	☐	☐	☐	☐	☐	☐	

Problems 5-10: Hand in full solutions

Good Luck!

1 Consider the following statements:

1 Solvency II is applicable to life insurance, non-life insurance, and reinsurance.

2 The Solvency Capital Requirement (SCR) is the amount of capital required when taking all quantifiable risks the company is exposed to into account. A consequence of this is that companies investing in high-risk investments, such as equities, must maintain higher SCR than companies investing in low-risk investments such as government bonds.

3 The Minimal Capital Requirement (MCR) is the smallest amount of capital the company is required to maintain before it is considered to be exposed to an unacceptable level of risk.

4 Solvency 2 only includes quantitative requirements, which can be given numerical values.

Which of the following is true?

(a) ☐ Statement 1 is wrong; the others are correct

(b) ☐ Statement 2 is wrong; the others are correct

(c) ☐ Statement 3 is wrong; the others are correct

(d) ☐ Statement 4 is wrong; the others are correct

(e) ☐ None of the above

(f) ☐ Don't know.

2 Consider the following statements:

1 In a Ponzi scheme the trick is to continuously attract new investors whose money then is used to pay dividends and cover cost for earlier investors who want to withdraw their money from the company.

2 The US Securities and Exchange Commission (SEC) is the agency responsible for enforcing the laws regarding stock and options exchange, to keep the market fair and to protect its investors. The SEC was able to very efficiently and quickly find out that Bernard L Madoff investment Securities firm was a fraud.

3 None of the persons involved in the Bernard L Madoff investment Securities firm were put in jail.

4 The Spanish bank Banco Santander lost a large amount of their customers' money by investing in Bernard L Madoff investment Securities.

Which of the following is true?

(a) ☐ All the statements are correct

(b) ☐ 1 and 2 are wrong; the others are correct

(c) ☐ 3 and 4 are wrong; the others are correct

(d) ☐ 2 and 3 are wrong; the others are correct

(e) ☐ None of the above

(f) ☐ Don't know.

3 Consider the following statements:

1 The three largest banks of Iceland were never deregulated but were throughout subject to strong regulatory requirements.

2 In 2008 the financial system in Iceland collapsed when the banks couldn't refinance their loans. The Icelandic government could have bailed out the banks, but decided not to do this.

3 A credit default swap (CDS) is an insurance against default of, e.g., a bond.

4 Major civil unrest followed from the risk of imminent collapse of the Icelandic financial system.

Which of the following is true?

(a) ☐ 1 and 2 are correct; the others are wrong

(b) ☐ 2 and 3 are correct; the others are wrong

(c) ☐ 3 and 4 are correct; the others are wrong

(d) ☐ 1 and 3 are correct; the others are wrong

(e) ☐ None of the above

(f) ☐ Don't know

4 Consider the following statements:

1 Tyco international provides an example of the financial risks caused by companies who misrepresent and overstate their financial reports.

2 The IT-company Xcelera managed to reach a market valuation in excess of $11 billion without having a working technology or any substantial sales.

3 Xcelera presented the market with erroneous information where important information was withheld. This was possible because the company was registered on the Cayman Islands which has more relaxed rules for financial supervision.

4 The goal for Basel III is that the regulation, supervision and risk management within the banking sector sould be improved and that this should make financial bubbles and crises less common.

Which of the following is true?

(a) ☐ Statement 1 is correct; the others are wrong

(b) ☐ Statements 1, 2 are correct; the others are wrong

(c) ☐ Statements 1, and 4 are correct; the others are wrong

(d) ☐ Statements 2 and 4 are correct; the others are wrong

(e) ☐ None of the above

(f) ☐ Don't know.

5 During a year there have been n excesses $x_1, x_2, \ldots, x_n$ of the level 3 by the losses (= -returns, with returns expressed in %) for a financial portfolio. Suppose that the excesses are exponentially distributed with distribution function $F(x) = 1 - e^{-x/\sigma}$.

a) Write down the log likelihood function for the observations. (2p)

b) Maximize the likelihood function with respect to σ and use this to find a formula for the maximum likelihood estimate of σ. (2p)

c) Suppose there were $n = 9$ excesses during the year, and that their values were $0.42, 3.53, 0.03, 2.56, 0.28, 0.01, 2.60, 0.27, 3.35$. Compute the maximum likelihood estimator of σ and use it to find an estimator of the median of the distribution of the excesses. (2p)

6 Suppose that the random variable X has follows a GP distribution with distribution function $F(x)$, and for $x > 0, u > 0$ define $F_u(x)$ by

$$F_u(x) = P(X - u \leq x | X > u),$$

so that $F_u(x)$ is the conditional distribution of excesses of the level u.

a) Write σ and γ for the scale and shape parameters, respectively, of $F(x)$. Assume that $\gamma > 0$. Show that also $F_u(x)$ is a GP distribution, and express the parameters of $F_u(x)$ in terms of the parameters of $F(x)$. (3p)

b) Assume that $\gamma \leq 0$. Show that also in this case $F_u(x)$ is a GP distribution, and express the parameters of $F_u(x)$ in terms of the parameters of $F(x)$. (Hint: treat the case $\gamma = 0$ separately.) (3p)

7 In a risk analysis 17531 hourly losses for a stock, measured in basis points (a basis point is 1/100 of 1 %), a GP distribution was fitted to the 152 excesses of the level 30 bp. The resulting computer output is given in figure 1 below (sigma = σ and gamma=γ are the scale and shape parameters, respectively, of the GP distribution).

a) Use the fitted GP model to estimate the probability that an hourly loss exceeds 55.4 (3p)

b) The 12 largest losses were 86.6, 83.3, 76.7, 72.4, 67.3, 59.4, 59.2, 55.9, 55.4. The proportions of hourly losses which exceed 55.4 provides another way of estimating the probability that an houly loss exceeds 55.4. Compute this estimate, and comment briefly on advantages and disadvantages of using this estimate instead of the GP estimate. (3p)

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$threshold:
[1] 30

$nexc: (Number of exceedances of threshold)
[1] 152

$conv:
[1] T

$nllh: (Negative log-likelihood)
[1] 485.0937

$mle:
     sigma     gamma
[1] 7.4402658 0.1844994

$rate:
[1] 0.008670355

$cov.mat:
            [,1]        [,2]
[1,]  0.91878428 -0.06550793
[2,] -0.06550793  0.01024228
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Figure 1:

c) Perform a statistical test of the hypothesis that the shape parameter $\gamma = 0$. (2p)

8 Consider a static credit portfolio with $m = 1000$ obligors which we model as a mixed binomial model with a logit-normal mixing distribution (for one year, say) with parameters $\mu = -2.5371$ and σ. Each loan have notional 1 million SEK and the individual loss is $\ell = 60\%$. We know that the one-year LPA-VaR formula produces the value $\text{VaR}_{95\%}(L) = 172.3$ million SEK. Use the LPA-approximation formula to compute the probability that within one year, the total portfolio credit loss will be more than 30 million SEK but less than 80 million SEK. (6p)

9 Assume that you manage a credit portfolio with $m = 1000$ loans issued by corporates all having identical asset structure, which is modeled according to Mertons framework. Recall that in this credit portfolio model each obligor i can be considered as a firm in the sense that the value of obligor i-s assets $V_{t,i}$ at any time point $t \geq 0$ follows the dynamics

$$V_{t,i} = V_{0,i} e^{(\mu_i - \frac{1}{2}\sigma_i^2)t + \sigma_i B_{t,i}}$$

where

$$B_{t,i} = \sqrt{\rho} W_{t,0} + \sqrt{1-\rho} W_{t,i}$$

and $W_{t,0}, W_{t,1}, \ldots, W_{t,m}$ are independent standard Brownian motions. Hence, at each time point t it holds that $W_{t,i} \sim N(0,t)$, i.e. $W_{t,i}$ is normally distributed with zero mean and variance t. Here, $W_{t,0}$ is the economic background factor affecting all obligors.

In the homogeneous model it holds that $V_{0,i} = V_0$, $D_i = D$, $\sigma_i = \sigma$, $\mu_i = \mu$ are the same for all corporates $i = 1, 2, \ldots, m$. The initial asset-to-debt ratio $R = \frac{V_0}{D}$ reflects the initial credit-riskiness for each company, where $R < 1$ means that each corporate is over-leveraged (i.e has more loans than asset) while $R > 1$ implies a profitable/healthy company at origin (i.e. today). Assume that you have estimated the asset volatility to $\sigma = 0.2$, the drift of the asset-return to $\mu = 0.05$ and consider the companies over one year, i.e. $T = 1$. The pairwise asset correlation ρ between any pair of companies in the portfolio is estimated as $\rho = 0.15$. At a default the individual loss is $\ell = 0.6$, i.e. 60% and we can due to the linearly of VaR assume that each loan in the portfolio has a notional exposure of one monetary unit. Use the mixed binomial model inspired by the Merton model together with the LPA approach to compute the one-year $\text{VaR}_\alpha(L)$ for this portfolio where $\alpha = 95\%$ and the asset-to-debt ratio R is given by $R = 1.1$. (8p)

10 Consider a homogeneous static credit portfolio which we model as mixed binomial model with mixing probability $p(Z)$ where Z and $p(Z)$ are continuous random variables. Let $F(x) = \mathbb{P}[p(Z) \leq x]$. Assume that the portfolio consists of m obligors where the individual loss is constant and in percent of the notional amount and each loan has notional amount 1. Use the LPA formulas for VaR and ES in order to rigourously prove that

$$1 \leq \frac{\mathrm{ES}_\alpha(L)}{\mathrm{VaR}_\alpha(L)} \leq \frac{1}{F^{-1}(\alpha)} \quad \text{for all } \alpha \in (0,1).$$

(6p)