Christian-Albrechts-Universität zu Kiel **WS 2016/17**
Mathematisches Seminar
Prof. Dr. Mathias Vetter
Mark Feodoria, Ole Martin Sheet 01

Risk Management

Exercises for participants of **mathematical programmes**

C-Exercise 1

On the OLAT entry of this course you will find a time series $s_1, \ldots, s_{6562}$ containing daily DAX data from 26.11.1990 to 25.10.2016.

(a) Import the time series to *scilab* and plot it.

(b) Compute the daily log returns

$$x_n := \log\left(\frac{s_n}{s_{n-1}}\right), \qquad n = 2, \ldots, 6562,$$

and plot them.

(c) Plot a histogram of the log returns using 30 intervals.

(d) Assume that the log returns are independent and identically distributed realizations from a normal distribution with mean μ and standard deviation σ. Give estimators for μ and σ.

Please label the diagrams and give a description of the *scilab* operations in your `sce`-file.

Useful *scilab* commands: `csvRead`, `plot`, `length`, `histplot`, `mean`, `variance`

C-Exercise 2

Assume that the daily log returns of some stock are independent and normally distributed with mean $\mu = 0.0003062$ and standard deviation $\sigma = 0.0143290$.

(a) Generate a random sample $x_2, \ldots, x_{6562}$ of daily returns and plot it.

(b) Compute with $s_1 = 1443.20$ the stock price pertaining to this random sample and plot it.

Please label the diagrams and give a description of the *scilab* operations in your `sce`-file.

Useful *scilab* commands: `grand`, `cumsum`

Please turn over.

T-Exercise 3

Let $S_{n,1}$ denote the price of the BMW stock and $S_{n,2}$ the price of the Siemens stock in Euros at time t_n. A Bank sets up a portfolio with value 1000 € at time $t_0 = 0$ that always invests 50% of the current portfolio value in the BMW stock and 50% in the Siemens stock. The bank wants to calculate the portfolio value V_n at time t_n in Euros. For the purpose of risk management the risk factors $Z_{n,1} := \log(S_{n,1})$ and $Z_{n,2} := \log(S_{n,2})$ are chosen.

(a) Derive the function that computes the portfolio value from the risk factors.

(b) Derive the risk factor changes $(X_{n+1,1}, X_{n+1,2})$ at time t_{n+1}.

(c) Derive the loss operator $l_{[n]}$, i.e. the function that computes the loss at time t_{n+1} from the risk factor changes.

(d) Derive the linearized loss operator $l^{\Delta}_{[n]}$, i.e. the function that computes the linearized loss at time t_{n+1} from the risk factor changes.

P-Exercise 4

For time points $t_n = n\Delta t, n \in \{0, \ldots, N\}$, let P_n denote the price of a zero coupon bond with maturity $T > t_N$ at time t_n. A Bank buys a portfolio consisting of one share of the zero coupon bond. For the purpose of risk management the bank chooses the so called *yield to maturity* $Z_n := -\frac{1}{T-t_n}\log(P_n)$ as a risk factor.

(a) Derive the function that computes the portfolio value from the risk factor.

(b) Derive the risk factor change X_{n+1} at time t_{n+1}.

(c) Derive the loss operator $l_{[n]}$, i.e. the function that computes the loss at time t_{n+1} from the risk factor change.

(d) Derive the linearized loss operator $l^{\Delta}_{[n]}$, i.e. the function that computes the linearized loss at time t_{n+1} from the risk factor change.

Please save your solution of each C-Exercise in a file named `Exercise_##.sce`, where ## denotes the number of the exercise. Please include your name(s) as comment in the beginning of the file.

Submit until: Wednesday, 9.11.2016, 12:00
Discussion: in tutorials on Mon, 14.11.2016 and Wed, 16.11.2016