Mini Cases

Risk Management

2024/2025

Please upload your solutions and indicate which Mini-Cases (MCs) you have solved before **May 12, 2025 at 7am**. To do so, go to the assignment section on Canvas and choose "Unit 1 Indication and Submission of MCs". Then answer the true/false questions (Questions 1 to 6) and upload your solutions file (Question 7). **There will be no deadline extensions! Only complete submissions containing answers to the T/F questions and a solutions upload will be considered, your last complete attempt counts!** You can either write your solutions using software or scan your handwritten solutions. Please note that you may only submit one solutions file. If your solutions consists of more than one file (e.g. 1 pdf and 1 Excel file), please upload a .zip file. Uploaded files will be checked for plagiarism. The solutions in your file should be self-explanatory - not only for the instructor, but for other students as well. Indicate only Mini-Cases you feel confident to present.

Important remark for the presentations: Make sure to provide a concise explanation of your solutions. In particular, when applying any formula from the lecture materials or other sources, you may be asked to explain the structure of your solutions and provide the intuition and underlying concepts behind the formula used.

Mini Case 1.1.

Consider the (equally likely) payoffs of two investment opportunities with the same mean in "Mini_Case_1_1.xslx" or "Mini_Case_1_1.Rdata". For simplicity, assume that both require an initial investment of 0. Now assuming you are a risk averse-investor, which investment opportunity would you choose if...

- ...you have a quadratic utility function?
- ...you use the 5% VaR (based on the quantile of the actual profit/loss distribution) as your risk measure?
- ...you use the 0.1% VaR (based on the quantile of the actual profit/loss distribution) as your risk measure?
- Finally, compare the histograms of the payoffs and discuss why your decision changes.

  Hint:
  For a better comparison, try to set an underflow/overflow bin at -4 *and* 6*, use* 22 *bins, and fix the y-axis from (*0 *to* 2000*). In R you have to create the underflow/overflow bin manually by assigning the respective cutoff values to all values that are greater or smaller. In Excel you can adjust them in "Format Axis".*

Mini Case 1.2.

Consider a value process W_t that follows a Random Walk with drift, i.e., $\frac{\Delta W}{W} = \mu H + \sigma\sqrt{H}Z, \quad Z \sim N(0,1)$, where $\mu = 8\%$ p.a., $\sigma = 16\%$ p.a., and $W_t = 150$.

- What is the expected return and volatility for a time period of 7 years?
- Consider a realization of Z equal to -1.6449. What is the return of W in 7 years?
- What is the 7 year 1% VaR?

Mini Case 1.3.

Download historical daily price data for the S&P 500 from 2015-01-01 to 2020-07-01. Assume that "today" is 2020-01-01, and you have a portfolio that perfectly tracks the S&P 500. You believe that the returns are normally distributed and want to know the one-day VaR of your position.

- Calculate daily returns based on the close prices for the entire time period. (For simplicity, we ignore dividends and/or capital gain distributions.)
- Use the daily returns from 2015-01-01 up to "today" 2020-01-01 to estimate the volatility of the process.
- Estimate the daily 5% VaR (short time horizon) in percent of some fixed notional W based on "past" returns.
- Looking at the period from "today" 2020-01-01 to the "future" 2020-07-01: How often would you expect to see more extreme returns than the 5% VaR, and how often do you actually see more extreme returns?
- Plot the return time series and explain what you see!

Mini Case 1.4.

Consider two value processes W and Y that follow a Random Walk with drift, i.e. $\frac{\Delta W}{W} = \mu_1 H + \sigma_1 \sqrt{H} Z_1, \quad Z_1 \sim N(0,1)$ and $\frac{\Delta Y}{Y} = \mu_2 H + \sigma_2 \sqrt{H} Z_2, \quad Z_2 \sim N(0,1)$ and correlation coefficient ρ. Both have an initial value of 80, $\mu_1 = 8\%$ p.a., $\mu_2 = 11\%$ p.a., $\sigma_1 = 19\%$ p.a., and $\sigma_2 = 22\%$ p.a. Assume that you have a portfolio P with an initial value of 80, and it contains equal weights of both assets W and Y. For which value of ρ is the 1-year 1% VaR equal to 24.2885.

Hint:
Start with writing down the value process of your portfolio and think about its drift

and volatility. Additionally, recall that for two assets:

$$\sigma = \sqrt{w^T \Sigma w} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2\rho w_1 w_2 \sigma_1 \sigma_2}.$$

Mini Case 1.5.

Consider the share prices in "Mini_Case_1_5.xslx" or "Mini_Case_1_5.Rdata". Assume that you own $6,000$ shares of Erste Bank Group (EBS), $4,000$ shares of Verbund (VER), $2,000$ shares of Voestalpine (VOE), 1000 shares of Andritz (ANDR), and $5,000$ shares of OMV (OMV).

- Estimate the variance-covariance matrix based on the historical time series.
- Calculate the daily 0.5% VaR using the delta-normal assumption.

Mini Case 1.6

Consider the share prices in "Mini_Case_1_6.xslx" or "Mini_Case_1_6.Rdata". Assume that you own $7,000$ shares of Erste Bank Group (EBS), $12,000$ shares of Verbund (VER), $7,000$ shares of Voestalpine (VOE), $4,000$ shares of Andritz (ANDR), and $2,000$ shares of OMV (OMV). Calculate the VaR for a time horizon of one trading day using the historical simulation approach for alphas 5% and 1%, respectively.