Assignment on Value-at-Risk

The aim of this assignment is to get an insight into some of the mostly used Value-at-Risk (VaR) approaches and their properties. By estimating the portfolio VaR using two simple models, i.e. the Parametric Normal VaR and the Historical VaR, you will understand certain pros and cons of these approaches as well as the model risk involved with VaR estimation. You will also assess these models empirically by performing a backtest where you compare the VaR estimates against the realized PnLs over time.

1. Normal VaR versus Historical VaR

In this exercise we estimate the *individual* VaR figures of two portfolios using the Parametric and Historical Simulation approaches.

Both portfolios represent an investment in equity market indices. The first portfolio is a tracker of the German DAX, the second is a tracker of the Swiss SMI. Assume that for the DAX tracker EUR 500 is invested per index point (eg, EUR 500,000 if the DAX tracker is at 1000), while for the SMI tracker the value of the portfolio is represented by EUR 450 per index point.

The history of the index values over the period 31 March 2007 – 1 April 2010 (785 observations) is provided in ‘Sheet1’ of **IndexData.xls**.

1. Estimate the 1-day 99% VaR of both portfolios (individually) on the situation date 1 April 2010 using the Normal VaR approach. To do this:
2. Assume that the overnight **relative** returns are Normally distributed. o
3. Use the entire data sample.o
4. Compute the portfolio VaR using today’s portfolio value. What dose mean? Change?
5. Explain if the assumption of normally distributed returns is valid.
6. Estimate the 1-day 99% VaR for both portfolios (individually) on the situation date 1 April 2010 using the Historical Simulation approach.
7. Use the historical distribution of overnight relative returns over the entire observation period.
8. Compute the portfolio VaR using today’s portfolio value.
9. Can you explain the difference between the Historical and the Normal VaR outcomes based on the model assumptions?
10. 히스토릭이 더 최근의 데이터를 잘 반영해서 그렇다.

2. Portfolio VaR

In this exercise we would like to compute the *consolidated* VaR of the two portfolios considered in exercise 1 using the Parametric and Historical Simulation approaches. Note that in this case we measure the market risk in the *consolidated* portfolio consisting of the two index trackers.

1. Estimate the 1-day 99% VaR of the consolidated portfolio for the situation date 1 April 2010 using the Normal Variance-Covariance VaR approach. To do this:
2. Use the overnight relative returns of individual indices for each day over the observation period.
3. Estimate the mean and standard deviation of the aggregate portfolio returns.
4. Assume that the returns are normally distributed.
5. Compute the portfolio VaR using today’s portfolio value.
6. Estimate the 1-day 99% VaR of the consolidated portfolio for the situation date 1 April 2010 using the Historical Simulation approach.
7. Use the overnight relative returns of the *consolidated* portfolio for each day from the observation period as , for all . Note that for each day in the history, we use today’s asset weights in the portfolio.
8. Compute the consolidated VaR using todays portfolio value
9. Compare the consolidated VaR figures to the sum of individual portfolio VaRs. Can you explain the difference? How large is the diversification effect for each of the VaR models?

3. VaR Backtesting

In this exercise we will look at the empirical performance of the Historical and Normal VaR models by performing backtests.

In a backtest we compare the 1-day VaR against the realized portfolio PnL over the next day for each day in our observation period.

Consider a tracker in the Eurostoxx 50 (SX5E) index. This portfolio is created on 2 January 2001 with an initial investment of EUR 1 mio. As a risk manager you are interested in the performance of the Historical and Normal VaR models.

Use the data in ‘Sheet2’ of **IndexData.xls** containing the SX5E index values over the period 3 January 2000 – 1 April 2010 (2674 observations) to perform this exercise.

1. Compute for each day from 2 January 2001 – 1 April 2010, i.e. the backtest period, the portfolio value and the daily portfolio PnL using the overnight index returns.
2. Compute for each day from the backtest period the Normal 1-day 99% VaR. Use for each situation date the most recent history of 260 daily returns to re-estimate the mean and the standard deviation of the returns. The data in the first year are provided to initialize the estimation.
3. Compute on each day from the backtest period the Historical 1-day 99% VaR. Use for each situation date the most recent history of 260 daily returns to re-estimate the 1% quantile of the return distribution.
4. Plot the realized portfolio PnL over time against the associated Normal and Historical VaR. Make sure that you compare the next day PnL against today’s VaR.
5. For each of the two VaR models, compute the realized number of VaR exceptions. What is the expected number of exceptions? Which of the two models performs best?