4. Risk Management

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Outline of the presentation

Outline

Measures of financial risk

- In the previous sessions, we have studied different tools to model time series processes, means, volatilities, correlations and higher order dependence structures
- Risk management uses these different modeling techniques to obtain measures of financial risk
- We will mainly focus on measures of tail risk, although the field of risk management covers a broader set of applications
- Main measures of tail risk: Value at risk (VaR), Expected shortfall (ES), CoVaR
- Different approaches are available to estimate these measures, from non-parametric to fully parametric (model-based) approaches

Outline

VaR

- Extreme price movements in the financial markets are rare but important: 1987 Wall Street stock market crash, collapse of LTCM (1998)
- In this context, VaR has become the standard measure of left-tail risk
- It can be defined as the maximal loss of a financial position during a given time period for a given probability
- VaR was originally designed as a measure of market risk, but the concept is also applicable to other types of risk
- It is generally used to estimate the capital needed to ensure that financial institutions can still be in business after a catastrophic event

- Consider a financial asset price P_t

- For a given confidence level α and a time horizon τ, the *VaR* is defined as the threshold value such that the probability that $P_{t+\tau}$ is lower than *VaR* is α:
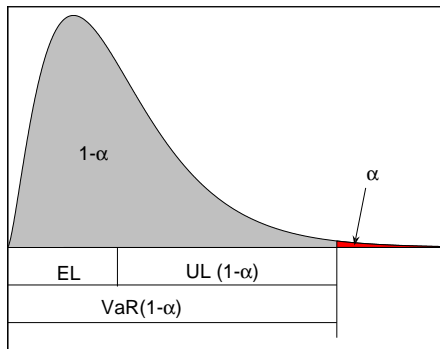
$$\alpha = \Pr(P_{t+\tau} < VaR_P)$$

- In finance, it is much more common to work with asset returns rather than prices. Therefore, it is more common to define the *VaR* in terms of the asset return $y_{t+\tau} = (P_{t+\tau} - P_t)/P_t$:

$$\alpha = \Pr(y_{t+\tau} < VaR)$$

VaR
Formal definition

Main relevant steps in the calculation of VaR

- The probability of interest α. Common values are $\alpha = 1\%, 5\%, 10\%$
- The time horizon τ, which can be 1 or 10 days (market risk), 1 or several years (more common in credit risk)
- Frequency of the data, which may not coincide with the time horizon
- The cumulative distribution function of the data: non-parametric or parametric estimation