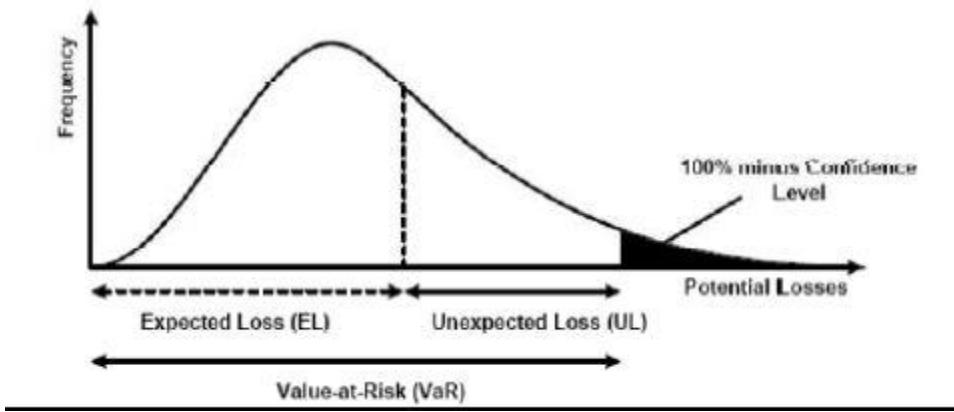


## Historical Value At Risk

Value at Risk is the regulatory measurement for assessing market risk. It reports the maximum likely loss on a portfolio for a given probability defined as  $x\%$  confidence level over  $N$  days.

Value at Risk is vital in market risk management and control. Also regulatory and economic capital computation is based on Value at Risk results. Although Value at Risk measure is objective and intuitive, it doesn't capture tail risk.

There are three commonly used methodologies to calculate Value at Risk – parametric, historical simulation and Monte Carlo simulation. This presentation focuses on historical Value at Risk.



### Value at Risk Approaches

- Parametric Value at Risk
- Historical Value at Risk
- Monte Carlo Value at Risk

### Historical Simulation

#### Assumption

The past is a good indicator of the near-future

- Pros
  - Simple
  - Intuitive
  - Easy back and stress test
  - No distribution assumption
  - No calibration
- Cons
  - Poor accuracy for higher confidence level and tail risk
  - Difficult for long horizons
  - Limited scenario

### Historical Value at Risk Methodology

- Obtain one year historical value time series of all market factors, such as a stock price time series is  $\bar{x}_1 \dots \bar{x}_{251}$
- Assuming today's value is  $x_0$ , generate 250 historical scenarios. The i-th is  $x_i = (\bar{x}_i / \bar{x}_{i-1} - 1)x_0$
- Compute base PV at today t as  $P(x_0)$
- Compute 250 scenario PVs:  $P(x_i)$
- Compute 250 scenario P&L:  $P(x_i) - P(x_0)$
- Sort 250 scenario P&L. The Value at Risk is the average between 2<sup>nd</sup> and 3<sup>rd</sup> lowest (negative) numbers

#### 1.1 Value at Risk Scaling

- Normally firms compute 1-day 99% Value at Risk
- Regulators require 10-day 99% Value at Risk
- Under IID assumption, 10-day Value at Risk =  $\sqrt{10} * VaR_{1-day}$

Reference:

<https://finpricing.com/lib/EqConvertible.html>