VaR Backtesting and the Risk Management Toolbox

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Agenda

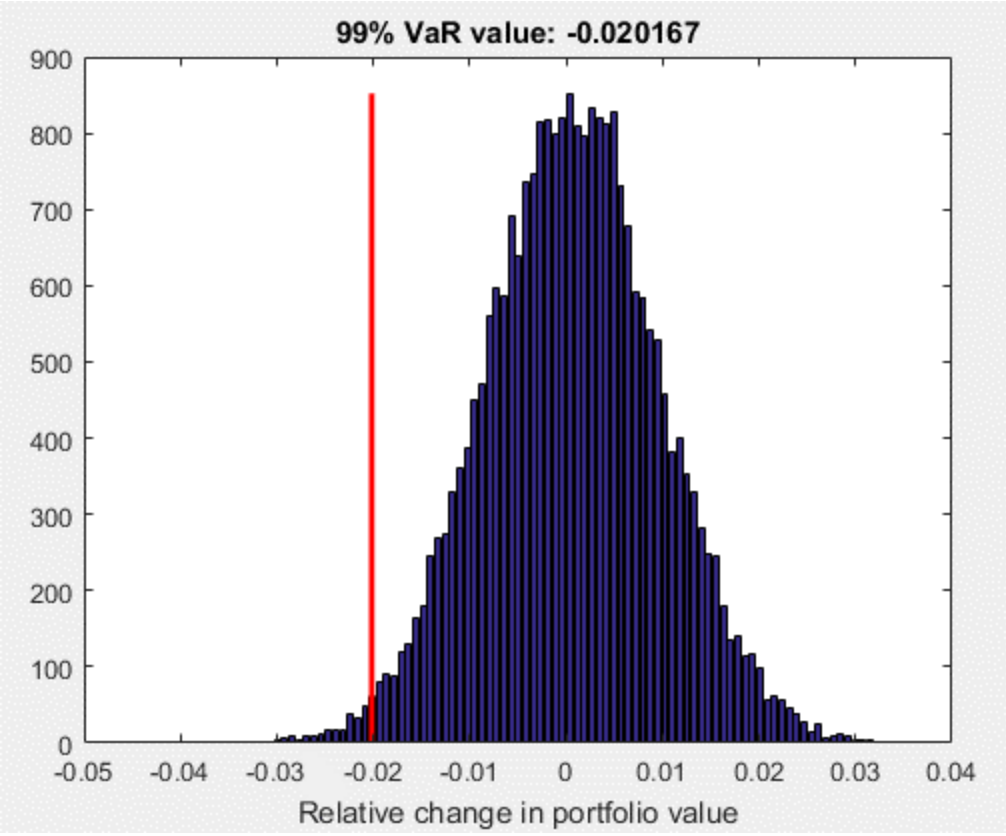
- Product Overview
- Value at Risk (VaR)
  - Definition
  - Demo: Measuring VaR
- VaR Backtesting
  - Definition
  - Using the **`varbacktest`** function

Risk Management Toolbox

- Specialized tools for financial risk management
- Three broad areas of coverage
  - Consumer credit: Binning Explorer app
  - Corporate credit: creditCopula for simulation of credit portfolio losses
  - **Market: VaR backtesting tools**

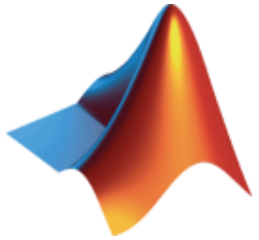
Value-at-Risk

- Value-at-Risk is
  - An estimate of how much value a portfolio can lose in a given time period (with a given confidence level)
  - Used by firms and regulators to gauge the amount of assets needed to cover possible losses

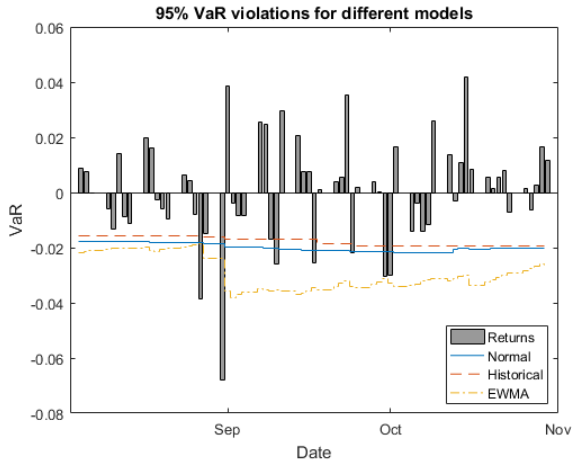


VaR Estimation and Backtesting Example

- Three methods to estimate the VaR:
  - Normal Distribution
  - Historical Simulation
  - Exponential Weighted Mean Average (EWMA)



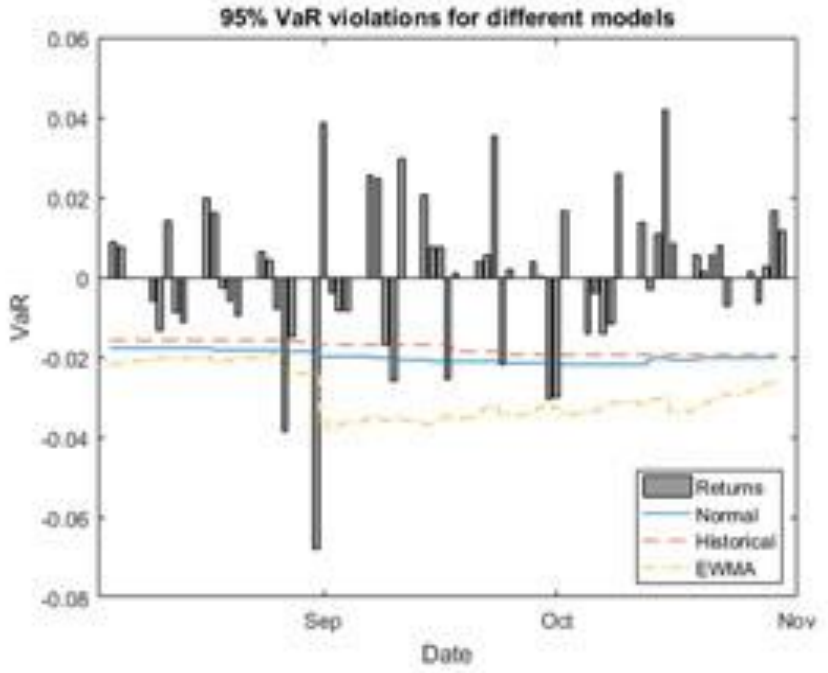
- VaR Backtesting: Visualizations, then formal tests with `varbacktest`

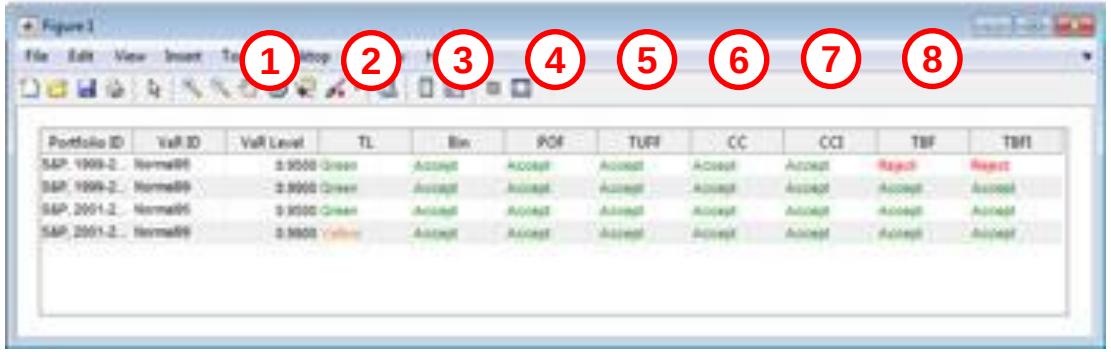


PortfolioID	VaRID	VaRLevel	TL	Bin	POF	TUFF	CC	CCI	TBF	TBFI
"S&P"	"Normal95"	0.95	green	accept	accept	accept	accept	reject	reject	reject
"S&P"	"Historical95"	0.95	yellow	accept	accept	accept	accept	accept	reject	reject
"S&P"	"EWMA95"	0.95	green	accept	accept	accept	accept	accept	reject	reject
"S&P"	"Normal99"	0.99	yellow	reject	reject	accept	reject	accept	reject	reject
"S&P"	"Historical99"	0.99	yellow	reject	reject	accept	reject	accept	reject	reject
"S&P"	"EWMA99"	0.99	red	reject	reject	accept	reject	accept	reject	reject

Value-at-Risk Backtesting

- Backtesting a VaR model will:
  - Assess the accuracy of a VaR model
  - Validate that the model doesn't over/under-estimate risk
- Risk Management Toolbox gives:
  - An easy framework for testing your VaR model
  - A library of 8 different standard tests

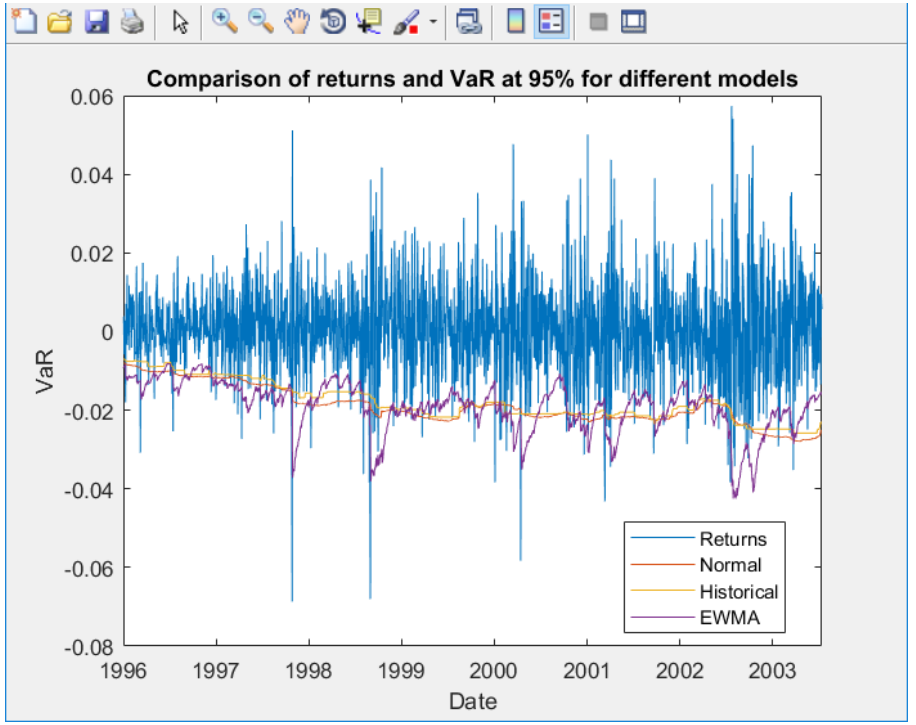




Types of Backtesting

- Unconditional coverage
  - Are we getting an actual risk that is higher or lower than the VaR?
  - In 95% VaR – should cross the estimation 1 out of 20 times

- Independence hypotheses
  - Are the violations of the VaR grouped together?
  - Indicating dependece not captured in estimation



Binomial Test

- Most straightforward test…
- Compares the **observed** number of exceptions *x*, to the **expected** number of exceptions
- For *N* observations and a (1 – VaR) level *p*, the test statistic is

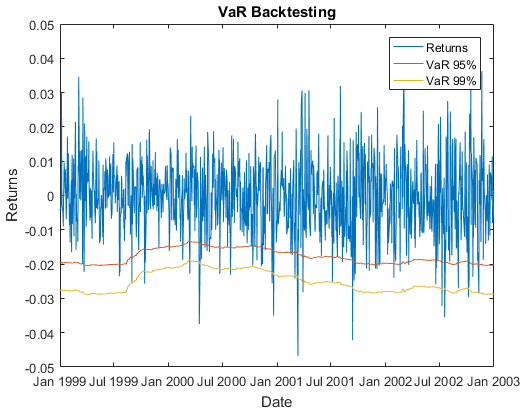
$$Z_{bin} = \frac{x - Np}{\sqrt{Np(1-p)}}$$

VaR Backtesting: `varbacktest`

- VaR backtesting: Assess the performance of VaR models
  - Data: Portfolio returns and corresponding VaR over a time window

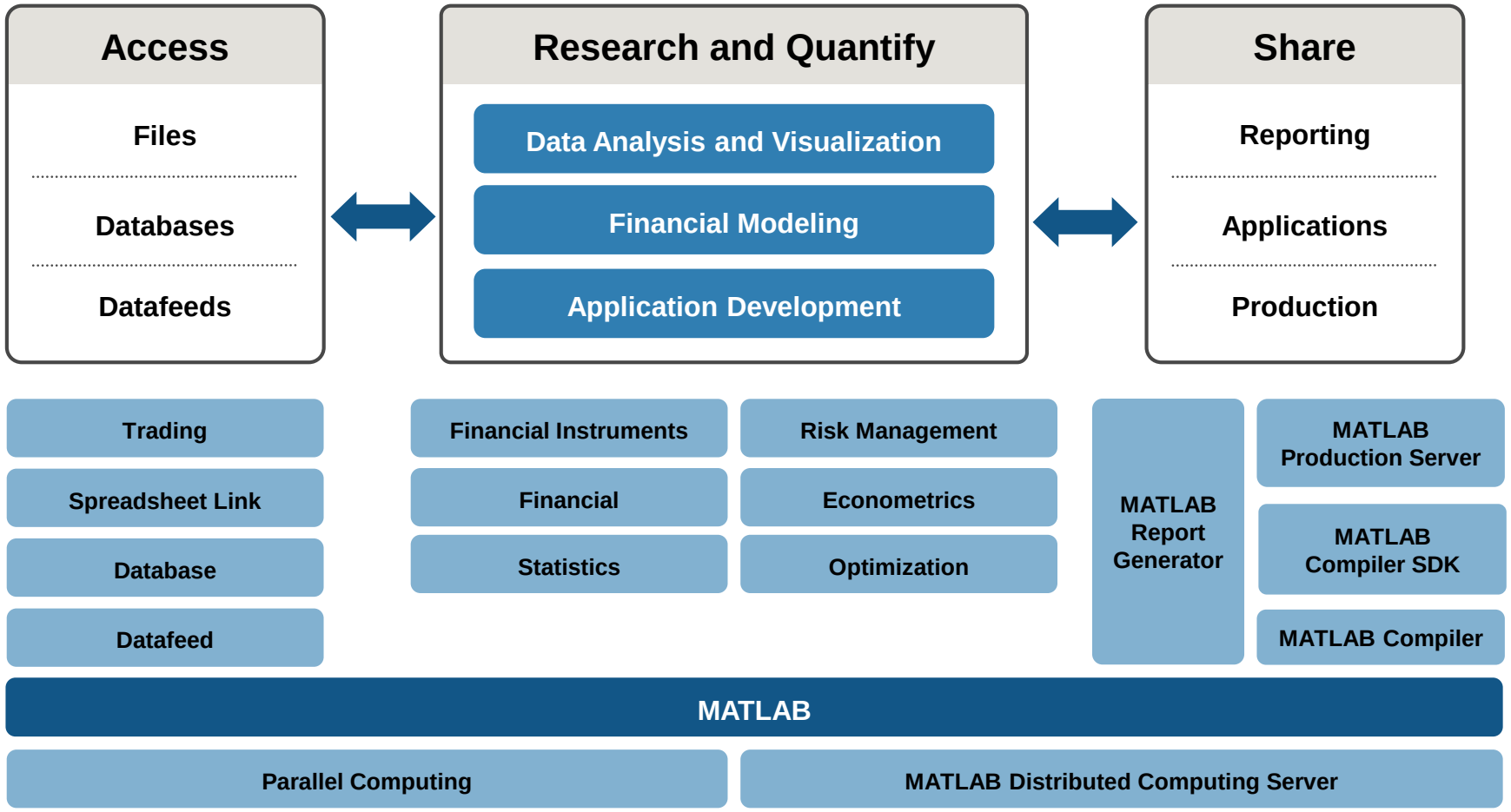
- `varbacktest` supports multiple statistical tests (frequency/unconditional coverage and independence) for VaR backtesting

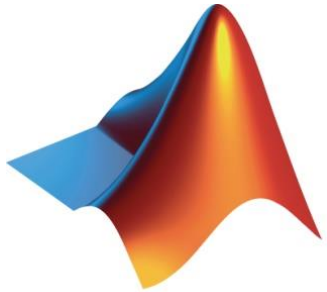
Date	Equity	VaREquity95	VaREquity99
01-Jan-1999 00:00:00	-0.0042729	0.015343	0.0217
04-Jan-1999 00:00:00	-0.0036195	0.014975	0.021179
05-Jan-1999 00:00:00	-3.9057e-05	0.014592	0.020638
06-Jan-1999 00:00:00	0.029803	0.014147	0.020009
07-Jan-1999 00:00:00	0.0023438	0.01823	0.025783
08-Jan-1999 00:00:00	-0.0029326	0.0177	0.025033
11-Jan-1999 00:00:00	-0.0052186	0.017201	0.024328
12-Jan-1999 00:00:00	-0.0090394	0.016809	0.023773
13-Jan-1999 00:00:00	-0.00047311	0.016699	0.023618
14-Jan-1999 00:00:00	0.0029209	0.016191	0.0229



tl	Traffic light test
bin	Binomial test
pof	Proportion of failures test
tuff	Time until first failure test
cc	Conditional coverage mixed test
cci	Conditional coverage independence test
tbf	Time between failures mixed test
tbfi	Time between failures independence test

MATLAB – The Financial Development Platform





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