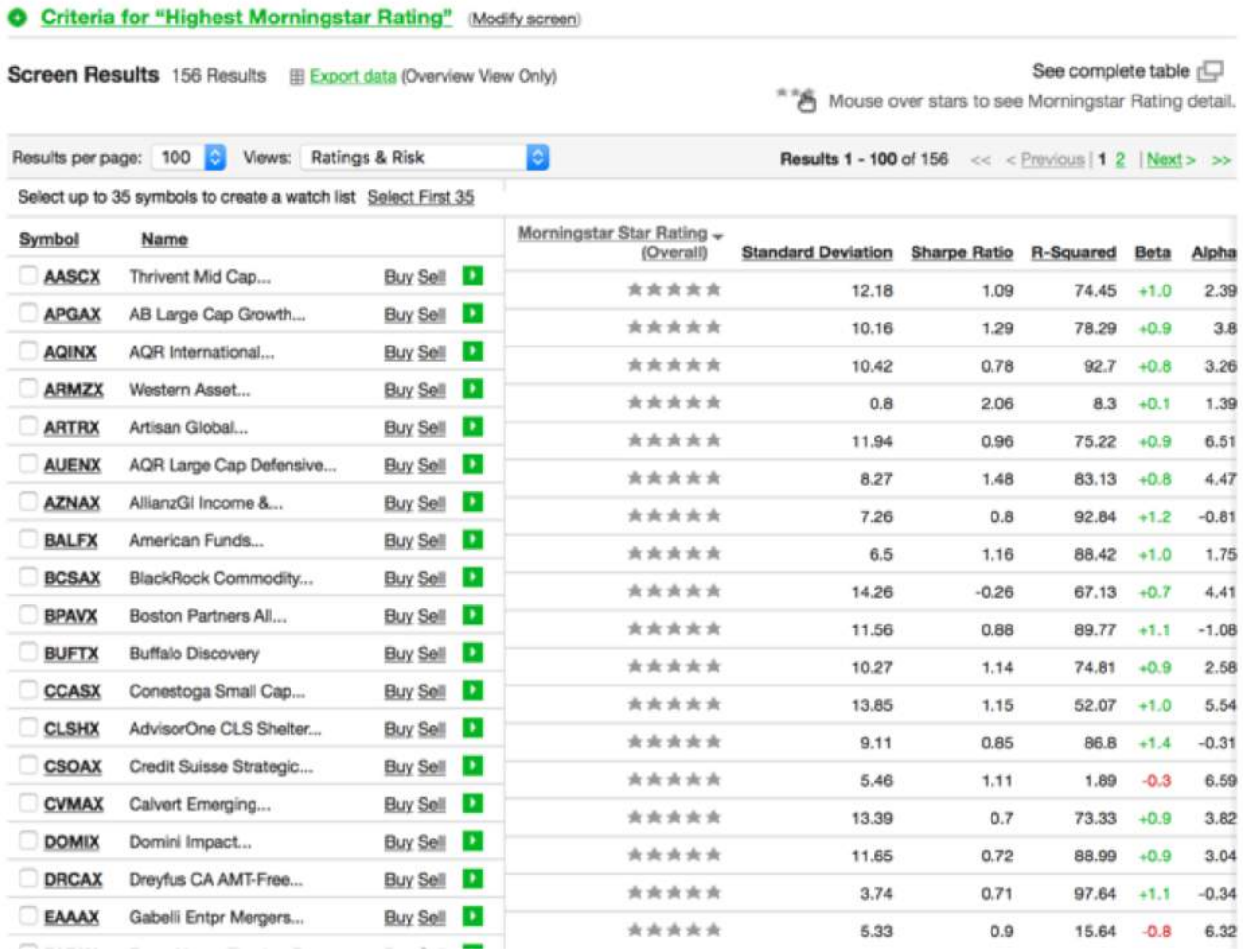
VaR analysis for Mutual Funds

Siddharth Chakravarty

Morningstar Rating process



Criteria for "Highest Morningstar Rating" (Modify screen)

Screen Results 156 Results | Export data (Overview View Only)

See complete table

Mouse over stars to see Morningstar Rating detail.

Results per page: 100 | Views: Ratings & Risk | Results 1 - 100 of 156 << < Previous | 1 2 | Next > >>

Select up to 35 symbols to create a watch list | Select First 35

Symbol	Name		Morningstar Star Rating (Overall)	Standard Deviation	Sharpe Ratio	R-Squared	Beta	Alpha
AASCX	Thrivent Mid Cap...	Buy Sell	★★★★★	12.18	1.09	74.45	+1.0	2.39
APGAX	AB Large Cap Growth...	Buy Sell	★★★★★	10.16	1.29	78.29	+0.9	3.8
AQINX	AQR International...	Buy Sell	★★★★★	10.42	0.78	92.7	+0.8	3.26
ARMZX	Western Asset...	Buy Sell	★★★★★	0.8	2.06	8.3	+0.1	1.39
ARTRX	Artisan Global...	Buy Sell	★★★★★	11.94	0.96	75.22	+0.9	6.51
AUENX	AQR Large Cap Defensive...	Buy Sell	★★★★★	8.27	1.48	83.13	+0.8	4.47
AZNAX	AllianzGI Income &...	Buy Sell	★★★★★	7.26	0.8	92.84	+1.2	-0.81
BALFX	American Funds...	Buy Sell	★★★★★	6.5	1.16	88.42	+1.0	1.75
BCSAX	BlackRock Commodity...	Buy Sell	★★★★★	14.26	-0.26	67.13	+0.7	4.41
BPAVX	Boston Partners All...	Buy Sell	★★★★★	11.56	0.88	89.77	+1.1	-1.08
BUFTX	Buffalo Discovery	Buy Sell	★★★★★	10.27	1.14	74.81	+0.9	2.58
CCASX	Conestoga Small Cap...	Buy Sell	★★★★★	13.85	1.15	52.07	+1.0	5.54
CLSHX	AdvisorOne CLS Shelter...	Buy Sell	★★★★★	9.11	0.85	86.8	+1.4	-0.31
CSOAX	Credit Suisse Strategic...	Buy Sell	★★★★★	5.46	1.11	1.89	-0.3	6.59
CVMAX	Calvert Emerging...	Buy Sell	★★★★★	13.39	0.7	73.33	+0.9	3.82
DOMIX	Domini Impact...	Buy Sell	★★★★★	11.65	0.72	88.99	+0.9	3.04
DRCAX	Dreyfus CA AMT-Free...	Buy Sell	★★★★★	3.74	0.71	97.64	+1.1	-0.34
EAAAX	Gabelli Entpr Mergers...	Buy Sell	★★★★★	5.33	0.9	15.64	-0.8	6.32

- Introduced in 1985
- Rating based on a scale of 1-5 stars
- Evaluates how the fund has performed adjusting for risk and cost compared to funds in the same category
- Separate ratings for 3,5 and 10 years which combined into an overall rating
- Ratings are graded on a curve
  - ✓ Top 10% 5 stars
  - ✓ Bottom 10% 1 star
- Based entirely on a mathematical evaluation of past performance
- Publishes Analyst rating which is forward looking

KEY POINTS – Measures of Risk

- There is no general agreement, however, about how best to measure and compare fund performance and on what information funds should disclose to investors.
- Firms face many different kinds of risks, including market risks, credit risks, liquidity risks, operational risks and legal risks.
- VaR is perhaps the most well-known risk measure. It is a single estimate of the amount by which an institution's position in a risk category could decline because of general market movements during a given holding period
- A VAR statistic has three components:
    1. A time period
    2. A confidence level
    3. Loss amount (or loss percentage).

Keep these three parts in mind as I give some examples of variations of the question that VAR answers:

Risk approaches

- **Traditional**
  - Mean variance – monthly data – 10/31/2017 (5 year)
    1. Sharpe ratio – risk adjusted return compared risk/reward per unit of risk
    2. Alpha – Excess return
    3. Beta – Market risk
- **VaR**
    1. Normal – assumes normal distribution
    2. Historical VaR
    3. Extreme Value Var (General pareto distribution)
       - Block Maxima approach
       - Peak over threshold
    4. Monte Carlo Simulation VaR

FUND SELECTION

Oppenheimer Global Opportunities A OPGIX | ★★★★★

Morningstar Analyst Rating

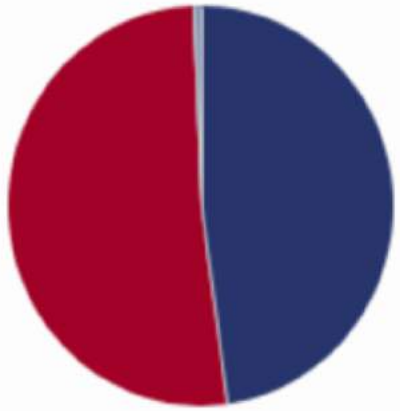
NAV	1-Day Total Return
$69.68	↑0.35%

USD | NAV as of 30 Nov 2017 | 1-Day Return as of 30 Nov 2017

TTM Yield	Load	Total Assets	Expenses	Fee Level	Turnover	Status	Min. Inv.
0.18%	5.75	$ 6.9 bil	1.19%	Below Average	18%	Open	$ 1,000

30-Day SEC Yield	Category	Investment Style
--	World Small/Mid Stock	Mid Growth

Asset Allocation OPGIX



Type	% Net	% Short	% Long	Bench-mark	Cat Avg
Cash	0.00	—	0.00	0.01	3.63
US Stock	47.79	—	47.79	46.48	47.98
Non US Stock	51.58	—	51.58	53.29	47.98
Bond	0.00	—	0.00	0.00	0.18
Other	0.63	—	0.63	0.23	0.23

As of 10/31/2017

Sector Weightings OPGIX

	% Stocks
Cyclical	
Basic Materials	1.13
Consumer Cyclical	16.39
Financial Services	2.90
Real Estate	1.52
Sensitive	
Communication Services	0.44
Energy	0.00
Industrials	12.06
Technology	32.53
Defensive	
Consumer Defensive	3.40
Healthcare	29.63
Utilities	0.00

As of 10/31/2017

FUND SELECTION

T. Rowe Price Growth Stock PRGFX | ★★★★★

Morningstar Analyst Rating

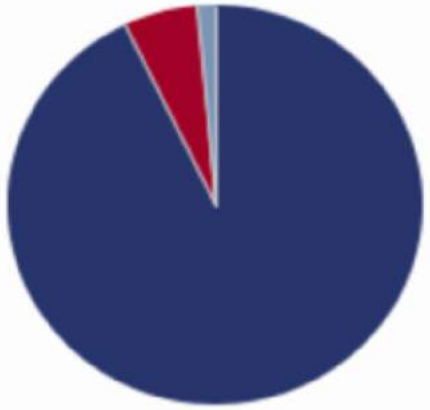
NAV	1-Day Total Return
$71.38	↑1.00%

USD | NAV as of 30 Nov 2017 | 1-Day Return as of 30 Nov 2017

TTM Yield	Load	Total Assets	Expenses	Fee Level	Turnover	Status	Min. Inv.
0.06%	None	$ 52.7 bil	0.68%	Below Average	44%	Open	$ 2,500

30-Day SEC Yield	Category	Investment Style
0.00%	Large Growth	Large Growth

Asset Allocation PRGFX



Type	% Net	% Short	% Long	Bench-mark	Cat Avg
Cash	0.00	—	0.00	0.00	2.01
US Stock	92.86	—	92.86	98.76	92.02
Non US Stock	5.77	—	5.77	1.24	5.66
Bond	0.00	—	0.00	0.00	0.10
Other	1.37	—	1.37	0.00	0.21

As of 09/30/2017

Sector Weightings PRGFX

	% Stocks
Cyclical	
Basic Materials	0.00
Consumer Cyclical	18.12
Financial Services	13.74
Real Estate	0.40
Sensitive	
Communication Services	3.65
Energy	0.00
Industrials	12.06
Technology	30.24
Defensive	
Consumer Defensive	3.24
Healthcare	17.72
Utilities	0.82

FUND SELECTION

Fidelity® Select Semiconductors FSELX | ★★★★

FF Fund Family Data | Add to Portfolio | Get E-mail Alerts | Print This Page | Data Definition | ? Data Question

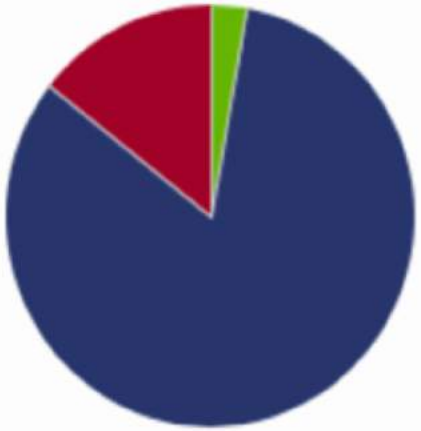
NAV	1-Day Total Return
$126.36	↑0.52%

USD | NAV as of 30 Nov 2017 | 1-Day Return as of 30 Nov 2017

TTM Yield	Load	Total Assets	Expenses	Fee Level	Turnover	Status	Min. Inv.
0.67%	None	$ 3.4 bil	0.77%	Low	110%	Open	$ 2,500

30-Day SEC Yield	Category	Investment Style
--	Technology	Large Growth

Asset Allocation FSELX



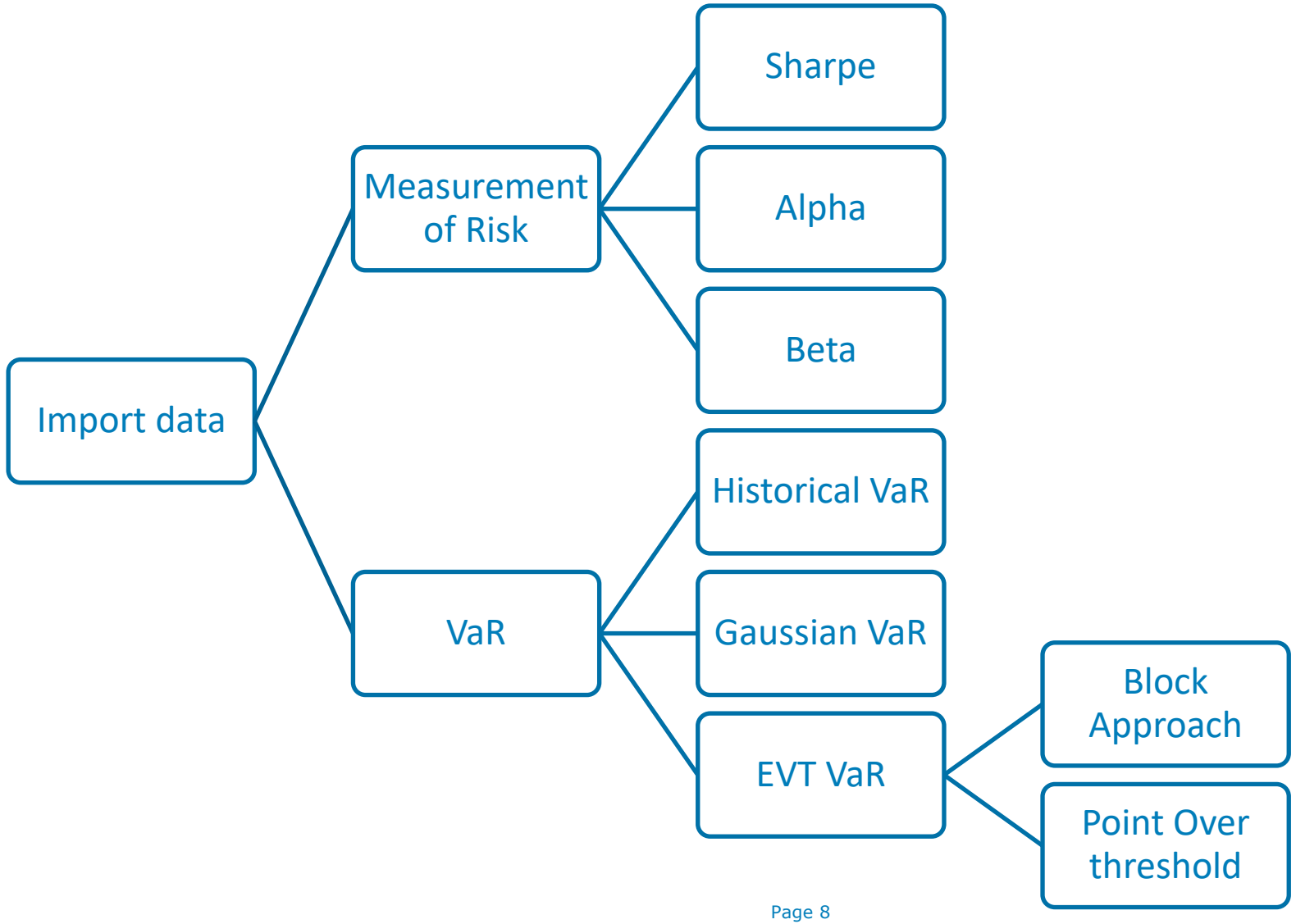
Type	% Net	% Short	% Long	Bench-mark	Cat Avg
Cash	2.98	—	2.98	0.00	0.60
US Stock	82.59	—	82.59	97.53	86.00
Non US Stock	14.43	—	14.43	2.47	12.63
Bond	0.00	—	0.00	0.00	0.07
Other	0.00	—	0.00	0.00	0.71

As of 10/31/2017

Sector Weightings FSELX

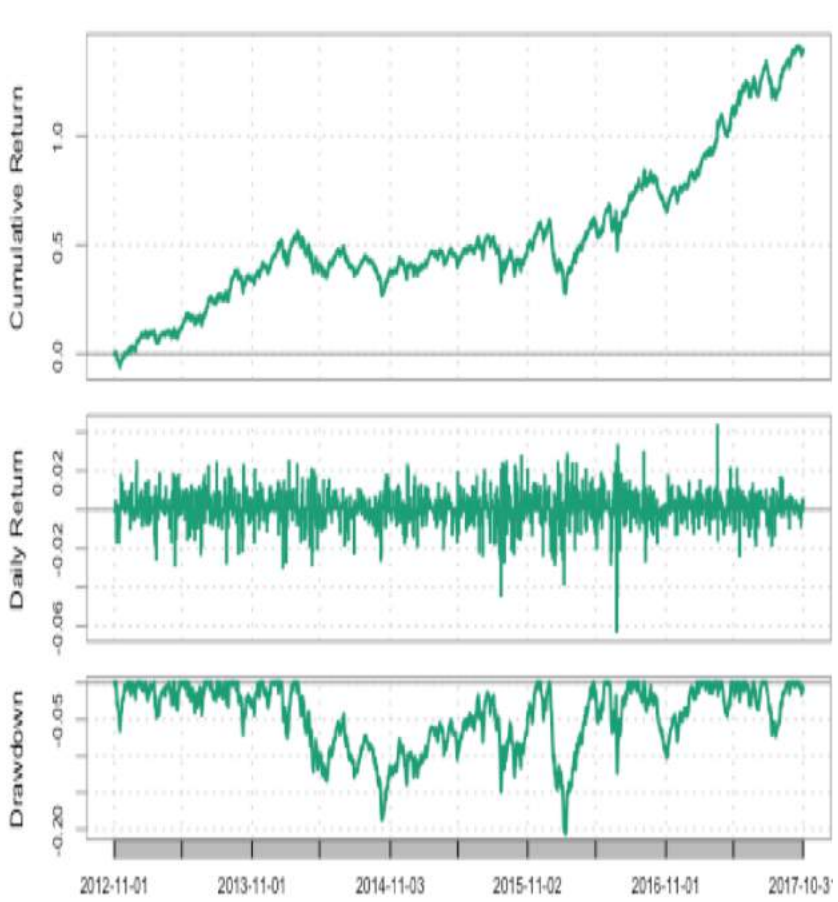
	% Stocks
Cyclical	
Basic Materials	0.00
Consumer Cyclical	0.00
Financial Services	0.00
Real Estate	0.00
Sensitive	
Communication Services	0.00
Energy	0.00
Industrials	0.00
Technology	100.00
Defensive	
Consumer Defensive	0.00
Healthcare	0.00
Utilities	0.00

Our Methodology

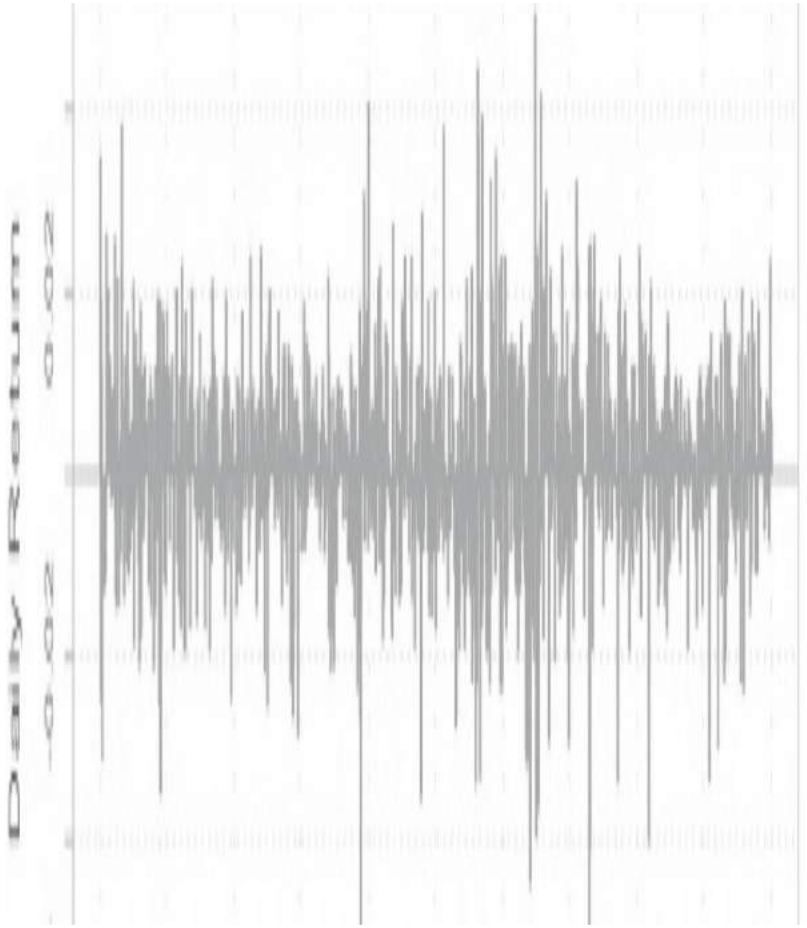


- Key R Packages used for analysis
  - library(xts)
  - library(timeSeries)
  - library(tseries)
  - library(TTR)
  - library(quantmod)
  - library(PerformanceAnalytics)
  - library(extRemes)
  - library(fExtremes)
  - library(evd)
  - library(ismev)
  - library(evir)
  - library(POT)

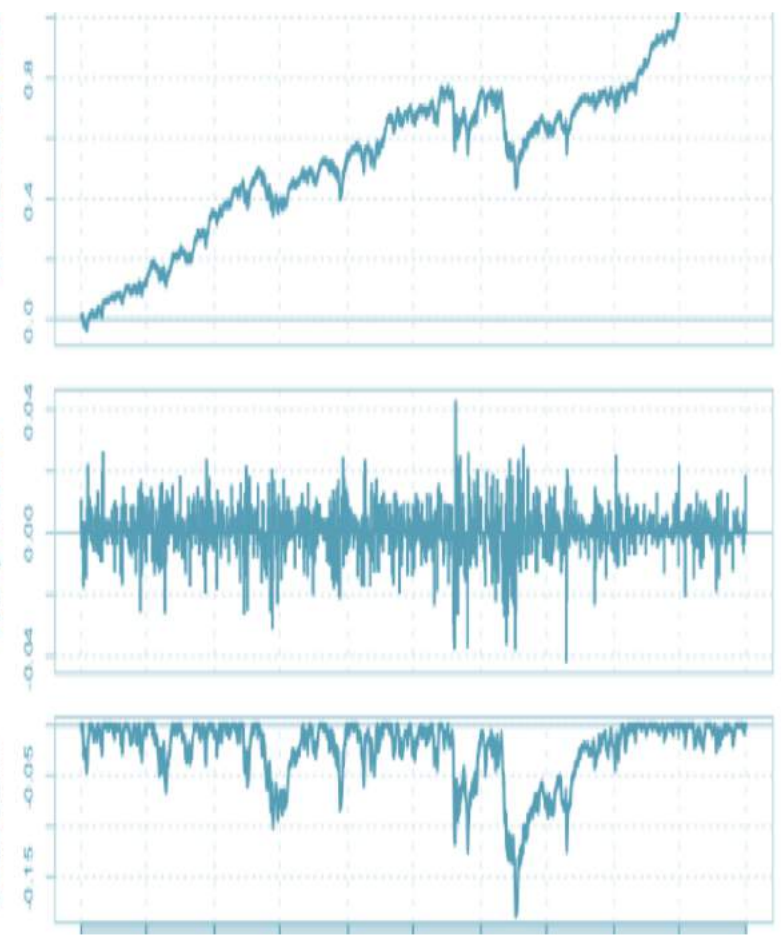
Historical returns



OPGIX



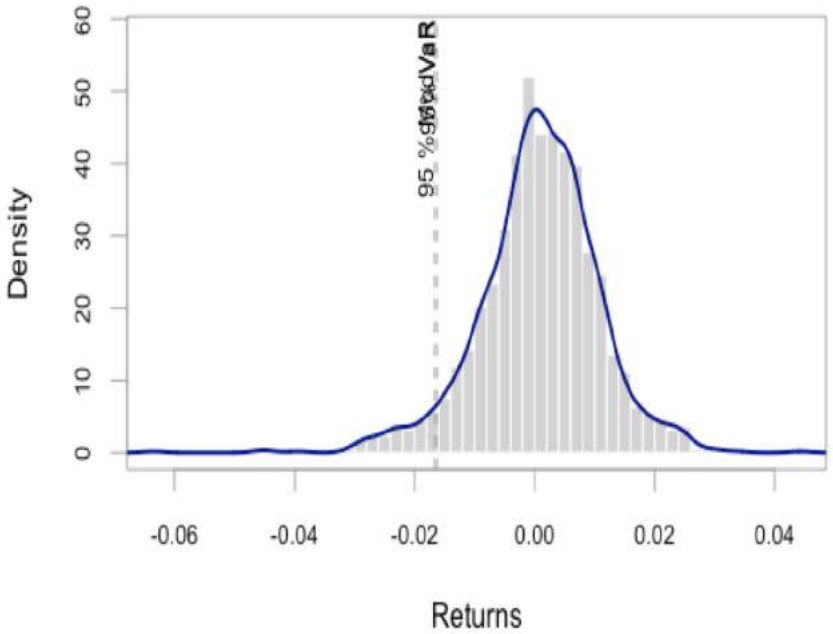
FSELX



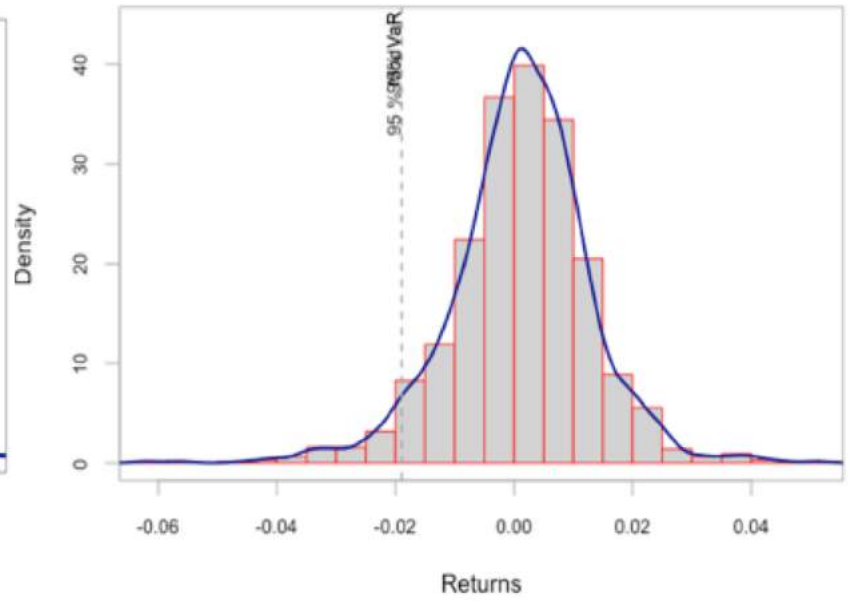
PRGFX

Return Distribution

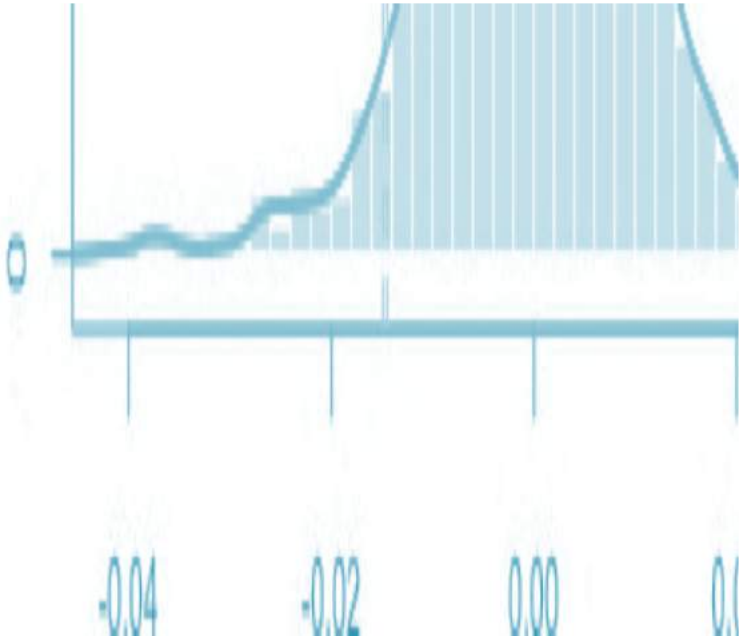
OPGIX



FSELX



PRGFX



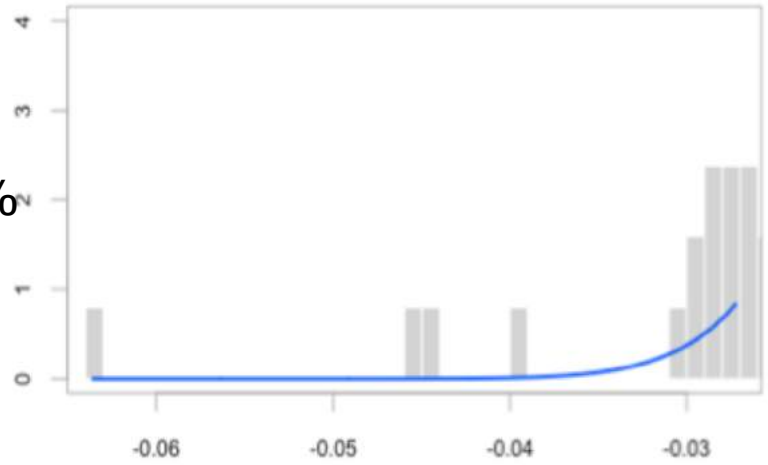
	OPGIX	FSELX	PRGFX
Annualized return	19%	31.53%	18.16%
Sharpe (Rf=1.2%, p=95%)	1.25	1.45	1.5
Alpha	10.8	14.71	4.42
Beta	0.85	1.12	0.69

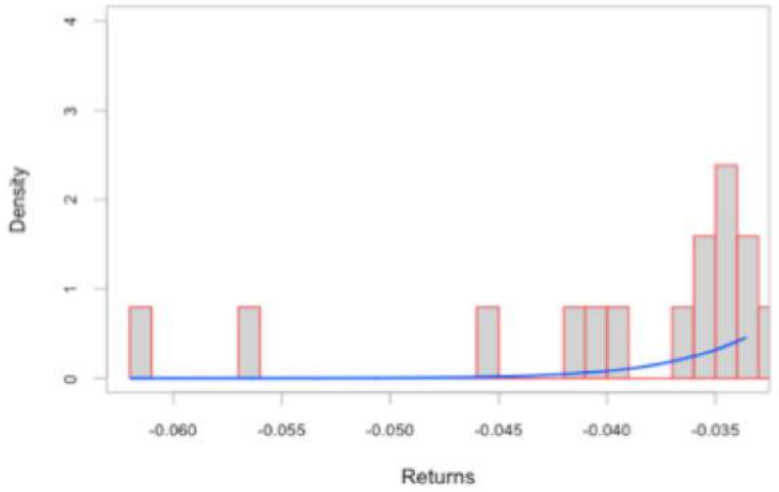
	OPGIX	FSELX	PRGFX
Kurtosis	2.55	2.27	2.21
Skew	-0.51	-0.34	-0.47
Std. Dev	0.010	0.012	0.009
Mean	0.0007	0.0011	0.0007

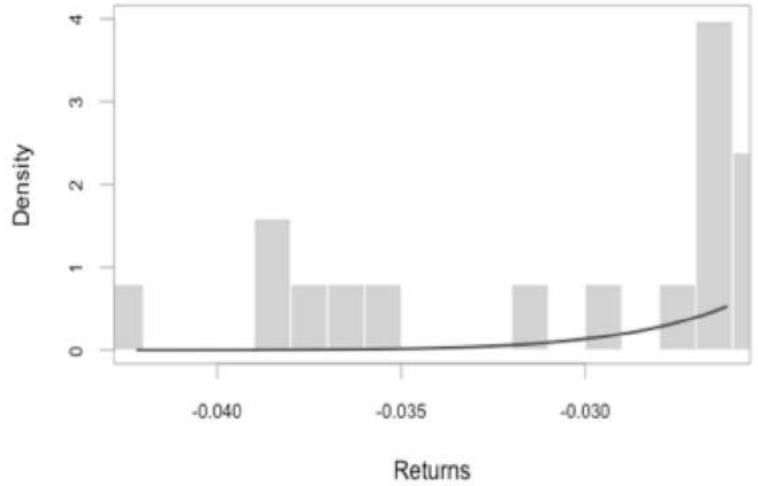
Tail Distribution at 99% & 95%

OPGIX **FSELX** **PRGFX**

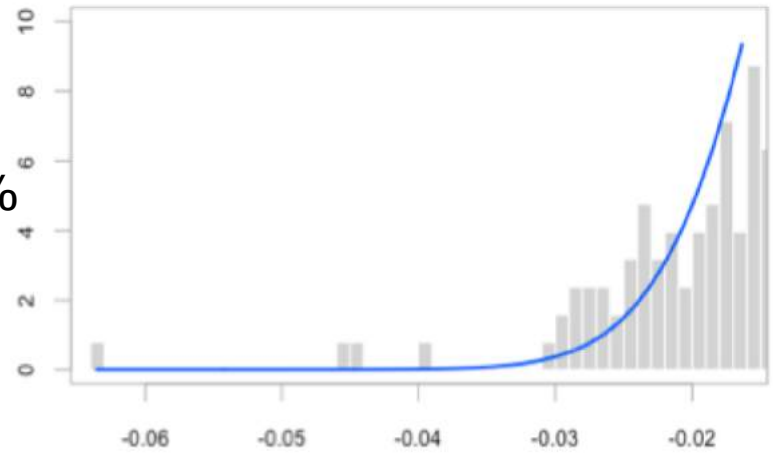
99%

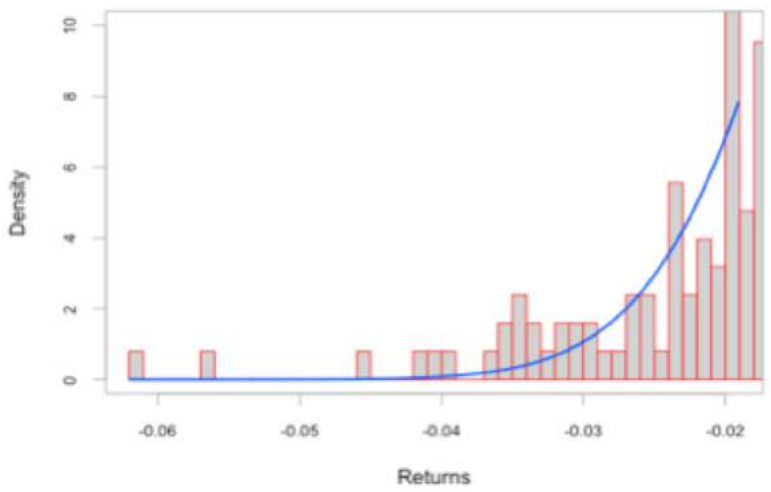


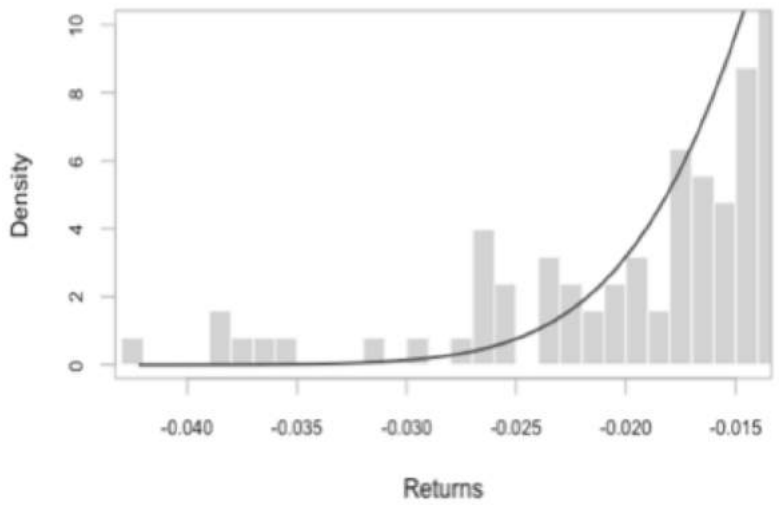




95%







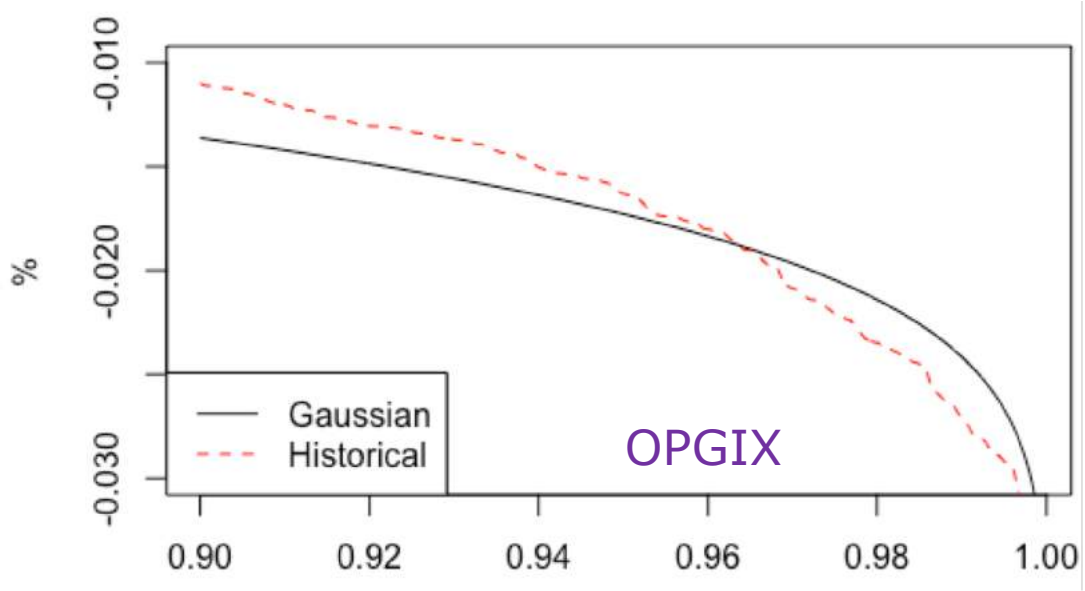
VaR Analysis

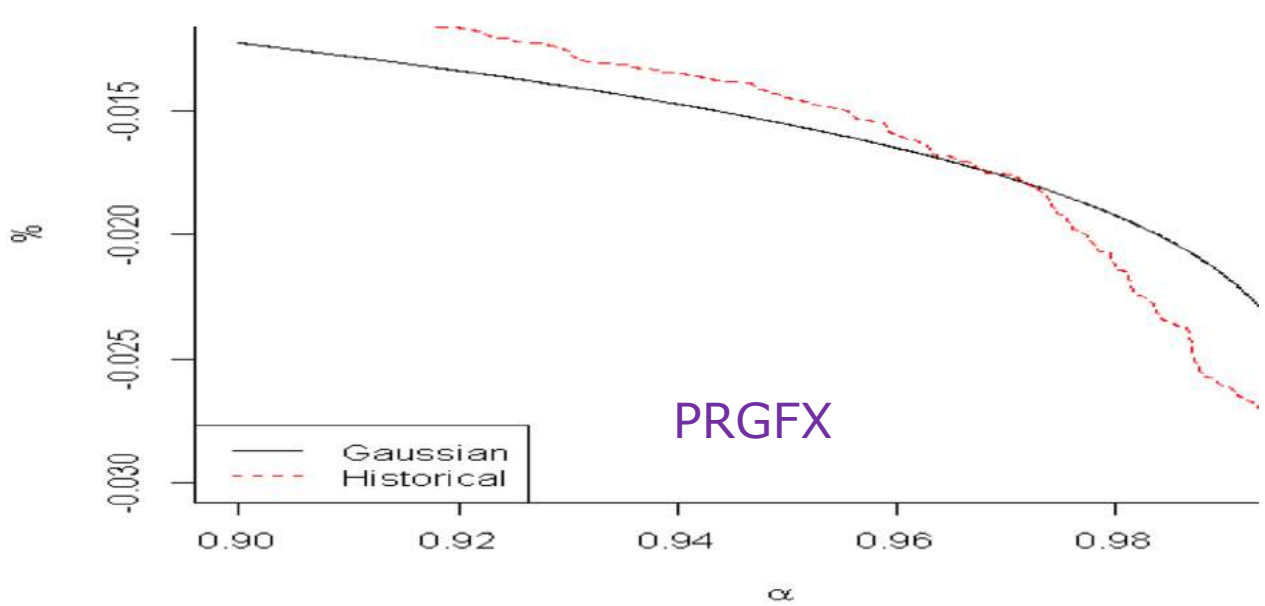
- Value at risk (VaR) is a statistical technique used to measure and quantify the level of financial risk within a firm or investment portfolio over a specific time frame.

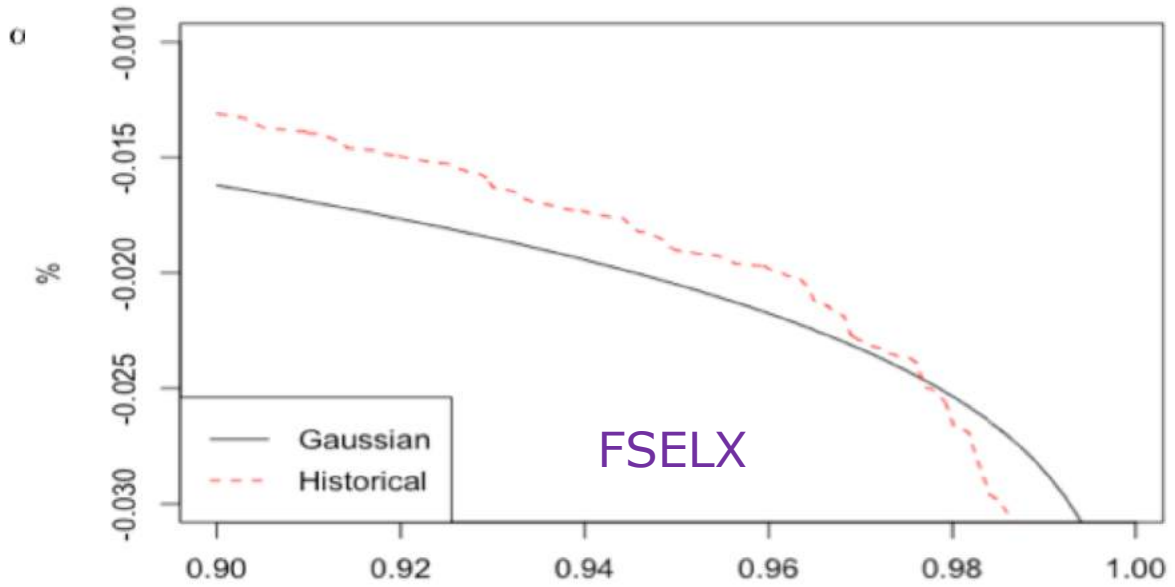
- Example:
  - What is the most I can - with a 95% or 99% level of confidence - expect to lose in dollars over the next month?
  - What is the maximum percentage I can - with 95% or 99% confidence - expect to lose over the next year?

- Different methodologies
  - Variance/ Covariace
  - Monte Carlo simulation
  - Historical simulation

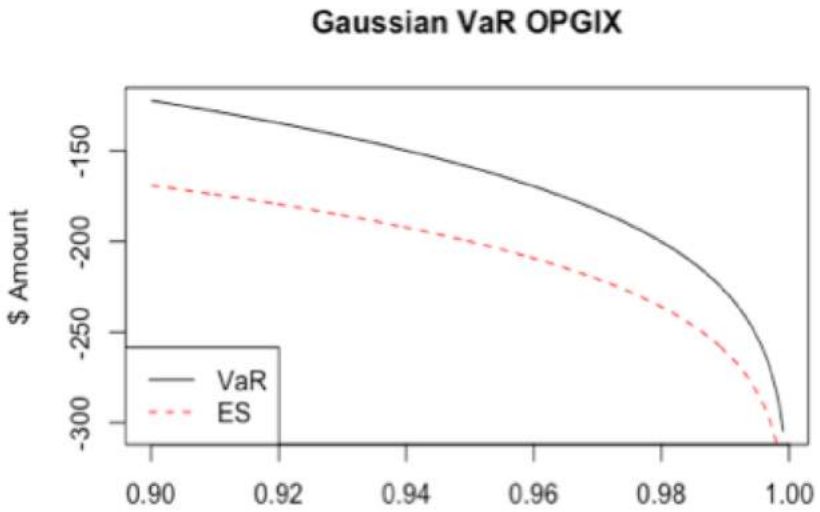
VaR Sensitivity

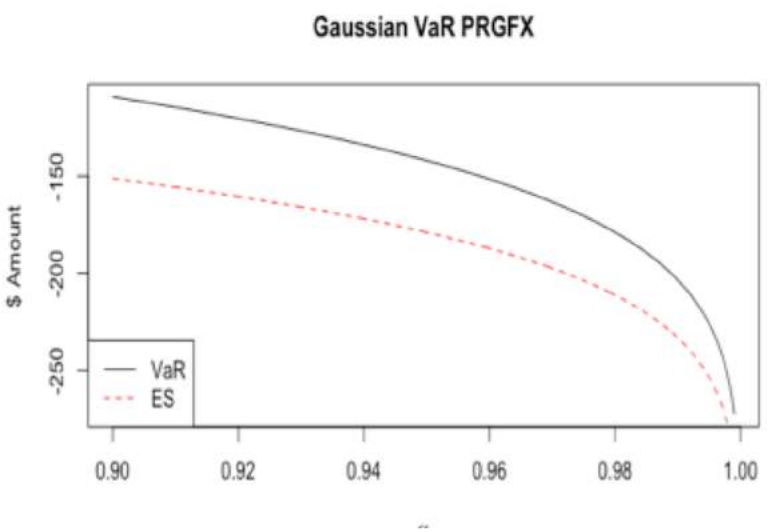


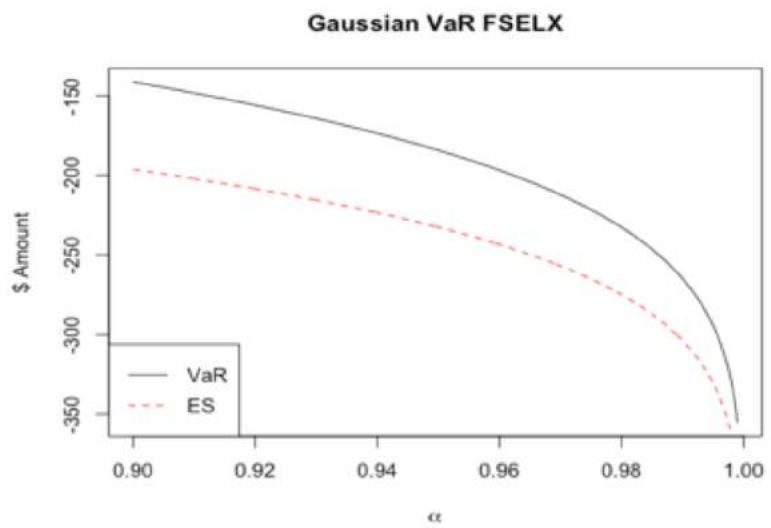


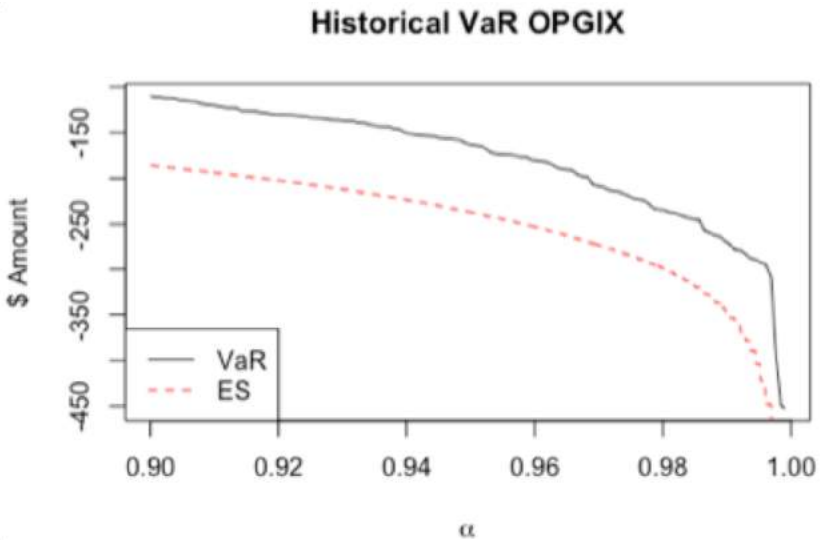


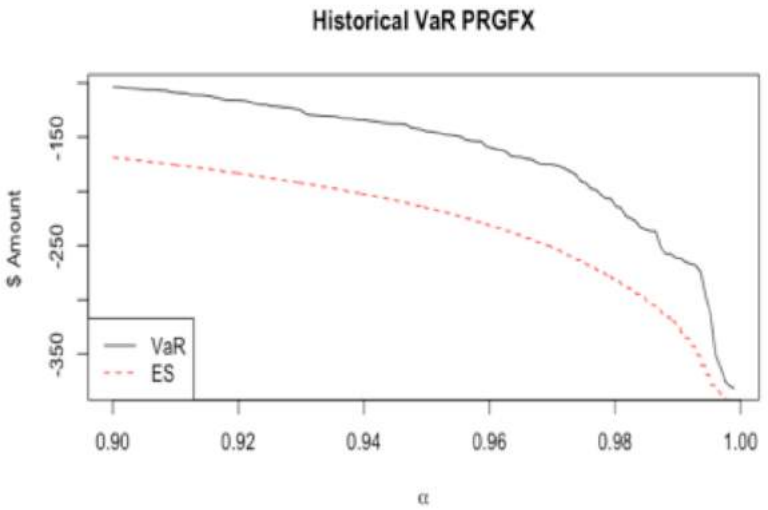
Simulation of Risk and Expected shortfall analysis

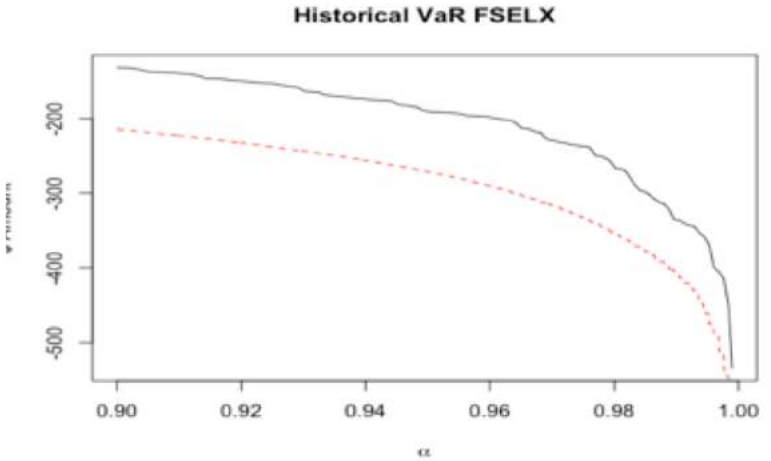






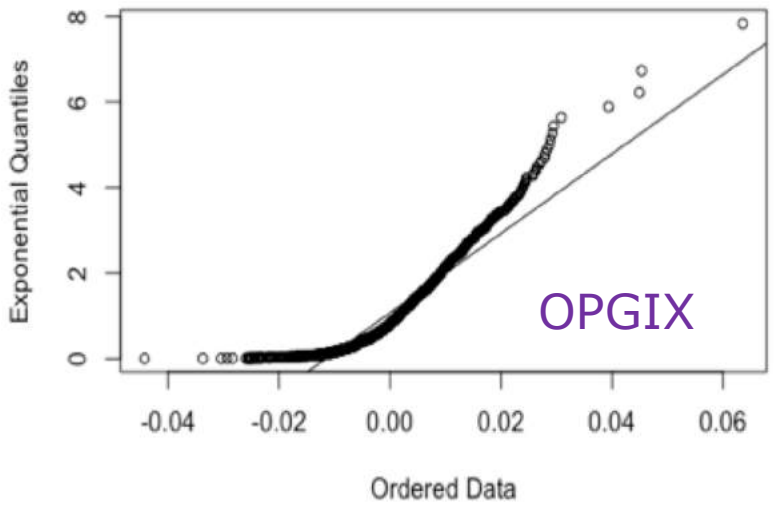


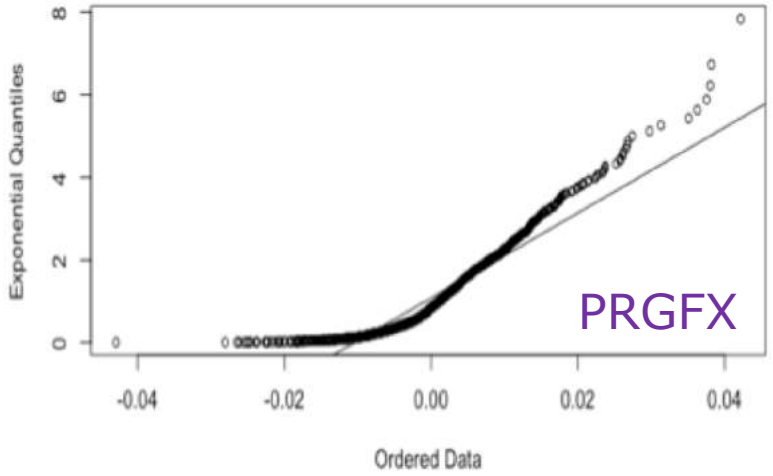


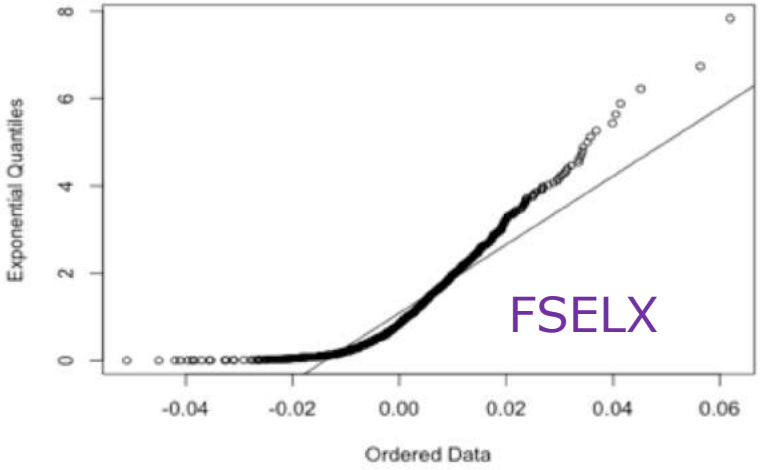


ES is the expected loss of $10,000 investment after a catastrophic event.

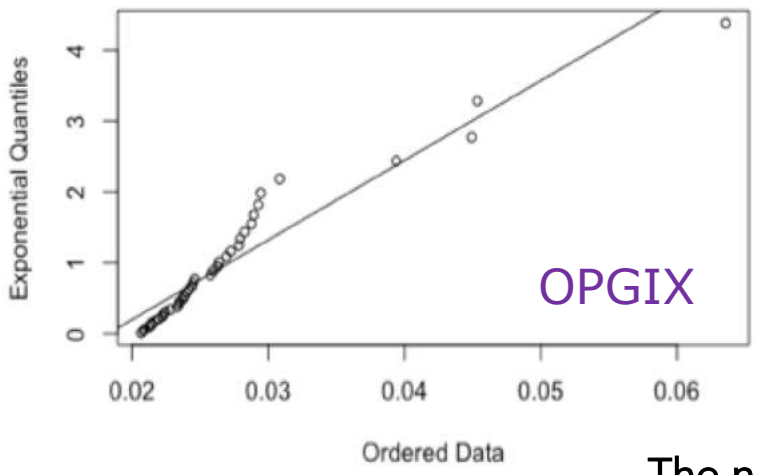
QQplot – for normality check

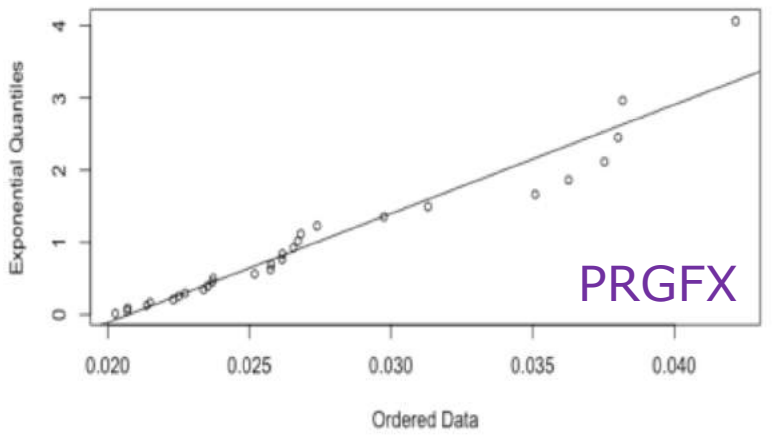


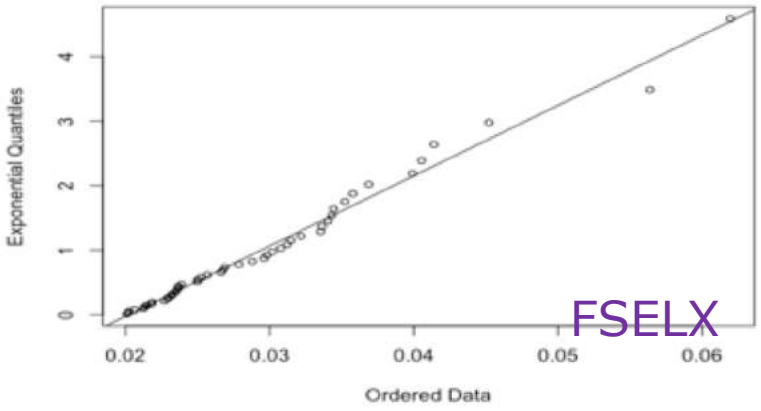




QQ plots along the tail



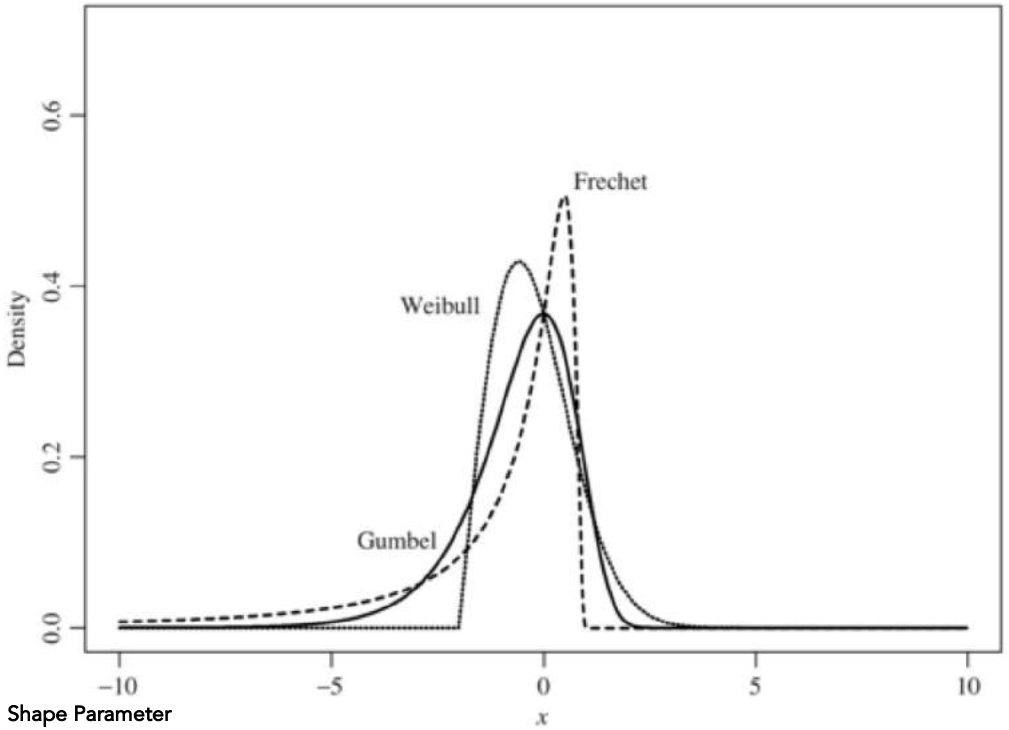




The normal distribution seems to be rather poor, especially in the tails

Introduction to EVT

- Standard VaR methods, such as variance-covariance method or historical simulation, can fail when the return distribution is fat tailed.
- This problem is aggravated when long-term VaR forecasts are desired.
- Extreme Value Theory (EVT) is proposed to overcome these problems



Shape Parameter

ξ>0 giving the heavy-tailed (Frechet) case

ξ=0 giving the light-tailed (Gumbel) case

ξ<0 giving the bounded-tailed (Weibull) case

- A main objective of the EVT is to make inferences about sample extrema (maxima or minima) .
- In this context the so called Generalized Extreme Value distribution (GEV) and General Pareto distribution play a central role (GPD).

GEV

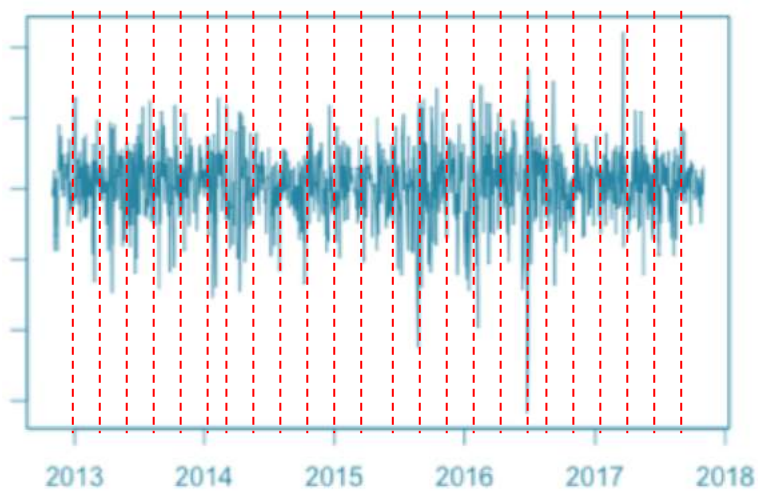
$$\xi \neq 0 \qquad G(y)=\exp\left(-\left[1+\xi\left(\frac{y-\mu}{\sigma}\right)\right]^{-1/\xi}\right)$$

$$\xi = 0 \qquad G(y)=\exp\left(-\exp\left(-\frac{y-\mu}{\sigma}\right)\right)$$

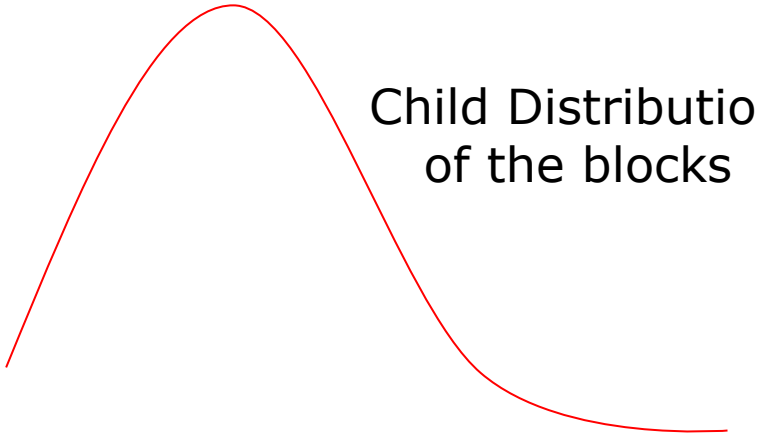
GPD

$$G_{\xi,\psi(\eta)}(y) = \begin{cases} 1-\left[1+\dfrac{\xi y}{\psi(\eta)}\right]^{-1/\xi} & \text{for } \xi \neq 0, \\ 1-\exp[-y/\psi(\eta)] & \text{for } \xi = 0, \end{cases}$$

Block Maxima



OPGIX returns



- Block Maxima approach divides the sample into subsamples and applies the EVT to the subsamples . For daily returns, n = 21 corresponds approximately to the number of trading days in a month and n = 63 denotes the number of trading days in a quarter.

$$\text{VaR} = \begin{cases} \mu_n - \dfrac{\sigma_n}{\xi_n}\left\{1 - \left[-n\ln(1-p)\right]^{-\xi_n}\right\} & \text{if } \xi_n \neq 0 \\ \mu_n - \sigma_n \ln[-n\ln(1-p)] & \text{if } \xi_n = 0, \end{cases}$$

where n is the length of subperiods.

The distribution contains three parameters.

1. *Shape* parameter **ξ**
2. *Location* parameter μ
3. *Scale* **σ**.

Select the length of the sub period *n*

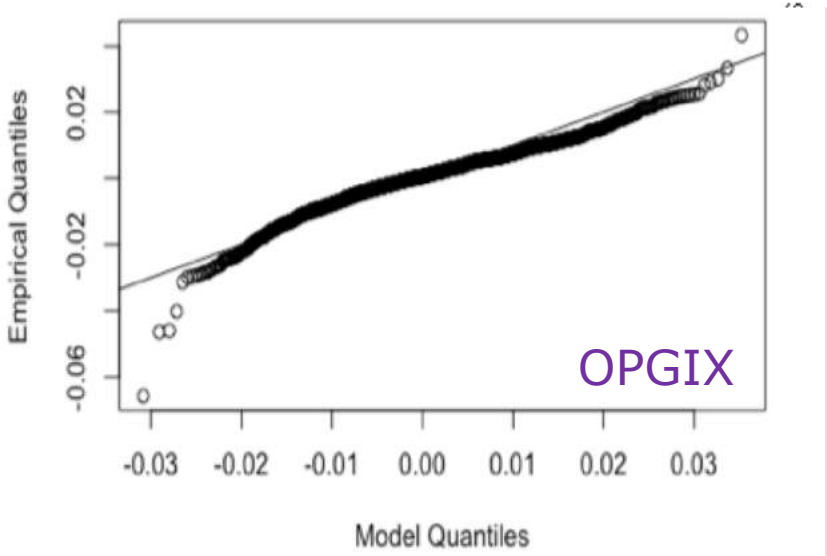
Obtain the maximum likelihood estimates of μ, **σ**, and **ξ**

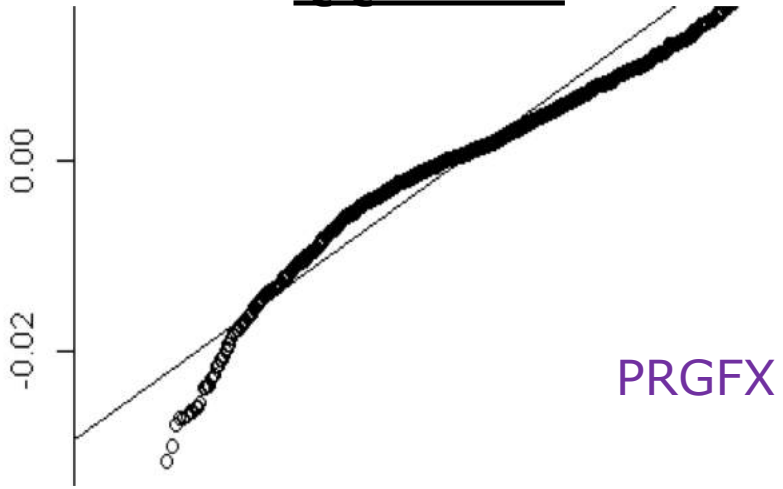
Check the adequacy of the fitted extreme value model

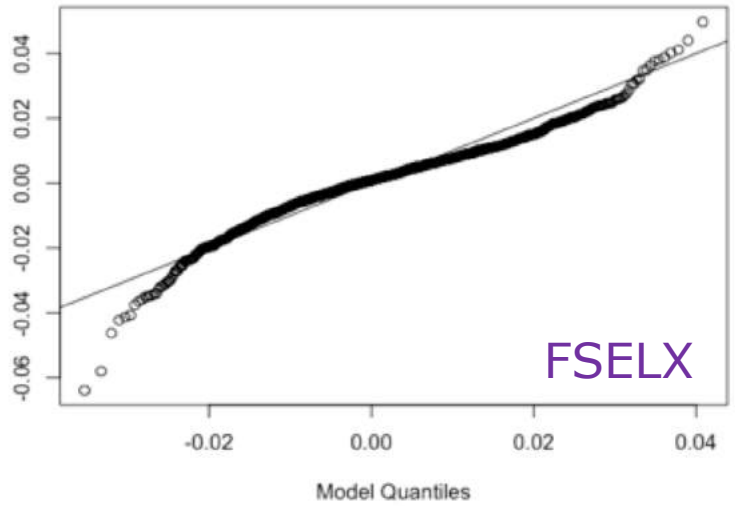
Apply equation to calculate VaR.

Fitting to GEV distribution

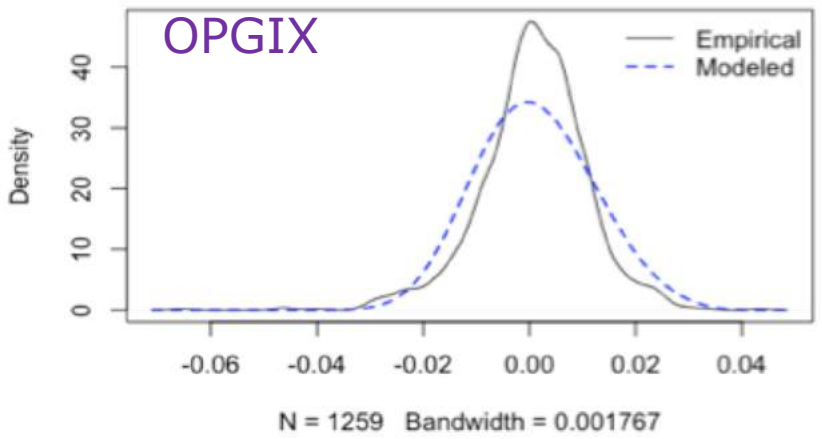
QQ PLOTS

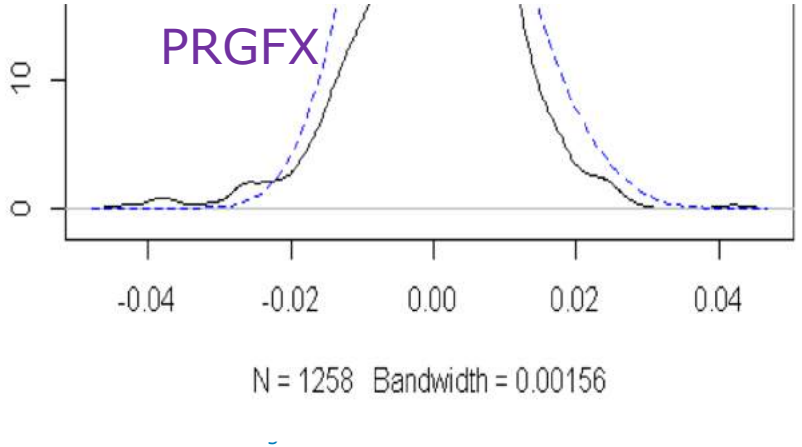


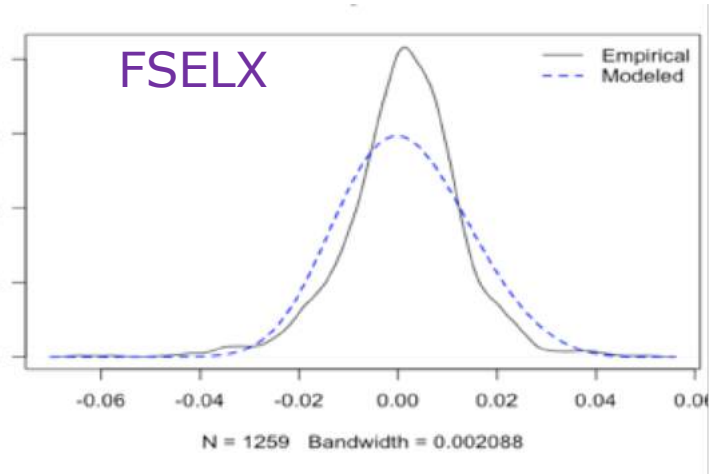




DENSITY

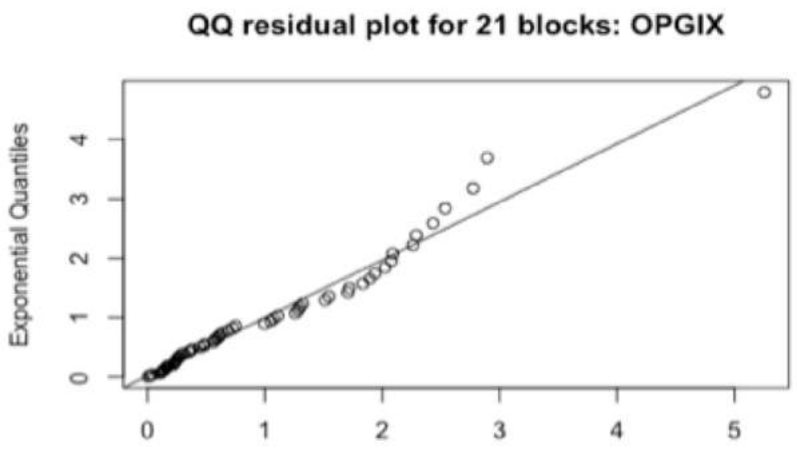


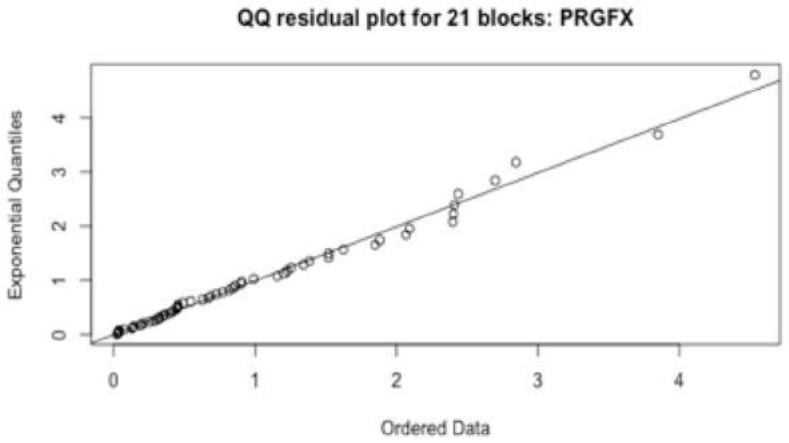


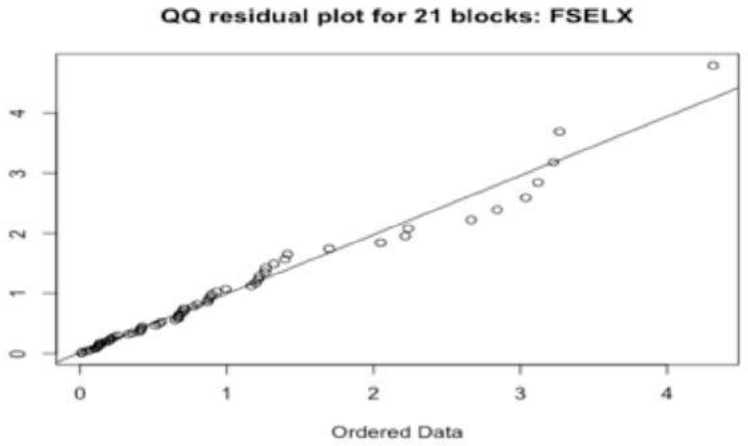


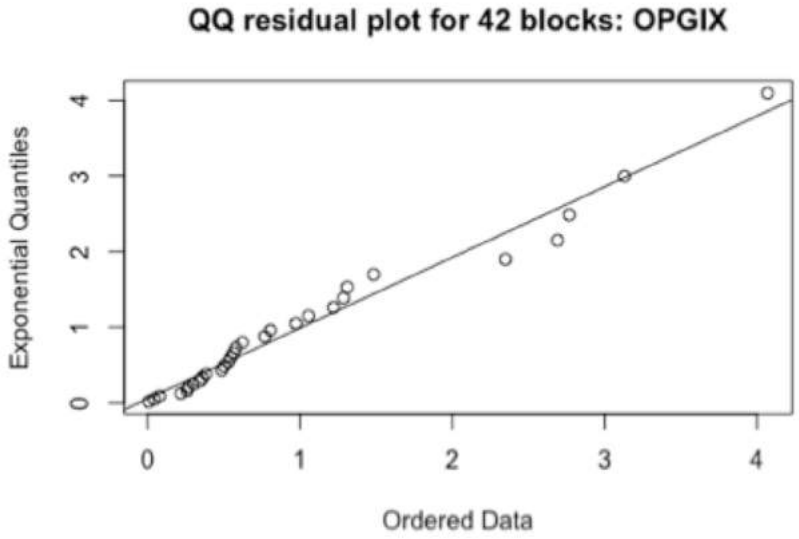
BLOCK MAXIMA APPROACH

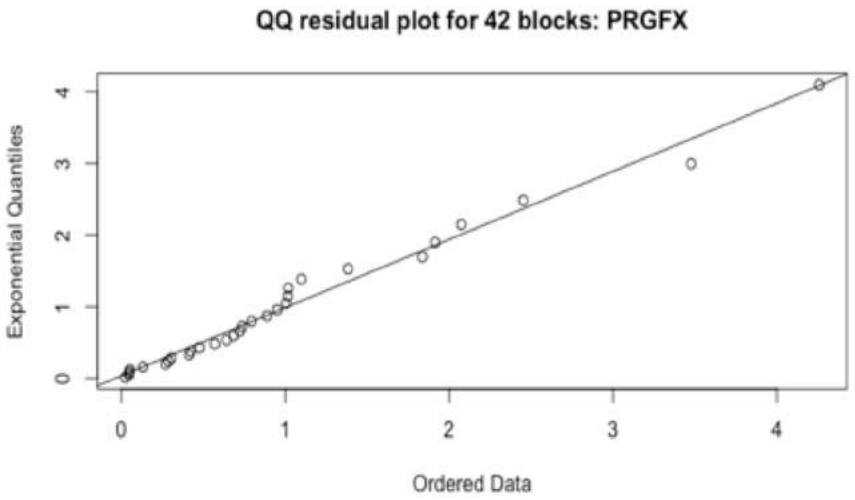
Parameter -*shape* parameter ξ, the *location* parameter μ, and the *scale* σ

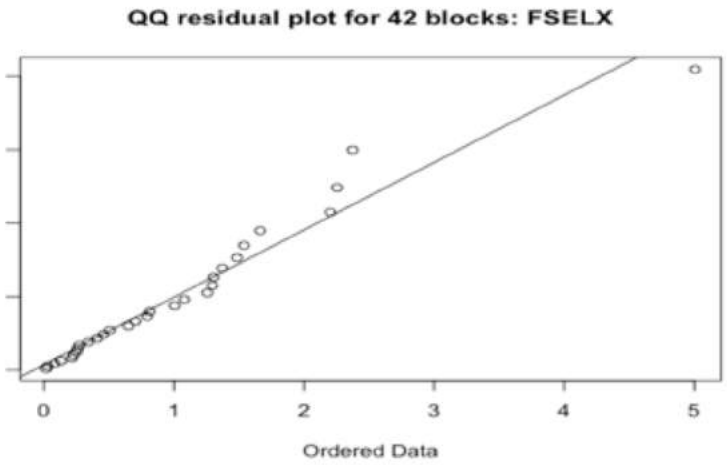






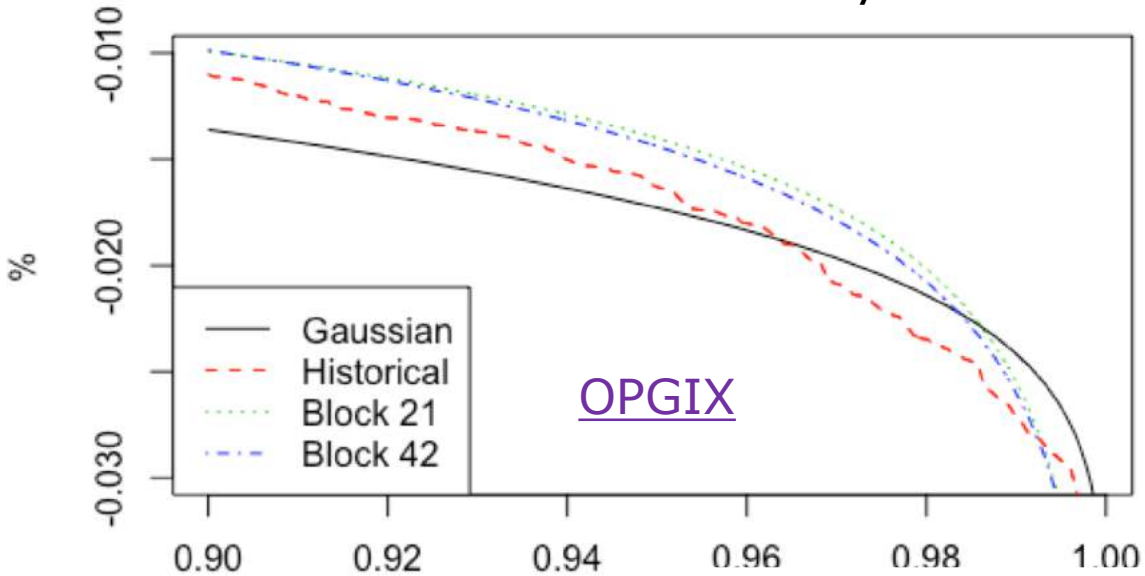


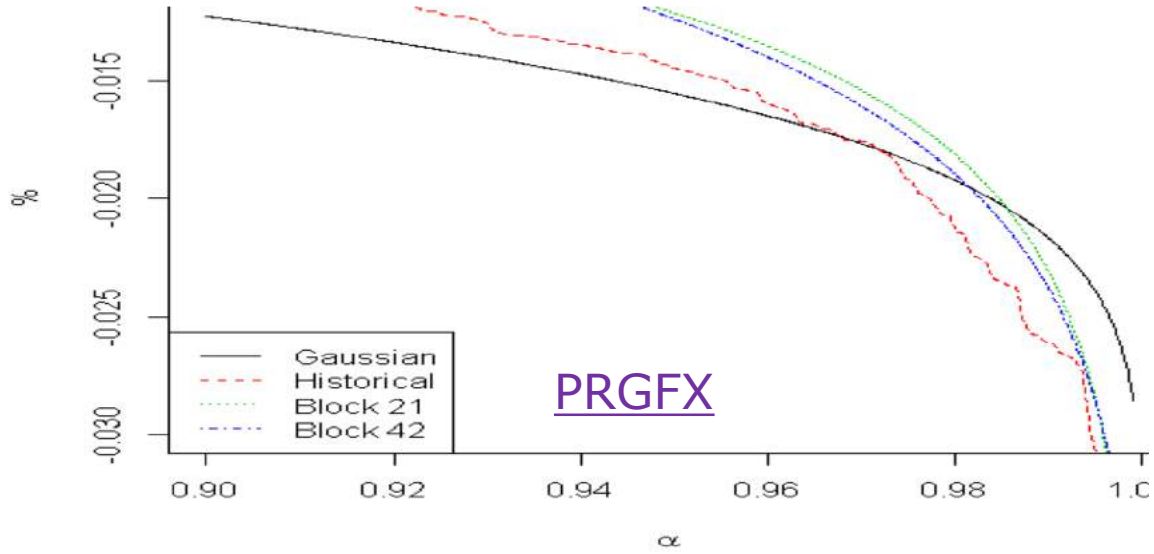


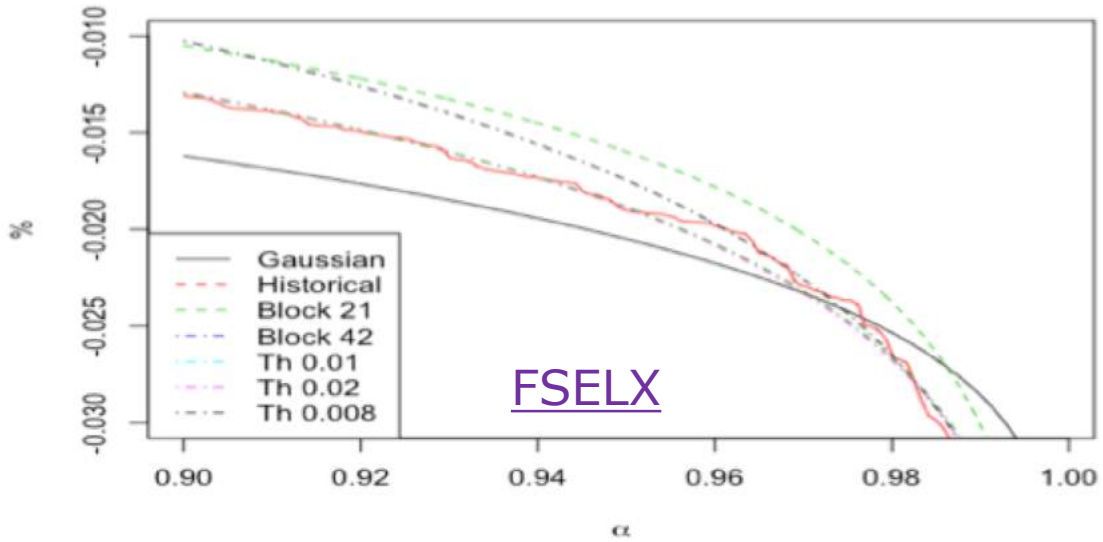


VaR Sensitivity

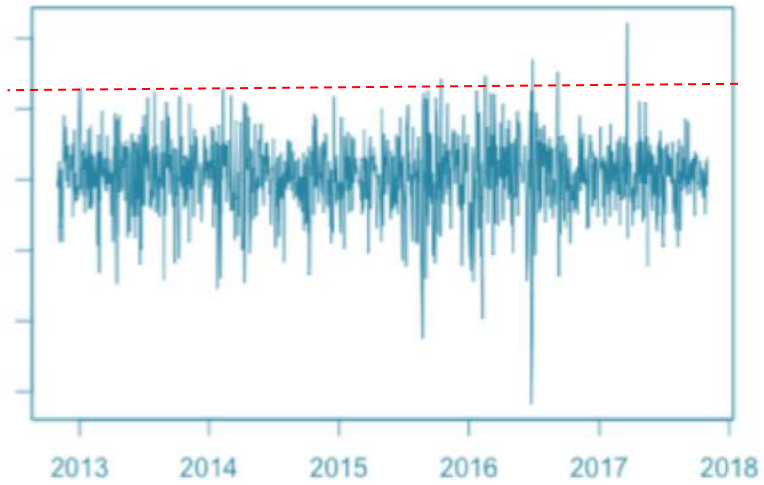
VaR Sensitivity for Gaussian, Historical and Block approaches



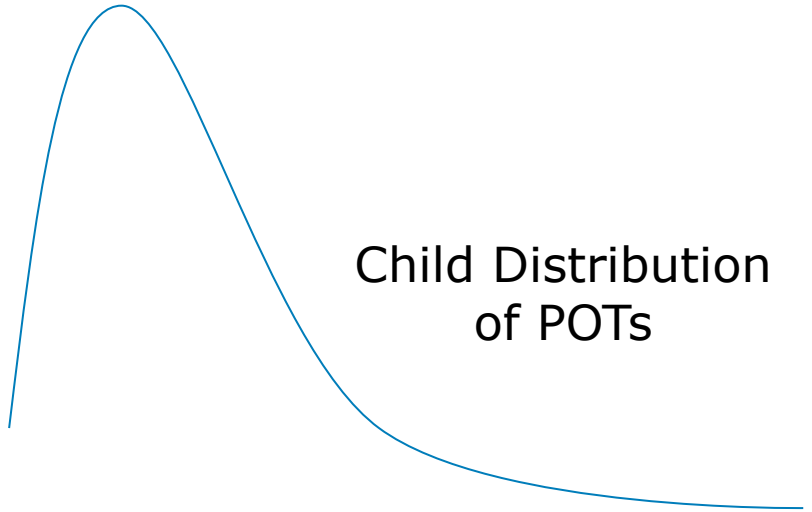




Peaks over threshold



OPGIX returns



Select the threshold

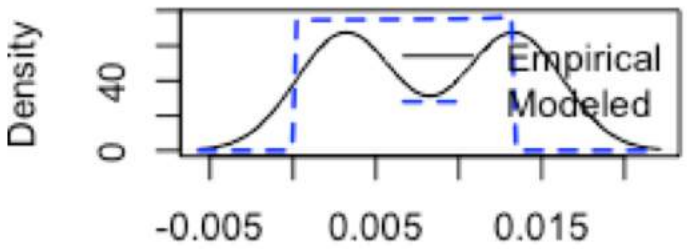
Obtain the estimates of ψ(η) and **ξ**

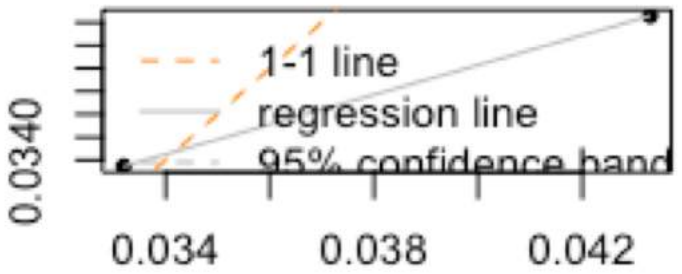
Check the adequacy of the fitted extreme value model

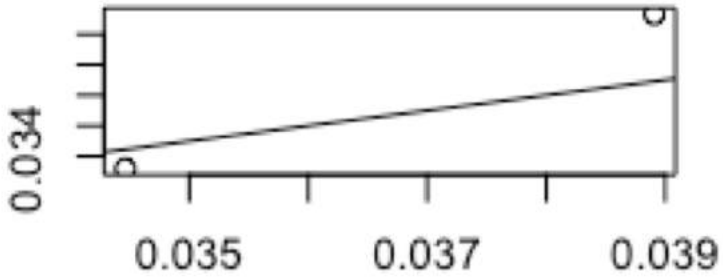
- The traditional EVT approach to risk calculation encounters some difficulties in the choice of sub-period length *n* is not clearly defined
- POT approach focuses on exceedances of the loss over some high threshold and the times at which the exceedances occur. Different choices of the threshold leads to different estimates of the **shape parameter ξ** . The choice of threshold depends on the observed returns.
  - For a stable return series, **η** = 2.5% may fare well for a long position.
  - For a volatile return series (e.g., daily returns of a dot-com stock), **η** may be as high as 10%.

Fitting to GPD distribution - OPGIX

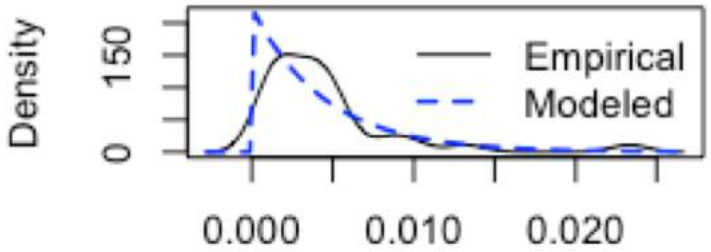
Threshold = 0.03 , N =2

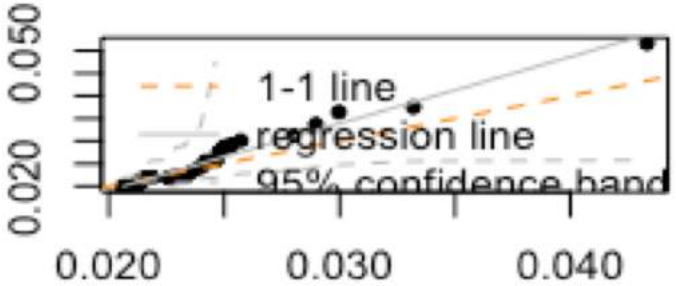


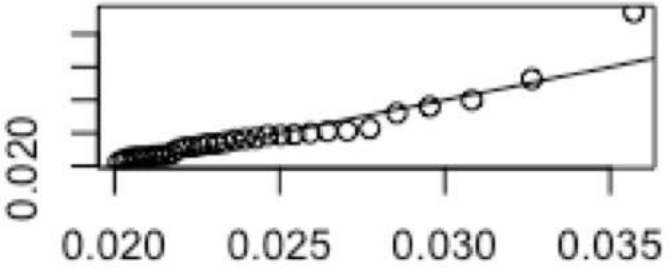




Threshold = 0.02 , N =33

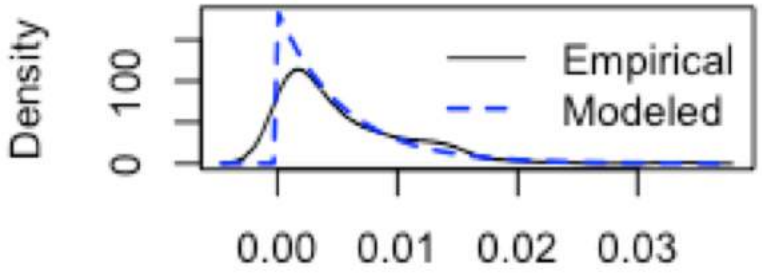


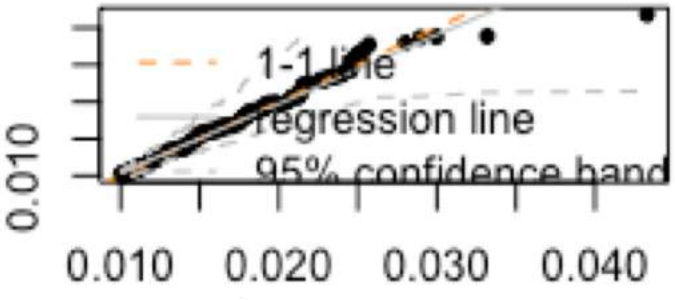


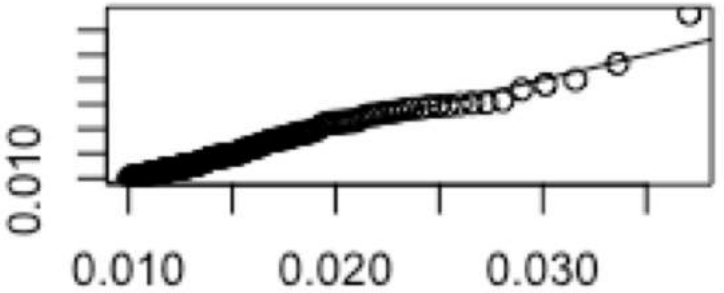


Model Quantiles

Threshold = 0.01 , N =187

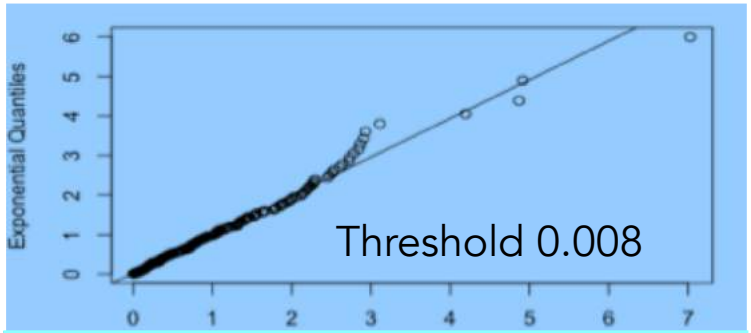


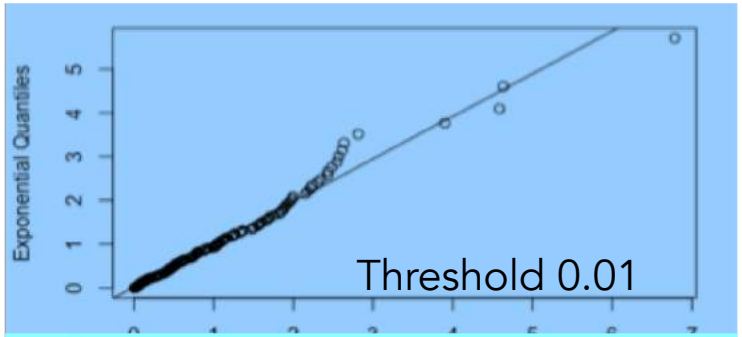


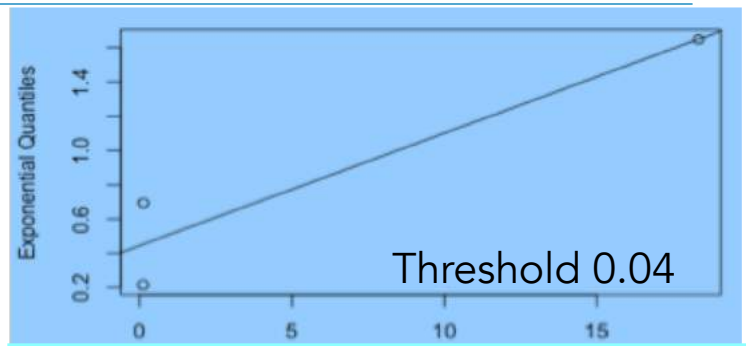


Model fit for different threshold values

OPGIX







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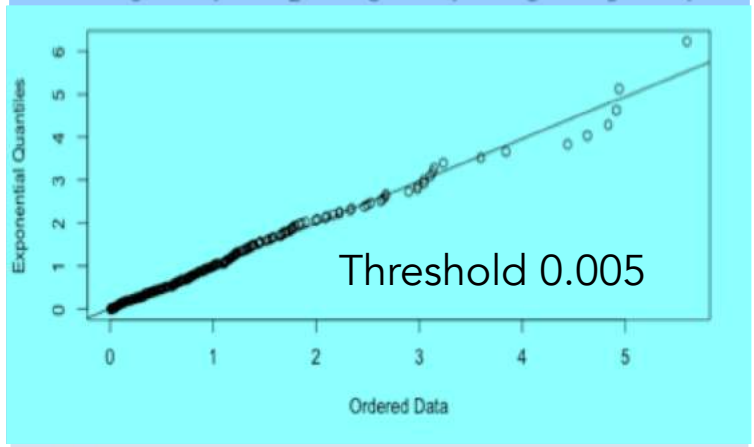

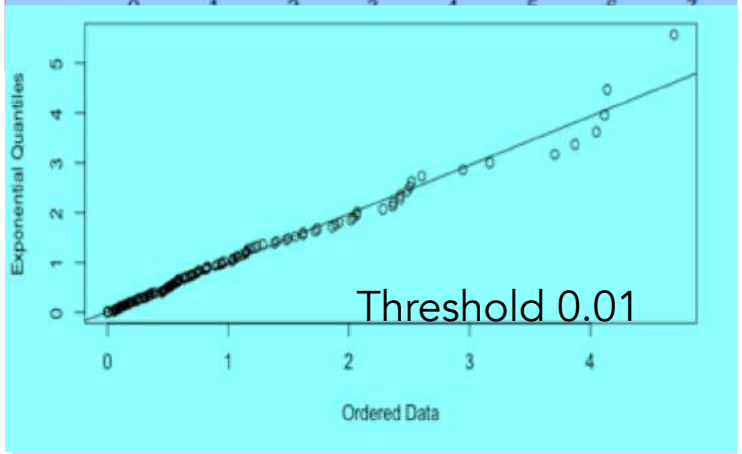

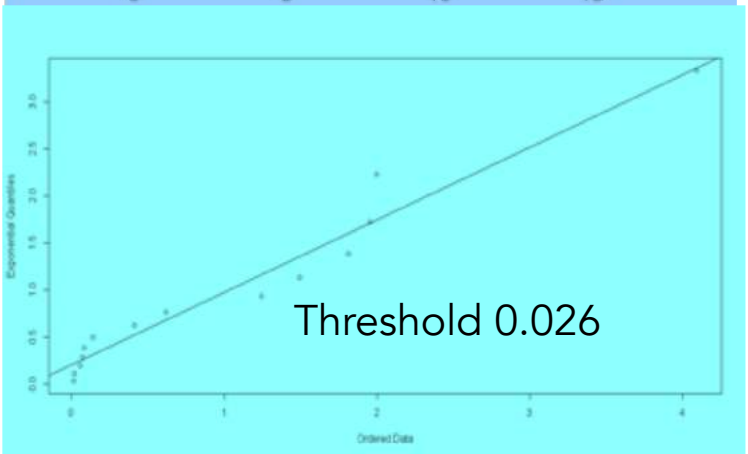

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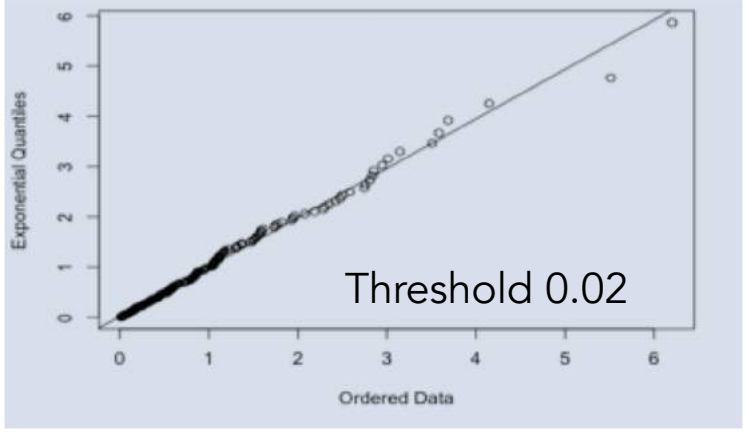
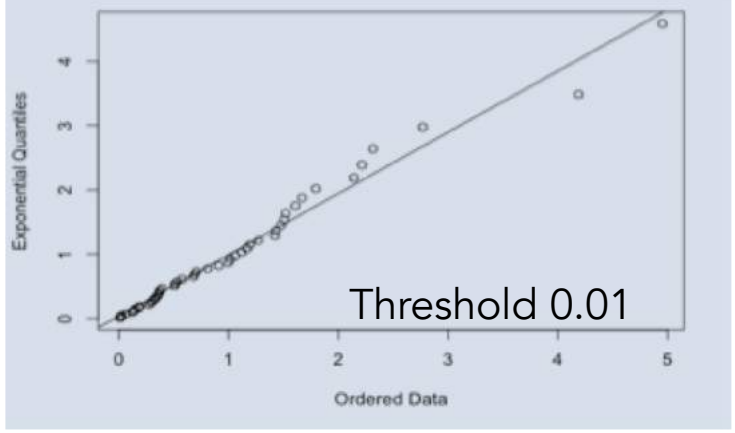
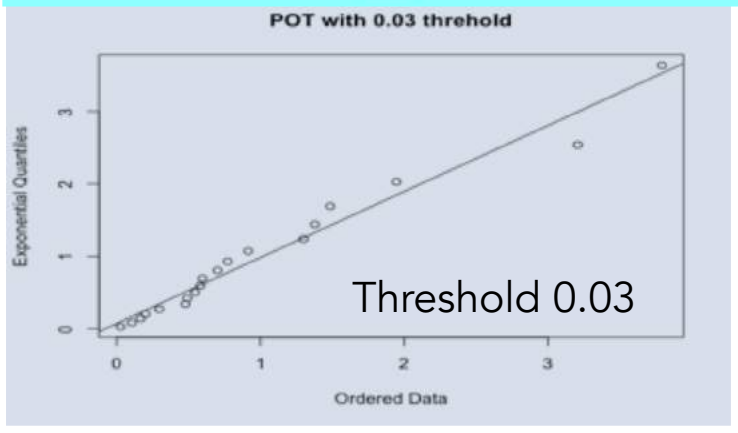
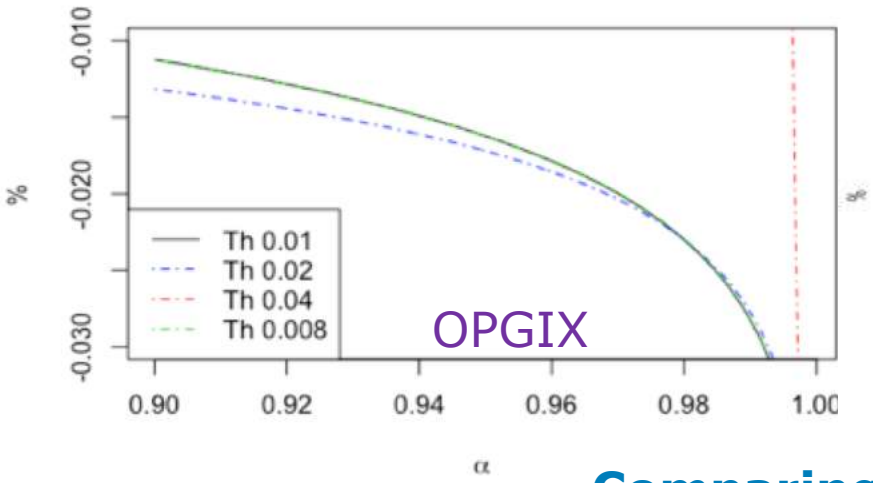


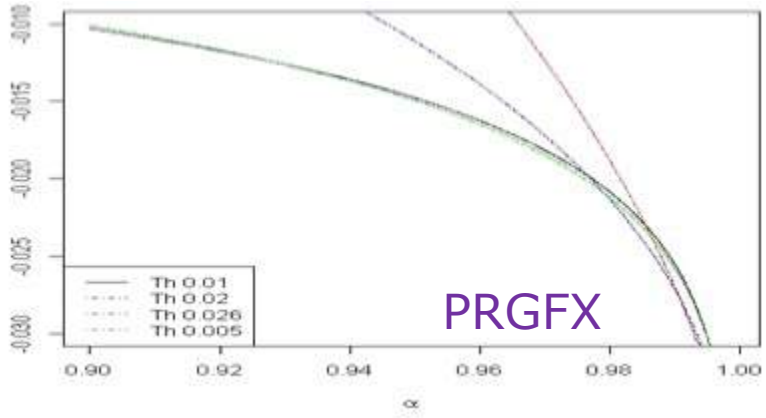


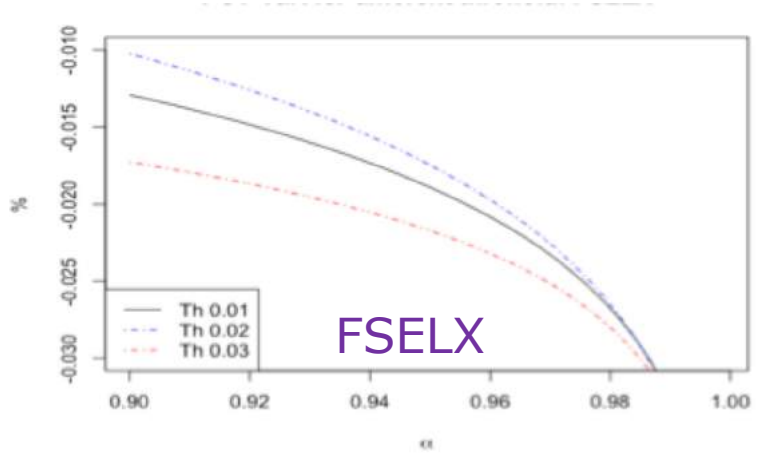


VaR Sensitivity

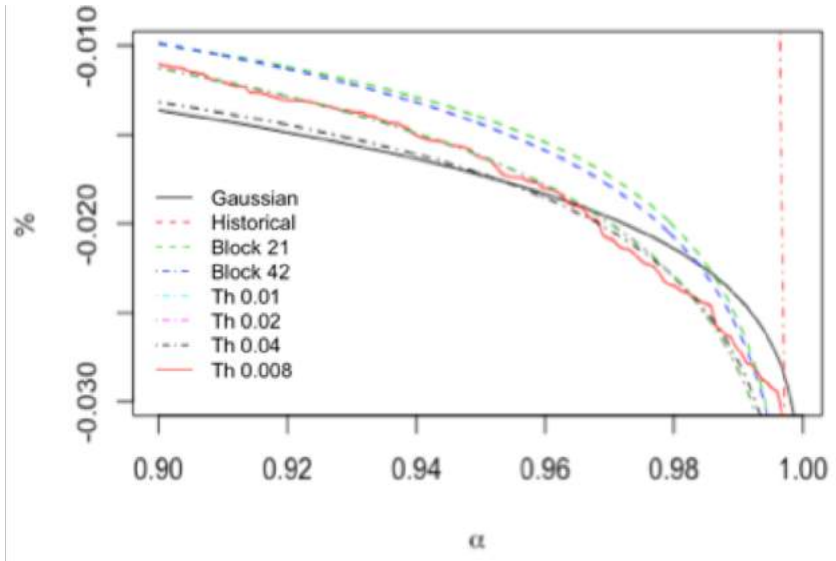
POT VaR

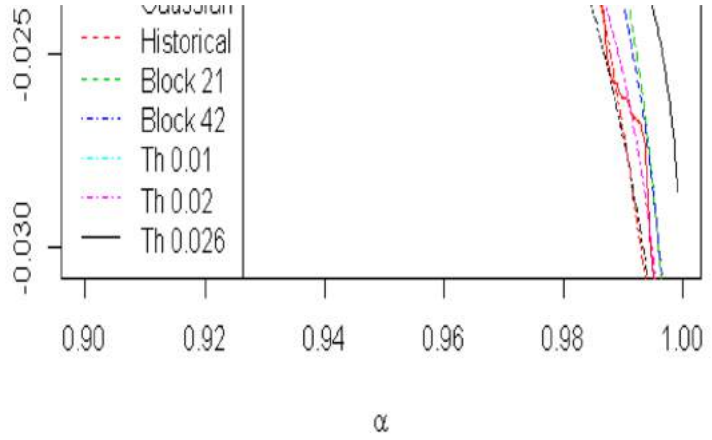


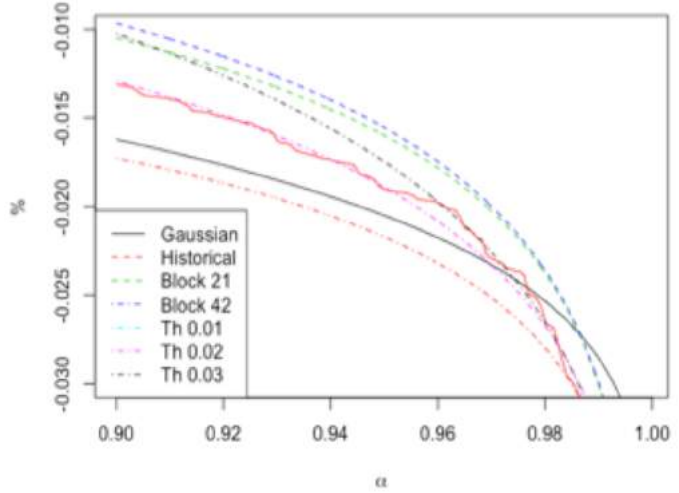




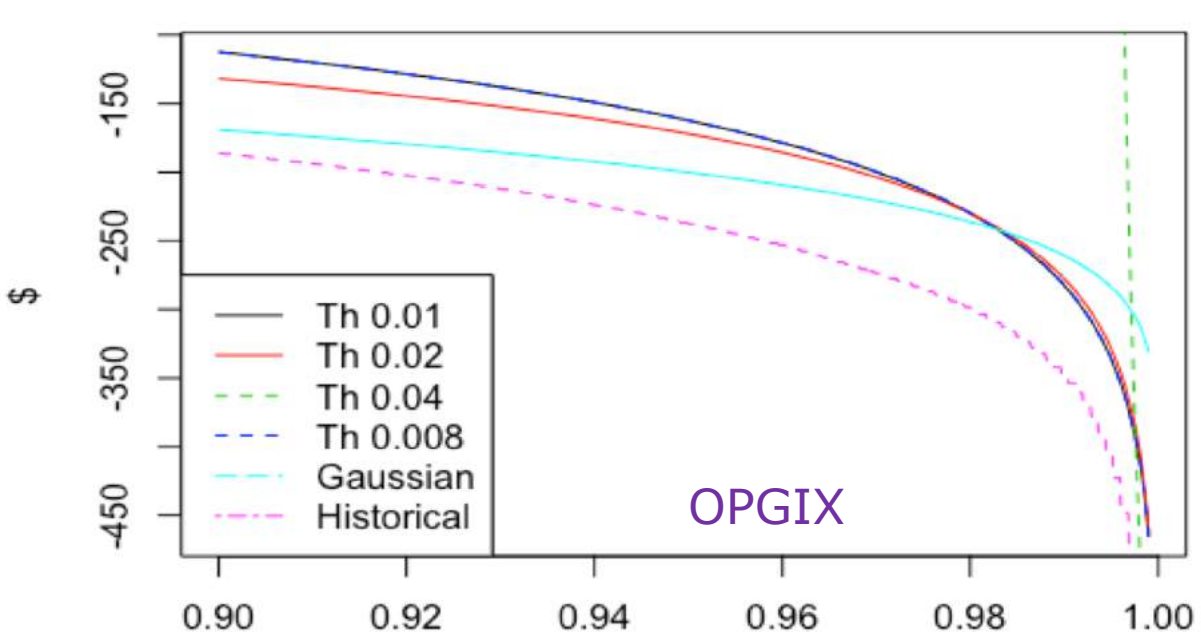
Comparing- Gaussian, Historical, Block and POT VaR

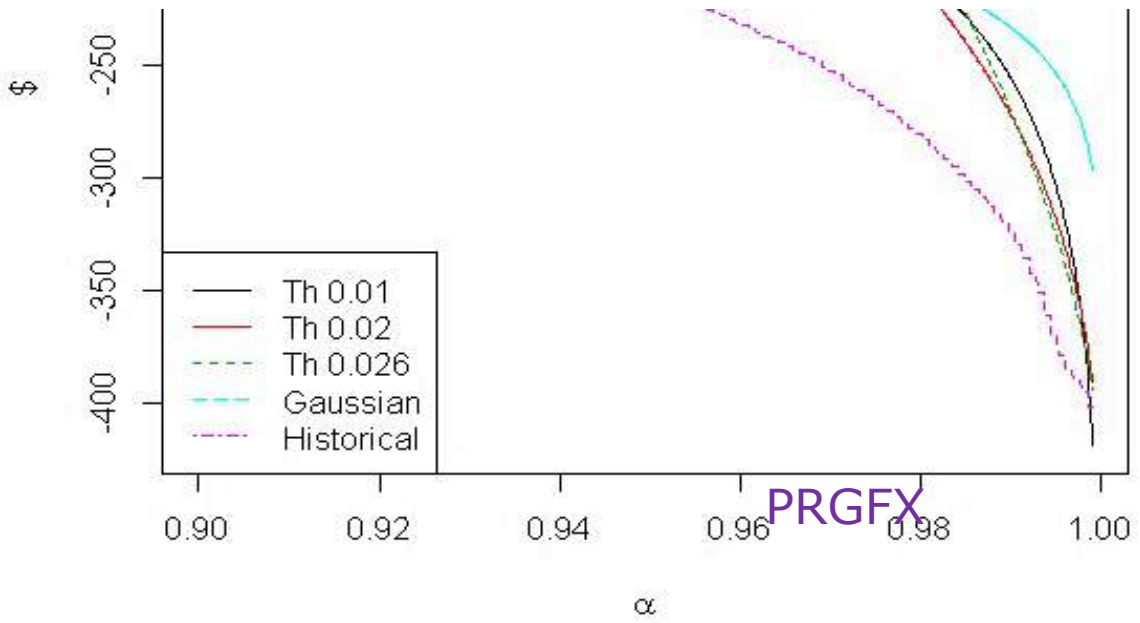


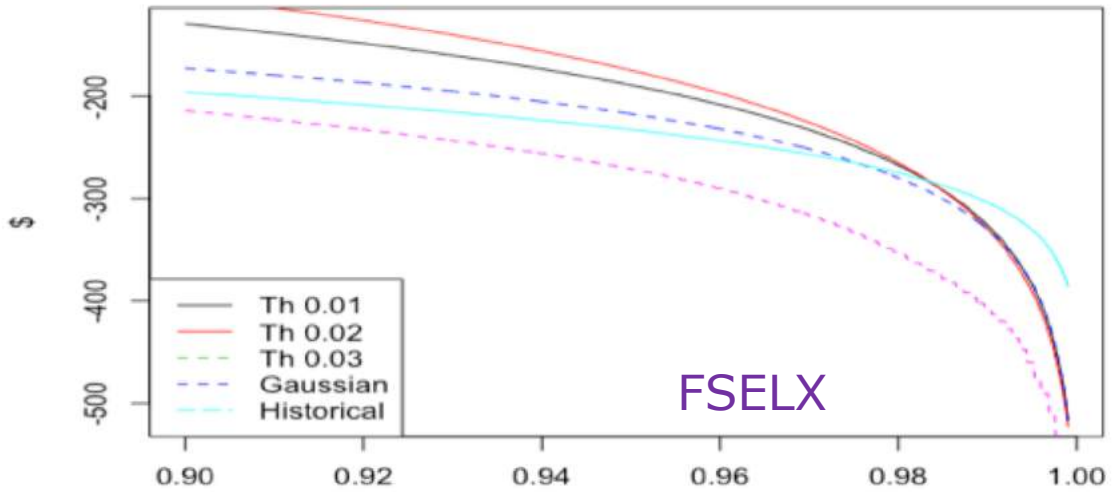




Expected Shortfall







Conclusion

- Pros:
  - VaR models can be used to estimate the loss of capital due to market risk
  - It can measure the risk of stocks and bonds, commodities, foreign exchange, and structured prod- ucts such as asset-backed securities and collateralized mortgage obligations (CMOs), as well as off-balance- sheet derivatives such as futures, forwards, swaps, and options.
  - It is particularly useful for a multi-asset-class portfolio and needs to measure its exposure to a variety of risk factors.
  - VaR is useful to plan sponsors who have their portfolios managed by a variety of external asset managers and need to compare their performance on a risk-adjusted basis.
- Cons:
  - The concept of VaR is very simple but this is also one of the main sources of critique.
  - It underestimates the frequency of "extreme events," such as outcomes several standard deviations away from the mean
  - All VaR approaches cannot be applied directly
  - For EVT VaR either the threshold or block values need to be calculated
  - VaR has also problems in estimating risk figures accurately for longer time horizons as the results quickly deteriorate when moving e.g. from monthly to annual measures.

VaR estimates should therefore always be accompanied by other risk management techniques, such as stress testing, sensitivity analysis and scenario analysis in order to obtain a wider view of surrounding risks.