Extreme Events (book by Malcolm Kemp) – Charts sourced from Nematrian

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The book Extreme Events: Robust Portfolio Construction in the Presence of Fat Tails by Malcolm Kemp contains a range of charts to illustrate some of the topics it covers. The majority of these charts are sourced from and copyrighted by Nematrian.

For ease of reference, we include below links to pages referring to these charts. The pages to which these hyperlinks are linked generally include an image of the chart as copied from the Microsoft Excel spreadsheet in which the charts were originally created as well as a SmartChart equivalent that uses the Nematrian website's online charting toolkit.

As the SmartChart often looks nicer in a web page it is shown first if it is available. Charts developed in Microsoft Excel do not always appear to copy well unless the spreadsheet itself is embedded within the document being viewed.

The SmartChart can be used as a template for creating similar charts using other datasets. If the copyright of the original chart is not held by Nematrian then the page only contains a SmartChart equivalent (if available).

- Chapter2
- Chapter3
- Chapter4
- Chapter5
- Chapter6
- Chapter7

Chapter 2

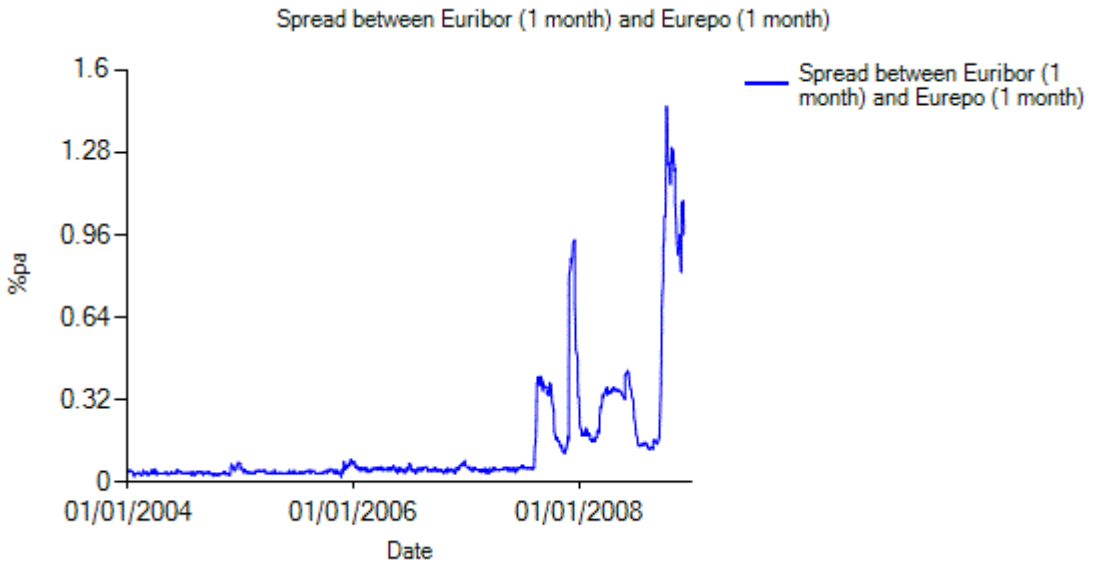
[Nematrian website page: ExtremeEventsFiguresChapter2, © Nematrian 2015]

Charts:

Figure 2.1: Spread between 1 month Eurepo and Euribor interest rates

[ExtremeEventsFigure2_1]

SmartChart version:



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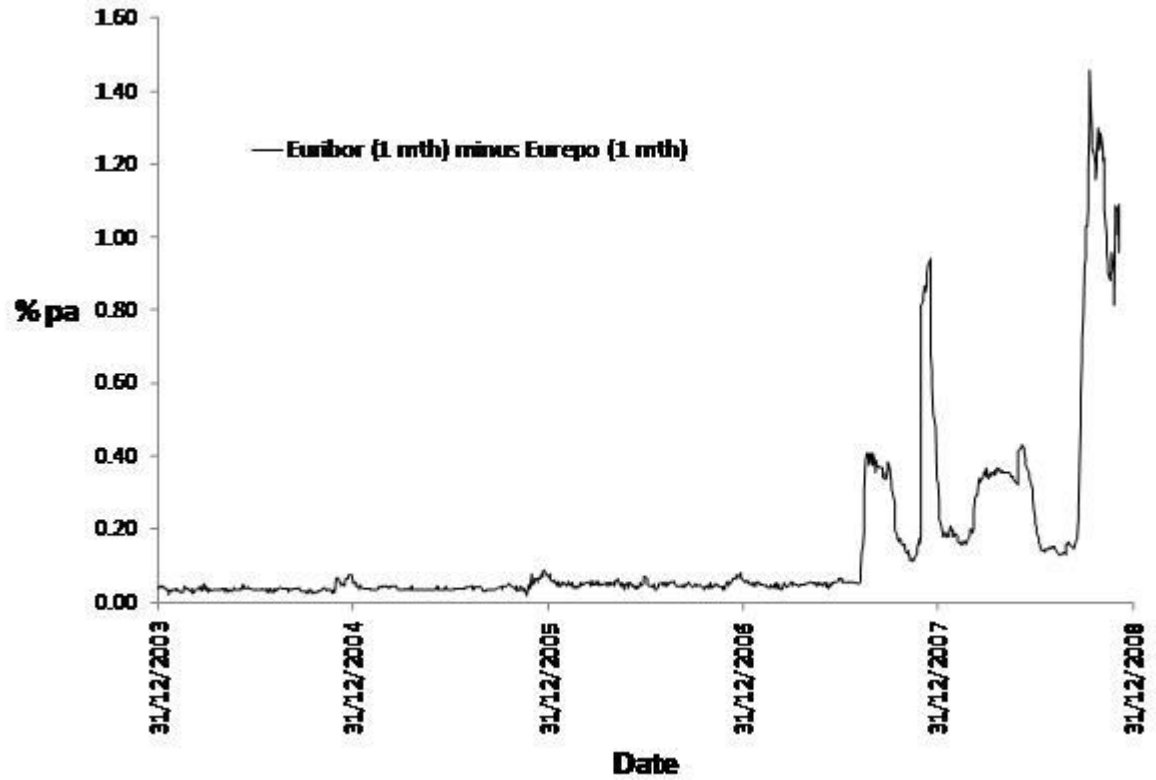

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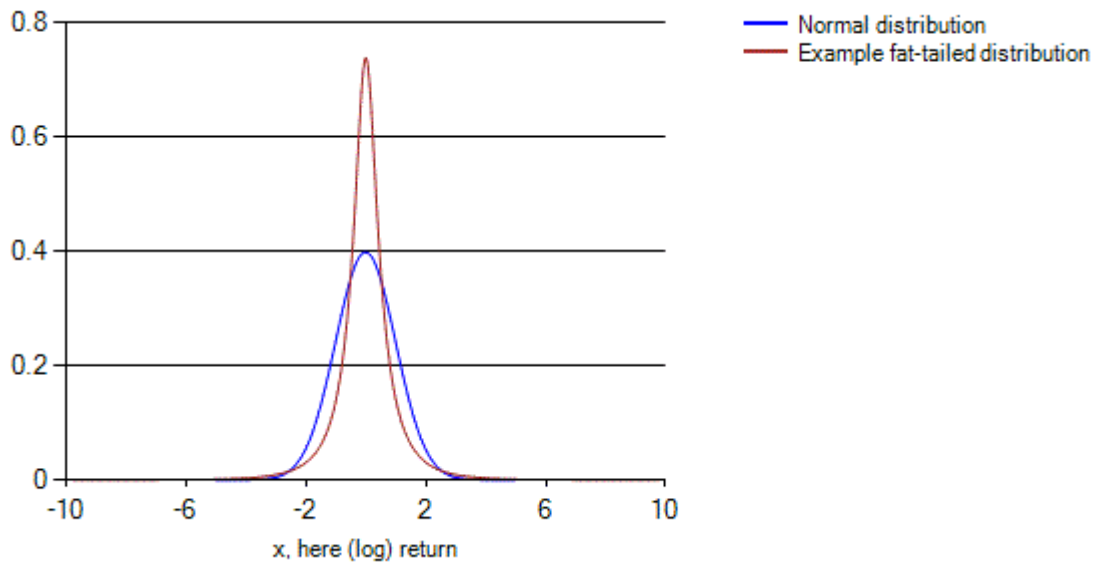
Figure 2.2: Illustrative probability density function plot

[ExtremeEventsFigure2_2]

SmartChart version:



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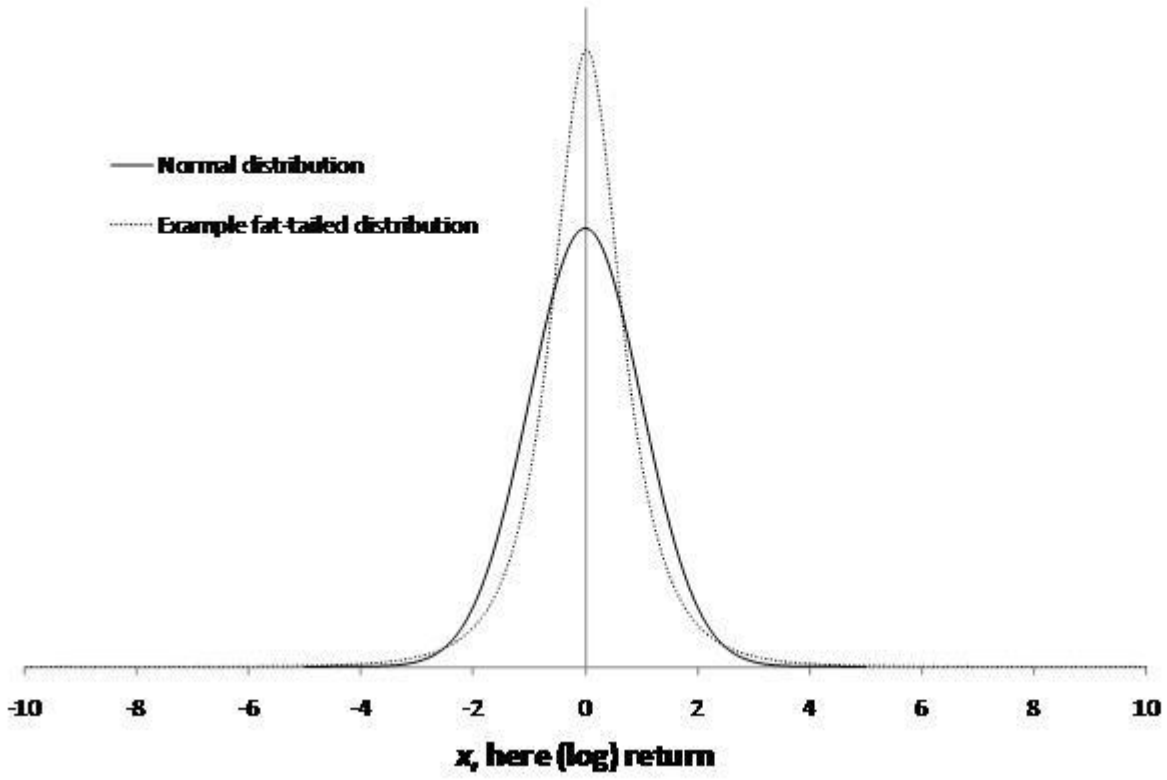

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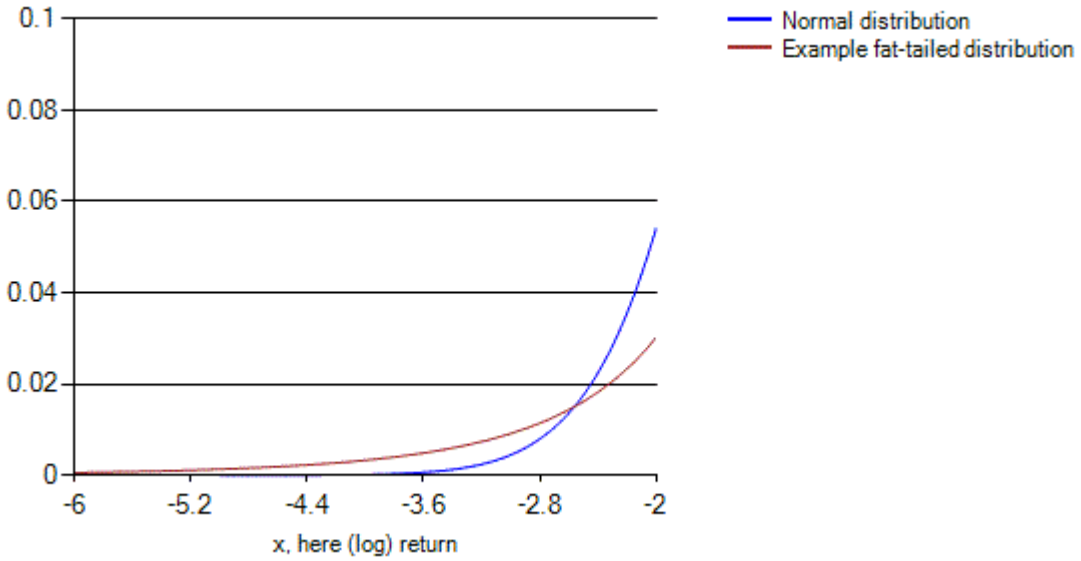
Figure 2.3: Illustrative probability density function plot as per Figure 2.2, but zooming in on just the part of the lower tail of the distribution between x = -6 and x = -2

[ExtremeEventsFigure2_3]

SmartChart version:



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Variant used in book:

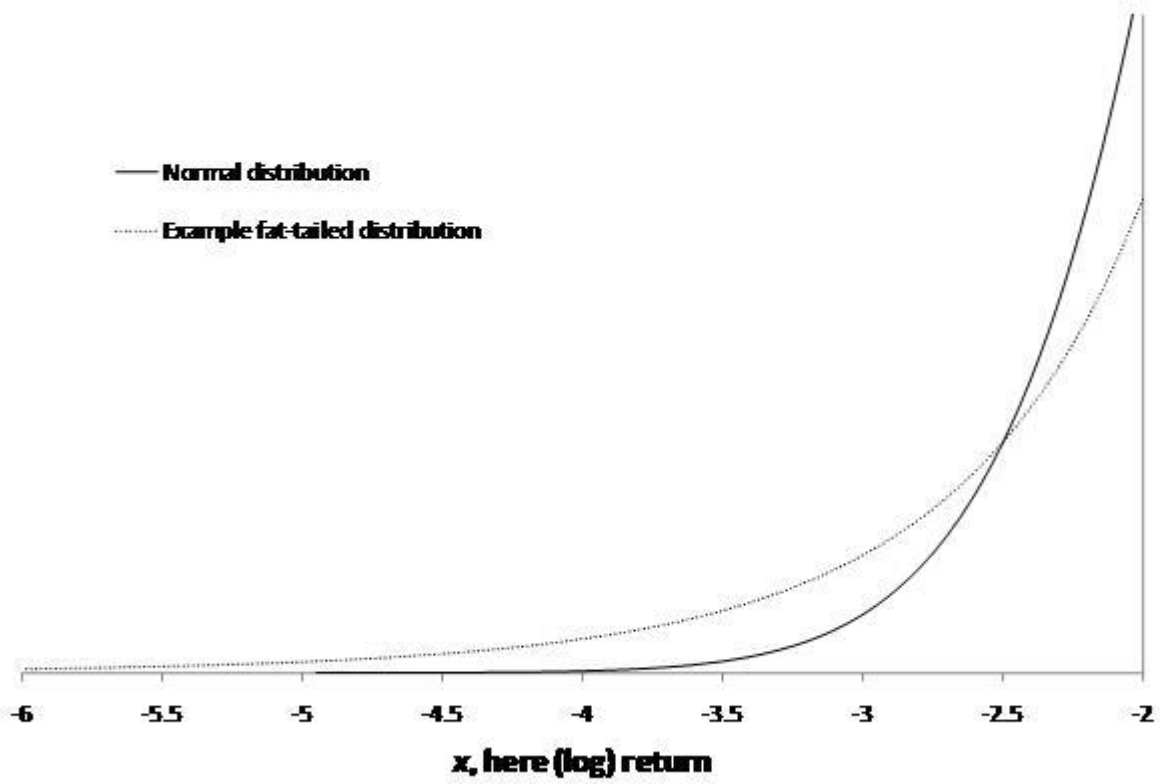

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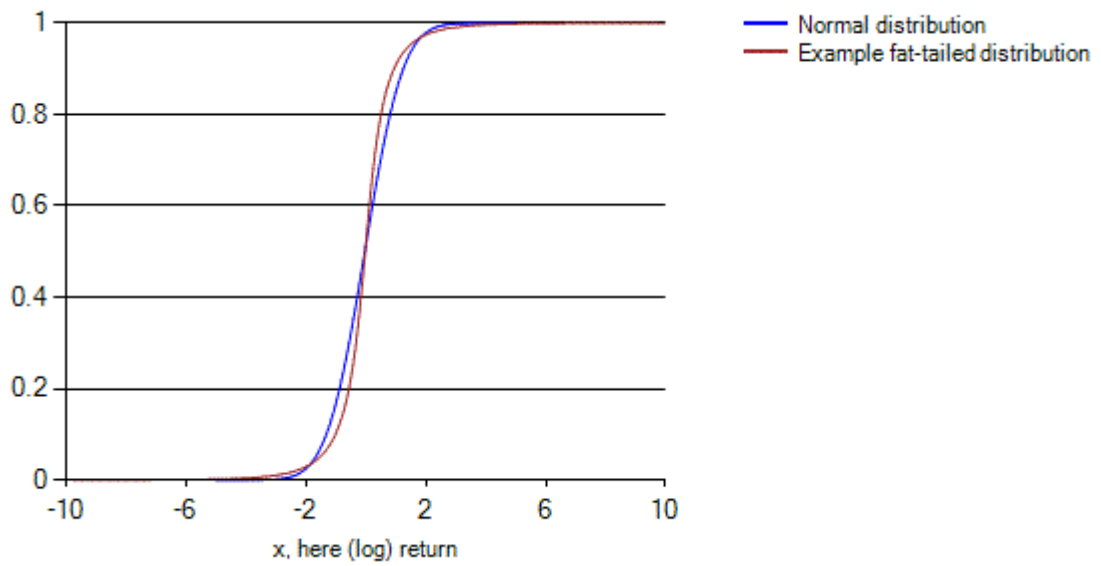
Figure 2.4: Illustrative cumulative probability distribution plot

[ExtremeEventsFigure2_4]

SmartChart version:



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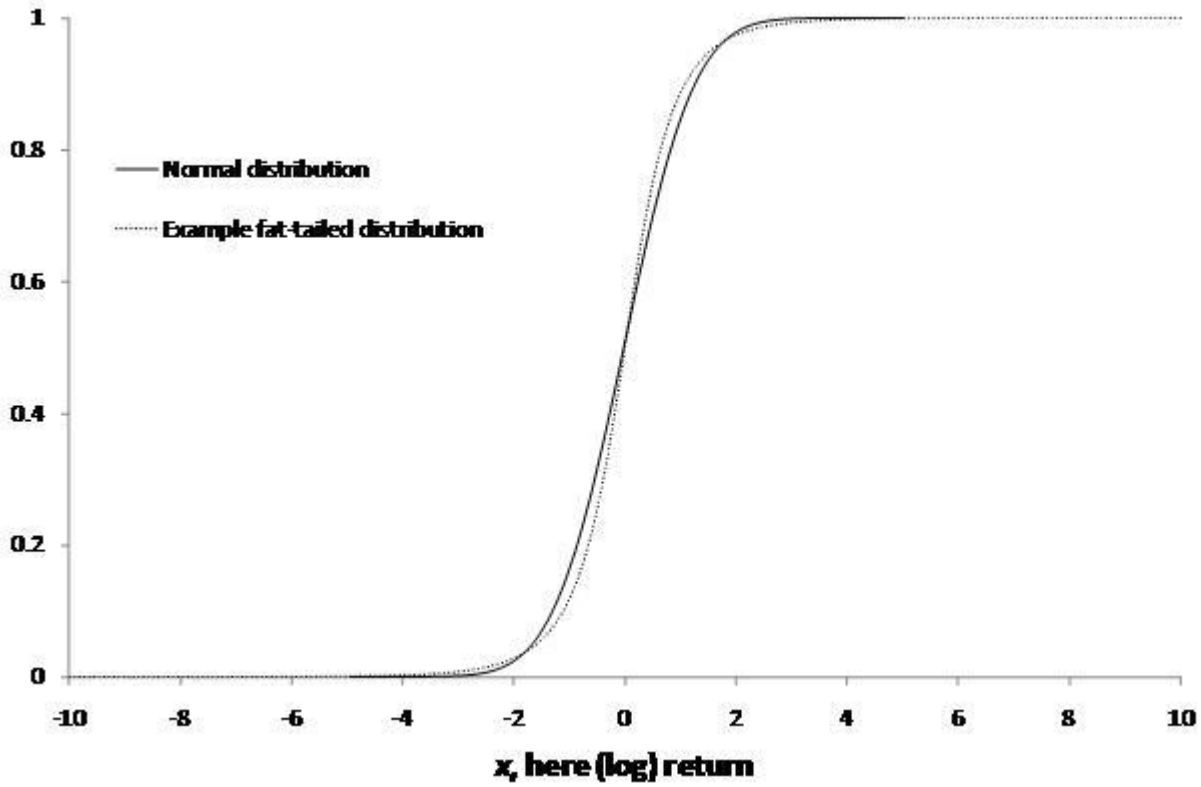

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Figure 2.5: Illustrative quantile-quantile plot

[ExtremeEventsFigure2_5]

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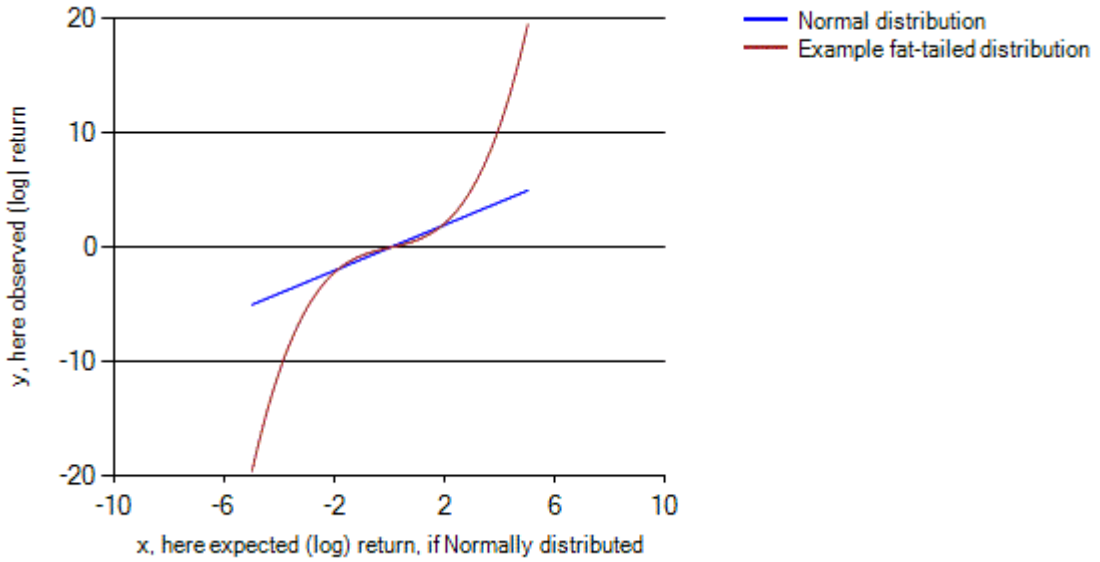

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Variant used in book:

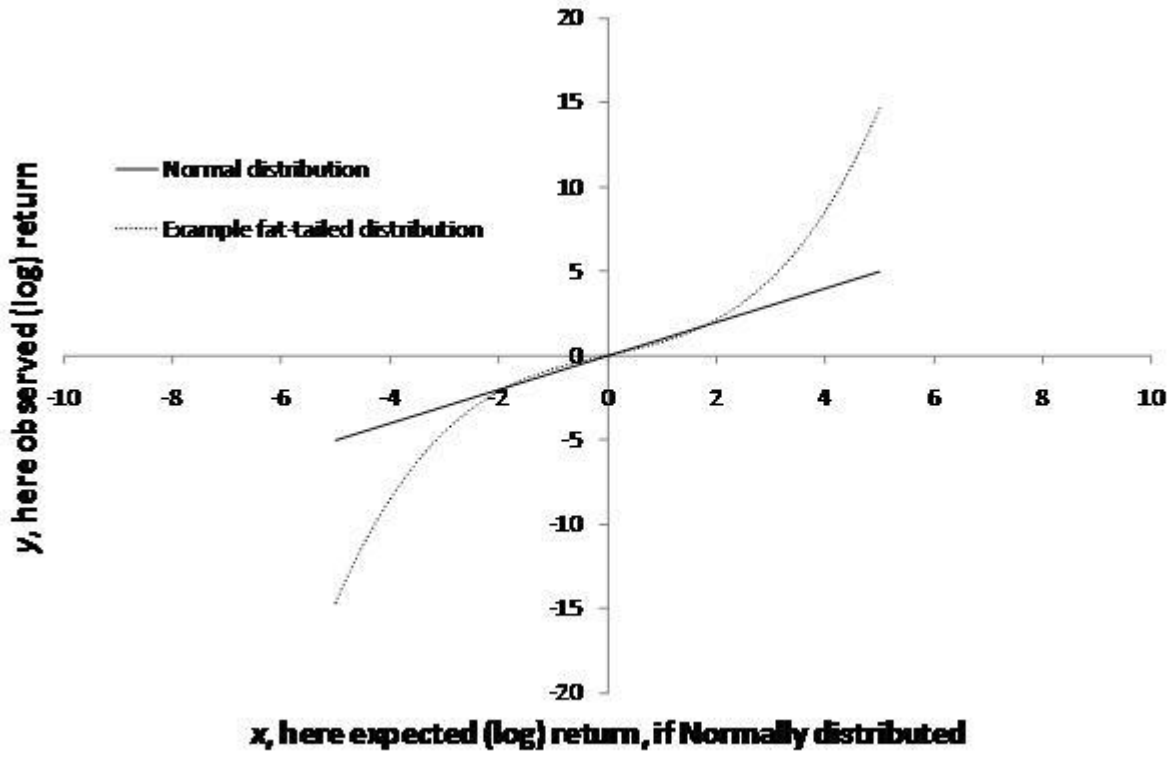

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Figure 2.6: Illustrative TVAR versus quantile plot

[ExtremeEventsFigure2_6]

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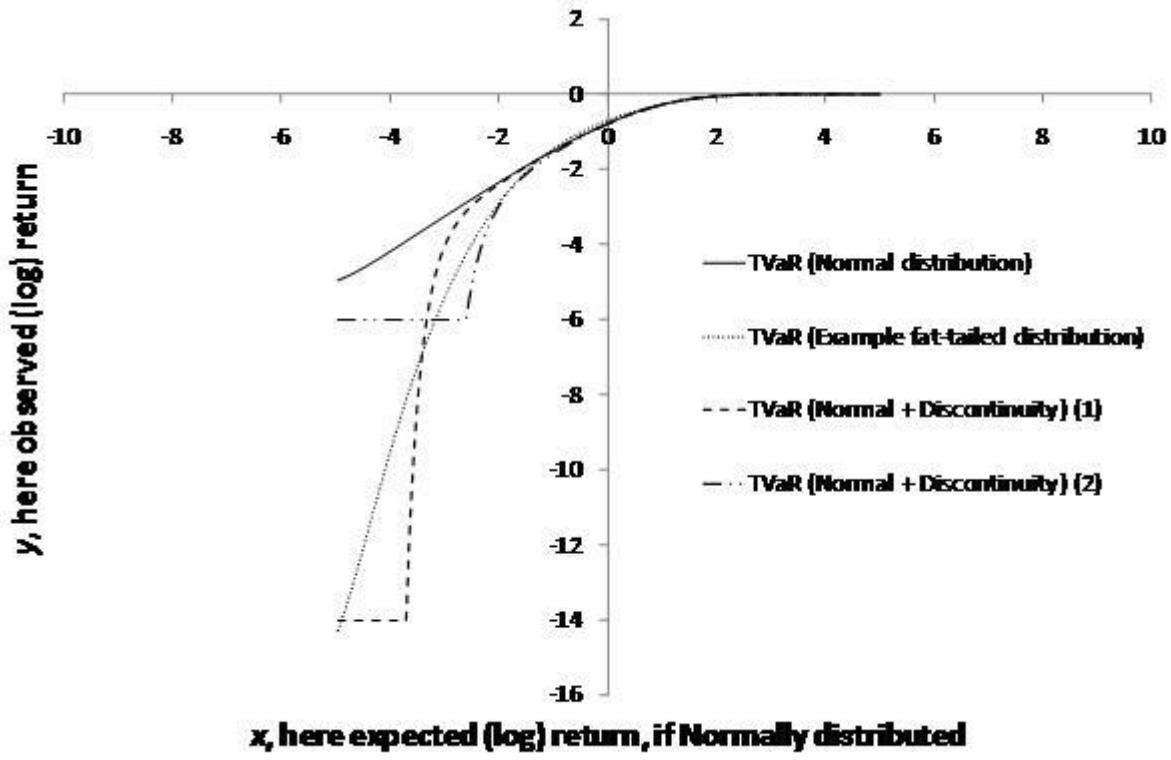

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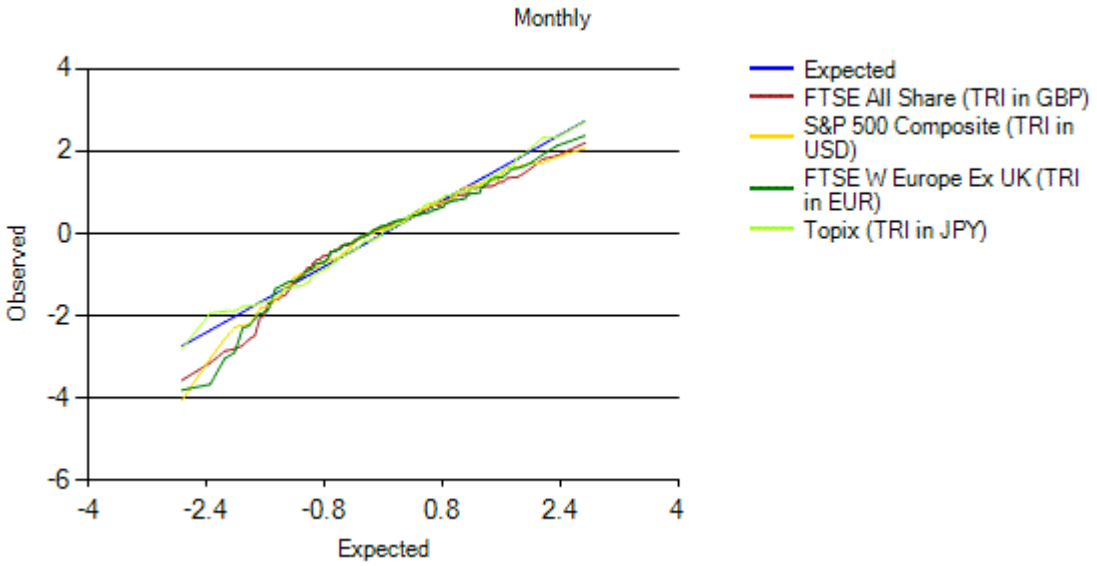
Figure 2.7: QQ-plots of monthly returns on various major equity market indices from end June 1994 to end December 2007

[ExtremeEventsFigure2_7]

SmartChart version:



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Variant used in book:

Figure 2.8: QQ-plots of weekly returns on various major equity market indices from end June 1994 to end December 2007

[ExtremeEventsFigure2_8]

SmartChart version:

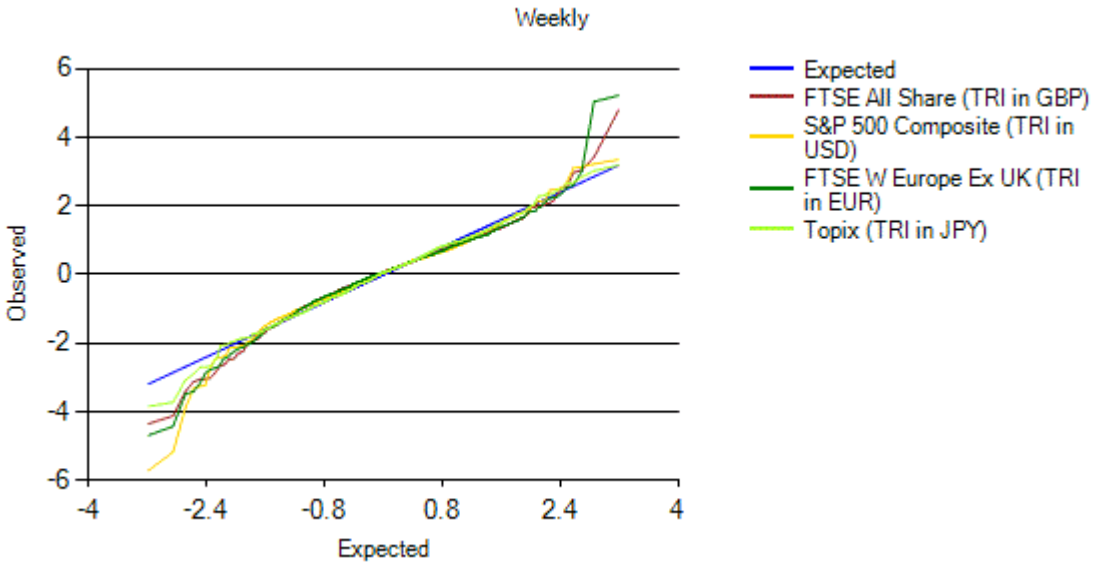

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Figure 2.9: QQ-plots of daily returns on various major equity market indices from end June 1994 to end December 2007

[ExtremeEventsFigure2_9]

SmartChart version:

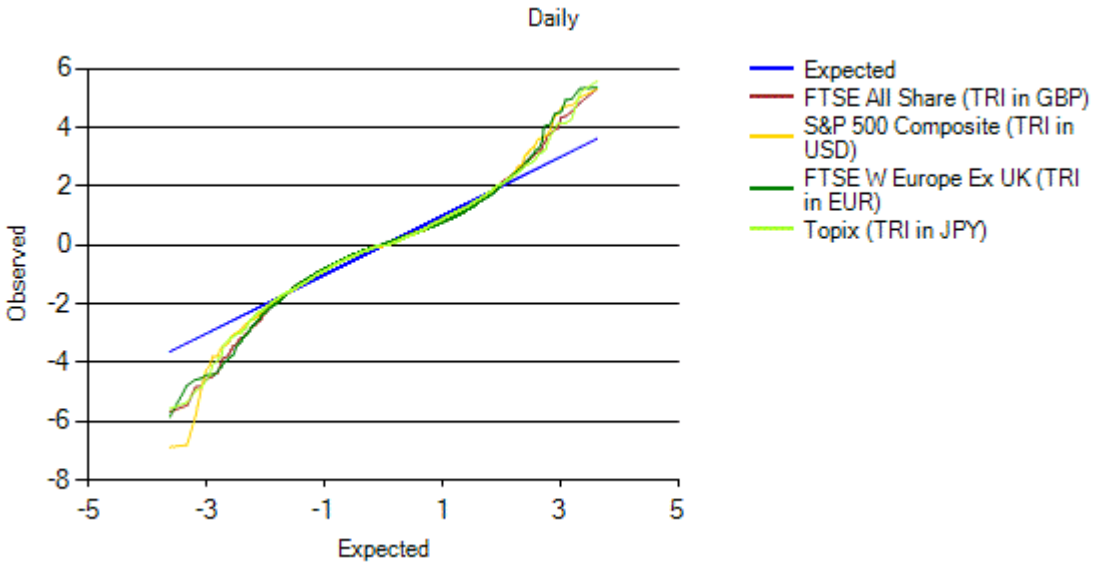

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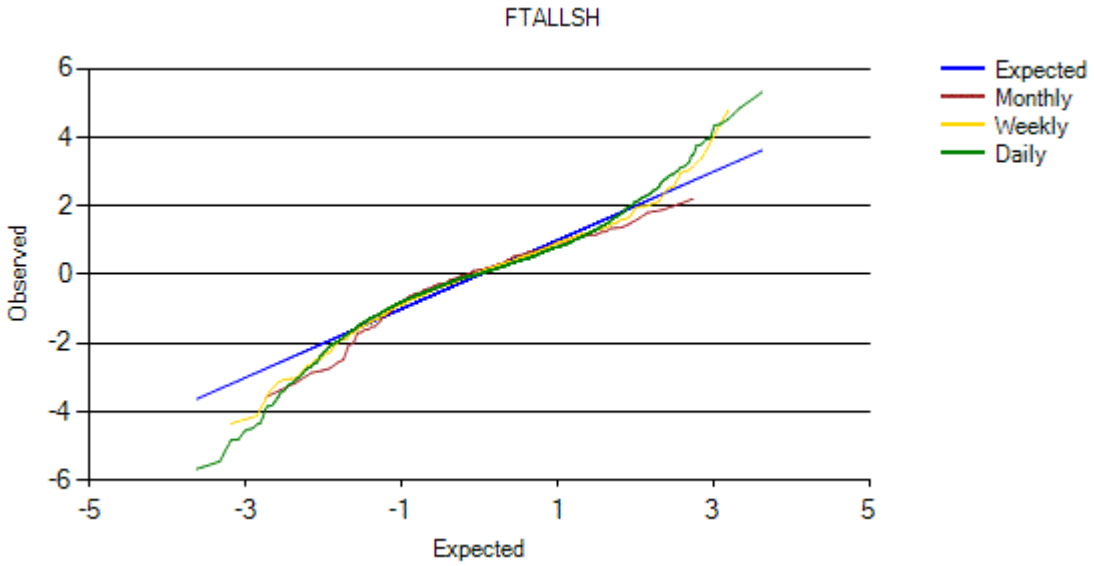
Figure 2.10: QQ-plots of daily, weekly and monthly returns on FTSE All Share index from end June 1994 to end December 2007

[ExtremeEventsFigure2_10]

SmartChart version:



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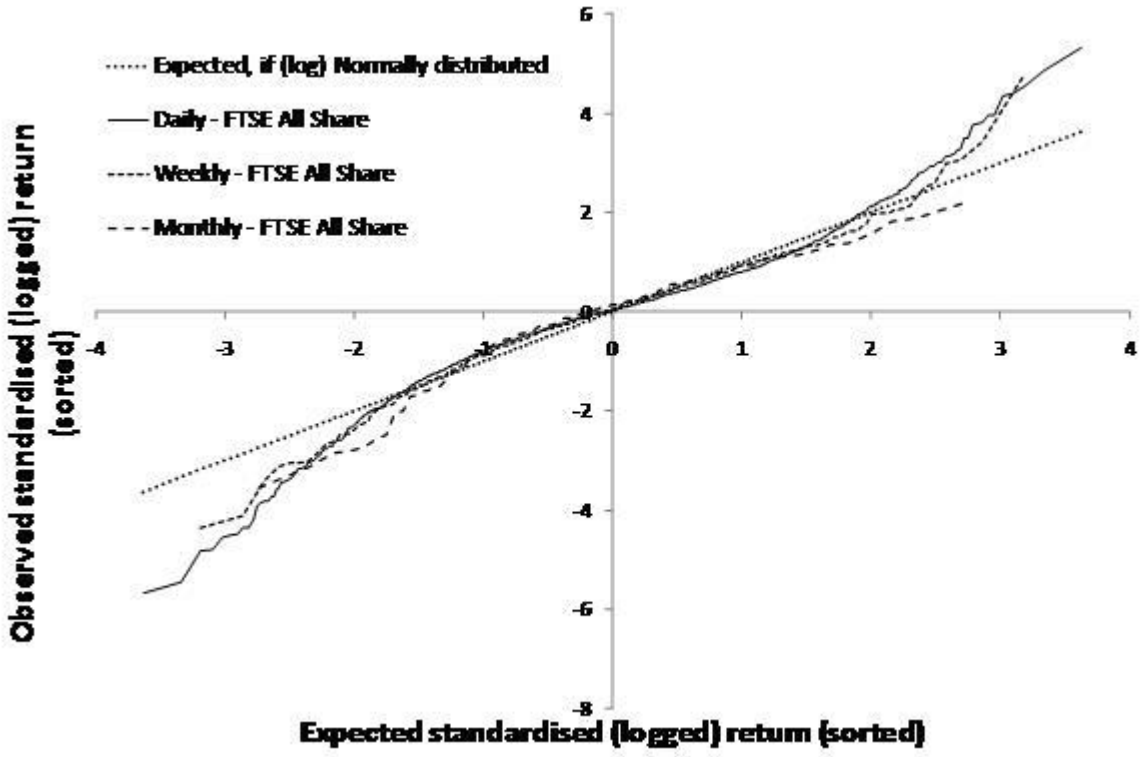

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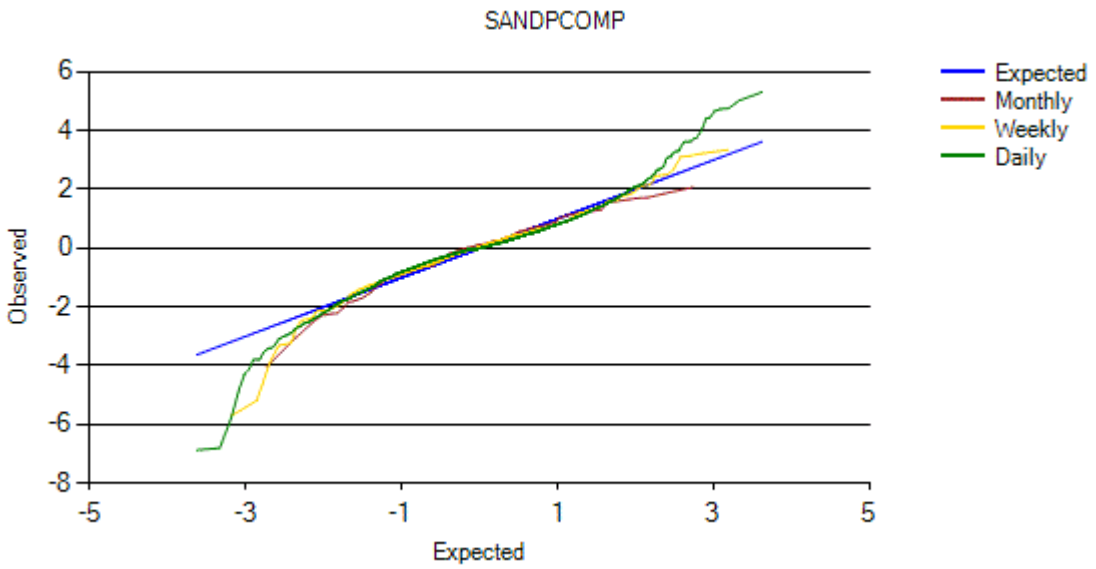
Figure 2.11: QQ-plots of daily, weekly and monthly returns on S&P 500 Composite index from end June 1994 to end December 2007

[ExtremeEventsFigure2_11]

SmartChart version:



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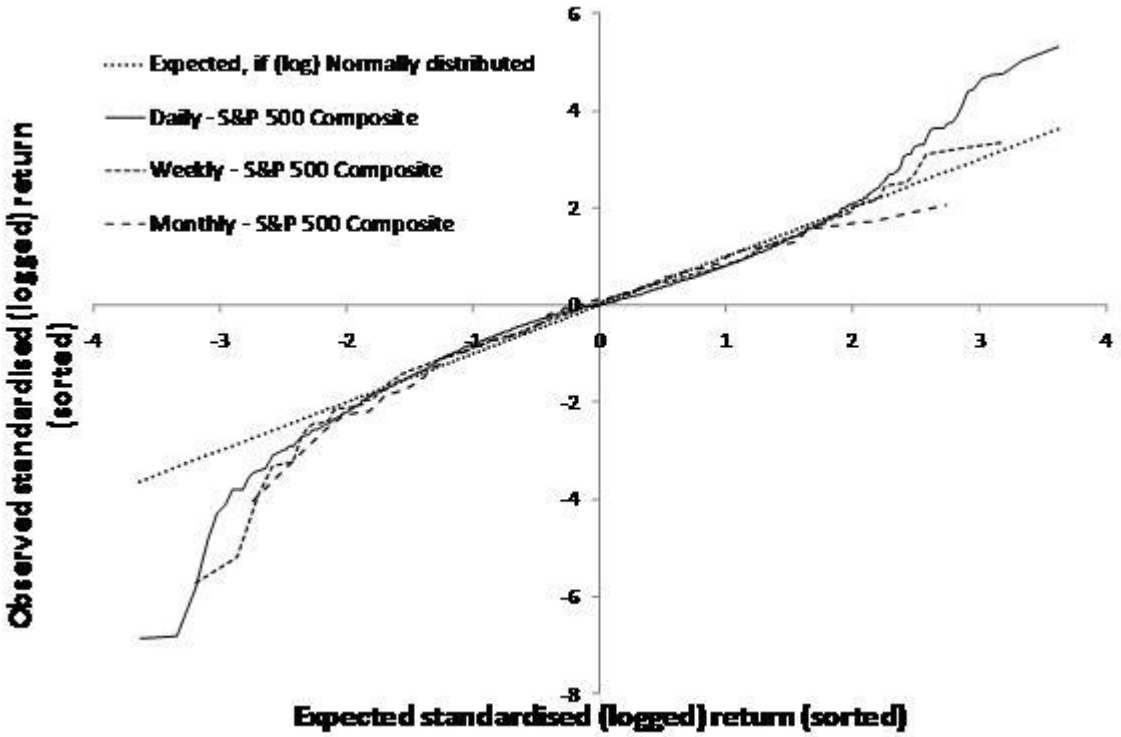

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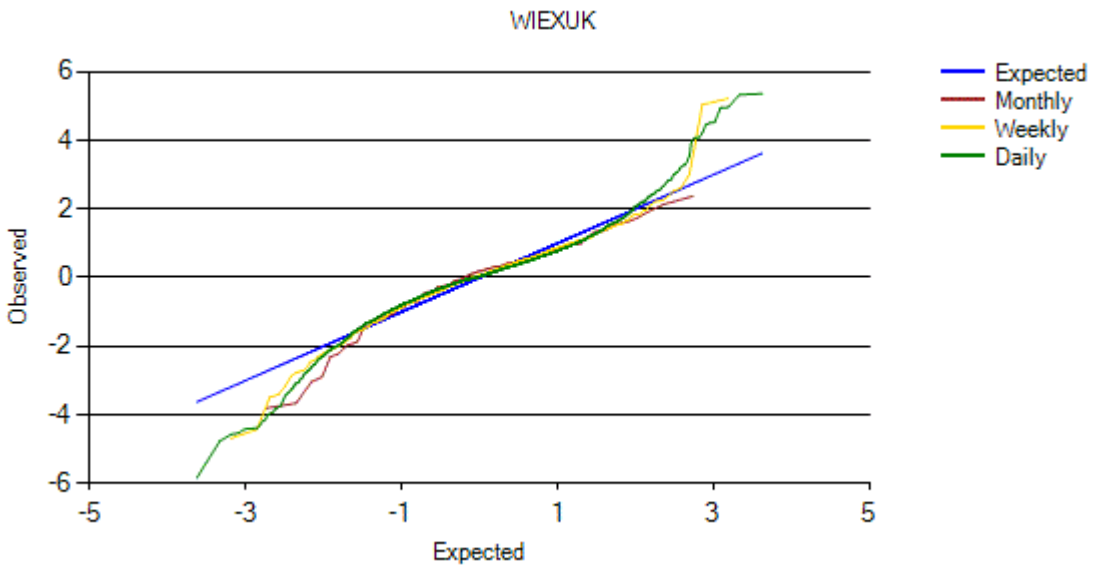
Figure 2.12: QQ-plots of daily, weekly and monthly returns on FTSE W Europe Ex UK index from end June 1994 to end December 2007

[ExtremeEventsFigure2_12]

SmartChart version:



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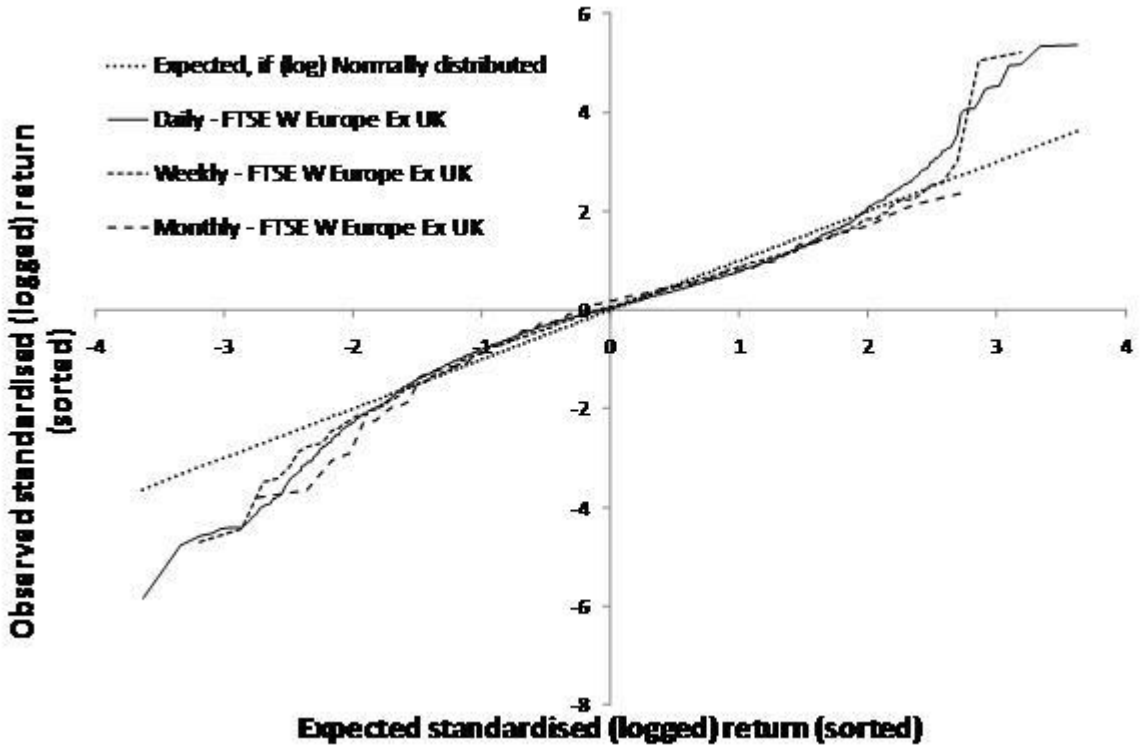

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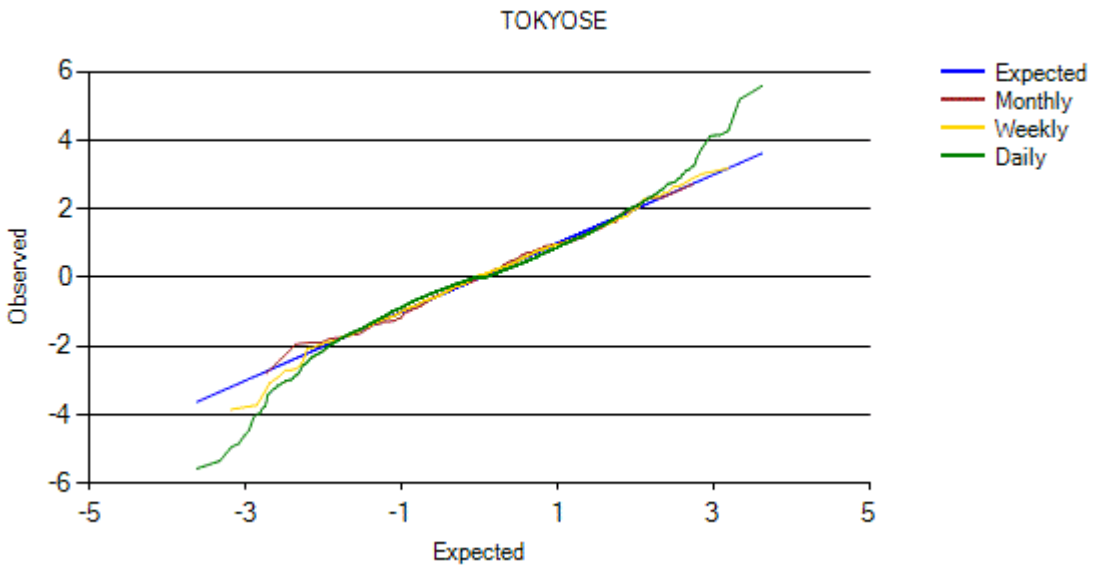
Figure 2.13: QQ-plots of daily, weekly and monthly returns on Tokyo SE (Topix) from end June 1994 to end December 2007

[ExtremeEventsFigure2_13]

SmartChart version:



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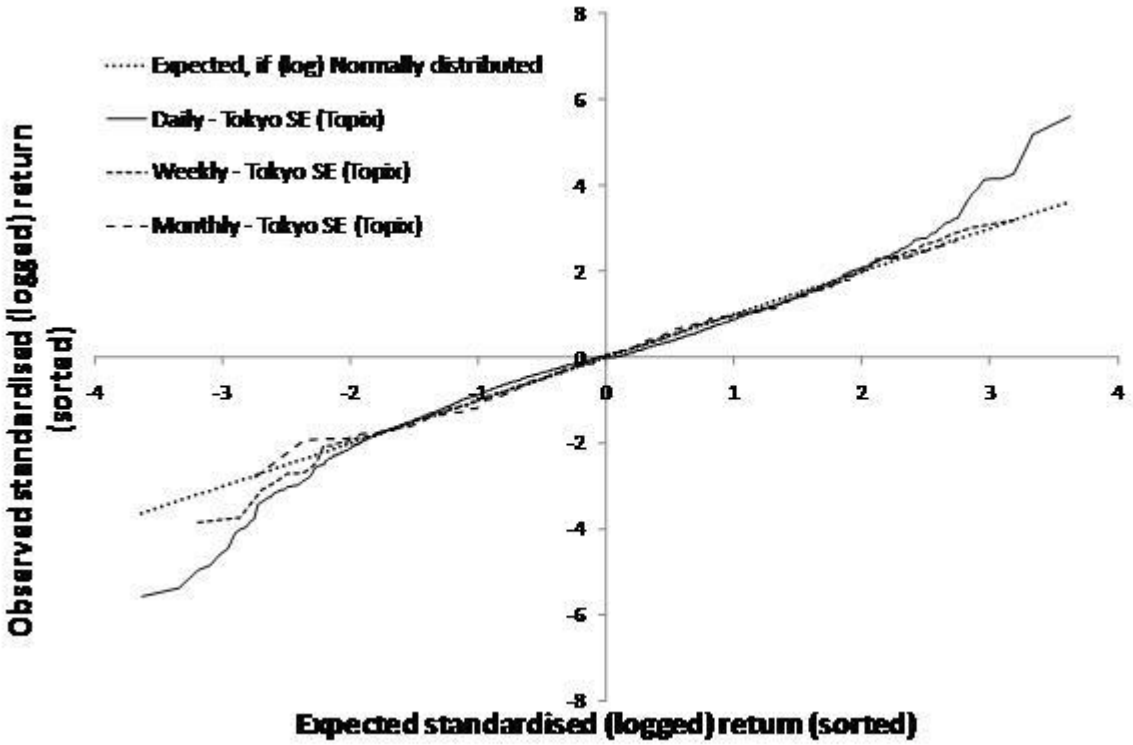

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Figure 2.14: QQ-plots of four Monte Carlo simulations of daily return data with samples drawn from a normal distribution

[ExtremeEventsFigure2_14]

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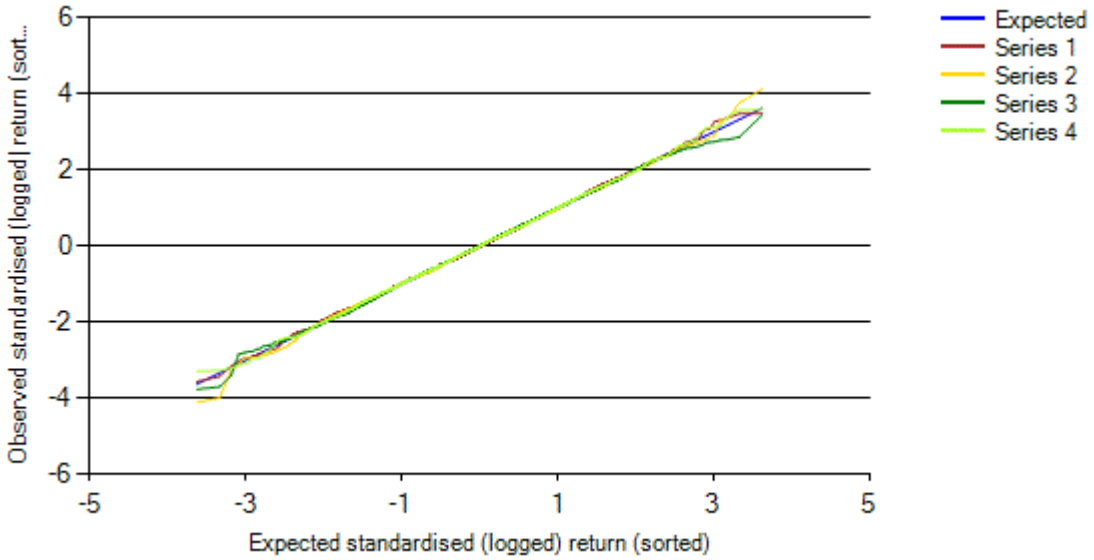

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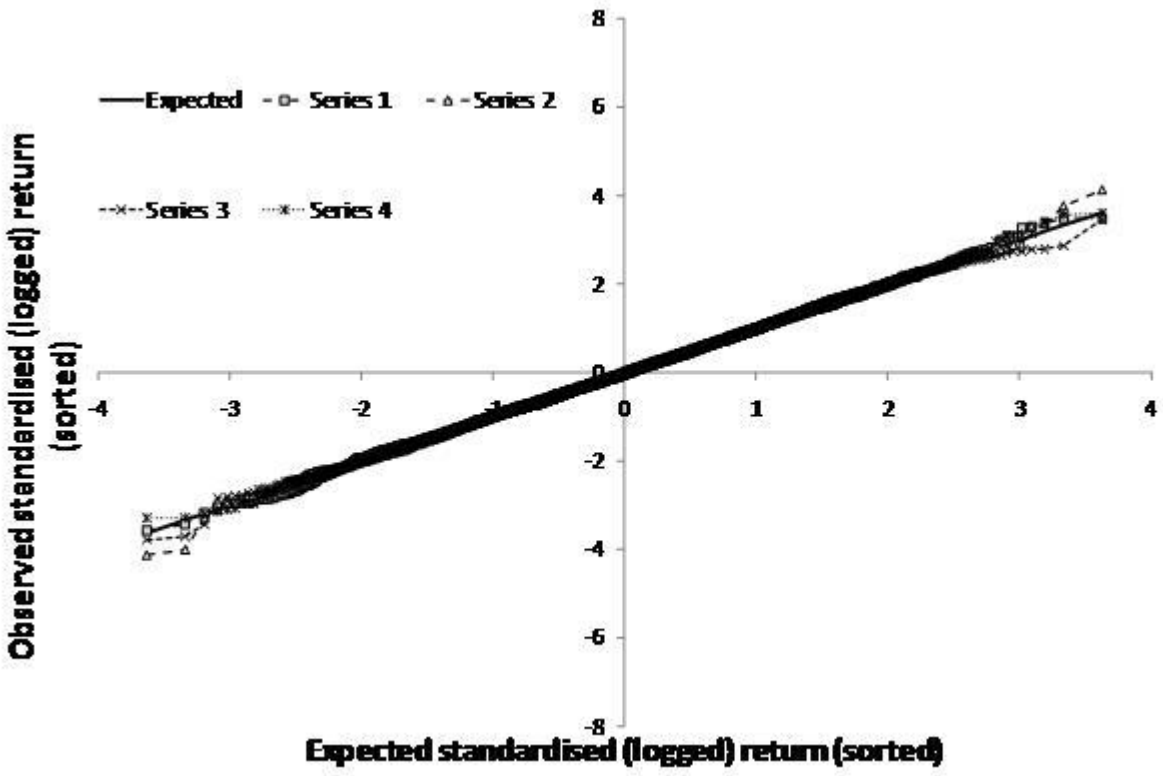

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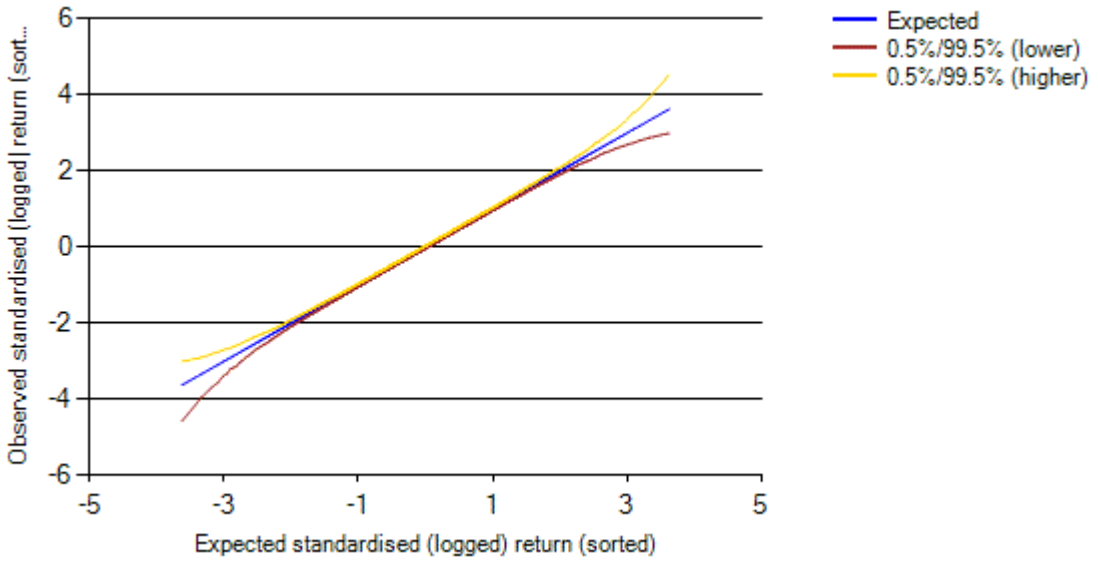
Figure 2.15: Envelopes of QQ-plots (at the 0.5% and 99.5% percentiles) of 1,000 Monte Carlo simulations of daily return data with samples drawn from a normal distribution

[ExtremeEventsFigure2_15]

SmartChart version:



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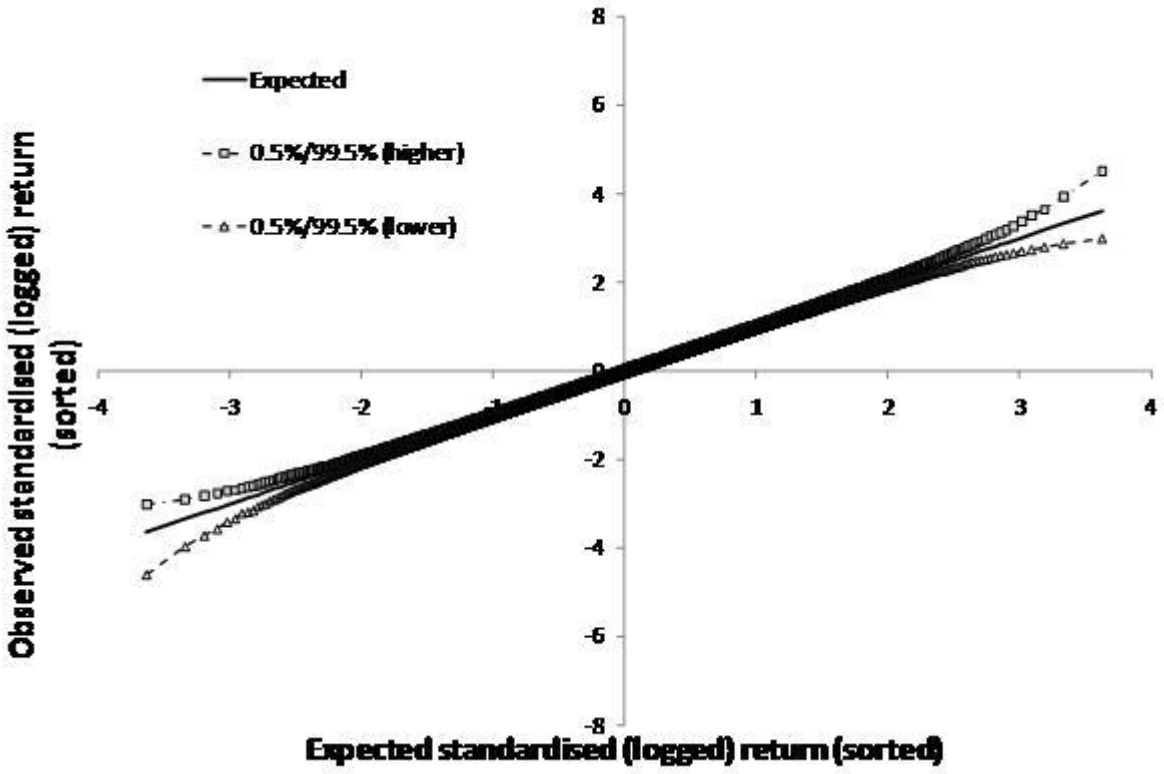

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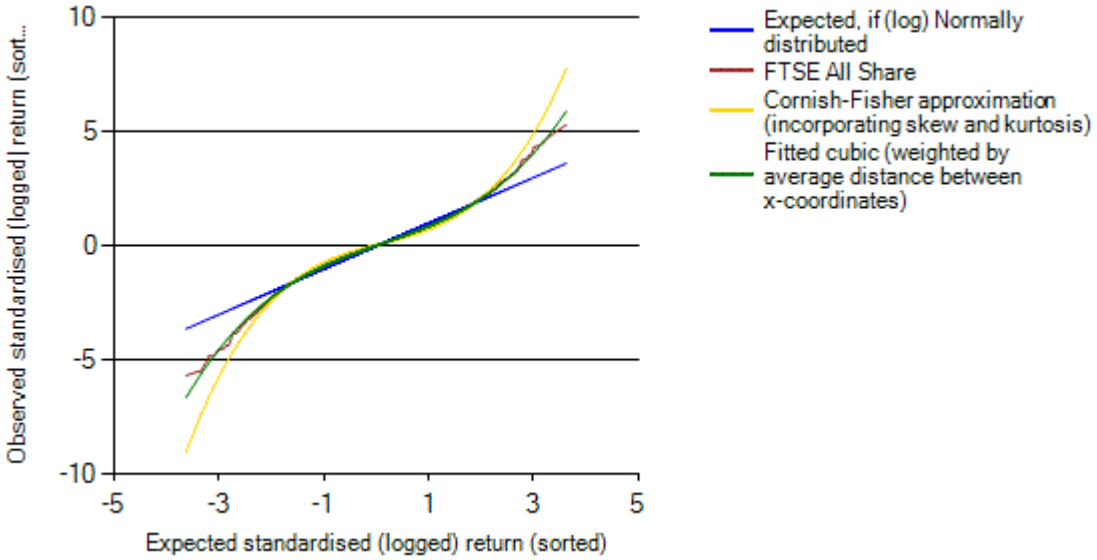
Figure 2.16: Fitting the distributional form for daily returns on FTSE All-Share Index from end Jun 1994 to end Dec 2007

[ExtremeEventsFigure2_16]

SmartChart version:

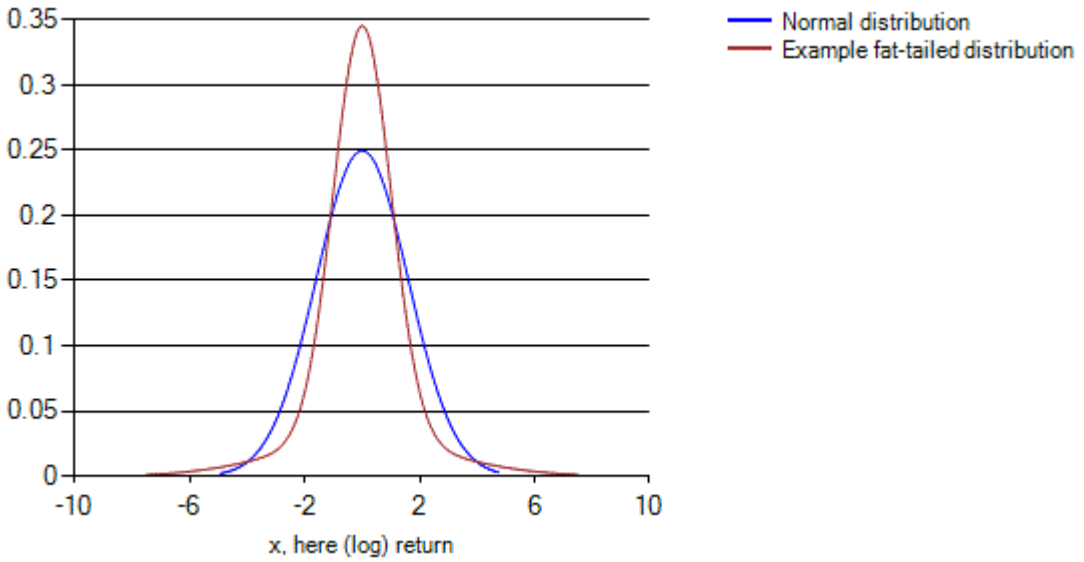


Variant used in book:

Figure 2.17: Probability density function of an example normal distributional mixture

[ExtremeEventsFigure2_17]

SmartChart version:



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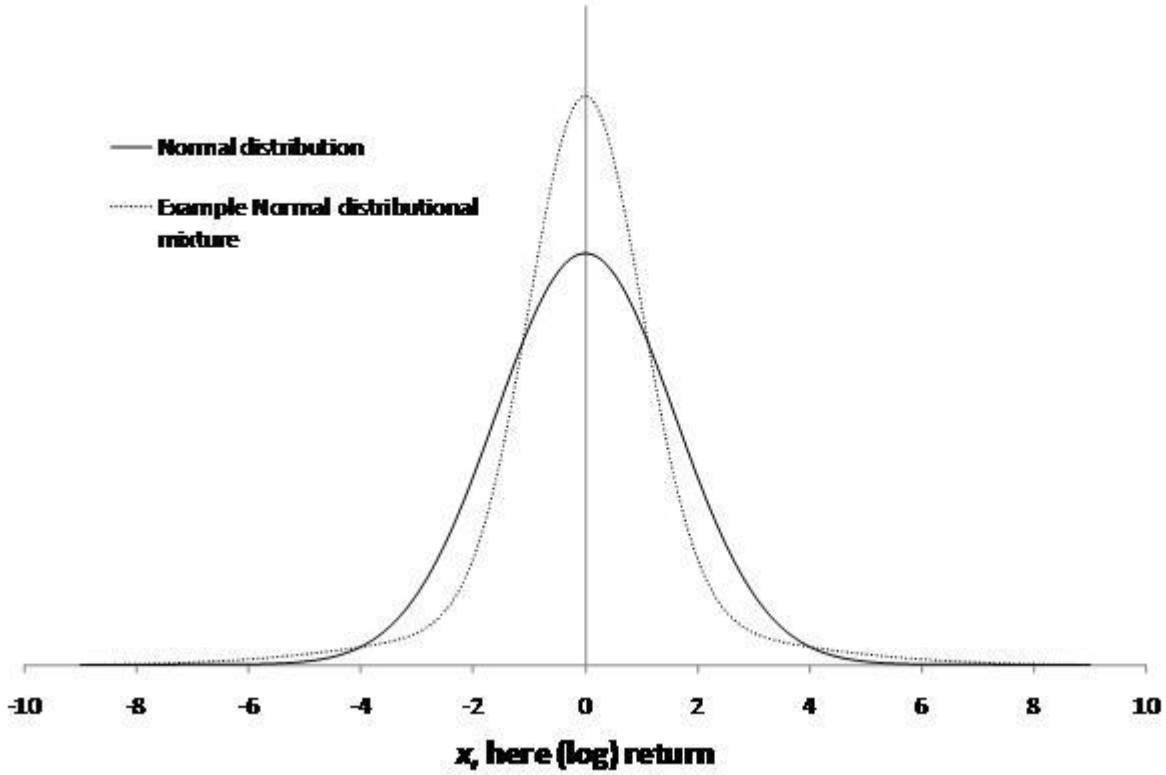

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The corresponding cumulative distribution function of this example normal distributional mixture is shown in ExtremeEventsFigure2_17_Extra

Additional Figure relating to Figure 2.17: Cumulative distribution function of example normal distributional mixture shown in Figure 2.17

[ExtremeEventsFigure2_17_Extra]

SmartChart version:

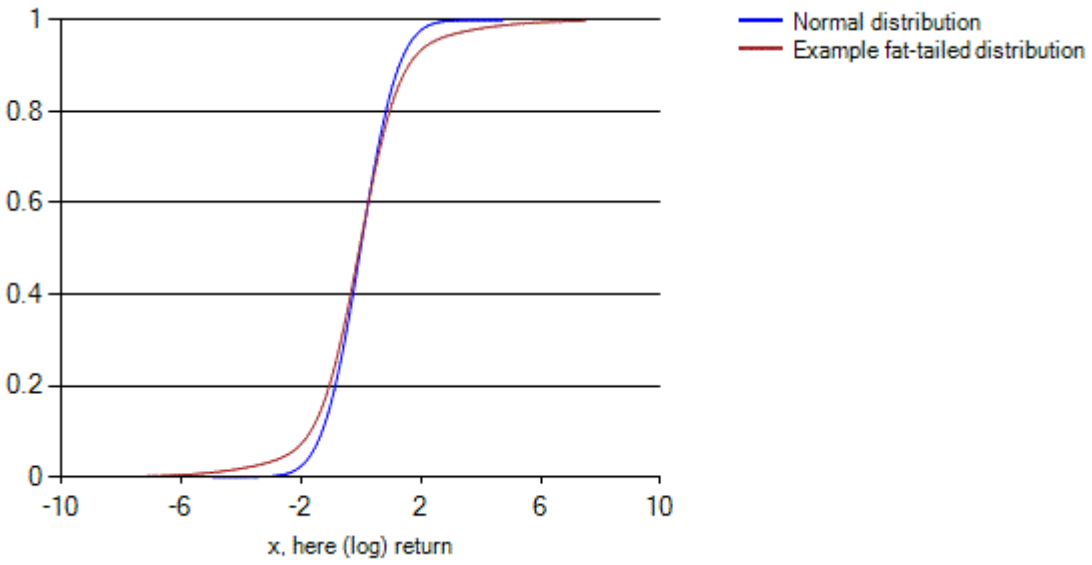

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Figure 2.18: QQ-plot of an example normal distributional mixture

[ExtremeEventsFigure2_18]

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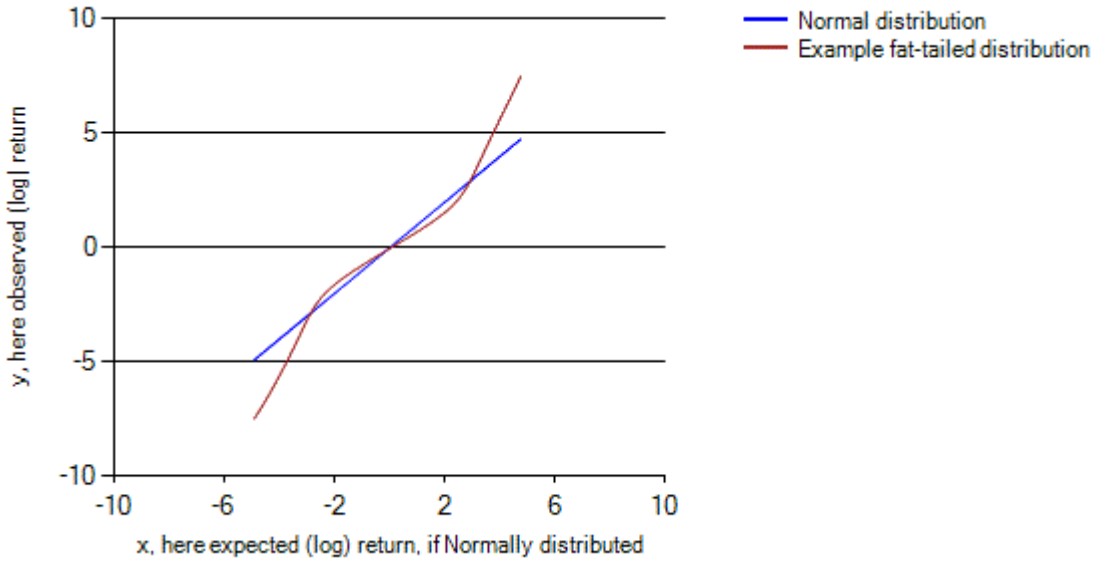

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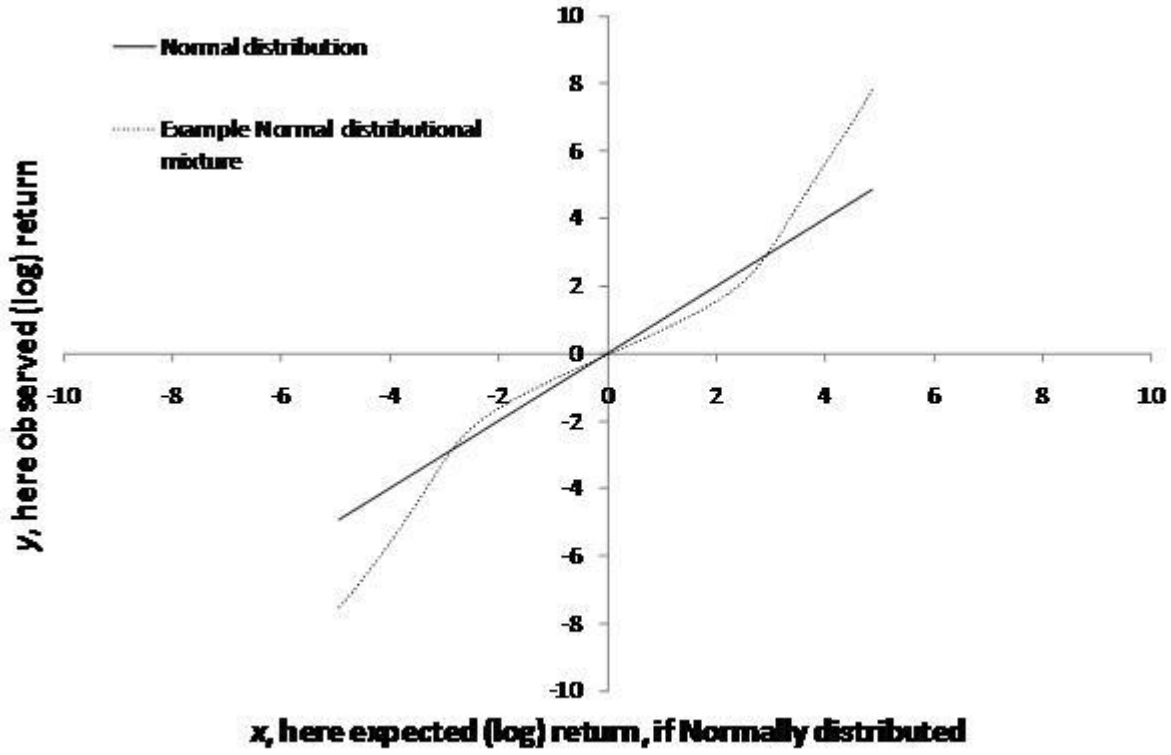

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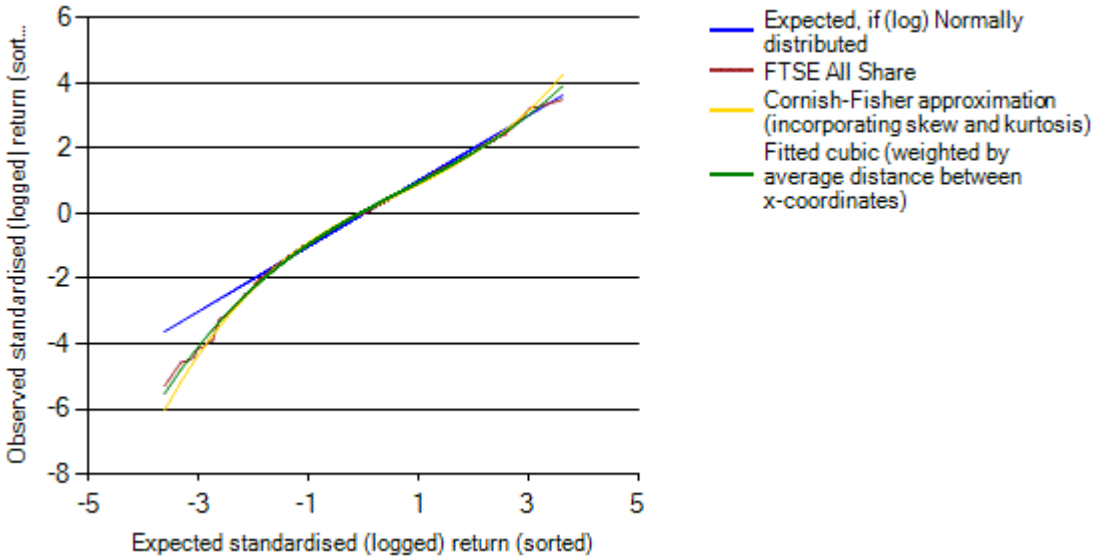
Figure 2.19: Daily returns on FTSE All-Share Index from end Jun 1994 to end Dec 2007, scaled by 50 business day trailing volatility

[ExtremeEventsFigure2_19]

SmartChart version:



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Equivalent results but with data scaled by trailing volatility over several different periods:

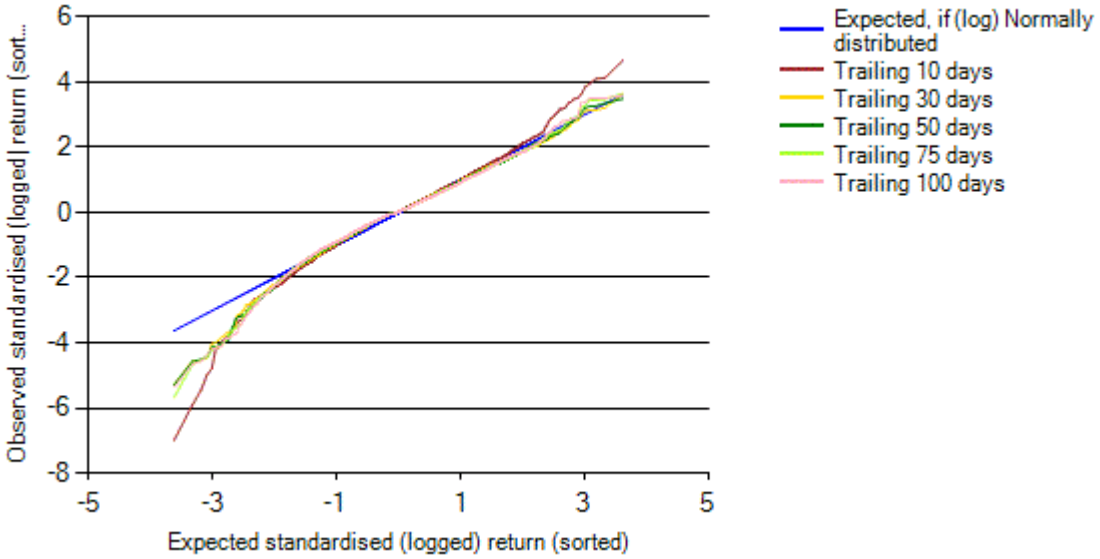

Figure 2.20: Illustration of the perils of extrapolating into the far tail

[ERMLectures]

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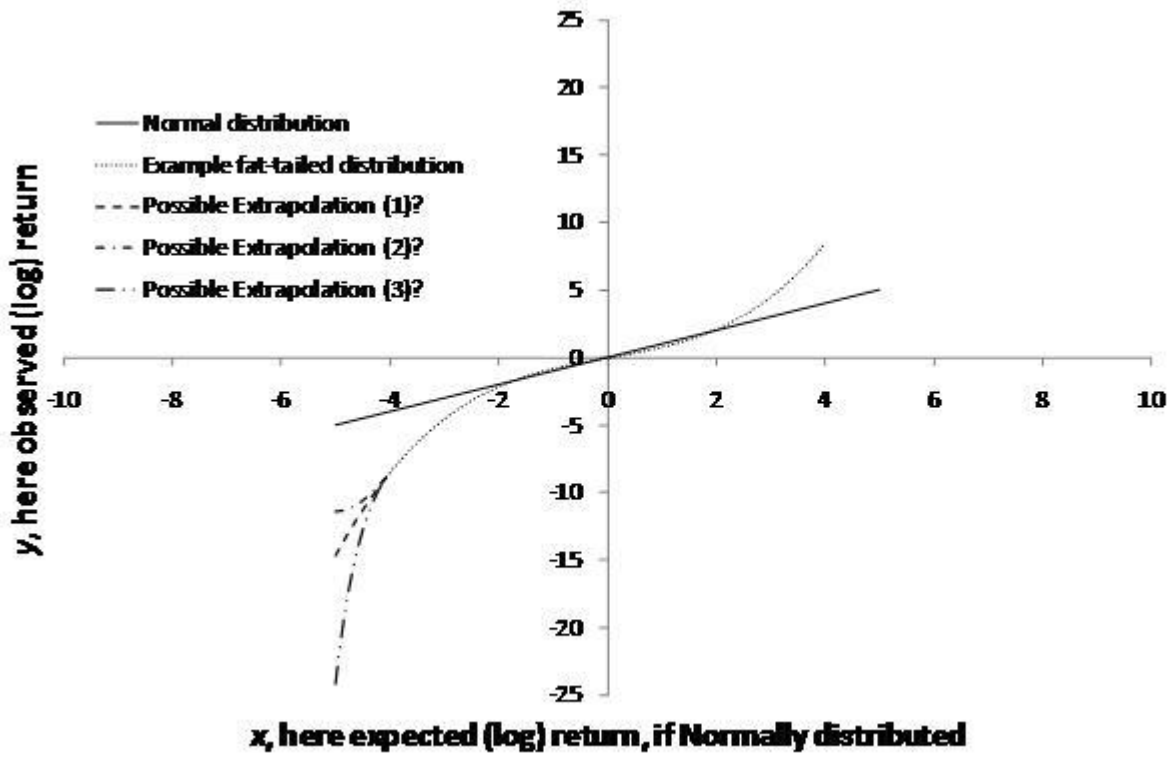

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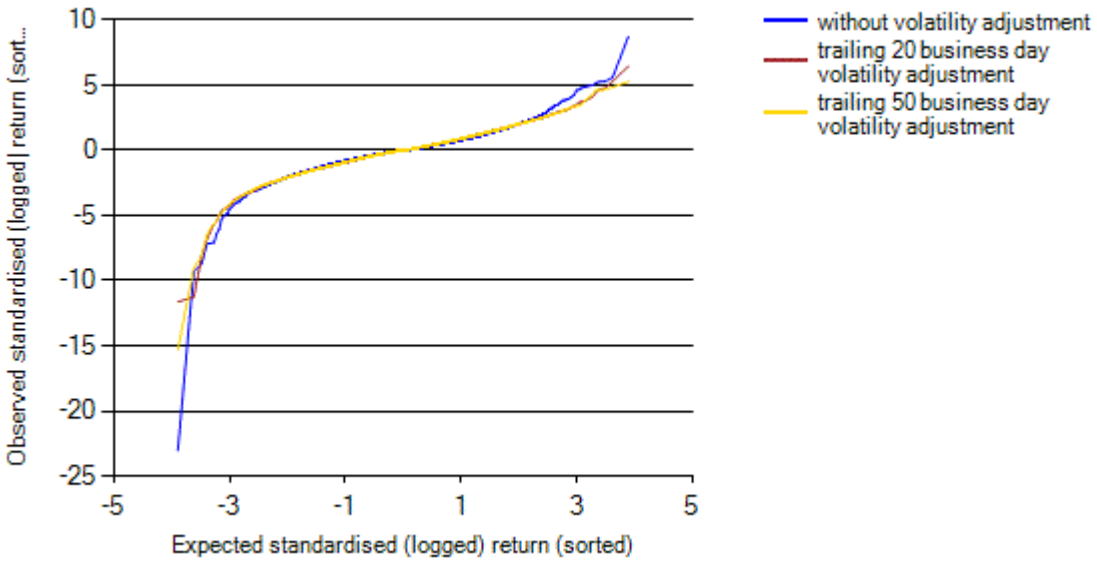
Figure 2.21: QQ-plot of S&P 500 daily price movements from early 1968 to 24 March 2009

[ExtremeEventsFigure2_21]

SmartChart version:



Variant used in book:

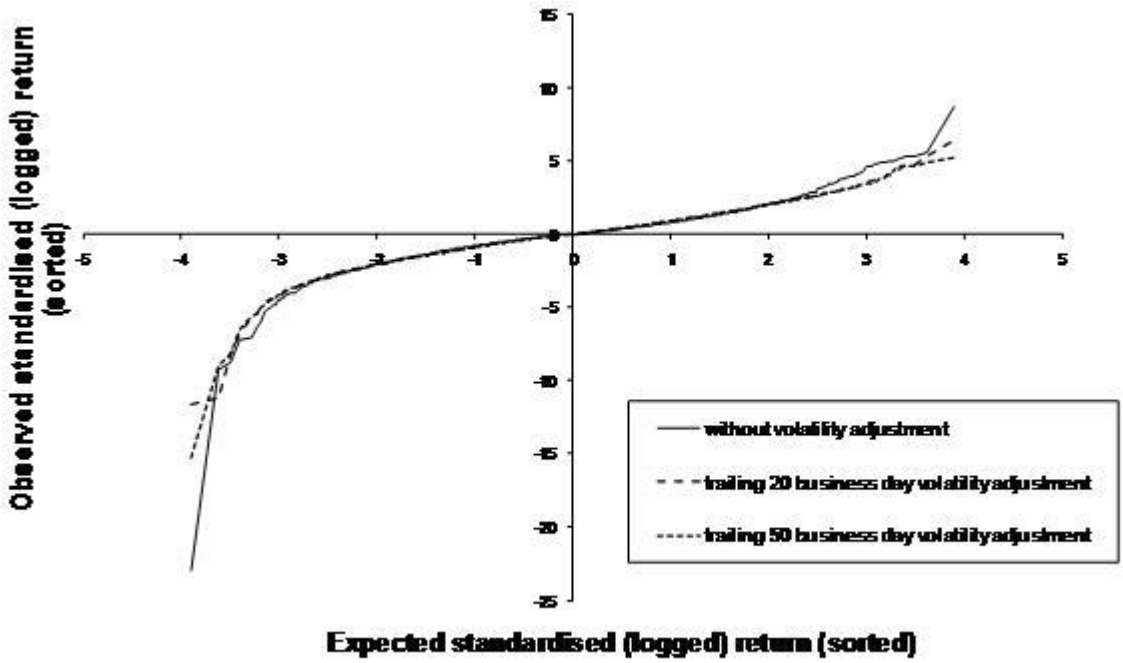


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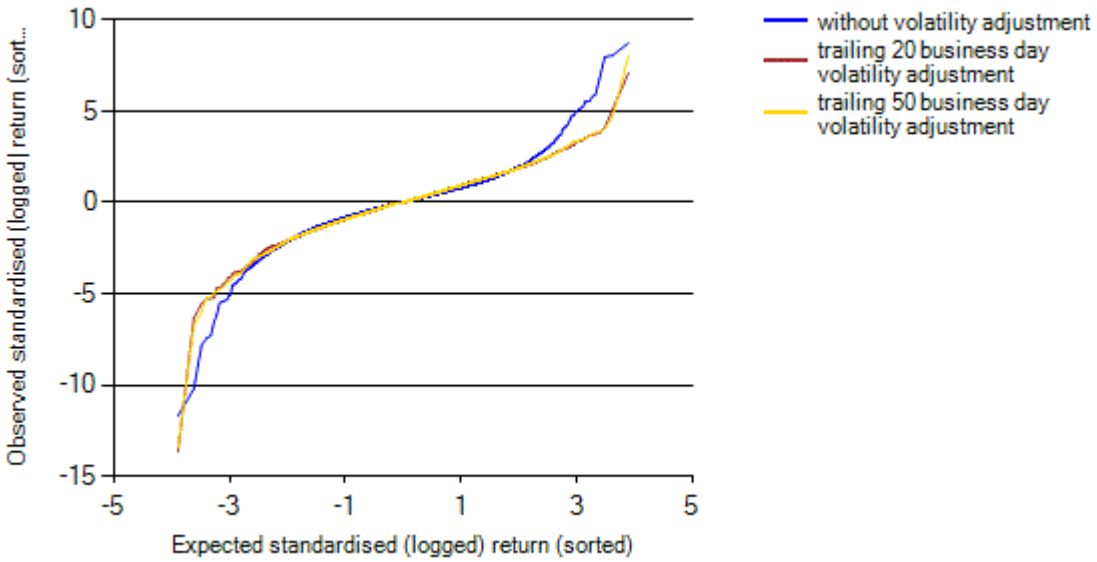
Figure 2.22: QQ-plots of FTSE All-Share daily price movements from early 1968 to 24 March 2009

[ExtremeEventsFigure2_22]

SmartChart version:



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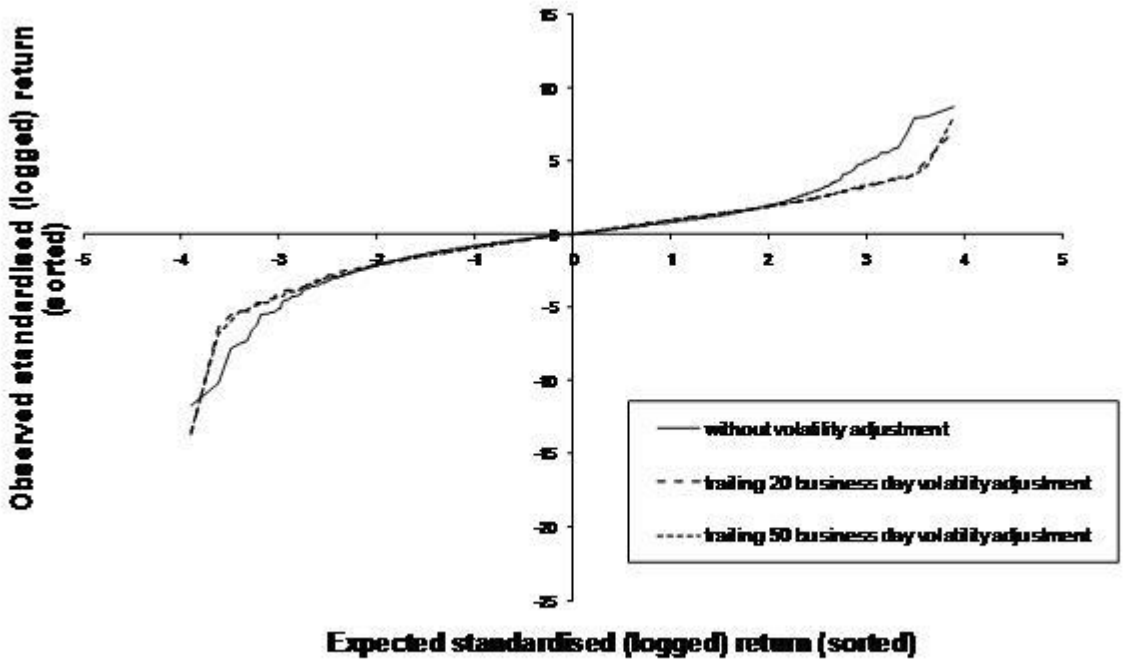

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Chapter 3

[Nematrian website page: ExtremeEventsFiguresChapter3, © Nematrian 2015]

Charts:

Figure 3.1: Standard bivariate normal probability density function with rho = 0

[ExtremeEventsFigure3_1]

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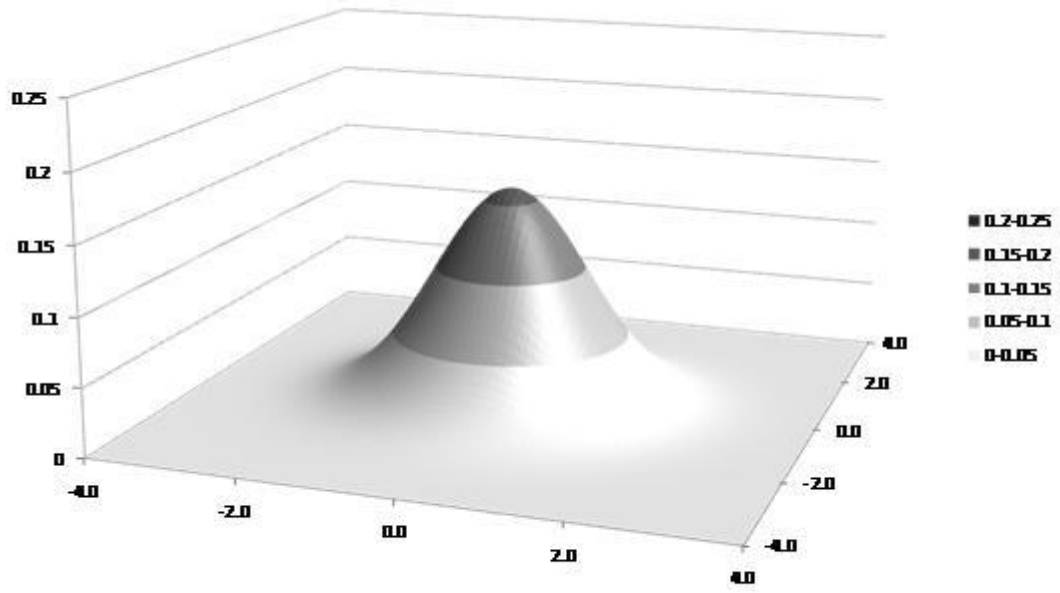

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Figure 3.2: Standard bivariate normal probability density function with rho = -0.3

[ExtremeEventsFigure3_2]

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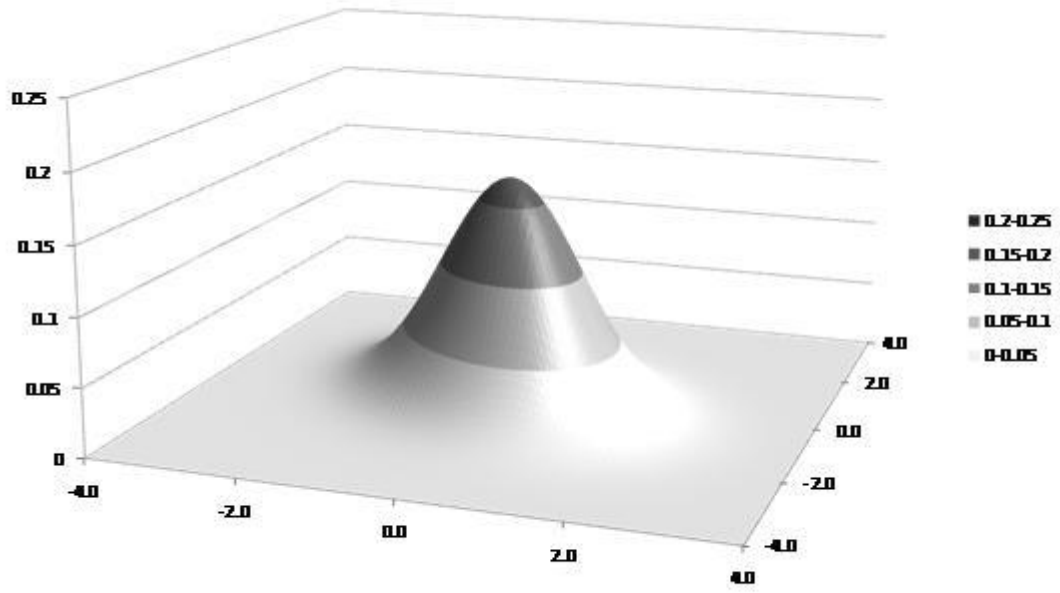

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Figure 3.3: Standard bivariate normal probability density function with rho = +0.6

[ExtremeEventsFigure3_3]

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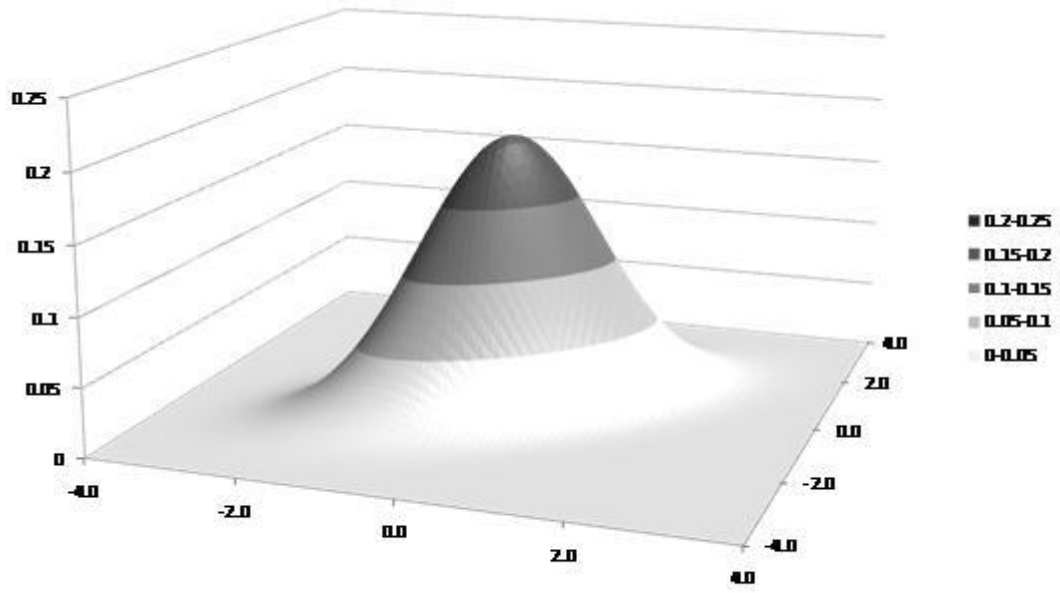

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Figure 3.4: Cumulative distribution function for standard bivariate normal with rho = 0

[ExtremeEventsFigure3_4]

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Variant used in book:

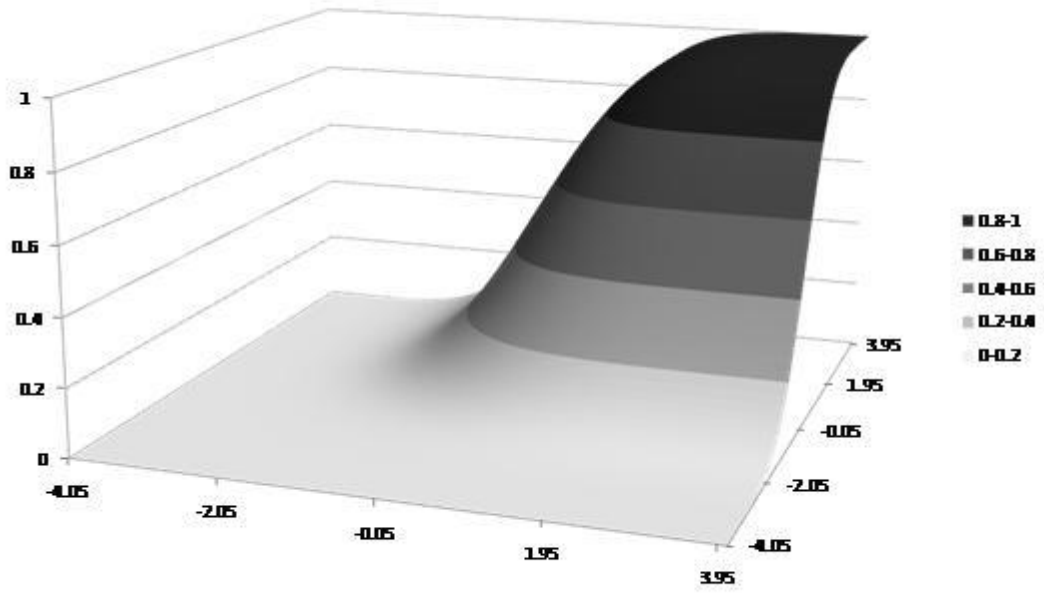

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Figure 3.5: Cumulative distribution function for standard bivariate normal with rho = 0.95

[ExtremeEventsFigure3_5]

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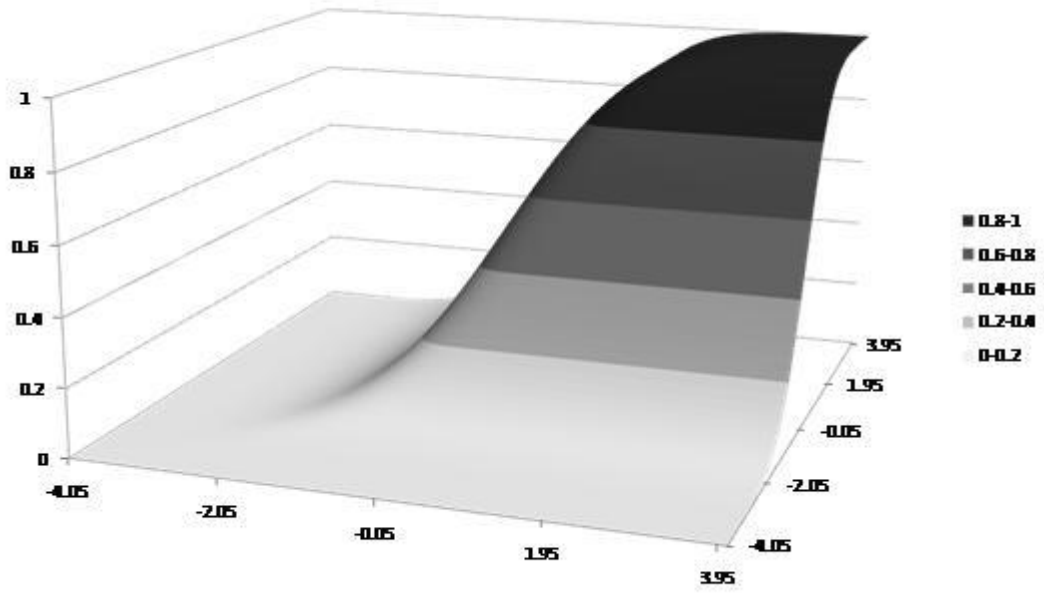

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Figure 3.6: Gaussian copula with rho = 0, also known as the *product* or *independence* copula

[ExtremeEventsFigure3_6]

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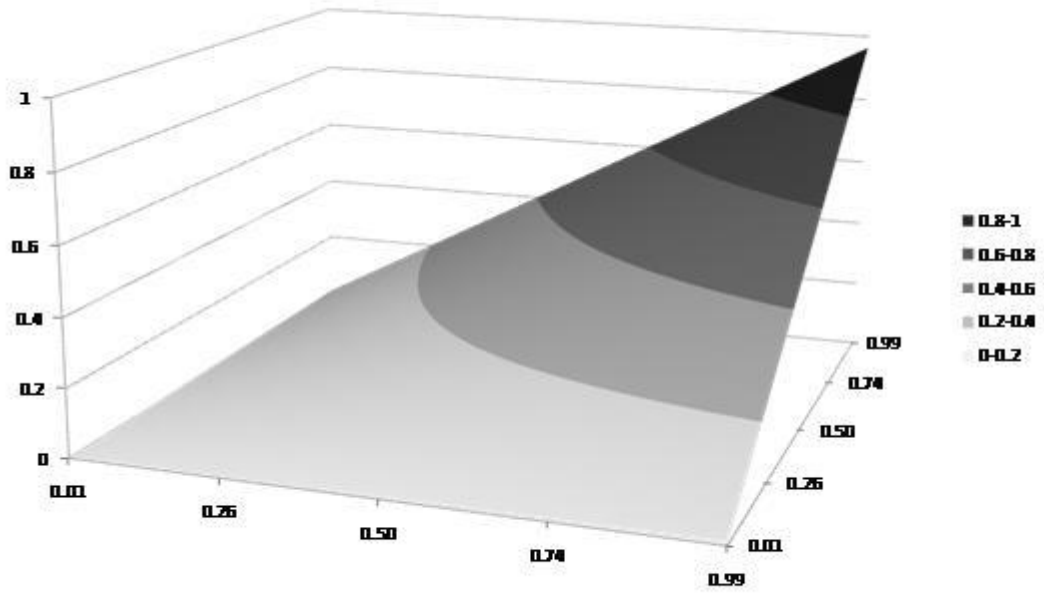

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Figure 3.7: Gaussian copula with rho = 0.95

[ExtremeEventsFigure3_7]

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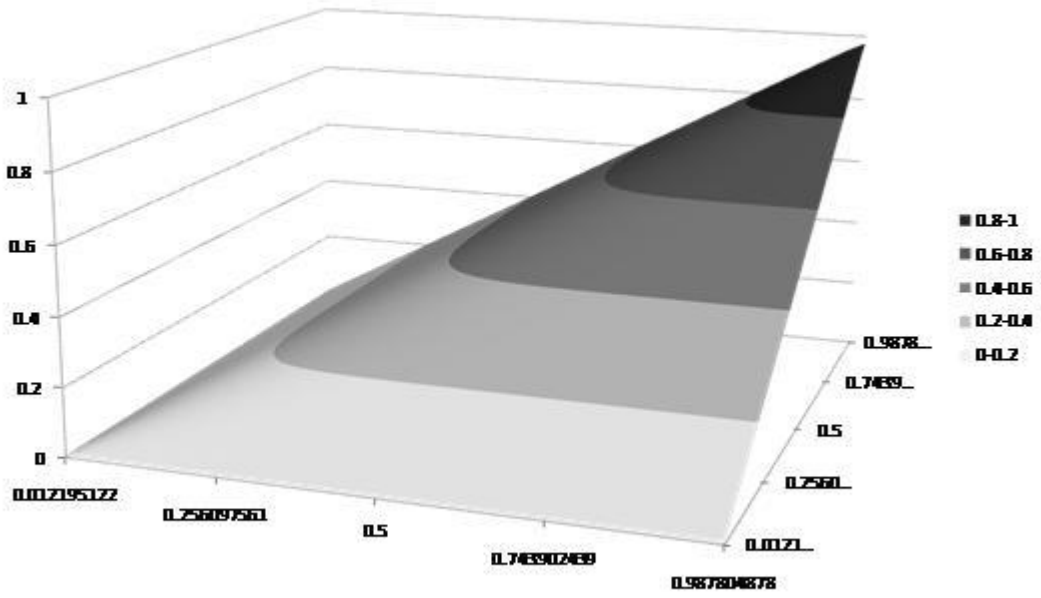

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Figure 3.8: Difference between Gaussian copula (rho = -0.3) and Product copula (expressed as difference between copula gradients/densities)

[ExtremeEventsFigure3_8]

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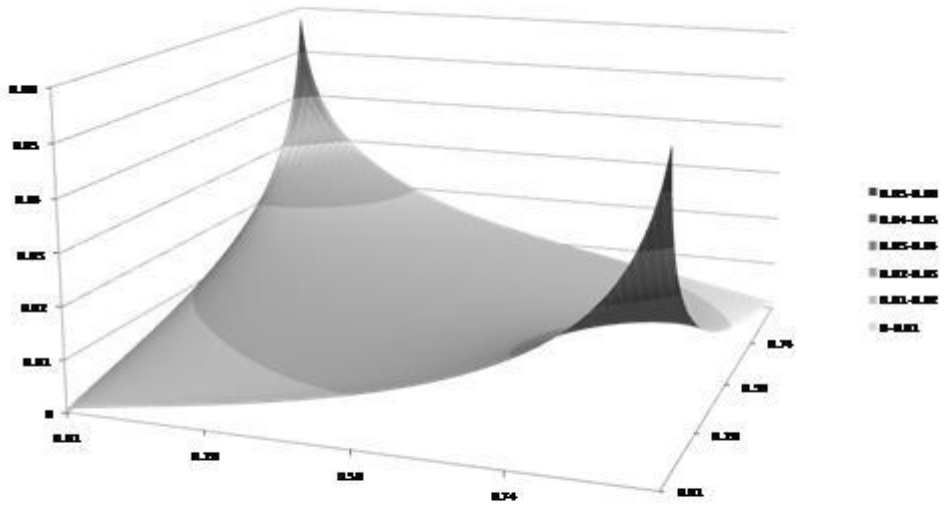

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Figure 3.9: Scatter plot of weekly sector relative returns for MSCI ACWI Utilities vs Transport

[ExtremeEventsFigure3_9]

SmartChart version:

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Figure 3.10: Scatter plot of weekly sector relative returns for MSCI ACWI Utilities vs Transport (rank of relative returns)

[ExtremeEventsFigure3_10]

SmartChart version:

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Figure 3.11: Decile-decile plot between MSCI ACWI Utilities and Transport sectors

[ExtremeEventsFigure3_11]

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Figure 3.12: Fractile-fractile plot of sector relative return rankings showing number of observations in each fractile pairing, averaged across all sector pairings and all +/- combinations of such pairs

[ExtremeEventsFigure3_12]

SmartChart version:

Not available

Variant used in book:

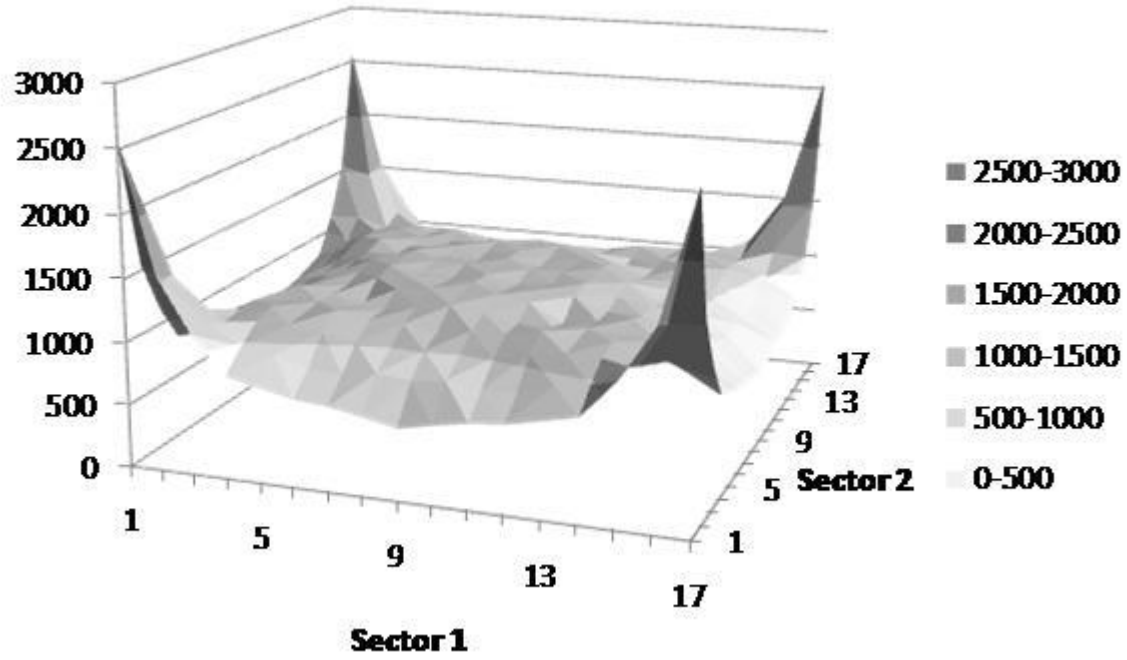

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Figure 3.13: Excess kurtosis of each series sector relative return series. x-axis shows the number of the relevant data series

[ExtremeEventsFigure3_13]

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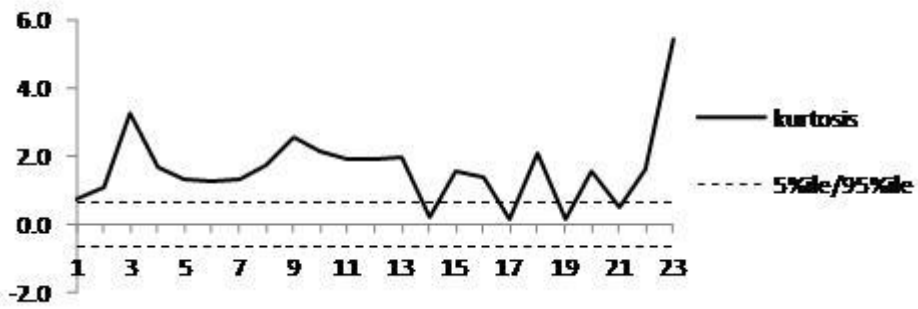

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Figure 3.14: Fractile-fractile plot of principal component rankings of sector relative returns showing number of observations in each fractile pairing, averaged across all principal component pairings and all +/- combinations of such pairs
[ExtremeEventsFigure3_14]

SmartChart version:

Not available

Variant used in book:

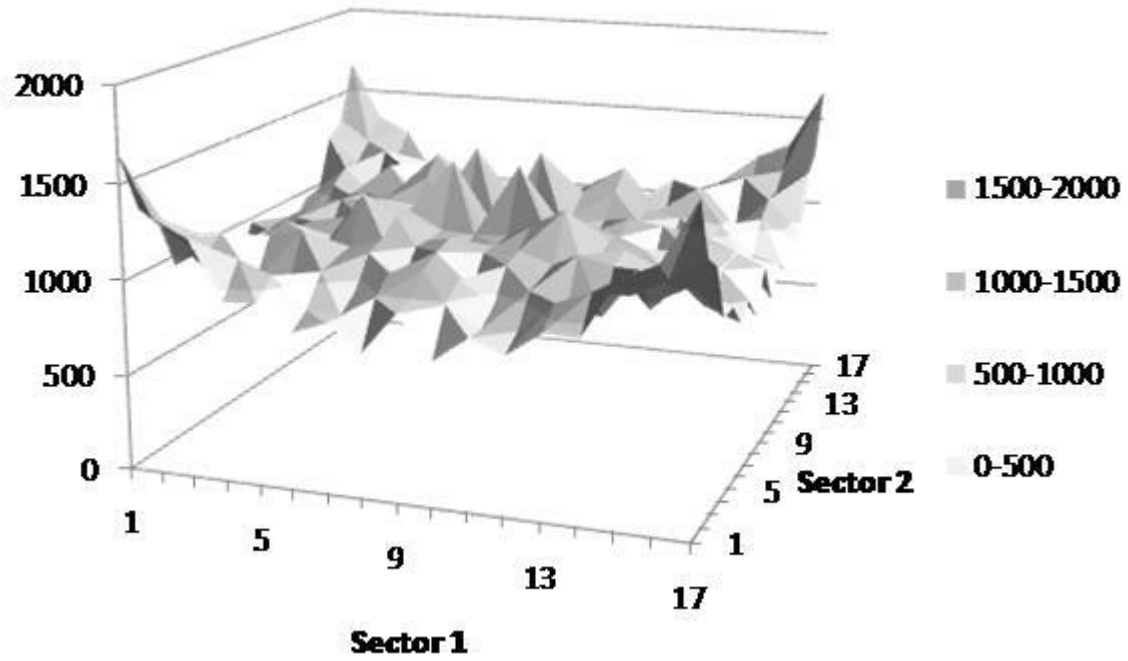

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Figure 3.15: Magnitudes of the eigenvalues of each principal component derived from the relative return series used in Figure 3.13 (most important principal components to the left of the chart)

[ExtremeEventsFigure3_15]

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Variant used in book:

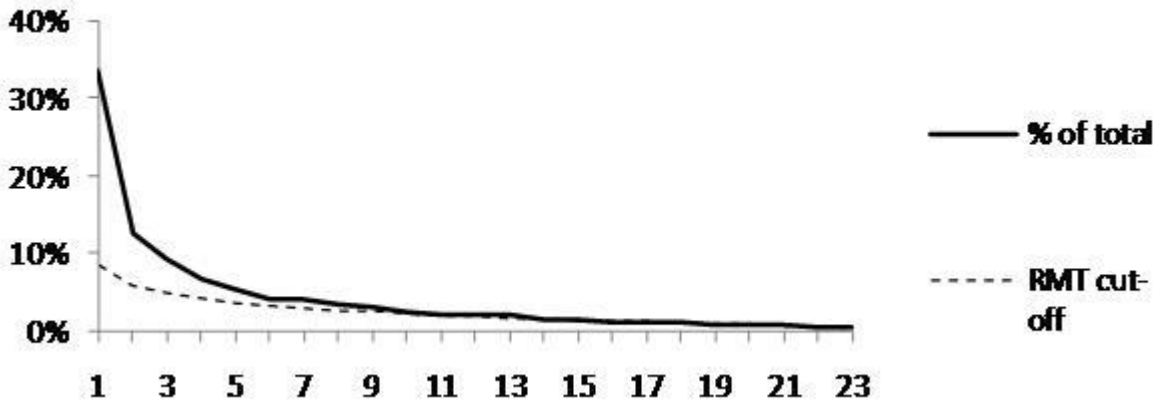

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Figure 3.16: Excess kurtosis of each principal component derived from the relative return series used in Figure 3.13 (most important principal components to the left of the chart)

[ExtremeEventsFigure3_16]

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Not available

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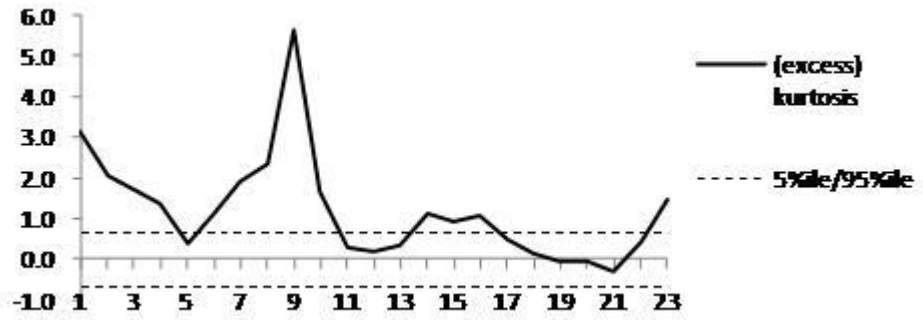

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Figure 3.17: Skewness of each principal component derived from the relative return series used in Figure 3.13 (most important principal components to the left of the chart)

[ExtremeEventsFigure3_17]

SmartChart version:

Not available

Variant used in book:

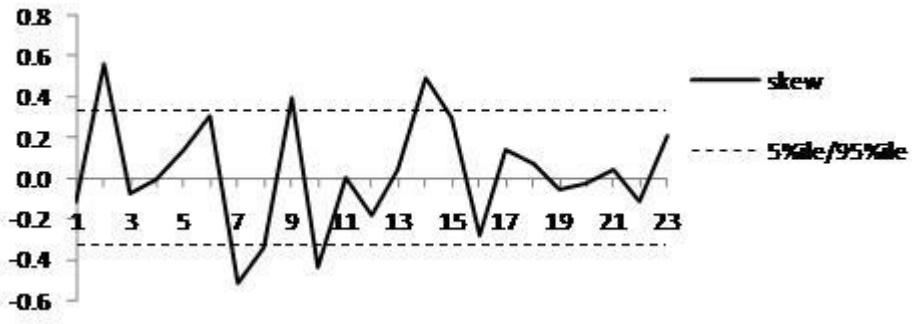

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Figure 3.18: Impact of adjusting each relative return series by its own recent past volatility

[ExtremeEventsFigure3_18]

Sub-charts:

(a) Number of observations in each fractile-fractile pairing
(b) Number of observations for each principal component pairing (weighted by eigenvalue size)
(c) (Excess) kurtosis of each underlying return series
(d) Eigenvalues (sorted by size)
(e) Skewness of each eigenseries (sorted in order of decreasing eigenvalue size)
(f) (Excess) kurtosis of each eigenseries (sorted in order of decreasing eigenvalue size)

SmartChart version:

Not available

Variant used in book:

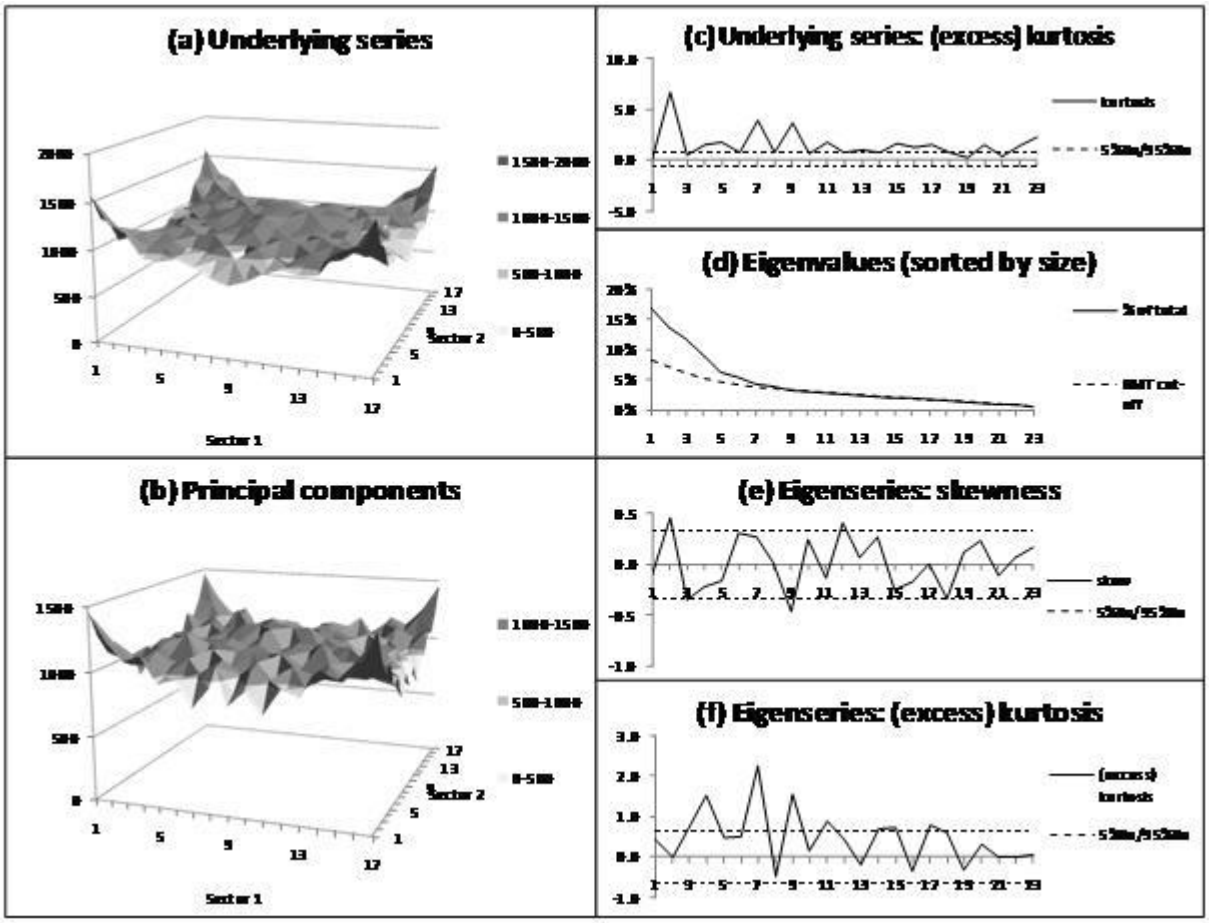

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Figure 3.19: Impact of adjusting every series simultaneously by recent past cross-sectional volatility

[ExtremeEventsFigure3_19]

Sub-charts:

(a) Number of observations in each fractile-fractile pairing
(b) Number of observations for each principal component pairing (weighted by eigenvalue size)
(c) (Excess) kurtosis of each underlying return series
(d) Eigenvalues (sorted by size)
(e) Skewness of each eigenseries (sorted in order of decreasing eigenvalue size)
(f) (Excess) kurtosis of each eigenseries (sorted in order of decreasing eigenvalue size)

SmartChart version:

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Variant used in book:

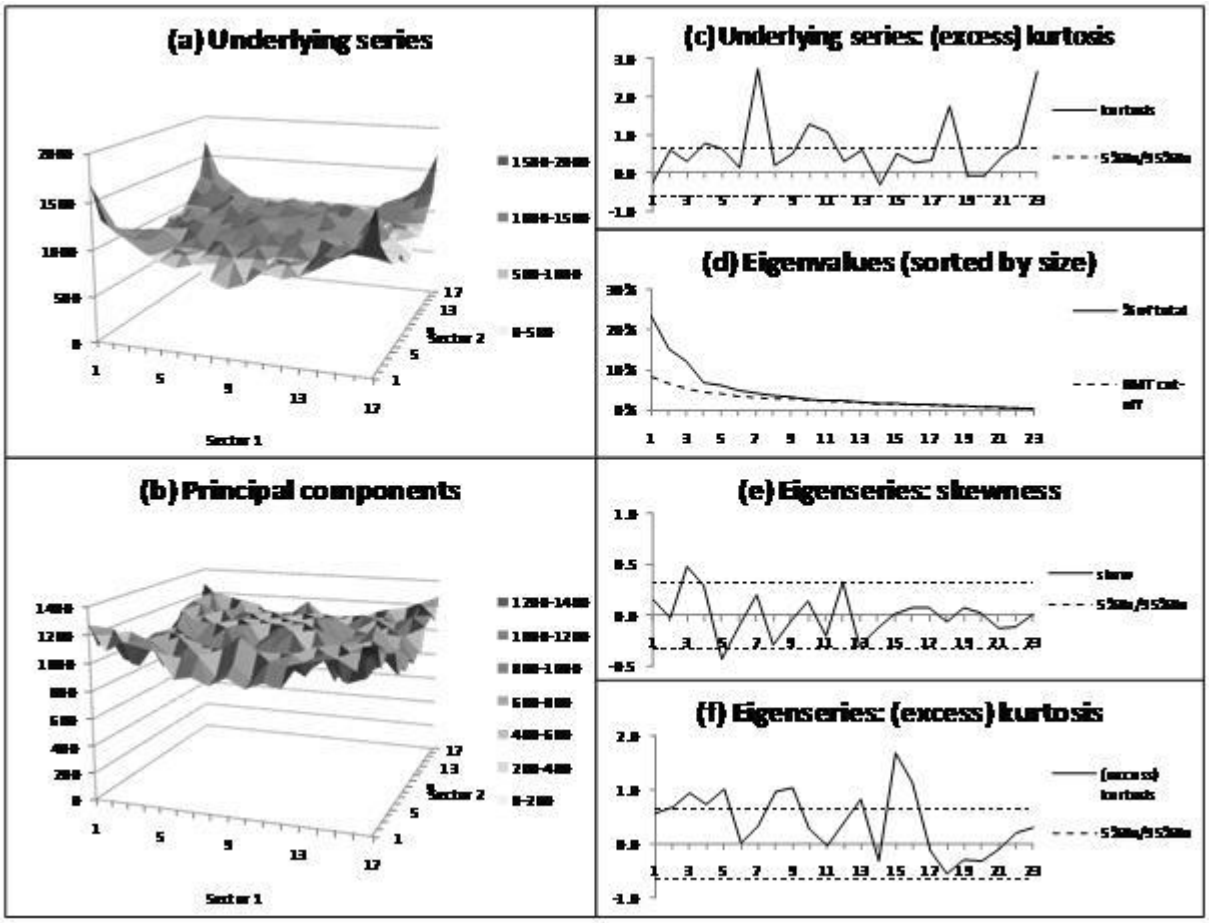

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Figure 3.20: A one-dimensional 'upwards' QQ-plot

[ExtremeEventsFigure3_20]

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Not available (although please note that there is a Nematrian web service function that does create such a plot, i.e. MnPlotStandardisedUpwards1dQQ)

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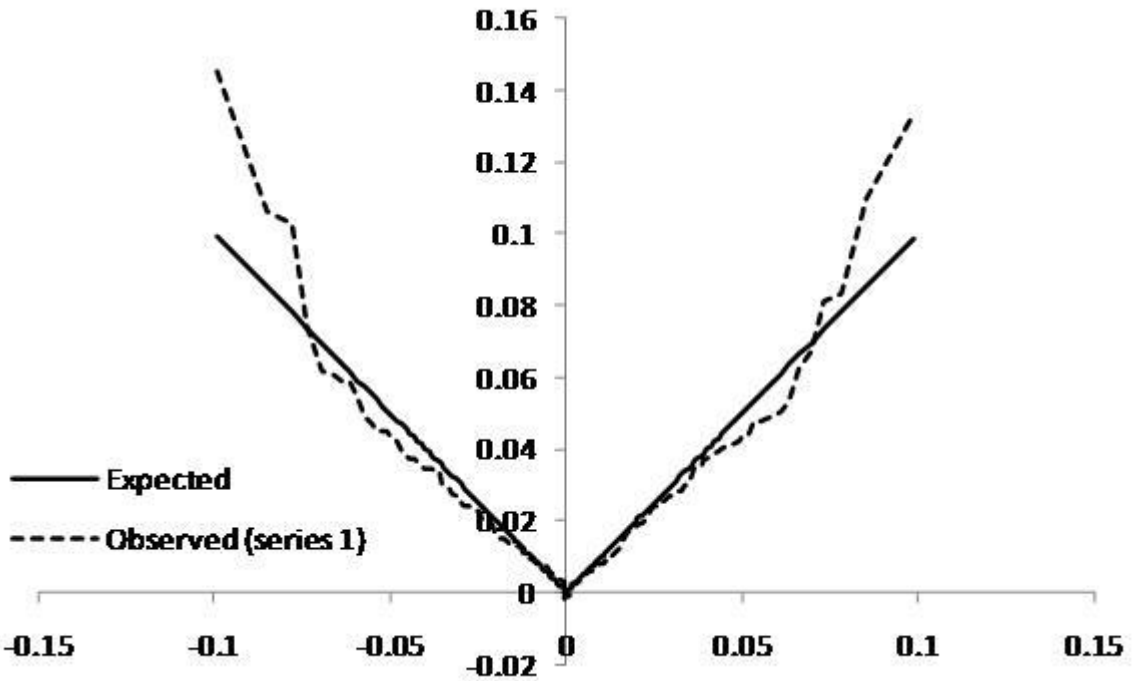

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Figure 3.21: A two-dimensional 'upwards' QQ-plot characterising all (linear) combinations of two return series

[ExtremeEventsFigure3_21]

SmartChart version:

Not available

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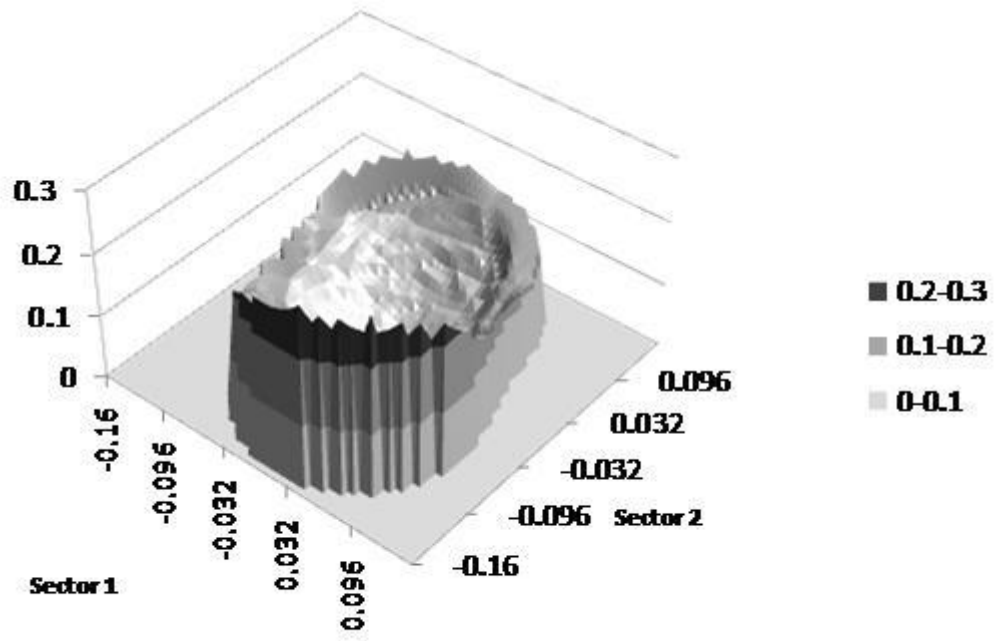

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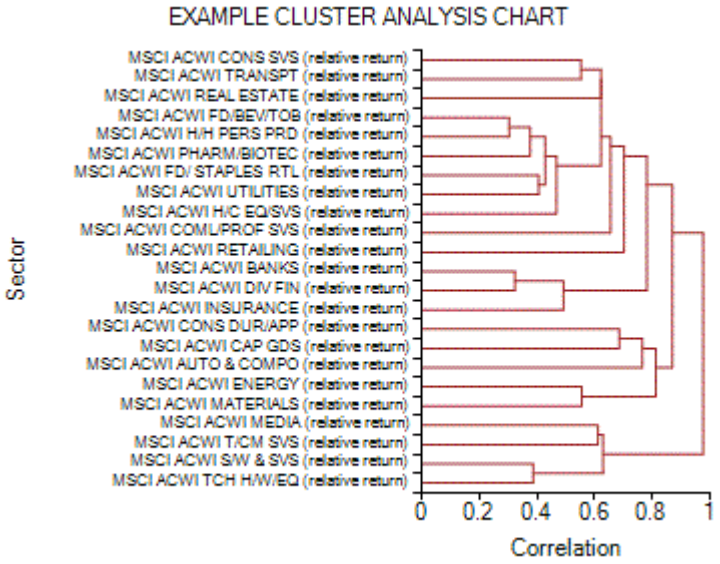
Figure 3.22: Illustrative cluster analysis of the sector relative return series used in Figure 3.12. The distance along the x-axis corresponds to the average 'distance' between the individual elements of the cluster.
[ExtremeEventsFigure3_22]

SmartChart version:



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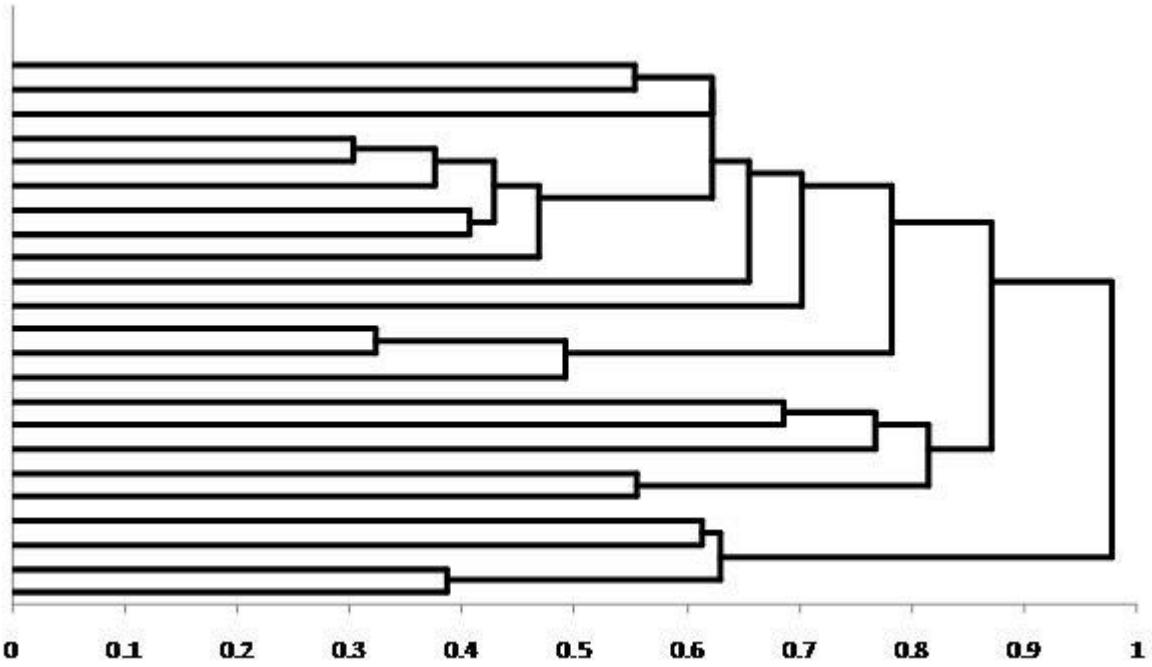

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Chapter 4

[Nematrian website page: ExtremeEventsFiguresChapter4, © Nematrian 2015]

Charts:

- Figure 4.1: Illustrative principal components analysis
- Figure 4.2: Schematic illustration of the impact of market dynamics
- Figure 4.3: Fractile-fractile plot of blended PCA/ICA component rankings of sector relative returns showing number of observations in each fractile pairing, averaged across all principal component pairings and all +/- combinations of such pairs
- Figure 4.4: Illustrative Gaussian mixture modelling analysis
- Figure 4.5: Illustrative *k*-means clustering analysis
- Figure 4.6: Illustration of the difficulties of finding global extrema, even in one dimension and even for smooth functions. Points *A* and *C* are local, but not global, maxima. The global maximum is at *E*, which is on the boundary of the interval so the derivative of the function need not vanish there. Points *B* and *D* are local minima and *B* is also the global minimum. The points *F*, *G* and *H* are said to *bracket* the maximum at *A*, since *G* is greater than both *F* and *H* and is in between them.

Figure 4.1: Illustrative principal components analysis

[ExtremeEventsFigure4_1]

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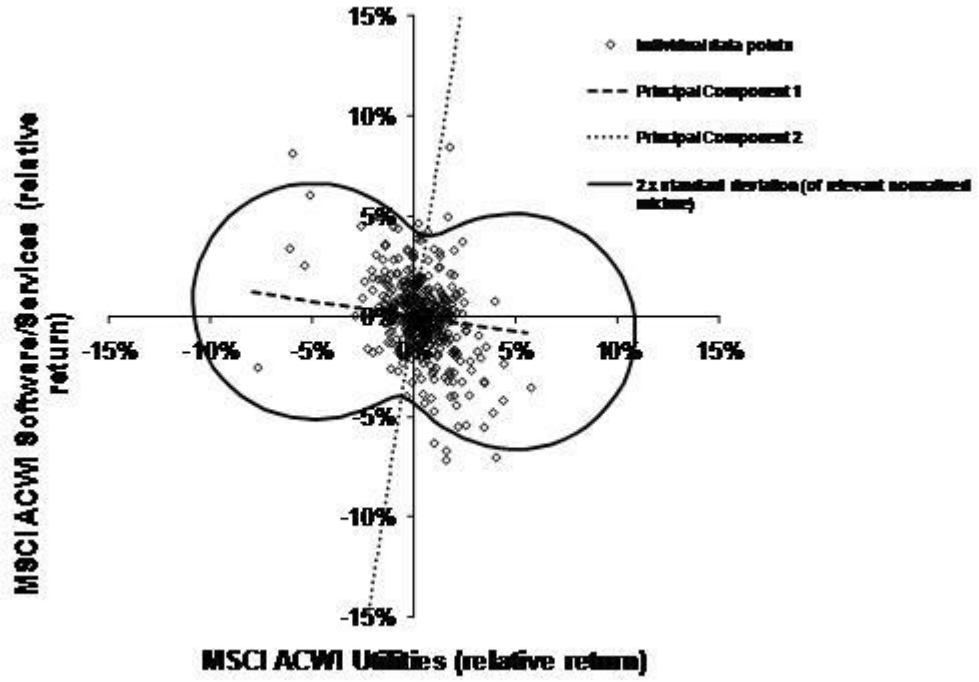

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Figure 4.2: Schematic illustration of the impact of market dynamics

[ExtremeEventsFigure4_2]

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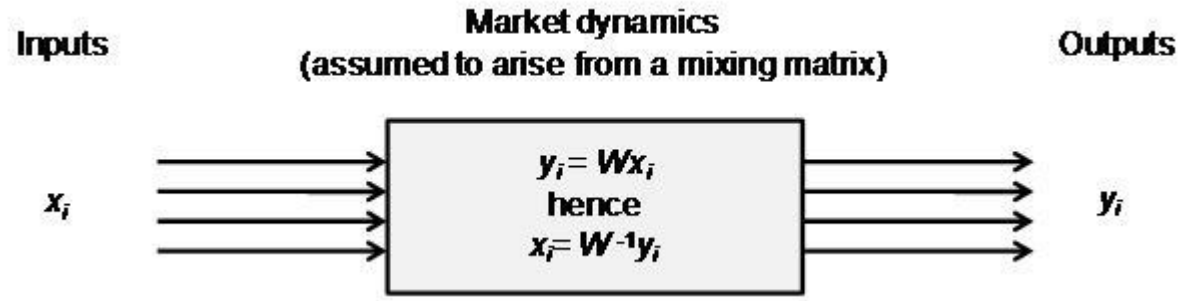

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Figure 4.3: Fractile-fractile plot of blended PCA/ICA component rankings of sector relative returns showing number of observations in each fractile pairing, averaged across all principal component pairings and all +/- combinations of such pairs
[ExtremeEventsFigure4_3]

SmartChart version:

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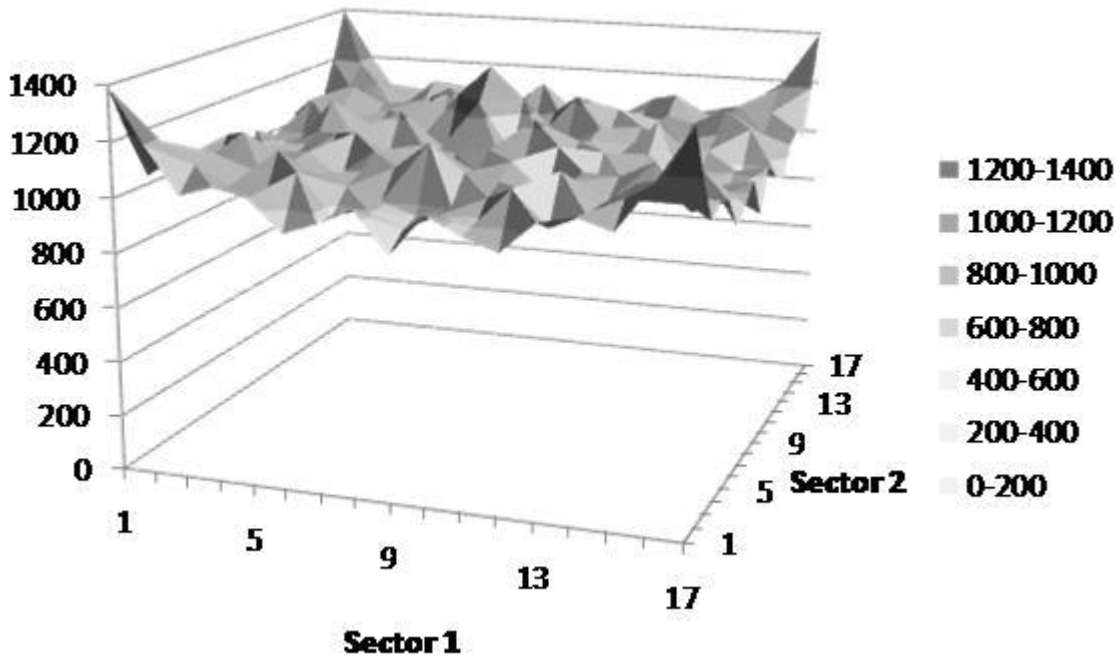

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Figure 4.4: Illustrative Gaussian mixture modelling analysis

[ExtremeEventsFigure4_4]

SmartChart version:

Not available

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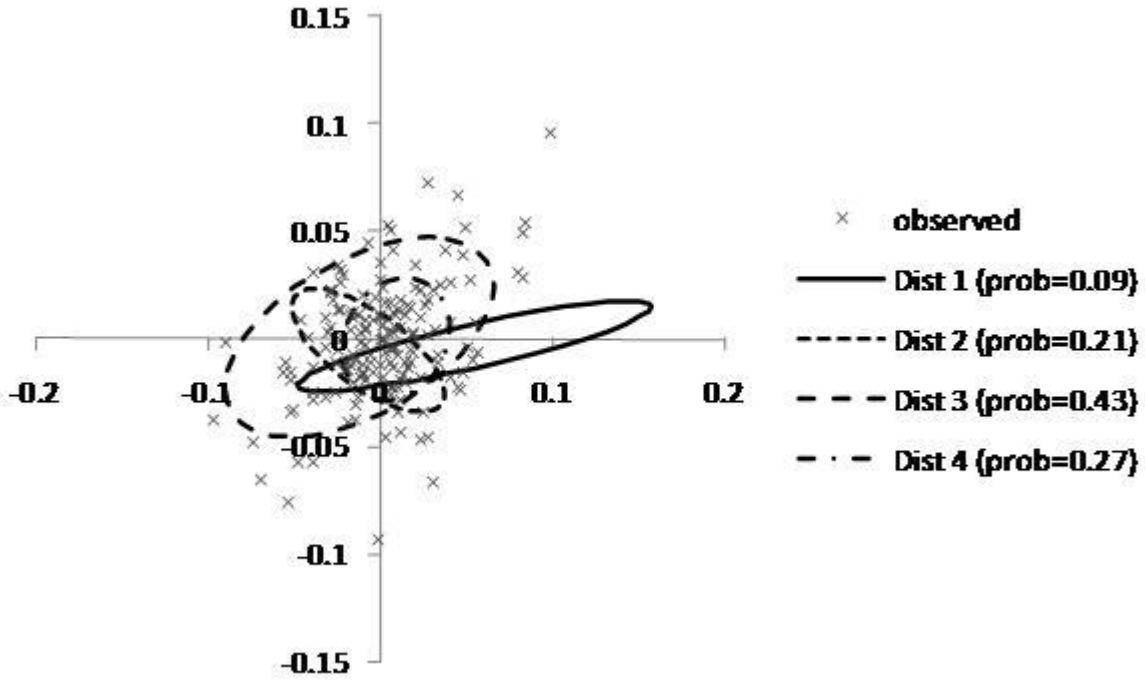

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Figure 4.5: Illustrative Gaussian mixture modelling analysis

[ExtremeEventsFigure4_5]

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Not available

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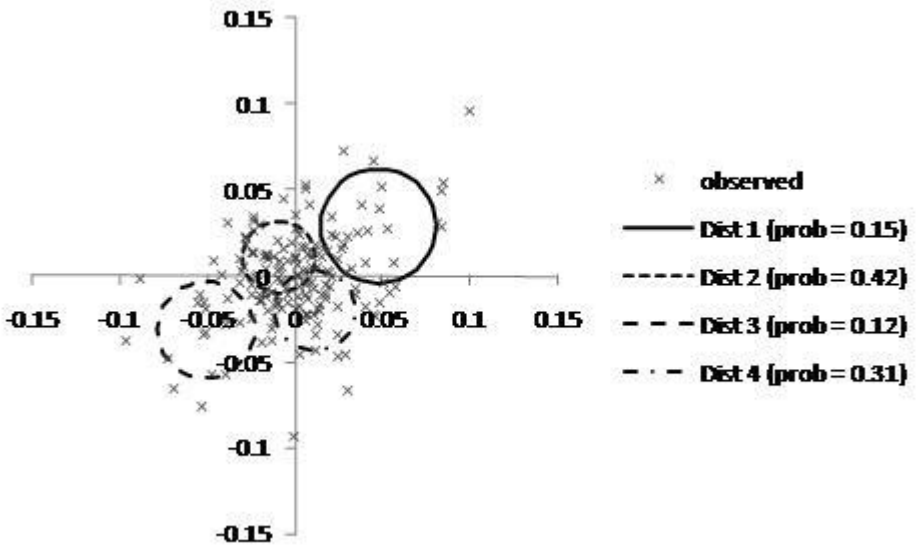

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Figure 4.6: Illustration of the difficulties of finding global extrema, even in one dimension and even for smooth functions

[ExtremeEventsFigure4_6]

Points *A* and *C* are local, but not global, maxima. The global maximum is at *E*, which is on the boundary of the interval so the derivative of the function need not vanish there. Points *B* and *D* are local minima and *B* is also the global minimum. The points *F*, *G* and *H* are said to *bracket* the maximum at *A*, since *G* is greater than both *F* and *H* and is in between them.

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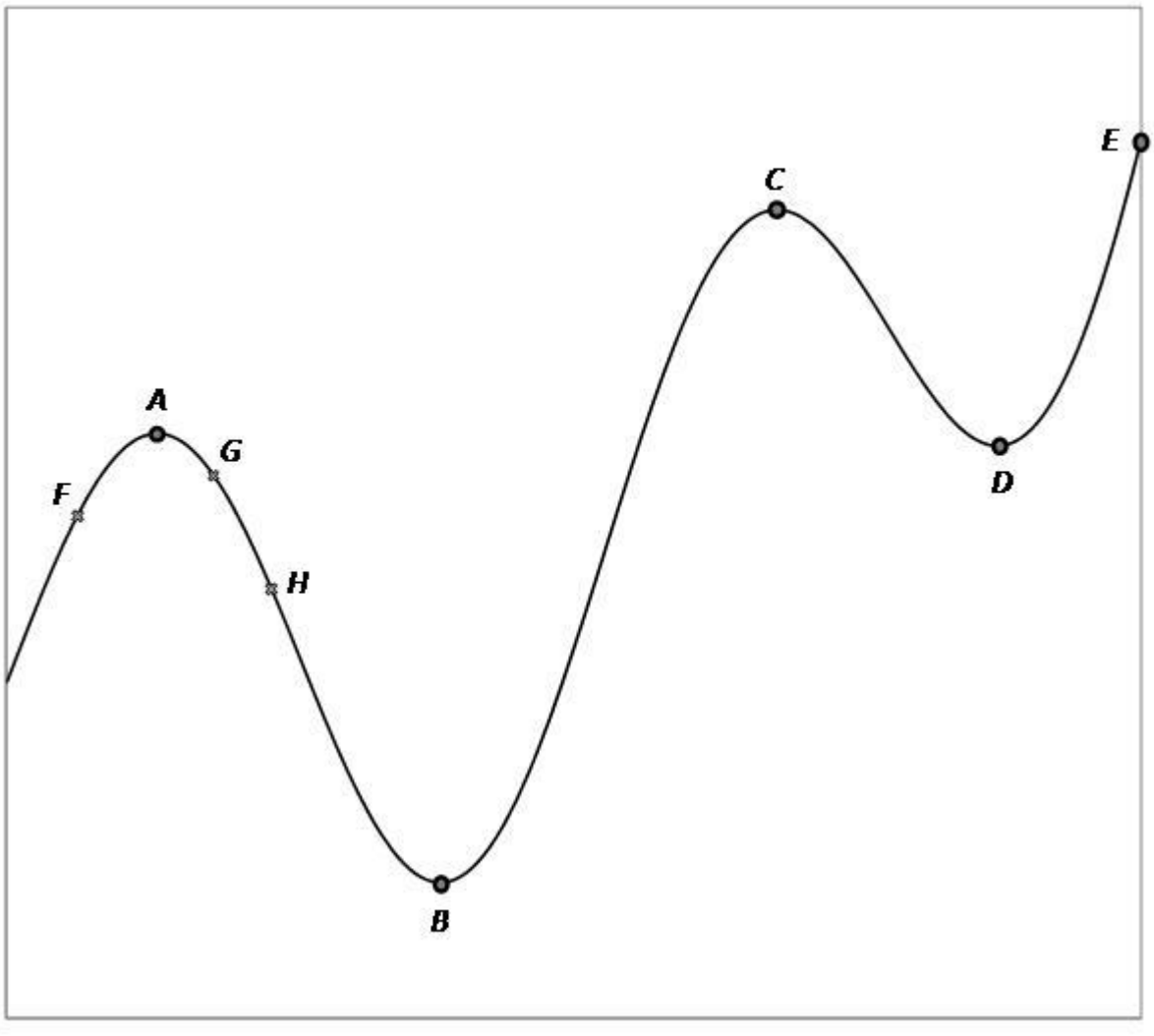

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Chapter 5

[Nematrian website page: ExtremeEventsFiguresChapter5, © Nematrian 2015]

Charts:

- Figure 5.1a: Illustrative efficient portfolio analysis: (a) Illustrative efficient frontier (including risks and returns of individual asset categories)
- Figure 5.1b: Illustrative efficient portfolio analysis: (b) Composition of corresponding efficient portfolios
- Figure 5.2: CAPM and the capital market line (CML)

Figure 5.1a: Illustrative efficient portfolio analysis: (a) Illustrative efficient frontier (including risks and returns of individual asset categories)

[ExtremeEventsFigure3_18]

SmartChart version:

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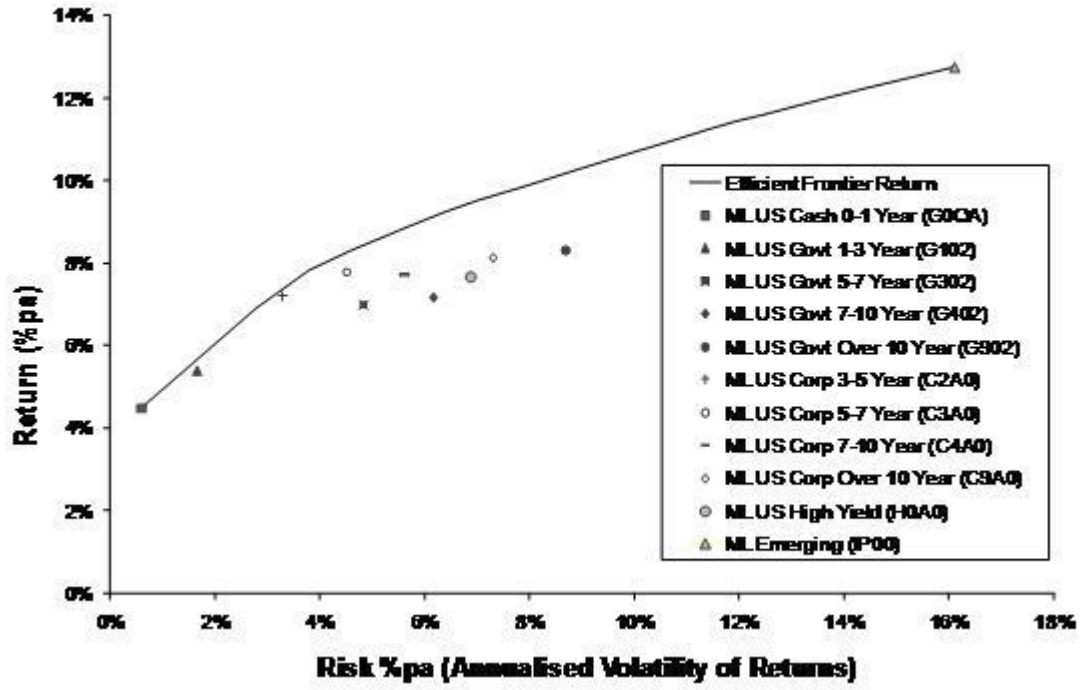

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Figure 5.1b: Illustrative efficient portfolio analysis: (b) Composition of corresponding efficient portfolios

[ExtremeEventsFigure5_1b]

SmartChart version:

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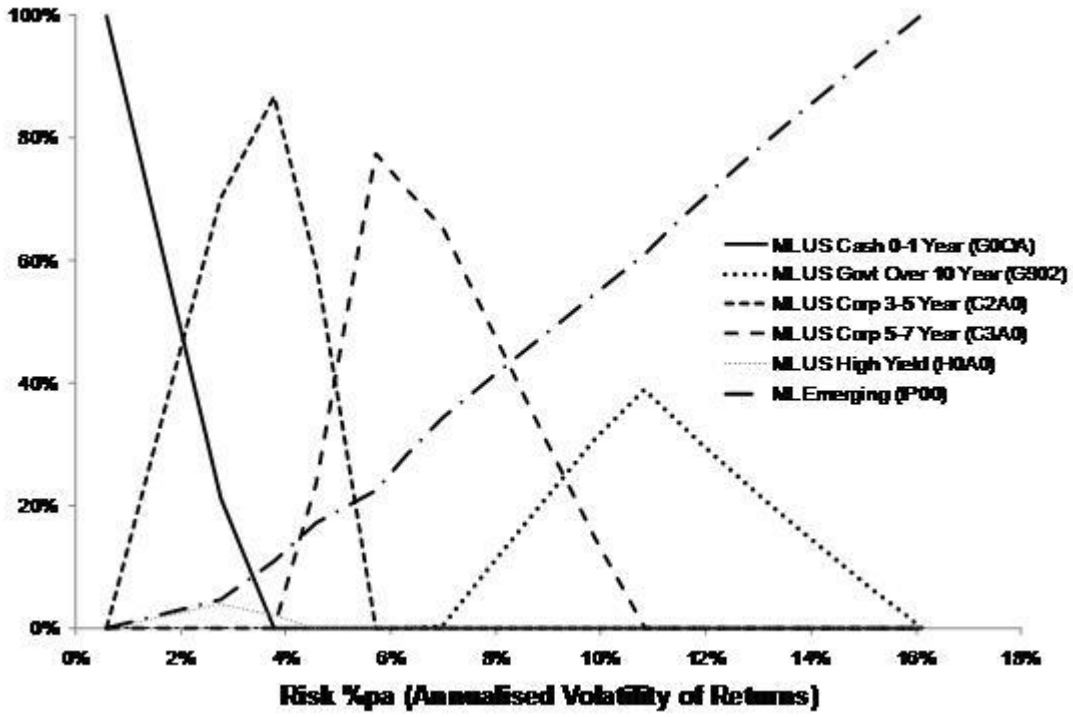

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Figure 5.2: CAPM and the capital market line (CML)

[ExtremeEventsFigure3_18]

SmartChart version:

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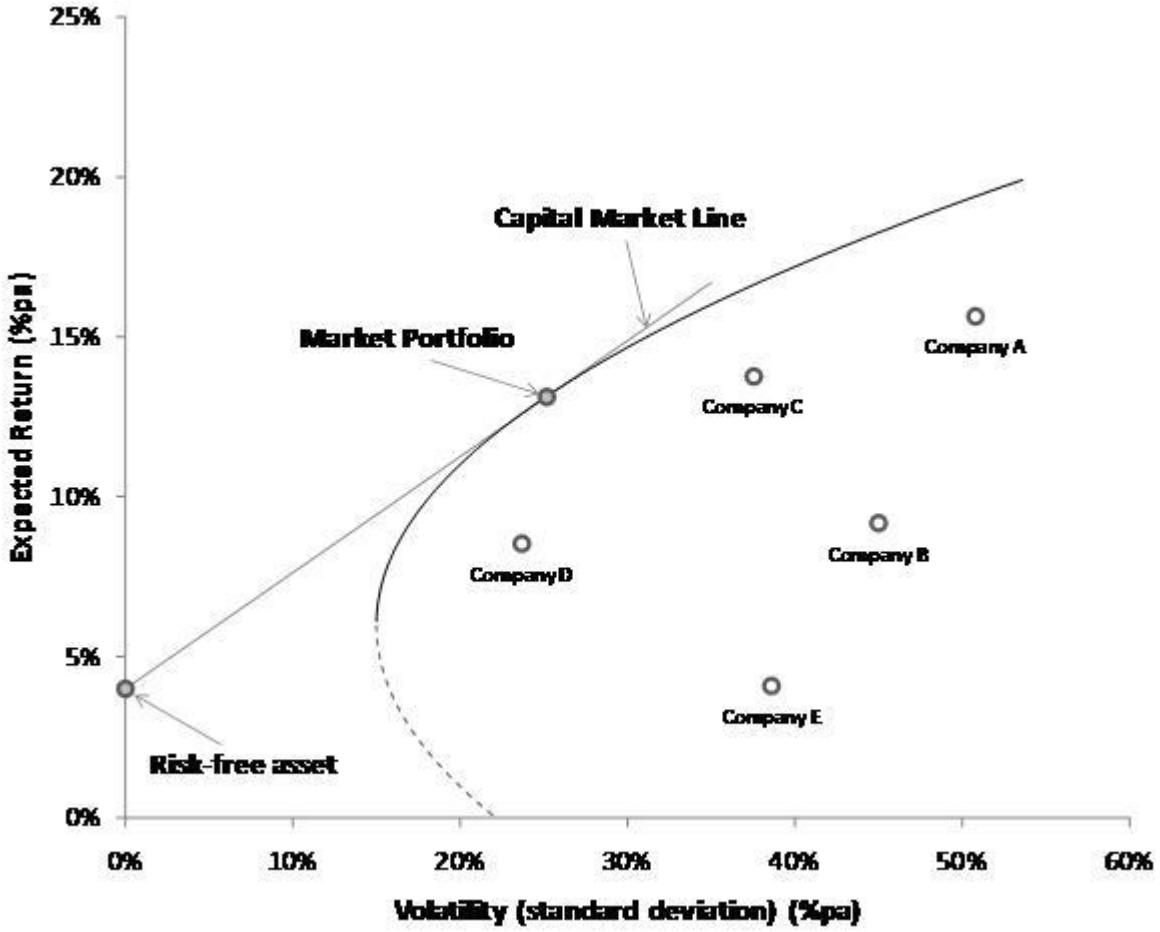

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Chapter 6

[Nematrian website page: ExtremeEventsFiguresChapter6, © Nematrian 2015]

Charts:

- Figure 6.1: Using OLS regression to identify exact error estimates for portfolio weights
- Figure 6.2: Illustrative efficient frontier using assumptions set out in Table 6.1

Figure 6.1: Using OLS regression to identify exact error estimates for portfolio weights

[ExtremeEventsFigure3_18]

SmartChart version:

Not available

Variant used in book:

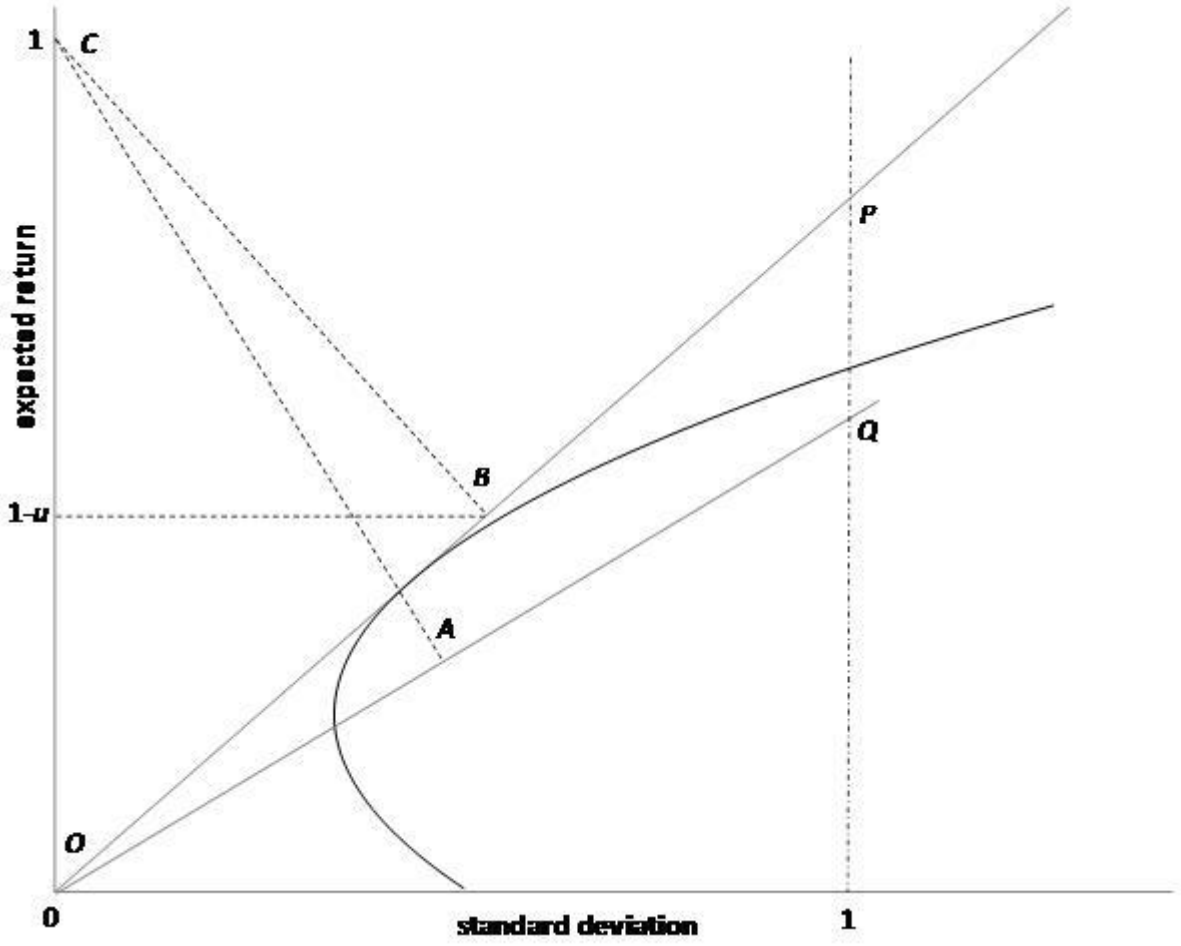

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Figure 6.2: Illustrative efficient frontier using assumptions set out in Table 6.1

[ExtremeEventsFigure6_2]

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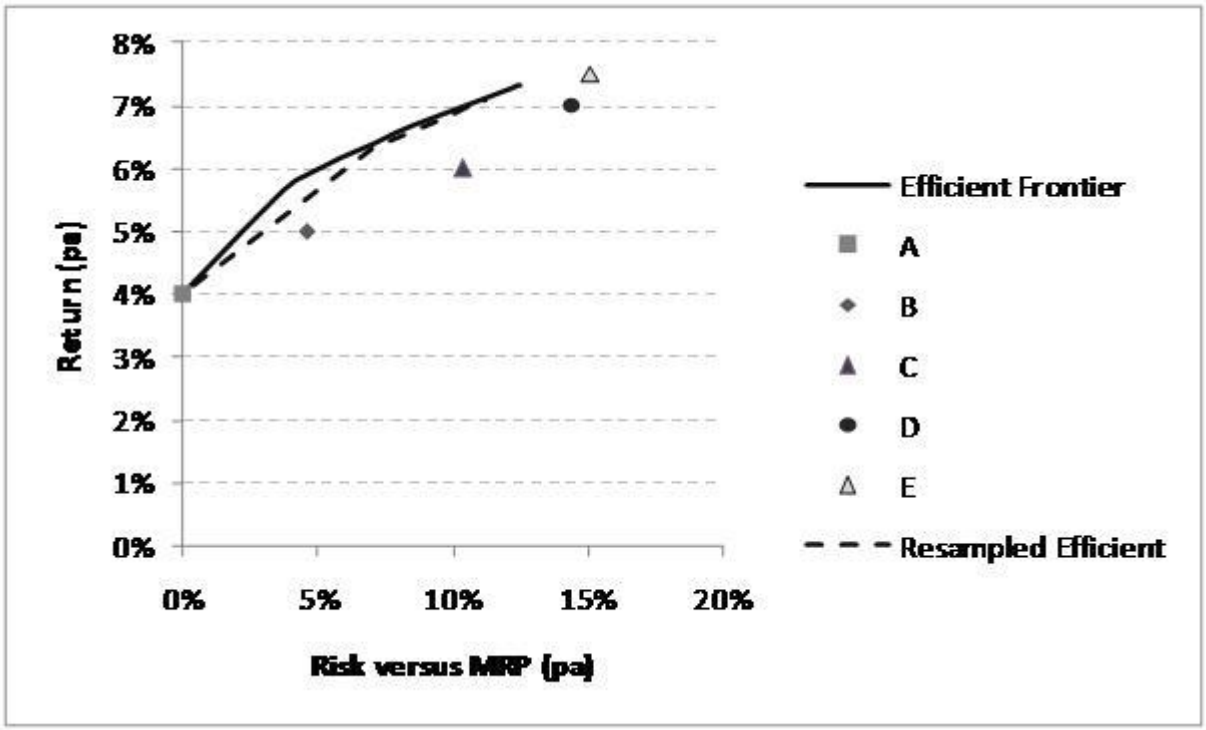

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Chapter 7

[Nematrian website page: ExtremeEventsFiguresChapter7, © Nematrian 2015]

Charts:

- Figure 7.1: The operation of a simple regime switching model

Figure 7.1: The operation of a simple regime switching model

[ExtremeEventsFigure7_1]

SmartChart version:

Not available

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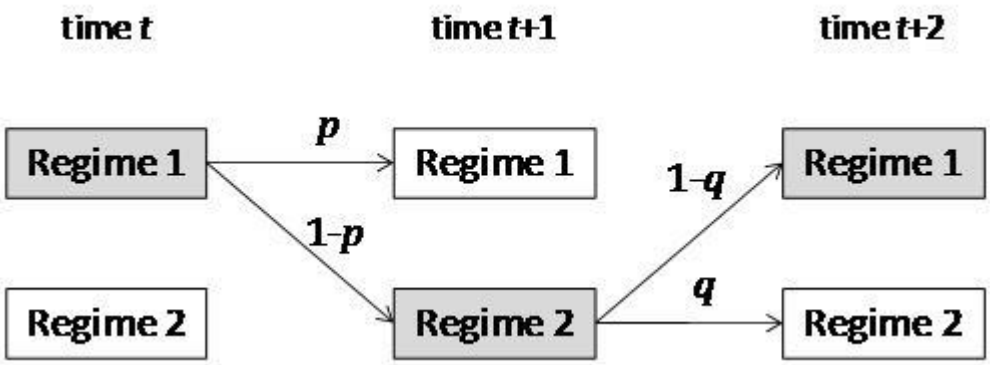

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