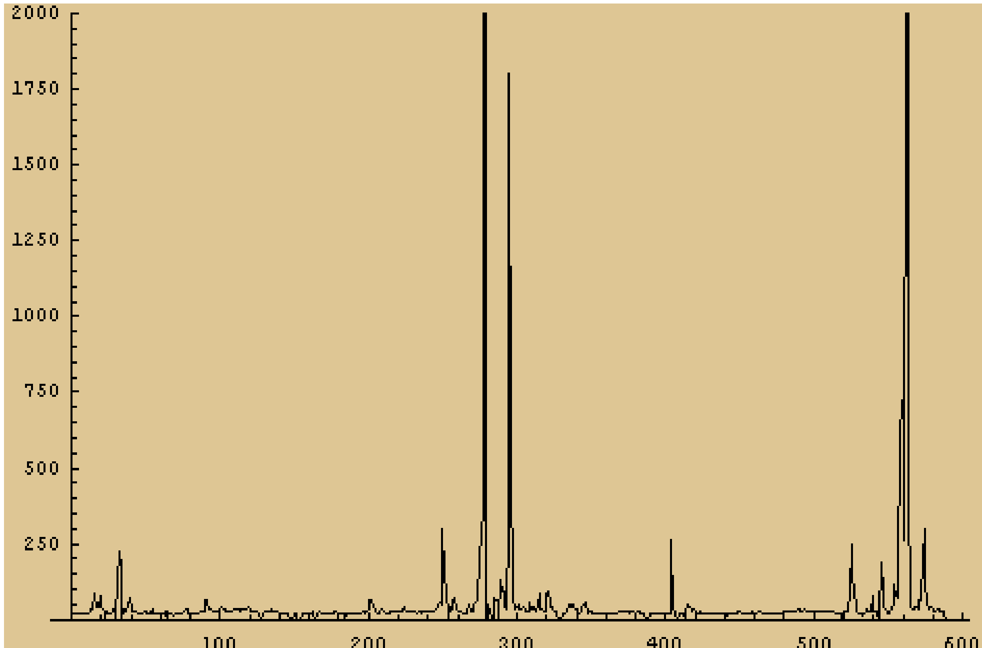
Title

by Olivier Croissant

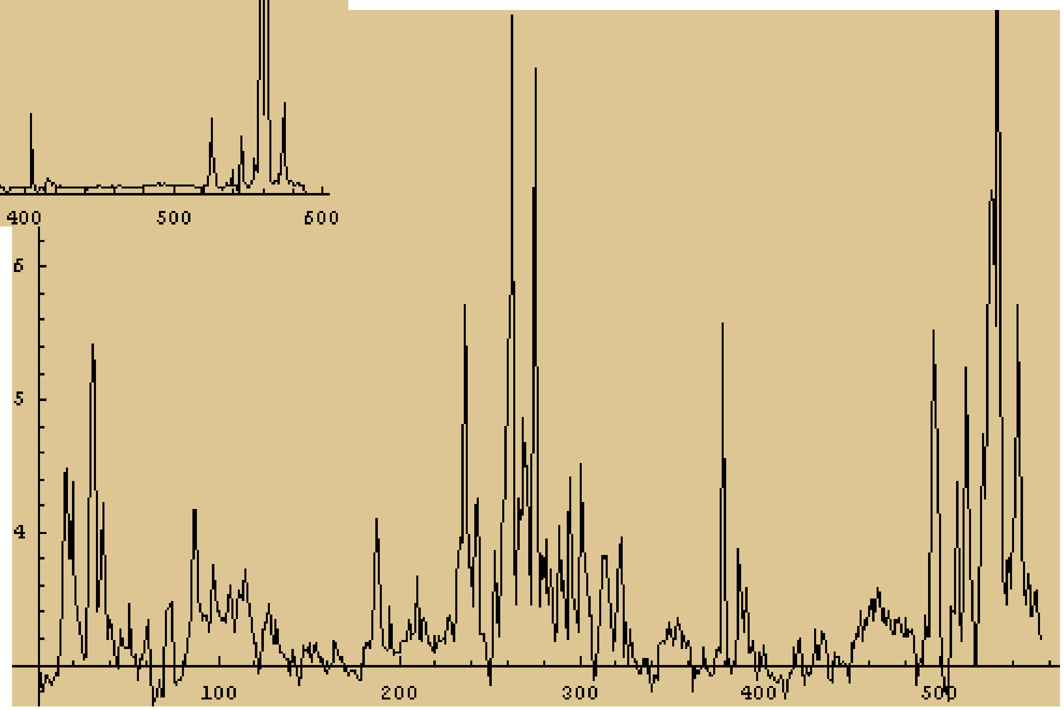
Caracteristics of the Power Markets

- The supply for electricity change slowly (Fixed capital of generation and transmission)
- The demand for electricity is relatively inelastic and will respond only slowly to a change in price pressure
- We cannot store electricity, therefore we cannot hedge even with a “convenient yield”
- Due to transmission limits there are several eletricity markets (regionalisation)
- Monthly contract are easier to price than daily or even hourly contract
- Contracts trend to be more complex than for the money markets
- Events are more frequent and economic drivers are more numerous than for the money markets

Exemple of Electricity Spot Price Serie



We
Take the Log



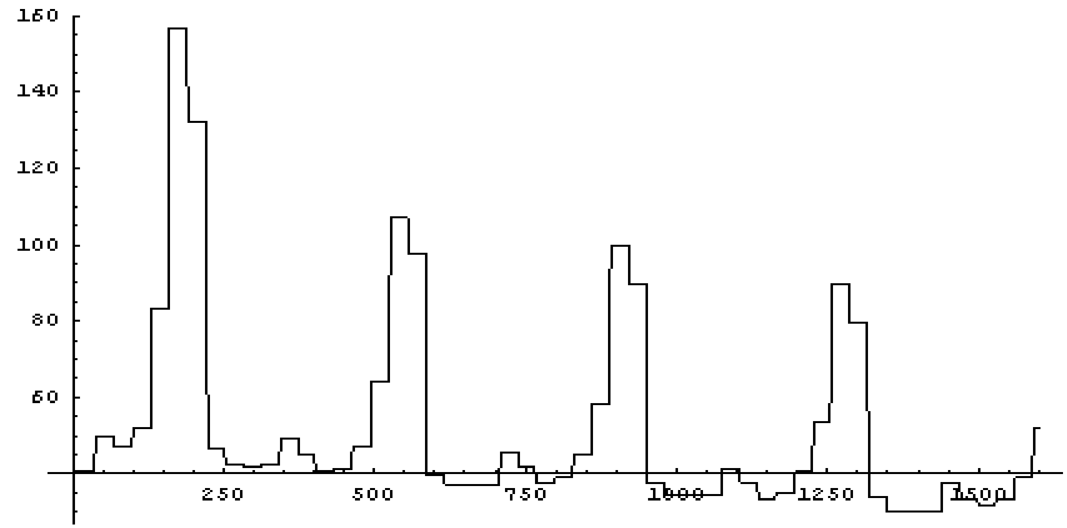
A pragmatic model

- we model the constant maturity forward

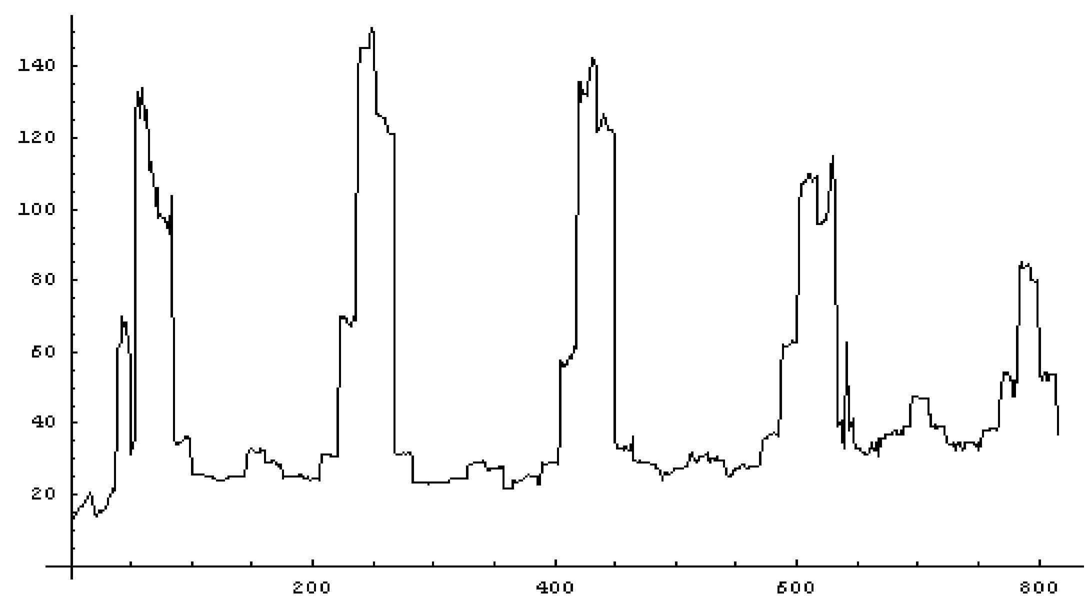
$$d(Log[F_{cons}(t,T)]) = \alpha_T(\mu - Log[F_{cons}])dt + \sigma_T dW_t + J_T(F_{cons})dq_t$$

Instantaneous Forward Price

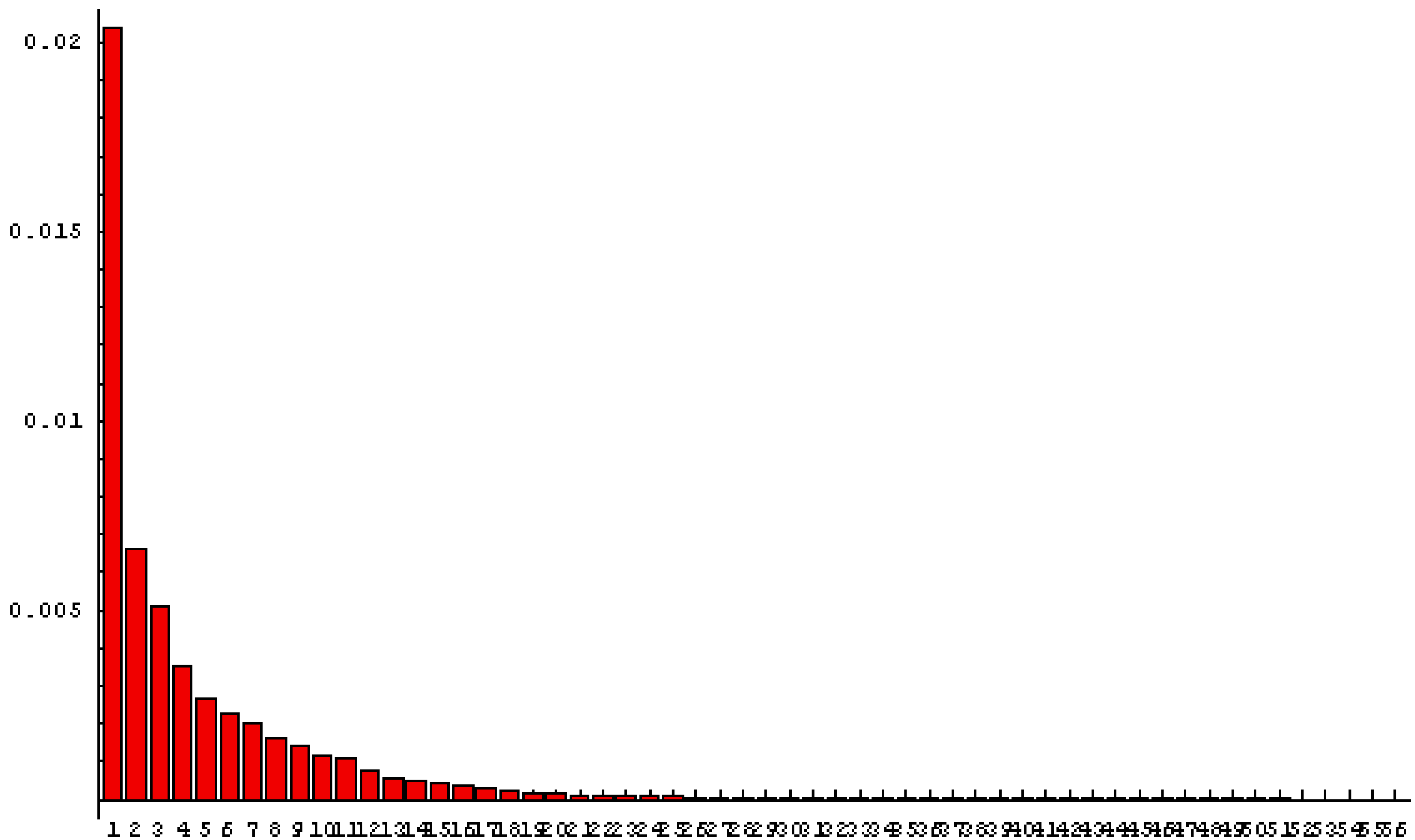
One specific date, all maturities



Maturity=1 day, Historical Serie

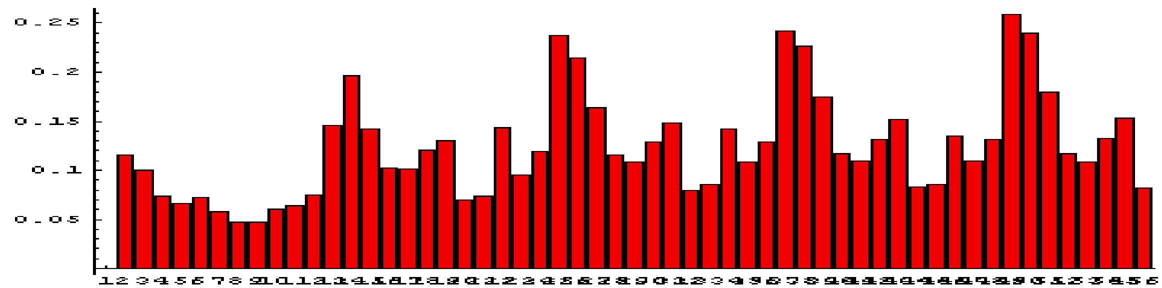


Principal Component Analysis Of the Deseasonalized Prices

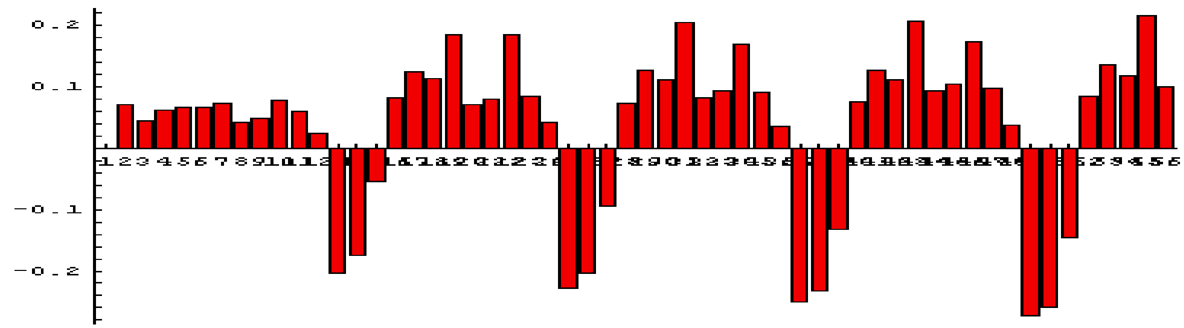


Eigen vectors

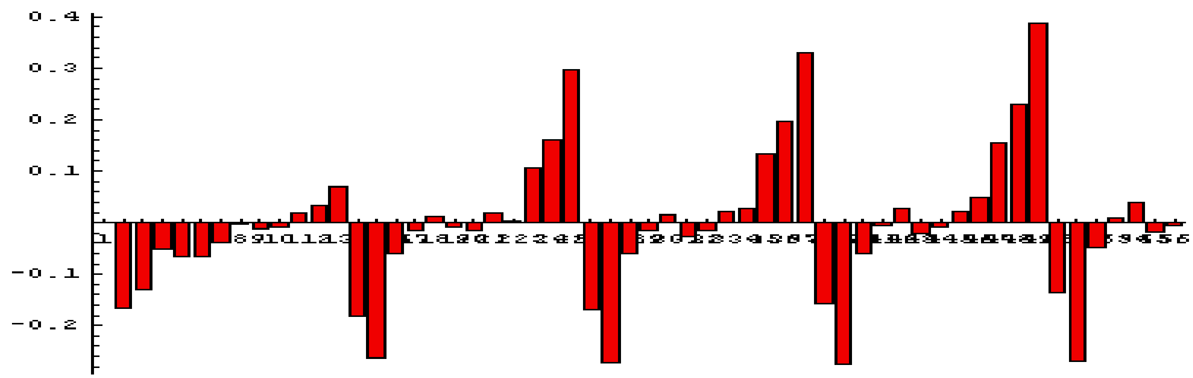
Vector 1



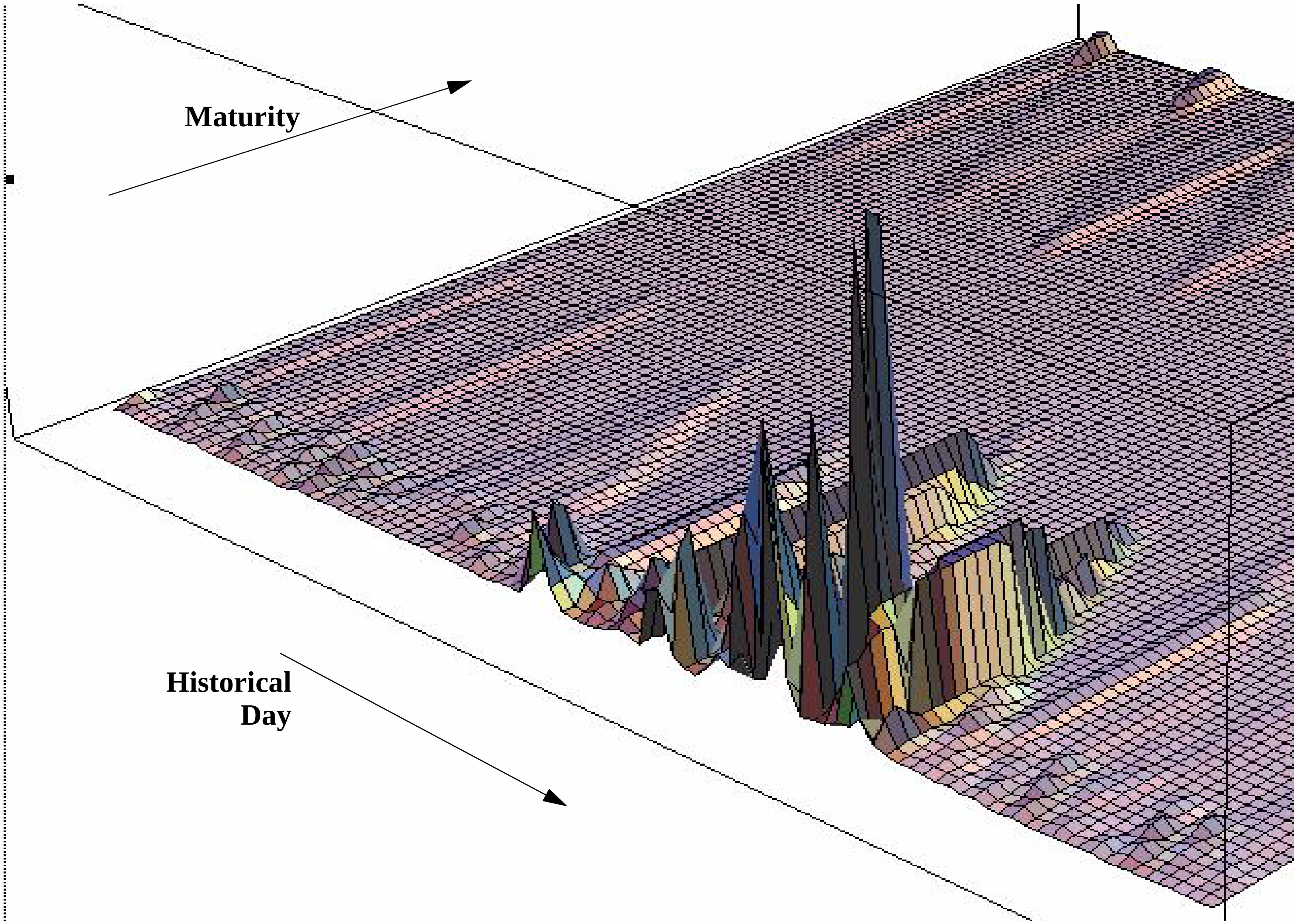
Vector 2



Vector 3

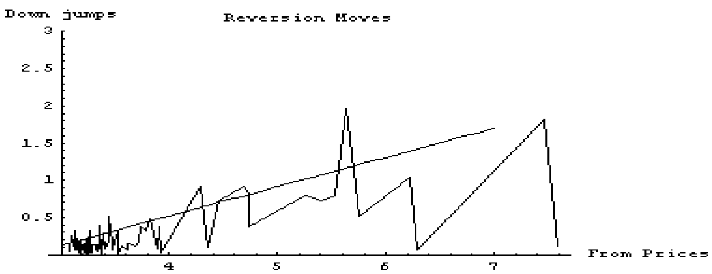


Short Term Sector : Constant Maturity Forward Prices



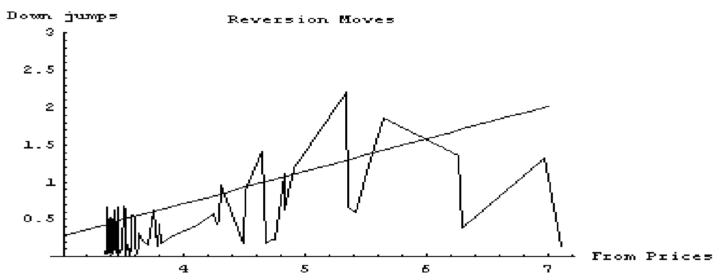
Mean Reversion Calibration

********* Maturity 1 ****************



mean reversion parameters{0.393536, 2.67796, 0}

********* Maturity 2 ****************

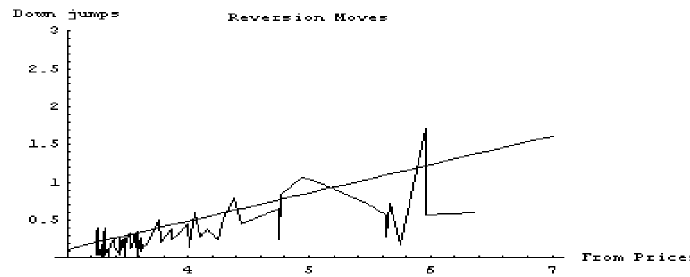


mean reversion parameters{0.434952, 2.35797, 0}

********* Maturity 3 ****************

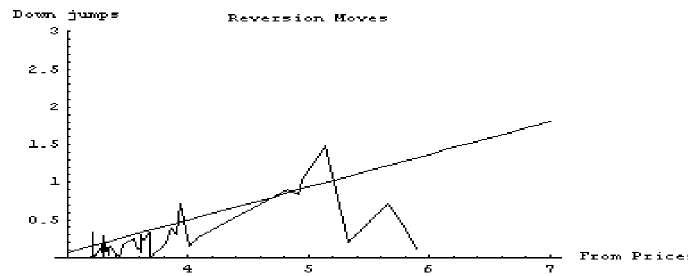
mean reversion parameters{0.73527, 3.09899, 0}

********* Maturity 4 ****************



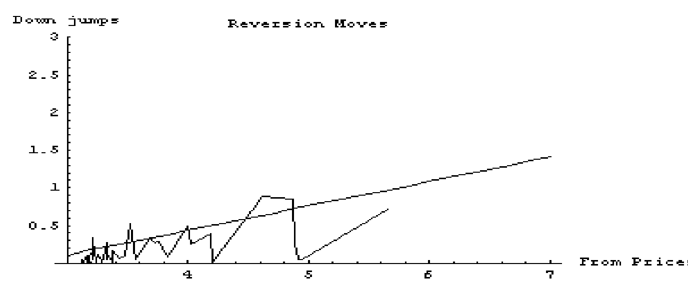
mean reversion parameters{0.373991, 2.6941, 0}

********* Maturity 5 ****************



mean reversion parameters{0.437313, 2.86759, 0}

********* Maturity 6 ****************



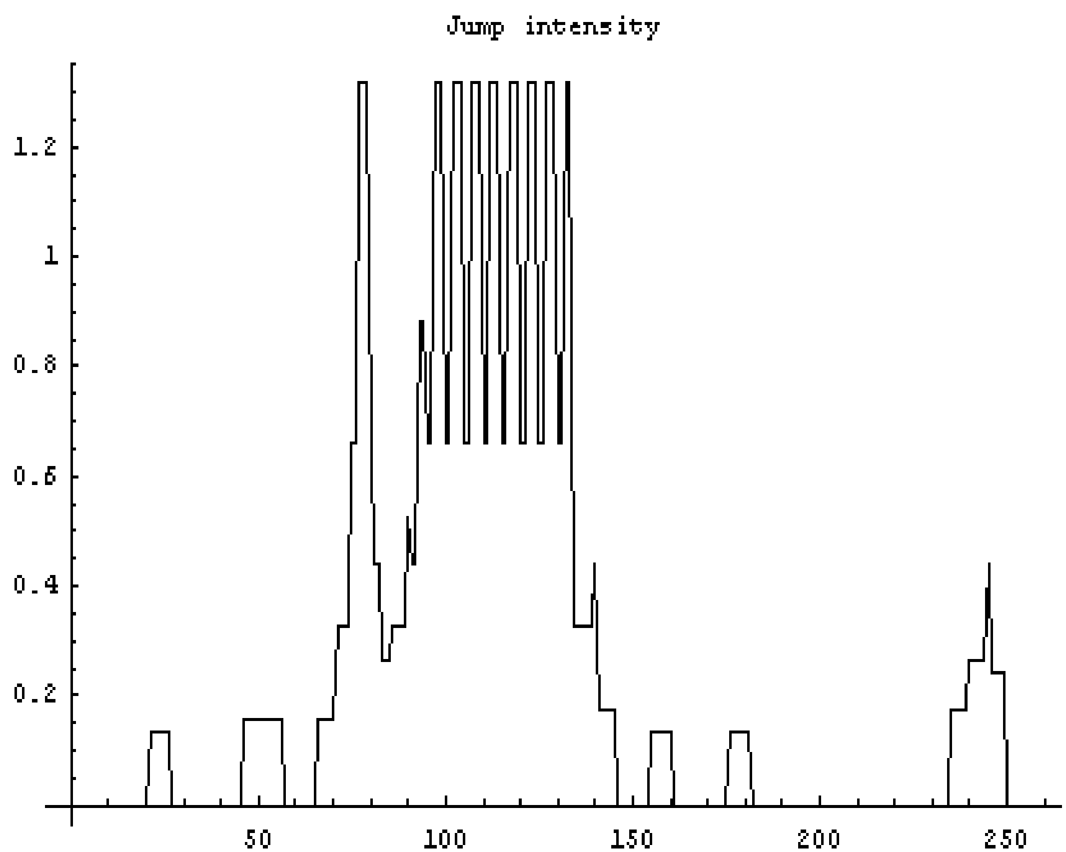
mean reversion parameters{0.326391, 2.67527, 0}

Extraction of a Jump Intensity

Using the cyclicity of yearly data, we build the density the following way: for every successive couple of dates, we define

$$d(t) = \frac{k}{(t_2 - t_1)} \qquad t_1 < t \le t_2$$

The constant k is then determined by a normalization consideration. : Total number of jumps over the period



Normal Rank Correlation Analysis

We have N empirical marginal distribution $D_T(x) = Prob[S_T < x]$

We want to find N Real functions $f_T: R \to R$ such that

$D_T(f_T(x)) = \Phi(x)$ where $\Phi(x) = \int_{-\infty}^{x} \frac{e^{-\frac{t^2}{2}}}{\sqrt{2\pi}} dt$ is the gaussian distribution

Having a multi-dimensional variable $f_T^{-1}(S_T)$ which is marginally gaussian, we make the important assumption that it is a multidimensional jointly gaussian variable.Therefore we compute a covariance matrix C.

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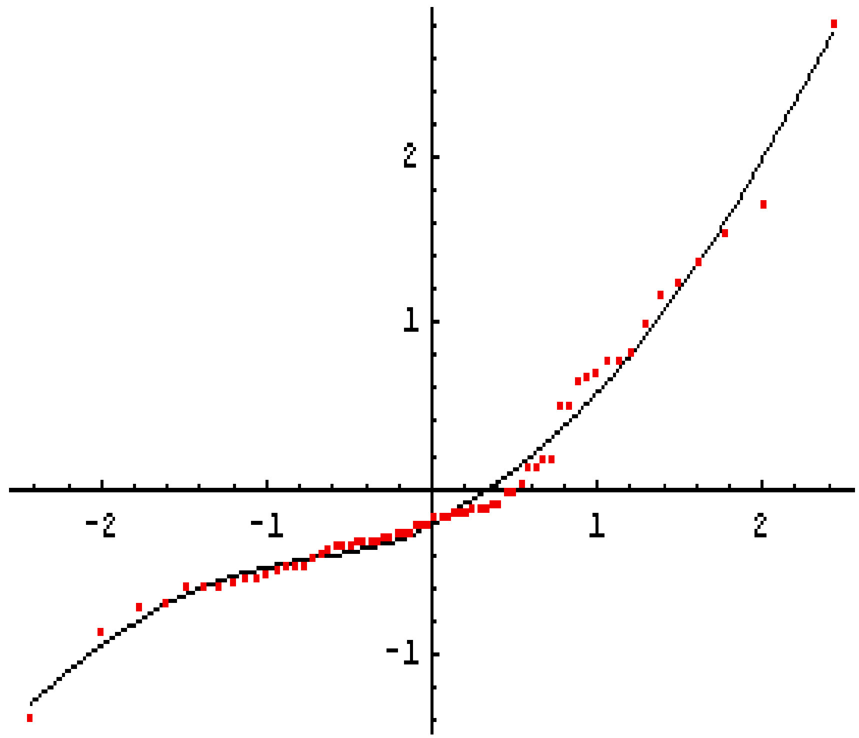
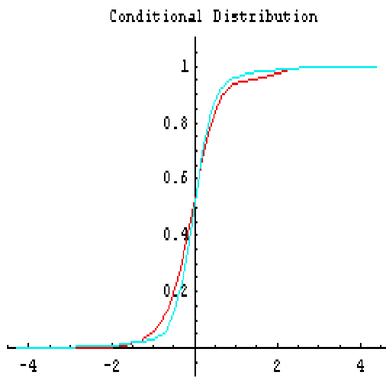
Fitting of the Marginals



Kolmogorof Analysis

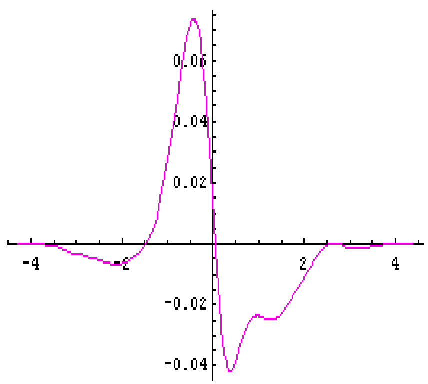
$S_n - S_{n-1}$



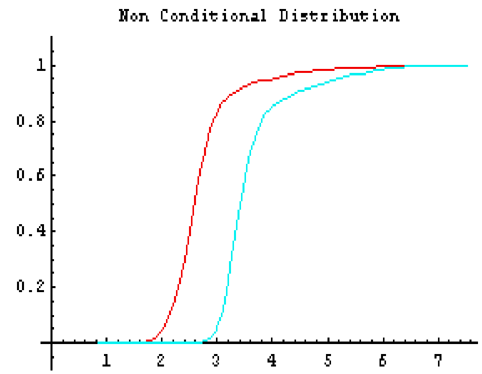
simulation mean=0.000533193 / Standard Deviation= 0.694912 (Red)

original mean=-0.00190435 / Standard Deviation= 0.588451 (Blue)

kolmogorov Distance :simulation - original



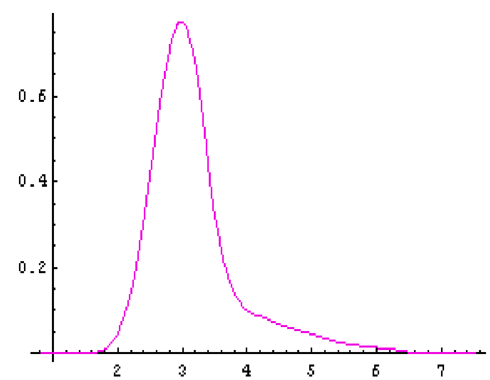
S_n



simulation mean=2.6952 / Standard Deviation= 0.623281 (Red)

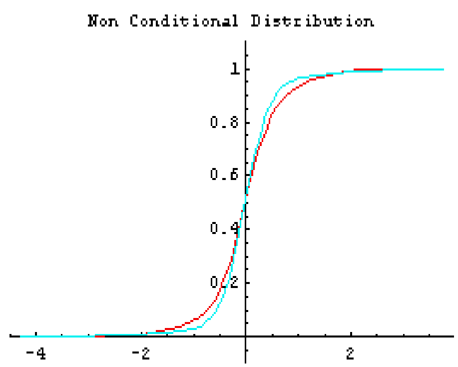
original mean=3.6597 / Standard Deviation= 0.673297 (Blue)

kolmogorov Distance :simulation - original



Kolmogorof Analysis (Adjusting the LTMR level)

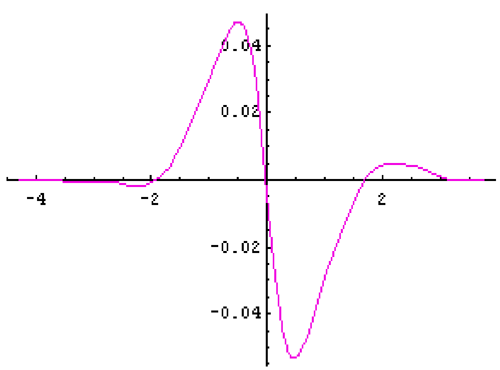
$S_n - S_{n-1}$



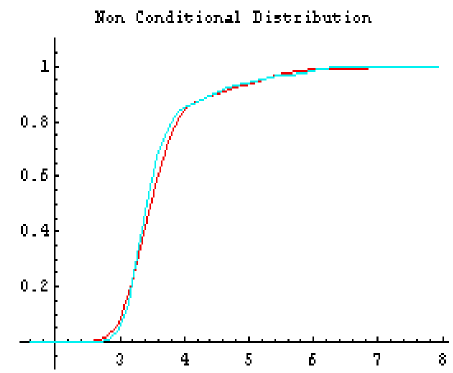
simulation mean=-0.00085932 / Standard Deviation= 0.676425 (Red)

original mean=-0.00190435 / Standard Deviation= 0.588451 (Blue)

kolmogorov Distance :simulation - original



S_n



simulation mean=3.66508 / Standard Deviation= 0.687189 (Red)

original mean=3.6597 / Standard Deviation= 0.673297 (Blue)

kolmogorov Distance :simulation - original