

Fx Volatility Surface Clustering

March 2018



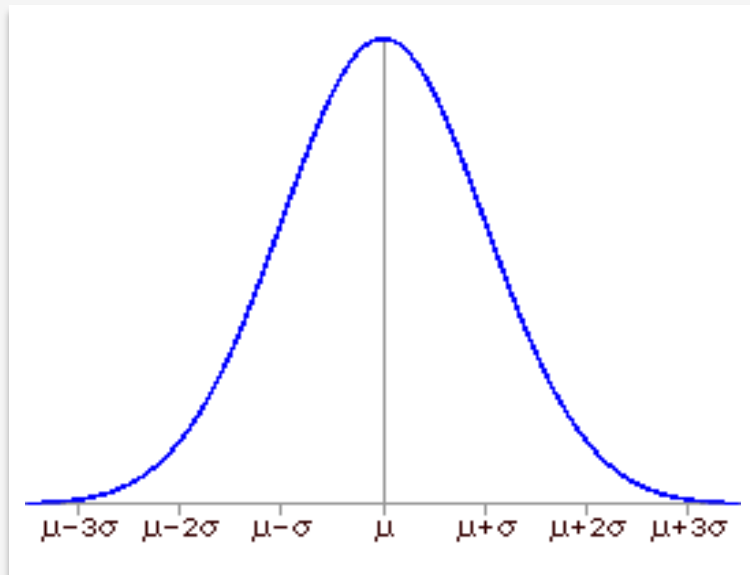
H2O Asset Management

- **Global macro discretionary boutique launched in 2010**
- AUM was **EUR 16.1 billion** as at 31/01/2018
- A **long-term**, top-down, **mostly relative value**, and unconstrained approach
- **Fully discretionary**, relying on strong convictions
- Dedicated Quant desk (5 people)

Realized Volatility

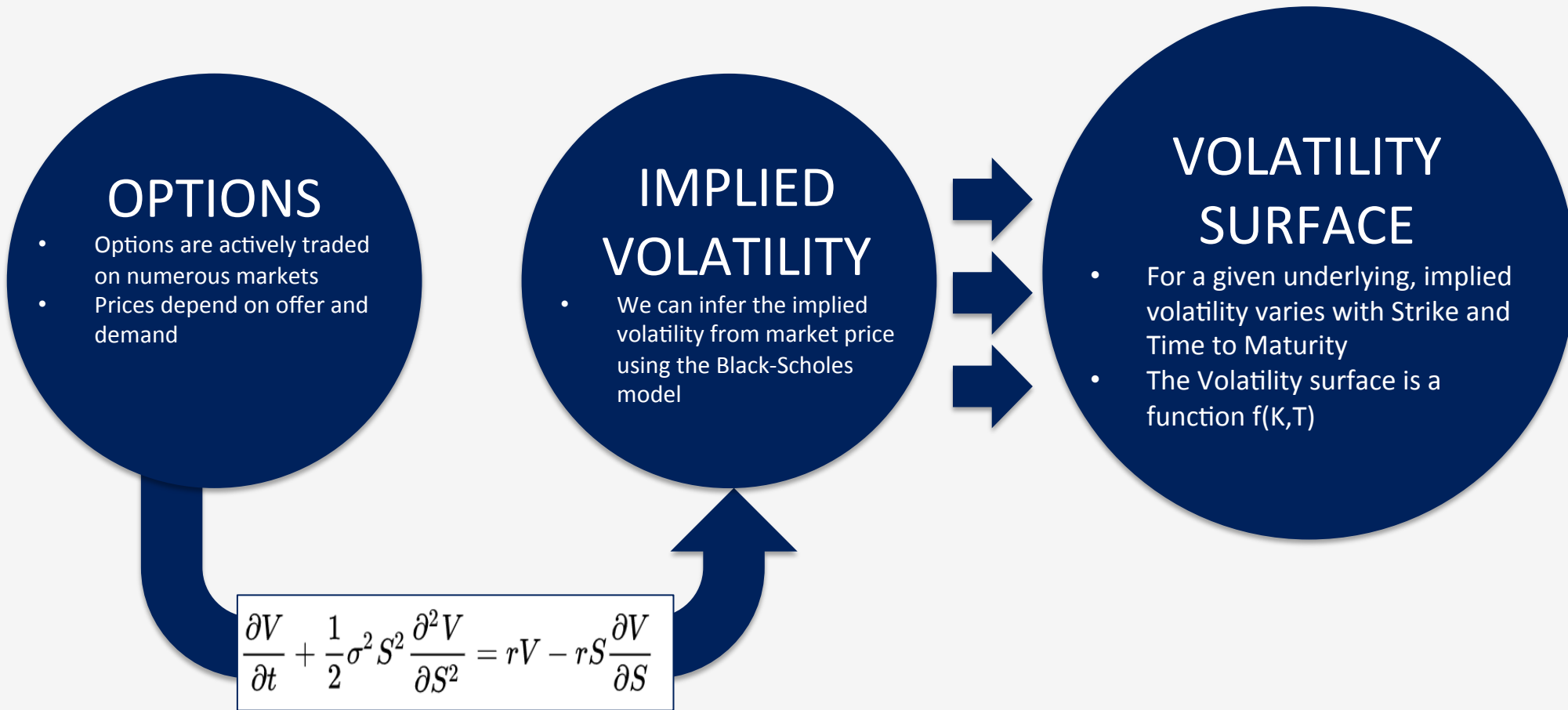
Volatility is defined as the standard deviation of the distribution of an asset's returns

- Quoted in percentage point, on a yearly basis (assuming 252 days a year)
- Volatility of 15 means an average yearly returns magnitude of 15%
- Returns being time-independent (i.e. no autocorrelation), volatility is scaled by the square-root of time:

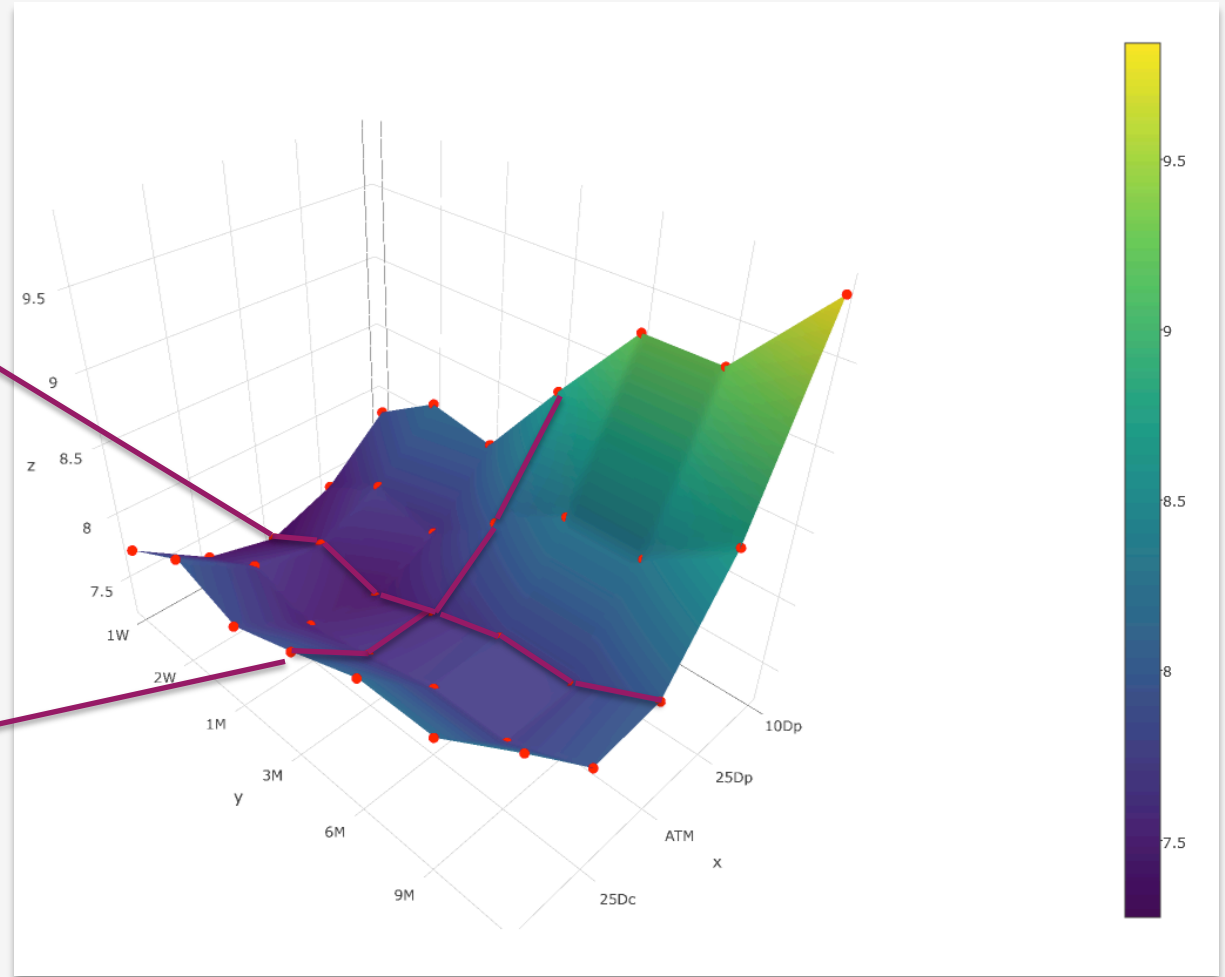
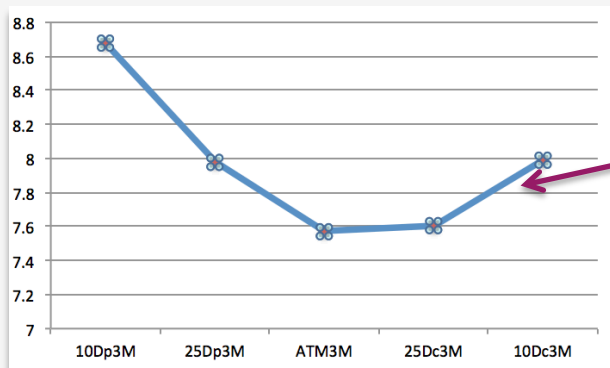
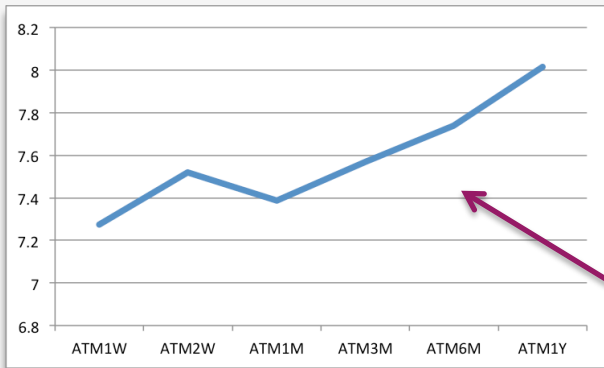


Asset Class	Volatility	Daily average move
Equity	16%	≈1.01%
FX	10%	≈0.63%
Bonds	5%	≈0.31% (8bp in yield)

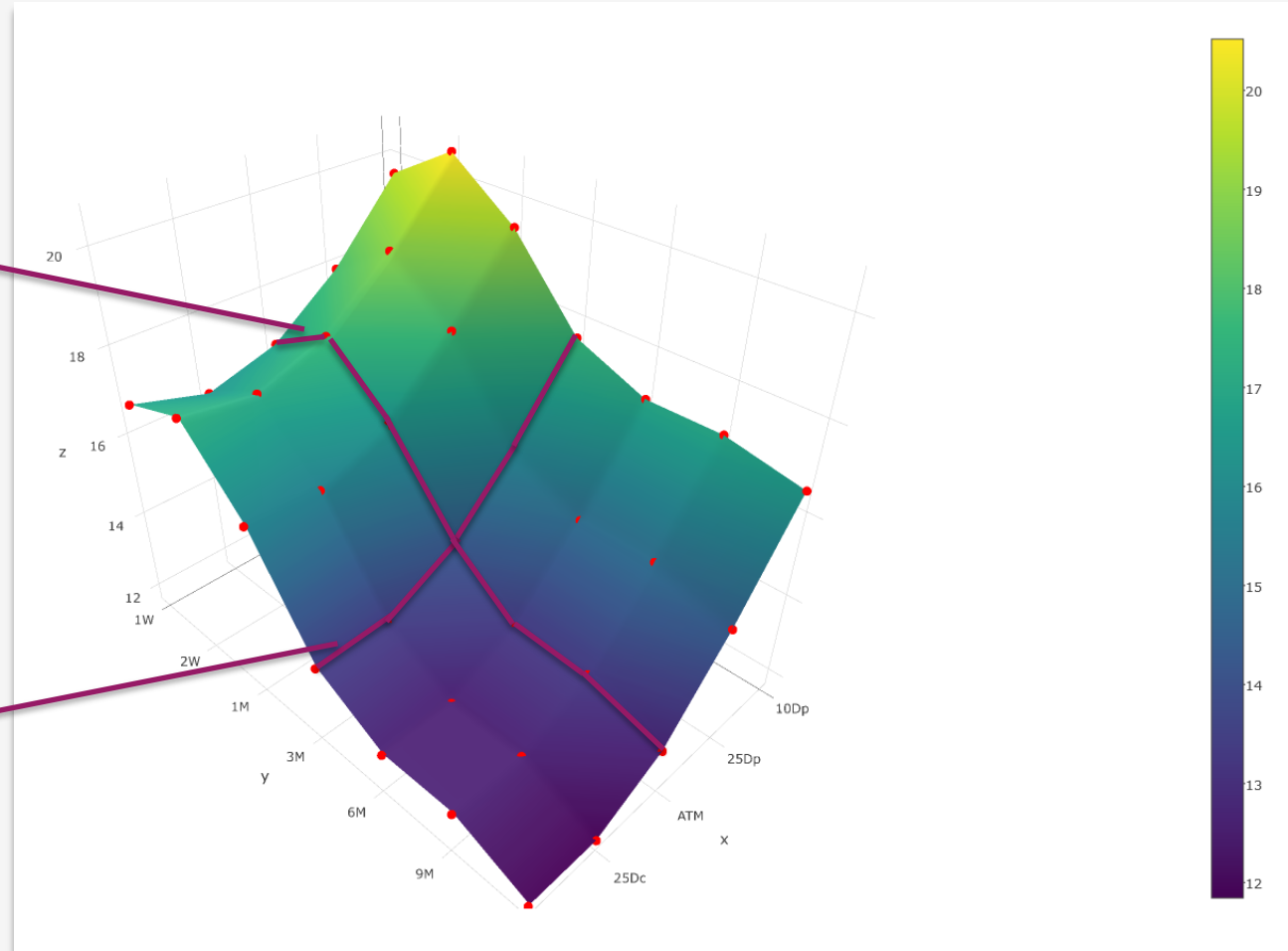
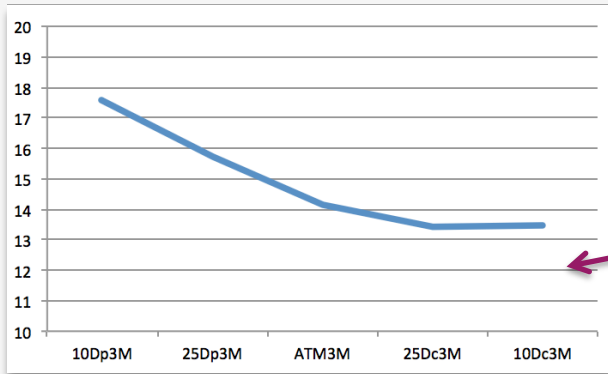
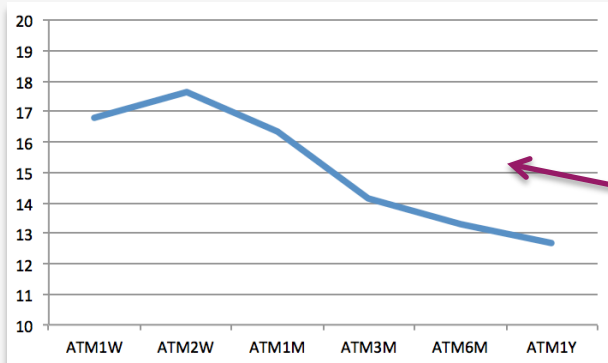
Option, Implied Volatility and Volatility surface



Volatility Surface – GBPUSD – Jan 14



Volatility Surface – GBPUSD – Jul 16



Volatility Surface

1

AS A SOURCE OF
INFORMATION

- Volatility surfaces are forward looking metrics giving insight on market expectations
- Expected distribution of returns can be inferred from Volatility Surface
- Volatility surfaces are related to market positioning, sentiment and exposure

2

AS A WAY TO
ENHANCE A DELTA-
ONE POSITION

- Hedging active positions
- Increase portfolio yield
- Leverage positions

3

AS AN
ASSET CLASS

- Directional exposure for portfolio construction
- Relative value
 - Between different underlying
 - Within the same underlying

Trading Volatility, Practical challenges

Finding the right instrument

vanilla options, vol/var swaps, exotic options, structured products...

Liquidity and Transaction costs

Complex instruments are less liquid

Trade implementation

Execution is Key

Risk Management

Non linear pay off
Gap risk

Huge amount of data to analyze and process

Analysis of Fx Volatility surfaces

OBJECTIVES

- Identify market regimes from volatility surface
- Highlight cheap/expensive points on a given surface



Analysis of Fx Volatility surfaces - Data

20+

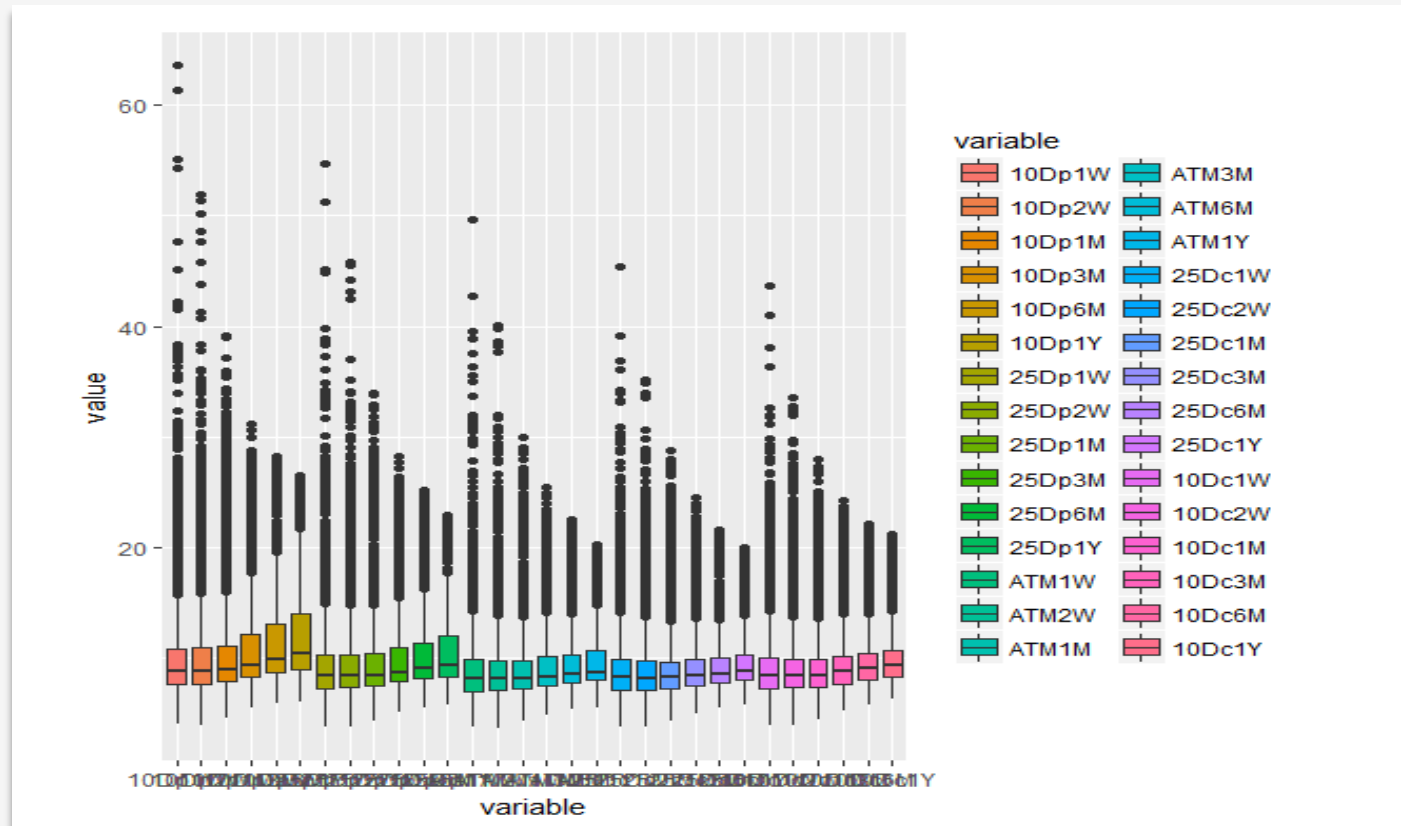
Fx Crosses since 2002 (daily)

5
deltas

10dp, 25dp, ATM,
25dc, 10dc

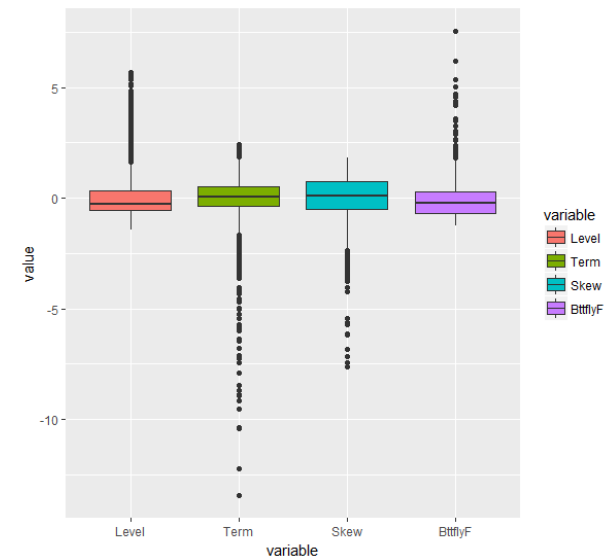
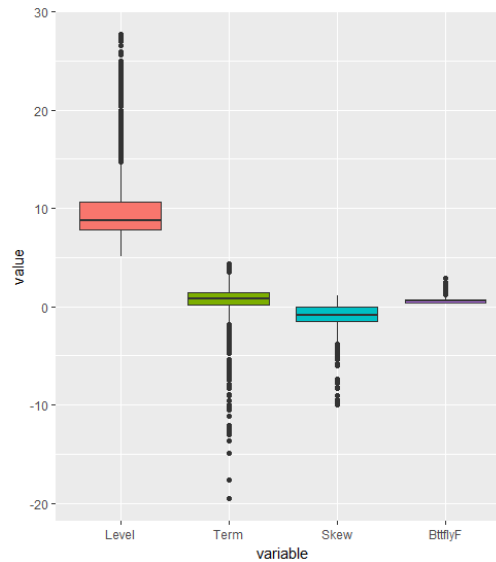
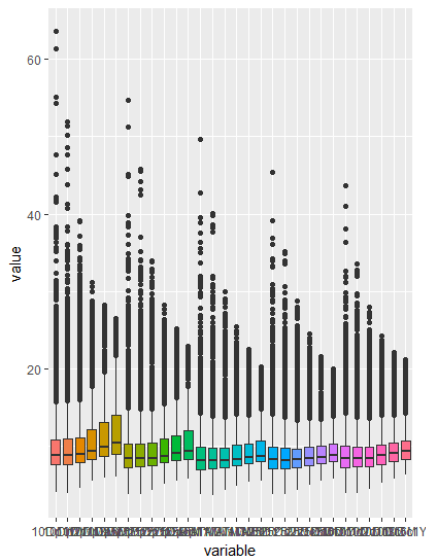
6
Tenors

1w, 2w,
1M, 3M, 6M, 1Y



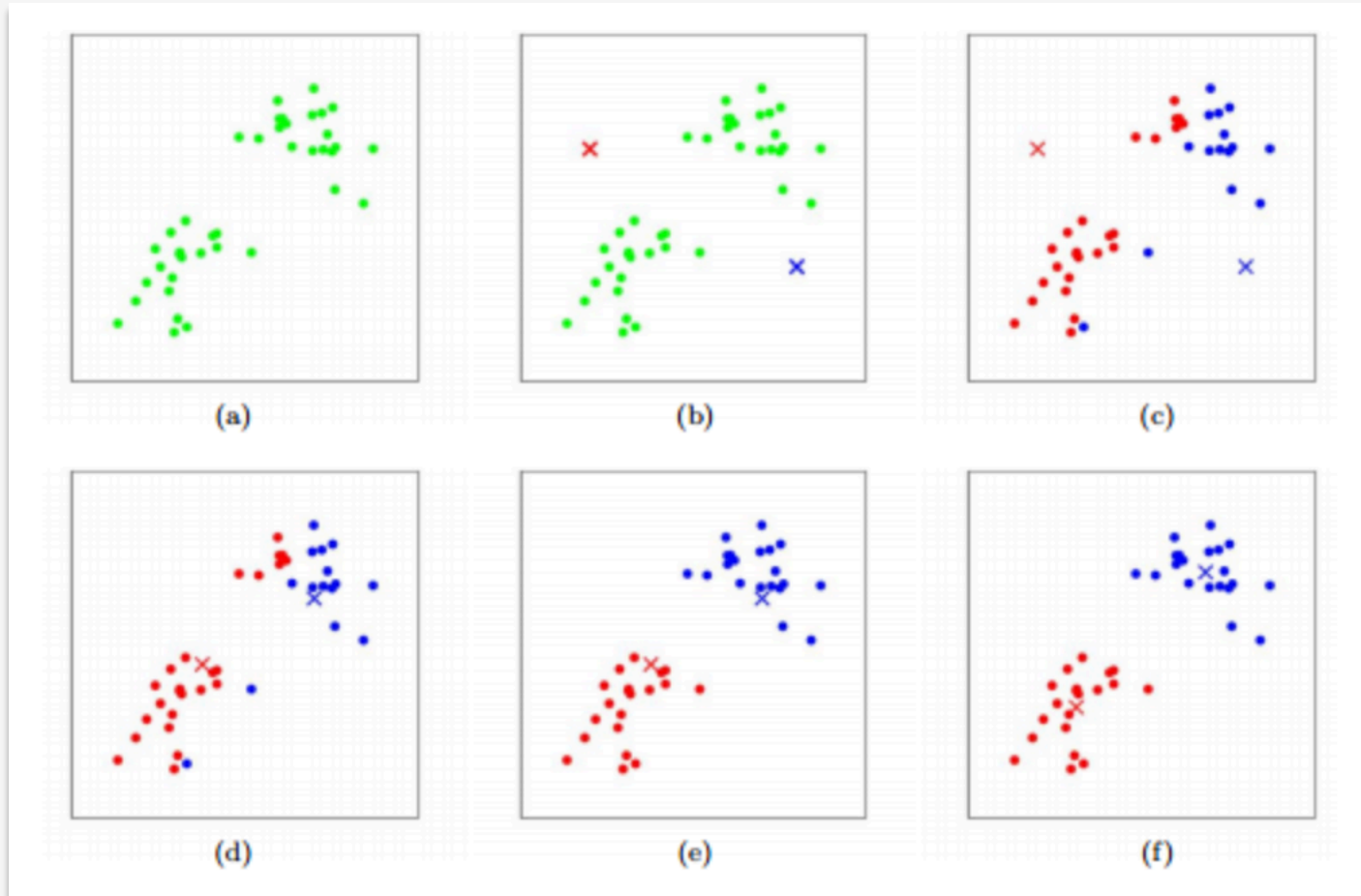
Analysis of Fx Volatility surfaces – Dimension reduction

Dim Reduction



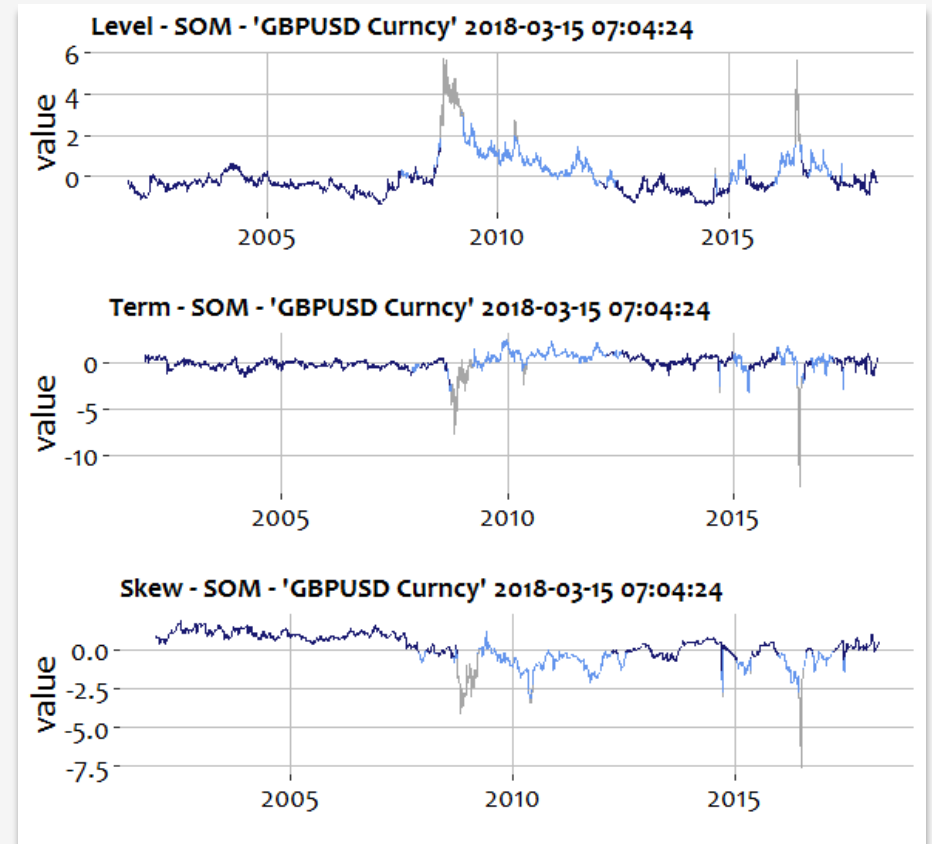
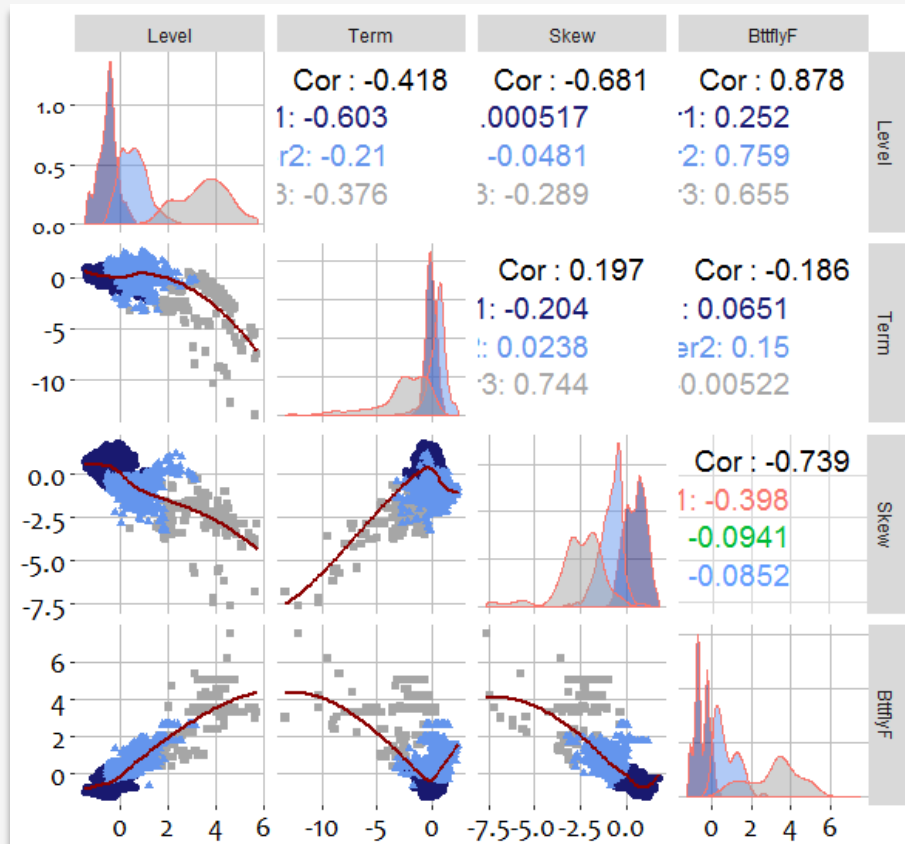
Scaling

K-Mean Clustering - Algorithm

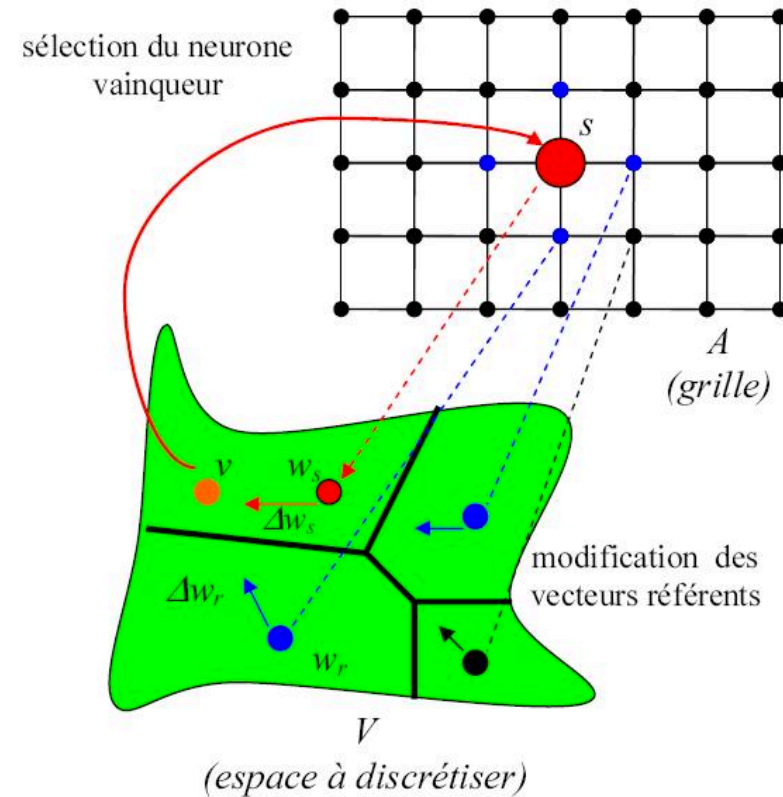
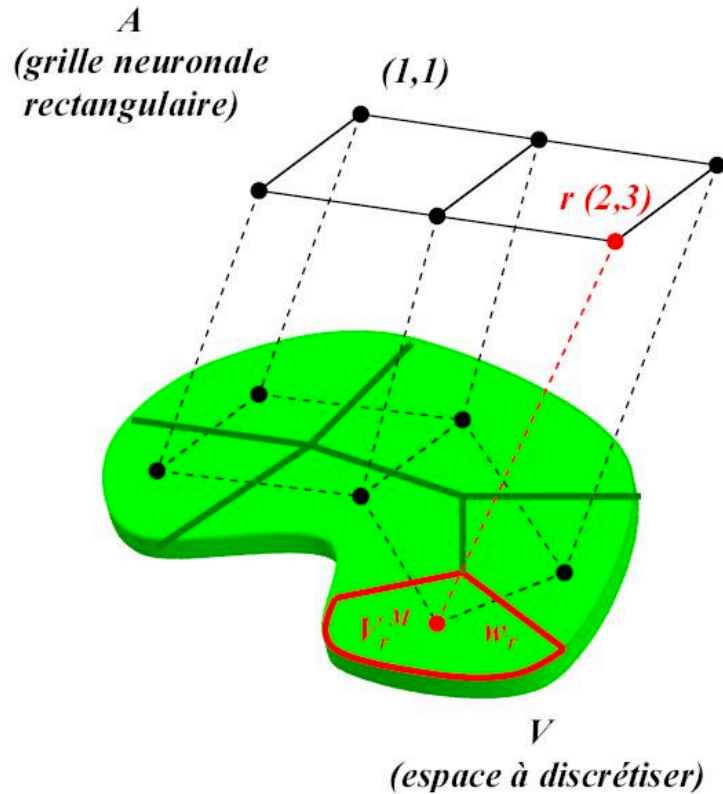


Source: Chris Piech, Stanford.edu

K-Mean Clustering - Results

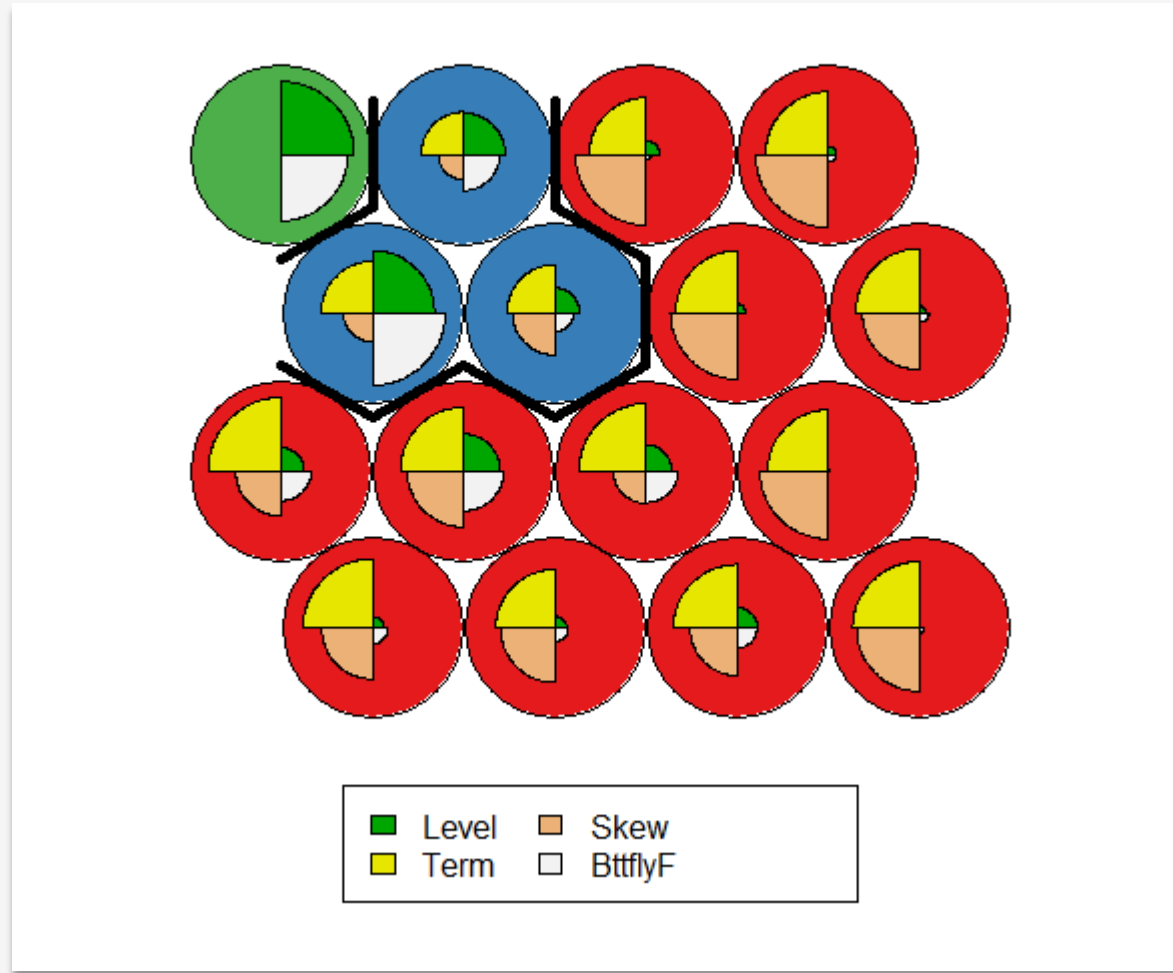


Self Organising Map - Algorithm

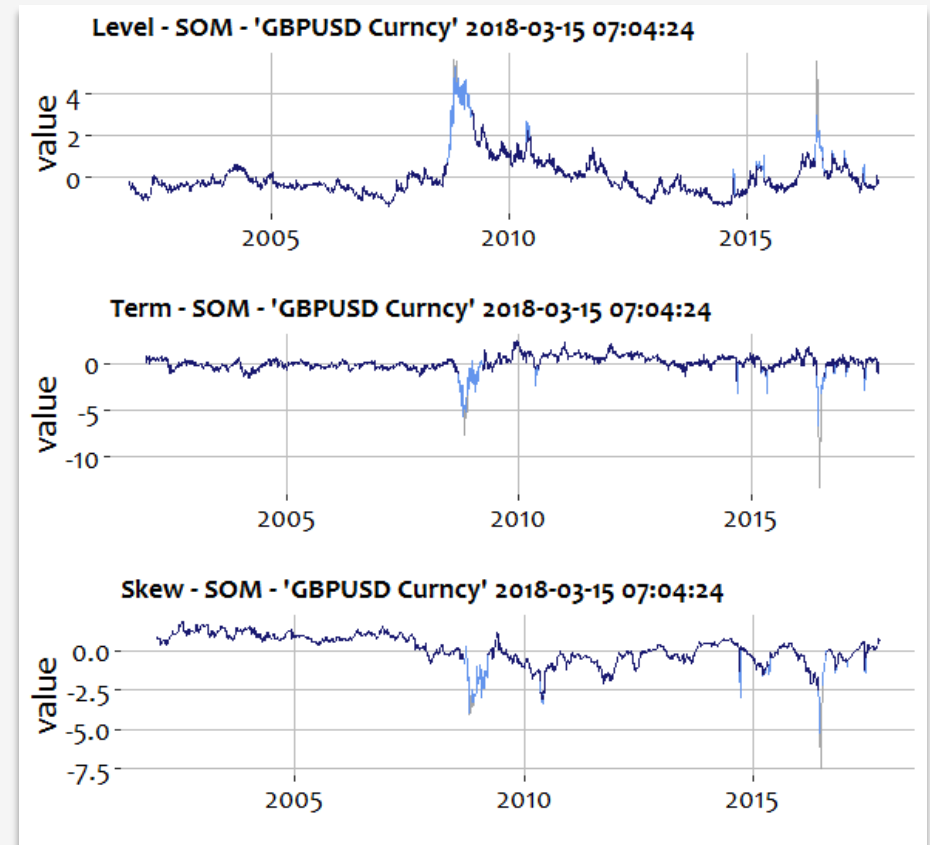
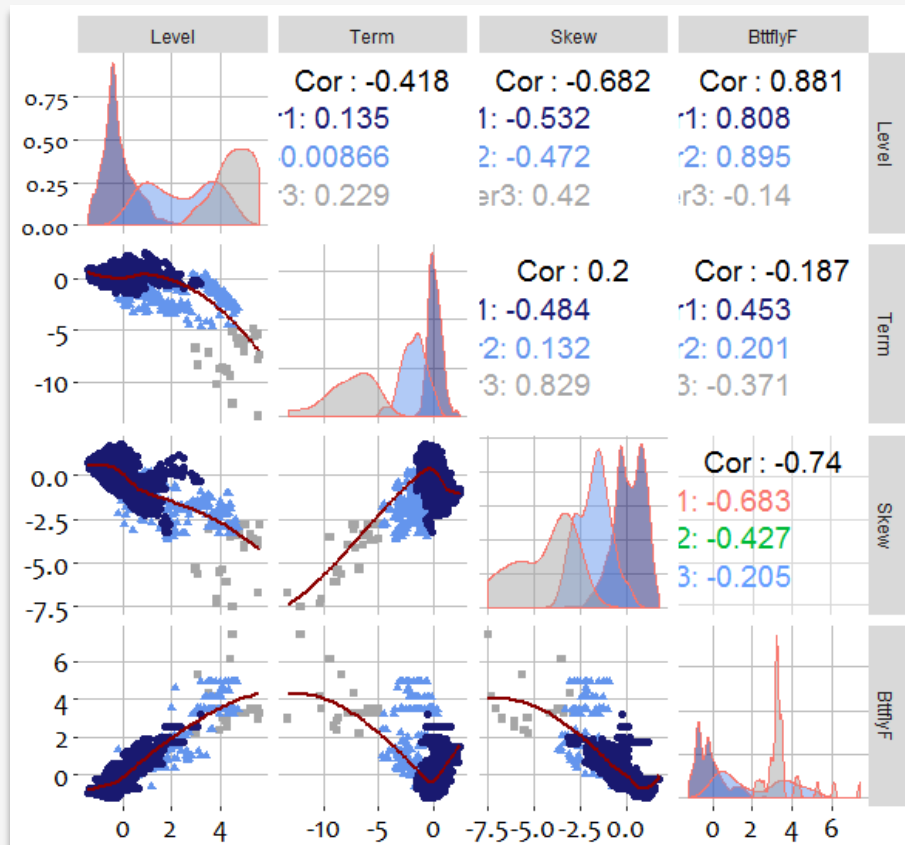


Source: wikipedia.fr

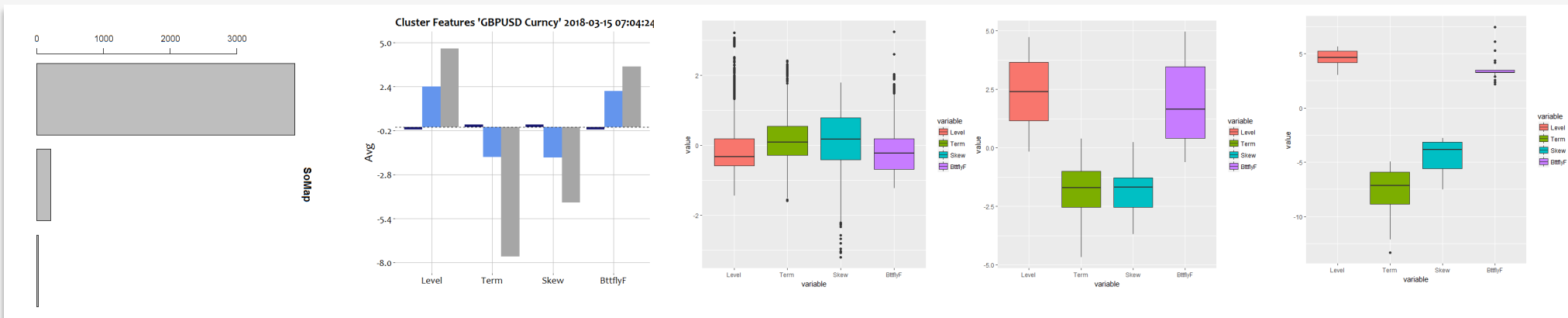
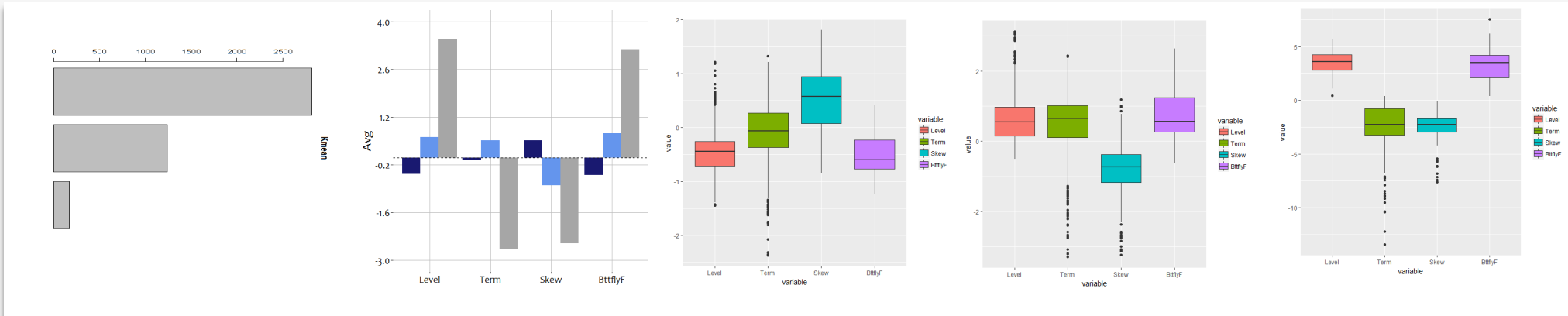
Self Organising Map – Trained Map



Self Organising Map - Results



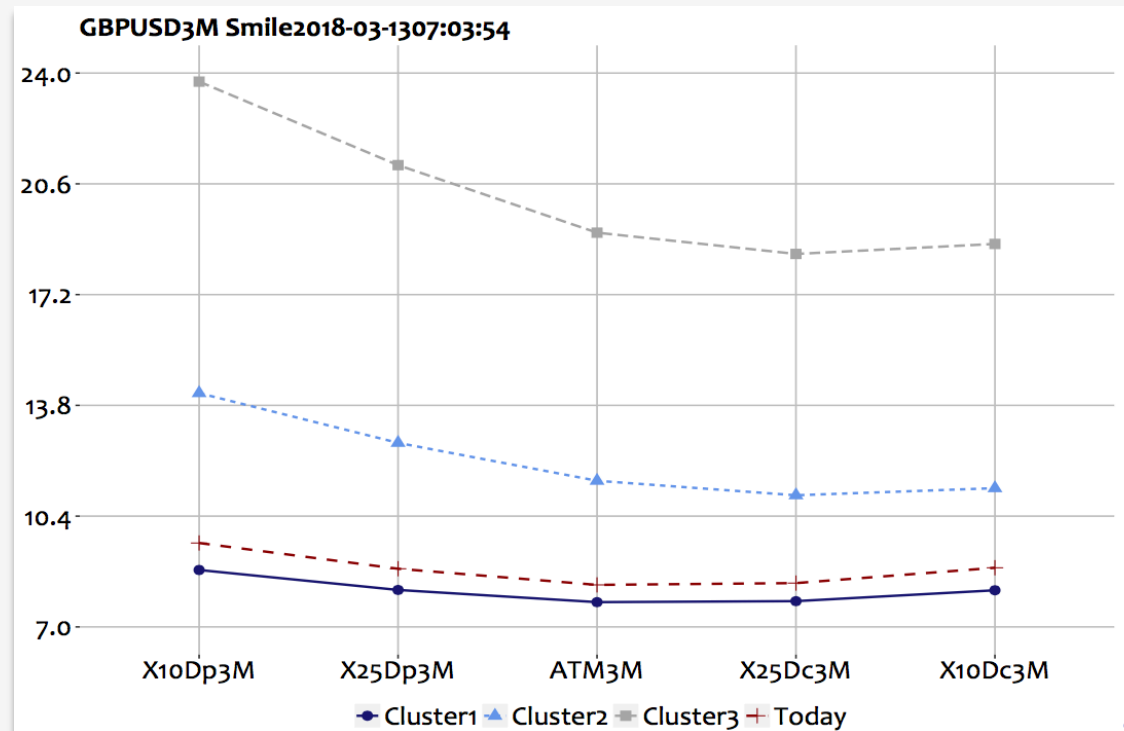
K-Means vs. Self Organising Map



Clustering - Market Regime

We can qualitatively link each cluster with a different market regime:

- Low vol regime, with steep Term structure and flat smile (60% of obs.)
- Mid Vol Regime, with flat Term Structure and convex smile (30 % of obs.)
- Stressed Regime, high vol, inverted term structure and strong skew (10 % of obs.)

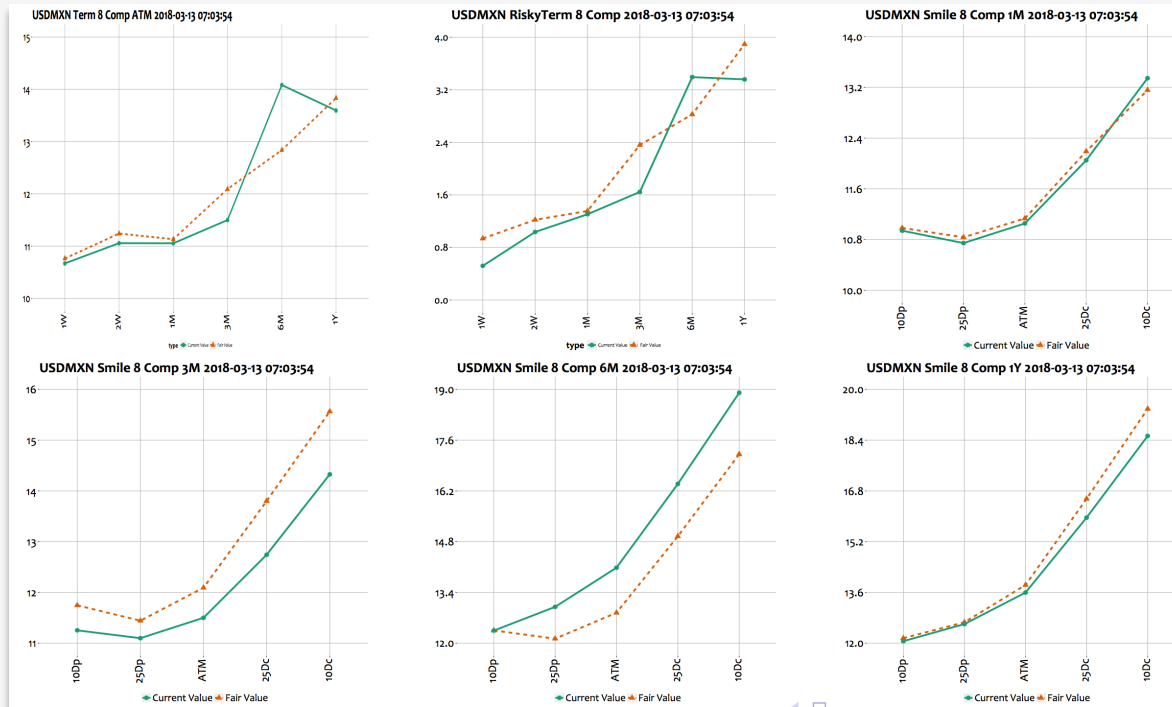


Fair Value Analysis

Identify Current Cluster

Perform PCA within the cluster

Recompute Volatility points based on the first n axis



Daily Market overview



Risk Premium to model (%)

EURUSD	0	-0.16	-0.3	-0.52	-0.38
USDJPY	0.01	0.01	0.09	-0.02	-0.17
GBPUSD	-0.09	-0.12	-0.12	-0.24	-0.2
EURGBP	0.11	0.02	-0.07	-0.03	0.08
USDCAD	0.03	0.18	-0.11	-0.03	0.17
AUDUSD	-0.14	0.22	-0.42	-0.21	0.13
NZDUSD	-0.08	-0.1	0.02	-0.08	0.04
AUDNZD	-0.14	-0.03	0.08	-0.11	0.11
USDTRY	0.13	0.4	-0.26	-0.18	0.44
EURTRY	-0.06	0.11	0.15	-0.15	0.02
USDZAR	-0.54	0.01	-0.25	-0.24	0.29
USDMXN	-0.09	-0.08	-0.59	1.24	-0.24
	1W	1M	3M	6M	1Y

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