

## Quant Products for Equity clients

- ❑ With a team strong of 25 Quants and 15 years of experience, we are at the disposal of our clients to share our expertise,
- ❑ We elaborate research publications and tools for analyzing markets and the economy,
- ❑ We also propose specific solutions and a wide range of tools to reply to questions and problems which faced our clients,
- ❑ A dedicated team of Quants works out studies and adaptations of our models in order to determine the risk of client's portfolios.

	Publication	Working Paper	Short Term	Mid Term	Long Term	Portfolio Analysis
<b>Hidden Markov Model</b>	- Note 2009 - HMM Sectorial Monthly - Specific Studies	✓		✓	✓	- Analysis of a portfolio by volatility regimes - Portfolio Hedging Optimization
<b>Sharpe Select</b>	- Note 2010 - Theoretical Analysis of Long-Short Strategies	✓		✓	✓	- Optimal allocation regarding a regime
<b>Market Predictor</b>	- Note 2010 - Daily Mail - Specific Daily Mail	✓	✓	✓		- Predictability of a portfolio (strategies "alpha booster" tool)
<b>Kaizoji</b>	- Note at the beginning of 2011				✓	- Bubbles Detection => timing to move capital
<b>Dividend Predictor</b>	- Note 2011	✓		✓	✓	- Epsilon Calibration - Strategies on Epsilon
<b>MRV</b>	- Note 2011	✓	✓	✓		- Evaluation of the mean-reversion coefficient (cf. Working Paper)

# Market Regimes Discoverer : Hidden Markov Model

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## Abstract

The term Hidden Markov Model (HMM) is now quite familiar in the speech of signal processing community and more and more accepted for communication systems. It is perhaps a little less daunting, and yet more mysterious than the term partially observed stochastic dynamical system model, which is a translation familiar to people in systems theory.

### Why in finance?

As all financial practitioners know, financial markets go through different regimes. This knowledge is of utmost importance for pricing and hedging purposes. It can also be applied successfully to asset allocation.

The HMM applied to finance and more specifically to the VIX brings valuable information to investors.

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## Keywords:

Hidden Markov Model; EM algorithm; Maximum likelihood; Iterative method; Market Regimes; Prediction volatility characteristics; Diversification; Market timing; Risk perception indicator; Dynamic Asset Allocation; Conditional Back Testing; Proprietary indices; Conditional Bootstrap;

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## References:

- [1] M. Saidane & C. Lavergne "Factor Analysed Hidden Markov Models for Conditionally Heteroscedastic Financial Time Series" Rapport de Recherche INRIA, N° 5862, Grenoble - France 2006.
- [2] R.J. Elliott, L. Aggoun, J.B. Moore, "Hidden Markov Models: Estimation and Control" Springer, New York, 1995.
- [3] Hamilton J. D. "A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle", *Econometrica* 57, pp. 357-384, 1989.
- [4] Hamilton J. D. "Analysis of Time Series Subject to Changes in Regimes", *Journal of Econometrics* 45, pp. 39-70, 1990.
- [5] Hamilton J. D. "Speciation Testing in Markov-Switching Time-Series Models", *Journal of Econometrics* 70, pp. 127-157, 1996.
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- [7] S. Loulidi, A. Reghai, V. Treulet, "How to predict volatility quantitatively" Natixis Securities 2009.
- [8] S. Loulidi, A. Reghai, A. Yedder "Hidden Markov Model", Natixis Road Show HMM présentation 2010.

## Solutions : Products & Services

### *Cash Services*

- **Quant Web Site**  
Access to HMM applied to VIX
- **Recurrent Publications**  
Receive dashboard up to date
- **Cash Strategies**  
Sector Select : allows a dynamic allocation based on mixed recommendations (fundamental and technical)
- **Execution Algorithms**  
Most execution algorithms depend on market ecology. HMM classifies performances based upon volatility regimes

### *Derivatives*

- **Timing Vanilla Derivatives**
- **VIX Futures and Options**
- **Volatility Derivatives**
- **Correlation Products**

### *Asset Allocation*

- **Regime dependent asset allocation**
- **Sector strategy**
- **NXS Sharpe Multi Asset**  
Bloomberg Ticker: NXSHMA
- **NXS Sharpe Euro Equity**  
Bloomberg Ticker: NXSHEE

### *Quant Advisory*

- **Direct Quant Advisory**
- **Specific adaptation to proprietary portfolios**
- **One to One**

# Sharpe Select

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## Abstract

When an investor has a vision of the market, he looks for the best investment regarding the Performance/Risk ratio. Several questions can be asked:

What is the best Product/Strategy which is optimizing the Risk Profile?

What is the best Equity Basket associated to this Product/Strategy?

Regarding the very important number of assets within the market, it's impossible to back-test all the combinations of baskets for a given payoff/strategy. Thus, we have developed an Investment Support Tool which optimizes the basket selection using a full scale approach.

The Fundamental Research, Indicators and Market Statistics, Investor's Experience are a part of the Market Views and Scenarios, and Regimes.

A profitable investment has the highest Sharpe Ratio for an Investor's Market View.

This solution can be described as follows:

- Selection of the Market: geographical areas, sectors, etc... which must appear in the baskets
- Definition of the investor's market view: the investor can have a view for the entire market, for particular geographical areas, sectors, assets...
- Generation of random baskets and a reduction of the complexity
- Evaluation of the Sharpe Ratio in order to rank the baskets regarding their expected performance and risk.

## Keywords:

Risk/Performance Optimization; Lloyds Algorithm; Bootstrap; Investor's Market View; Investment Support Tool; Sharpe Ratio; basket quantization; product evaluation

## References:

[1] A. Reghaï and al "Underlying Selection for Basket Optimisation", Natixis-Equity Derivatives Quantitative Research 2007

[2] R. CHHAIBI, S. MIELNIK, "UN SYSTEME EXPERT DE CLASSIFICATION DE PANIERS D'ACTIFS " Natixis internal paper 2009

[3] N. El Karoui "Couverture des risques dans les marchés financiers"

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## Solutions : Products & Services

### *Cash Services*

- **Recurrent publications**  
Receive dashboard up to date
- **Cash Strategies**
- **Market Behavior Scenario**

### *Derivatives*

- **Basket / Correlation products**
- **Singe-stock products**
- **Structured products**

### *Asset Allocation*

- **"Delta-One" Strategies**  
asset allocation
- **Asset Allocation for structured products**
- **Diversification Opportunities**

### *Quant Advisory*

- **Specific adaptation to proprietary portfolios**
- **One to One**

# Market Predictor

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## Abstract

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In this project we propose an original mathematical model to predict equity market trends.

Market Predictor aims to detect the several market cyclical – psychological effects.

Mathematically, Market Predictor is based on the quantization technique combined with the generation of multidimensional Markov chains.

Learning is done in three steps:

- The mono-dimensional quantization of daily returns,
- The generation of multidimensional patterns,
- And finally the calculation of transition matrices.

Using those transition matrices, future returns can be easily predicted from the class of the current trajectory.

## Keywords:

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Market prediction; Optimization Lloyd algorithm; Product quantization; Genetic algorithm; Statistic; Cyclical market effect; Hedging strategies

## References:

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[1] A. Reghai, A. Ben Haj Yedder, M. Anane, "Market Predictor: Quantitative prediction of market trends" Natixis 2010

[2] S. Corlay, G. Pages "Functional Quantization Based Stratified Sampling Methods", Natixis Equity Derivatives Quantitative Research, LPMA Paris 6, March 2010

[3] D., Dorigo, M. and Glover, F. (eds), "An Introduction to Differential Evolution" in Corne, New Ideas in Optimization, McGraw-Hill, London. Price, K.V. 1999

[4] A. Ben Haj Yedder "Optimisation numérique et Contrôle optimal: Applications en chimie moléculaire" Ecole Nationale des Ponts des Chaussées, December 2002

## Solutions : Products & Services

### *Cash Services*

- **Quant Web Site**
- **Recurrent Publications**  
Receive dashboard up to date
- **Cash Strategies**  
Allows allocation strategies based on market predictions

### *Derivatives*

- **Future**
- **Volatility**
- **Short Maturity Option**

### *Asset Allocation*

- **Hedging Strategies**
- **Long/Short Strategies**

### *Quant Advisory*

- **Daily Adviser**
- **One to One**

### Abstract

We study the features of a statistical tool made for detecting financial bubbles.

Some of the most famous bubbles (Internet 2000, Commodities 2008) are clearly identified.

We also highlight the relationship between this statistical indicator and the variance-covariance matrix of the universe of assets under consideration.

The statistic we use measures dispersion of performances with fixed starting date over a large universe of assets. It shows an explosive behavior when a bubble is building up and a dissipative behavior during market crashes.

### Keywords:

Financial Bubbles; Dispersion; Ensemble Statistics; Bubble Risk; Economic Cycles

### References:

- [1] Kaizoji, T. A precursor of market crashes: Empirical laws of Japan's internet bubble. *The European Physical Journal B* 50, 5 pages, 2006
- [2] F. Abergel & N. Huth "High frequency correlation modelling" *Econophys-Kolkata V conference*, Kolkata March 2010
- [3] Lillo, F. & Mantegna, R.N. Variety and volatility in financial markets. *Physical Review E* 62, 6126, 2000
- [4] Sornette, D. & Johansen, A. Significance of log-periodic precursors to financial crashes. *Quantitative Finance* 1, 452-471, 2001
- [5] Borland, L. Statistical signatures in times of panic: Markets as a self-organizing system. *Arxiv preprint arxiv: 0908.0111*, 2009
- [6] Kaizoji, T. & Kaizoji, M. Power-law of ensemble of stock prices. *Physica A: Statistical Mechanics and its Applications* 344, 240-243, 2004

## Solutions : Products & Services

### *Cash Services*

- **Cash Strategy**  
Sector based long-short strategies

### *Derivatives*

- **Hedging Strategy**  
against massive downward moves

### *Asset Allocation*

- **Timing Portfolio Rebalancing**
- **Sector Selection**

### *Quant Advisory*

- **Specific adaptation to proprietary portfolios**
- **One to One**

## Dividend Predictor

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### Abstract

The popularity of Kalman filter is increasing in financial studies, notably to estimate diffusion processes. In this work, we show how we can use it to forecast the parameters of the mixed dividends model: cash dividends and proportional dividends, using historical data of Eurostoxx and dividend future.

Kalman Filter is an adaptive least square error filter that provides an efficient computational recursive solution for estimating a signal in presence of Gaussian noises. It is an algorithm which makes optimal use of imprecise data on a linear (or nearly linear) system with Gaussian errors to continuously update the best estimate of the system's current state.

The Dividend Predictor applied to the dividend index detects the different regimes for the dividends. Also, it allows the construction of a mean reverting position to take advantage of the dividend investment. We can predict levels but also propose a model for pricing options on dividends that show reasonable values.

### Keywords:

Kalman Filter; Dividend; Dividend Risk Prediction; Recursive Estimator; Epsilon Indicator, dividend Options

### References:

- [1] A. Reghai, M. Abdelhedi, A. Ben Haj Yedder « The dividend index through the Kalman filter » Natixis, Equity Derivatives Quantitative Research, 2009
- [2] R. E. Kalman « A new Approach to Linear Filtering and Prediction Problems » Journal of Basic Engineering pp.35-45, March 1960.
- [3] Harvey, A. C. "Forecasting, structural time series models and the Kalman filter", Cambridge University Press, Cambridge, 1994.

## Solutions : Products & Services

### *Cash Services*

- **Quant web site**

### *Derivatives*

- **Pricing American options**
- **Hedging dividends swap**

### *Asset Allocation*

- **Epsilon Calibration**
- **Build Long-Short**
- **Strategies on Epsilon**

### *Quant Advisory*

- **Specific adaptation to proprietary portfolios**
- **One to One**

## MRV:Multi-Resolution Volatility

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### Abstract

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The market is never as efficient as we describe in classical theories. The non-zero autocorrelation may appear for some stocks returns, even for basket returns. The lead-lag phenomenon exists also for certain assets. We propose a multi-resolution volatility based method for the selection of pair basket in order to benefit from the presence of autocorrelation and inter-stocks lead-lag.

### Keywords:

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Pair trading; portfolio selection; autocorrelation; lead-lag

### References:

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[1] Rama CONT, Empirical properties of asset returns: stylized facts and statistical issues (2001), Quantitative Finance, pages 223-236

[2] Robert F. ENGLE et W.J. GRANGER, Co-intégration and error correction : representation, estimation and testing (1987), Econometrica, Vol.55, NO.2, pages 251-276

[3]Alexandre D'ASPREMOND, Identifying Small Mean Reverting Portfolios (2008), ORFE, Princeton University, <http://www.princeton.edu/~aspremon/MeanRevVec.pdf>

## Solutions : Products & Services

### *Cash Services*

- **Quant web site**

### *Derivatives*

- **Correlation product**
- **Single stock**

### *Asset Allocation*

- **Long-short arbitrage**
- **Mean-reversion portfolio selection**
- **Trend-Following portfolio selection**

### *Quant Advisory*

- **Specific adaptation to proprietary portfolios**
- **One to One**

# Contacts

**Adil REGHAI**  
**Natixis**  
47 Quai d'Austerlitz,  
75013 Paris  
France  
Tel: +33(0)1.58.55.55.12  
adil.reghai@natixis.com

**Sixte DE GASTINES**  
**Natixis**  
47 Quai d'Austerlitz,  
75013 Paris  
France  
Tel: +33(0)1.58.55.06.87  
sixte.degastines@natixis.com

**Didier HIRSCH**  
**Natixis**  
CANNON BRIDGE HOUSE  
25 DOWGATE HILL  
EC4R 2YA LONDON  
ROYAUME-UNI  
Tel:+44(0) 203 216 9201  
didier.hirsch@uk.natixis.com

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NATIXIS Banque de Financement et d'Investissement - 47, quai d'Austerlitz – BP 4 - 75060 Paris  
Cedex 02 [www.natixis.com](http://www.natixis.com)

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