

# **TIMES SERIES**

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## **STOCHASTIC PROCESSES**

- Definition
- Moments
- Stationarity
- Autocorrelation and partial autocorrelation functions
- Estimation of autocorrelation and partial autocorrelation functions

## **ARMA ARIMA, SARIMA MODELS**

- Lag operator
- Autoregressive processes
- Moving average processes
- ARMA processes
- ARIMA processes
- SARIMA processes

## **PREDICTION IN ARIMA MODEL**

- General principles of prediction
- Prediction in ARIMA models
- Prediction function and pivotal values
- Prediction intervals

## **ESTIMATION, TEST, CONFIDENCE REGIONS, VALIDATION, MODEL SELECTION**

- Estimation
- Tests and confidence regions
- Validation
- Model selection

## **EXOGENEITY AND CAUSALITY**

- Definition based on probability distributions
- Other definitions
- Causality measures

## **VAR MODELS**

- Multivariate processes
- Definition of a VAR
- Estimation and tests in a VAR
- Causality
- Shock propagation, impulse response function, variance decomposition
- Scenario response function
- Structural shocks

## **STYLISTED FACTS IN FINANCIAL AND MONETARY TIME SERIES**

- Fat tails
- Volatility clustering
- Asymmetric response the shocks
- Correlation of powers, persistence
- Covolatility

## **UNIVARIATE ARCH-GARCH MODELS**

- Motivations
- Five kinds of white noises
- Definitions of ARCH and GARCH models
- Stationarity
- Coherence with stylized facts

## **GENERALIZATIONS OF UNIVARIATE GARCH MODELS**

- Regression models with GARCH errors
- ARMA-GARCH models
- GARCH-M models
- Asymmetric response models
- Examples

## **INFERENCE IN GARCH TYPE MODELS**

- Inference under conditional normality
- Inference under conditional Student assumption
- Semiparametric approach
- Examples

## **MULTIVARIATE GARCH MODELS**

- An exploding number of parameters
- CCC multivariate GARCH models
- DCC models
- Inference
- Examples
- Asymmetry

## **KALMAN FILTER AND EXTENSIONS**

- Definition of a linear factor model
- Examples
- Kalman filter
- Kalman smoother
- Estimation and tests
- Extended Kalman Filter of order 1
- Extended Kalman Filter of order 2
- Quadratic Kalman Filter
- Unscented Kalman Filter

## **APPLICATIONS OF THE KALMAN FILTER**

- Macroeconomic applications : stochastic linear models, structural models, unobserved components ARMA models, stochastic trend models, coincident index models
- Financial applications : VaR modeling, factor multivariate GARCH models, stochastic volatility models.

## **HIDDEN MARKOV CHAINS**

- Markov chains
- Switching regime models
- Kitagawa-Hamilton algorithm
- EM algorithm
- Prediction
- Applications
- Coding the variables
- Parameterisation of the transition matrix

## **References**

- C. Gouriéroux and A. Monfort : "Time Series and Dynamic Models" Cambridge University Press (1996).
- J. Hamilton : "Time Series Analysis", Princeton University Press (1994).
- C. Gouriéroux : "ARCH Models and Financial Applications", Springer-Verlag (1997).
- C. Francq and J.M. Zakoian : "Garch Models", Wiley (2010)