

# **Empirical Methods for Business Cycle Research**

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The course provides the students with a set of tools to analyze different set of applied macroeconomic problems that they could need to solve in their own research or in their current day-to-day analysis. The orientation of the course is mainly applied. We will cover theoretical econometric issues but only with the intention of providing the necessary background to confront the data. The course, including the programming part in GAUSS (interested students can translate during the course into MATLAB) is designed to be self-contained requiring just a minimum knowledge of statistics and econometrics.

We will provide the students with a CD with all the Gauss codes taught during the course and most of the codes to replicate the results of the papers seen in class.

## **Syllabus**

### **Session 1: Linear filters for unobserved components.**

#### **Theory:**

General introduction to unobserved components models. Kalman filter as a linear filter to capture unobserved components. Derivation of the Kalman filter. Estimation of the parameters. Smoothing. Kalman filter with time varying parameters. Filters not based on models, HP filter, Band Pass filters.

#### **Economic applications:**

Permanent and transitory components of economic time series. Coincident indicators. Output gap. NAIRU estimation

### **Session 2: Non linear filters. Markov switching models.**

#### **Theory:**

Limitations of linear filters. Markov chains. Estimation of the parameters. Smoothing. Extensions. Linearity tests.

#### **Economic applications:**

Statistical definitions of economic recessions. Predictability of recessions. Financial effects of macroeconomic variables. The great moderation. Third-phase in US GDP cycle. Friedman's plucking model.

### **Session 3: Non linear filters. Threshold and Smooth Threshold models**

#### **Theory:**

Intuition and motivation. TAR and STAR models. OLS and Maximum likelihood estimations. Linearity tests.

**Economic applications:**

Unemployment in the US. STAR models for the US GDP. STAR models in finance.

**Session 4: Nowcasting and real time forecasting**

**Theory:**

Linear and non linear models. Principal components. Dynamic factor models. Forecast evaluation. Prediction of turning points. Leading indicators.

**Economic applications:**

Forecasting Euro-area GDP in real time.

**Session 5: New techniques for the measurement of business cycle features**

**Theory:**

Comovements in linear and non-linear frameworks. Markov switching and Kalman filter techniques. Bootstrapping and Monte- Carlo analysis.

**Economic applications:**

European and World Business cycles. Measuring business cycle features and synchronization.