

Dynamic factor models

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Course description: A gentle introduction to State Space models and Kalman Filter. Dynamic factor model in state-space form, its' specifications and estimation techniques.

Requirements: Python, R

Curriculum:

PCA: 21/12/2023, 19:30

- Introduction to High-Dimensional Data. Challenges in handling High-Dimensional Data.
- Understanding PCA. Definition and fundamentals of PCA. Mathematical foundation: Eigenvalues and eigenvectors. Step-by-step computational procedure. The vitality of standardization of data before PCA.
- Interpreting PCA Results. Analyzing the variance explained by principal components. Importance of selecting the number of components.
- Applications of PCA. Data visualization in lower dimensions. Feature extraction and data compression.
- PCA in Forecasting Models. Integration of PCA in forecasting models. PCA and DFM.
- Empirical Performance and applications. Summary of PCA benefits and limitations.
- EM algorithm. Overview of applications. Iterative approaches in the presence of incomplete data. The two main steps: Expectation (E-step) and Maximization (M-step). Applications and Examples.

Kalman Filter: 22/12/2023, 19:30

- Introduction to the Kalman Filter. Overview and historical context of the Kalman Filter. Basic concepts and intuition behind the filtering process.
- Mathematical Foundations of the Kalman Filter. Linear algebra and probability theory prerequisites. State-space representation of dynamic systems.
- The Kalman Filter Equations. Derivation of the Kalman Filter equations. Understanding the prediction and update steps.
- Implementation of the Kalman Filter. Kalman Filter in One Dimension. Multivariate Kalman Filter.

Dynamic Factor Models: 27/12/2023, 19:30

- Theoretical Background of Dynamic Factor Models (DFM). Specification and estimation of DFMs. The curse of dimensionality and how DFMs provide a solution (PCA).
- Implementation of DFMs. Steps involved in specifying and estimating DFMs. Practical considerations and common pitfalls.
- Application of DFMs.