

Financial Econometrics

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In this lecture, we propose first to study two selected pillars of financial econometrics: the Generalized Method of Moments and the Kalman Filter with financial applications. The main textbook for this lecture is DAVIDSON and MACKINNON (2003). A companion document for this lecture is *Lecture Notes on Kalman Filtering*.

Then, four projects will be studied (one for each group) and numerically implemented using GAUSS. Then, students will have to present their findings to others during seminar sessions.

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1 Generalized Method of Moments

1.1 Theory

1.2 Some applications GMM

1.2.1 ARCH models

1.2.2 Continuous time models

1.3 Simulated Moments and GMM

2 Kalman Filter in Finance: some applications

2.1 State-space models

2.2 Case 1: Term structure of interest rates

2.2.1 The Babbs-Ben Nowman model

2.2.2 Empirical application

2.3 Case 2: Investment Strategies Tracking problems

2.3.1 Innovation representation

2.3.2 Empirical application

References

- [1] BABBS Simon H. and K. BEN NOWMAN (1999), Kalman Filtering of Generalized Vasicek Term Structure Models, *Journal of Financial and Quantitative Analysis*, **34**, No. 1, March.
- [2] BOUYÉ Eric (2009), *Lecture Notes on Kalman Filtering*.
- [3] DAVIDSON Russell and James G. MACKINNON (1993), *Estimation and Inference in Econometrics*, Oxford University Press (New York).
- [4] DAVIDSON Russell and James G. MACKINNON (2003), *Econometric Theory and Methods*, Oxford University Press (New York).
- [5] HARVEY A. C. (1991), *Forecasting, Structural Time Series and the Kalman Filter*, Cambridge: Cambridge University.
- [6] KALMAN R.E. (1960), A new approach to linear filtering and prediction problems, *J. Basic Eng.*, **82**, 35-45, March.
- [7] RONCALLI Thierry and Guillaume WEISANG (2008), Tracking Problems, Hedge Fund Replication and Alternative Beta, *Working Paper*.

3 Projects

3.1 Style regression and constrained OLS

SHARPE William (1992), Asset Allocation: Management Style and Performance Measurement, *Journal of Portfolio Management*.

1. Summarize the analysis proposed by Sharpe to study the performance of a fund (5 pages) and provide (2 pages) *the modus operandi* for an OLS estimation under inequality constraints - for example weights between 0 and 1.
2. Apply the methodology to estimate the sensitivity of the Franklin US Opportunities Fund (former Templeton Aggressive Growth Fund) to different factors: large/small/mid cap, growth/value, geographic and sectors.
3. Please provide an analysis that studies the change through time of the allocation

3.2 Replicating the CSFB Tremont with the Kalman Filter

RONCALLI Thierry and Jérôme TEILETCHE (2008), An Alternative Approach to Alternative Beta, *Journal of Financial Transformation*.

1. Summarize the methodology proposed by Roncalli and Teiletche (5 pages),
2. In order to study the sensitivities of the CSFB Tremont index, estimate the 24 months rolling betas for the 6 factors described in the paper above. Please comment your results.
3. Using the TSM GAUSS library, implement a tracking method based on the Kalman Filter and compare with your previous results. Comment.

3.3 Application of copulas to risk management

BOUYE E., V. DURRLEMAN, A. NIKEGHBALI G. RIBOULET and T. RONCALLI (2001), Copulas: an open field for risk management, March.

1. Estimate the univariate distribution for SP500, CITIGROUP WGBI and a Commodities Index (CRB index for example) using a fat tailed distribution, e.g. the NIG (Normal Inverse Gaussian), for the period starting in 1995. Then estimate - non-parametric estimation - the correlation assuming a gaussian Copula using the Inference for Margins (IFM) method.
2. Compute the empirical VaR and the semi-parametric VaR at 0.01%,1%, 5% for the equally weighted portfolio in the three assets. Please comment.

You will first provide a 5 pages summary about the data used, the model and methodology you will apply.

3.4 Term Structure Estimation using Kalman Filter

BABBS Simon H. and K. BEN NOWMAN (1999), Kalman Filtering of Generalized Vasicek Term Structure Models, *Journal of Financial and Quantitative Analysis*, **34**, No. 1, March.

1. Summarize the estimation methodology proposed by Babbs and Ben Nowman in the case of 1 factor and 1 source of risk (5 pages). You will especially provide the equations (14) and (15) for this simplified case.
2. By using weekly historical data for zero-coupon interest rates (minimum 10 years), estimate the 1 factor model using GAUSS TSM and OPTMUM libraries.

NB: the parameters to be estimated will have to be properly constrained