

Forecast Evaluation and Model Selection

Description : The course (18 hours) is designed to acquire tools and techniques to evaluate the accuracy model based forecasts and operate model selection in a variety of settings. The tools and techniques can be applied to a variety of settings ranging from macroeconomic forecast evaluation to finance, although a specific focus is devoted to financial applications. The course has several specific objectives :

- 1- Discuss mathematical/statistical tools for forecast evaluation and model selection for scalar, vector and matrix valued outcomes and lay their theoretical foundation
- 2- Provide clear definition and interpretation of the metrics used to assess forecast accuracy
- 3- Focus on problems arising in forecast evaluation of latent target variables with emphasis on the case of volatility forecasts evaluation
- 4- Analyze recent work in forecast evaluation and model selection based on forecast accuracy and discuss their empirical implementation

Exam : written, 2 hours, closed book.

Material : Slides, notes, references

Content :

1) Measures of forecast accuracy : Notion of empirical ranking. Definition of statistical loss functions (in scalar/vector/matrix spaces), construction and interpretation. Definition of economic loss functions (Minimum variance portfolio, Option pricing accuracy). Regression-based evaluation of predictive accuracy. Observable vs. Latent target variables. (3h)

2) Special issues 1 : Evaluation of nested models. Estimation sampling schemes (Expanding vs. rolling window). Structural breaks/time varying parameters. Absolute vs. conditional forecasting performance (1.5h)

3) Tests of Forecast Comparison – Theory and Hypotheses : Single hypothesis (Diebold-Mariano, West, Clark-McCracken, Giacomini-White, Mincer-Zarnowitz), Multiple hypotheses (Superior Predictive Ability, Model Confidence Set). Simple vs. Composite hypotheses (testing equalities vs. weak inequalities) (5h)

4) Special issues 2 : Evaluation latent target variables forecasts (Volatility forecast evaluation) :

- a) Introduction to ex-post measures of volatility (semi and non-parametric univariate and multivariate) (realized variance, multi-power variations, realized kernels), related issues : microstructure noise, observation frequency, sampling schemes and prefiltering, seasonality, robustification, jump detection and synchronicity (3h)
- b) Consistency of forecasts ranking under statistical and economic loss functions. Sufficient and necessary conditions for ranking consistency (4.5h)

Additional topic (depending on time)

5) Predictive density evaluation (Diebold-Gunther-Tay, Corradi-Swanson, Amisano-Giacomini) (1h)

References :

Measures of forecast accuracy and consistency of the ranking with latent target:

- Bregman, L., (1967). *The relaxation method of finding the common point of convex sets and its application to the solution of problems in convex programming*. URSS Computational Mathematics and Physics 7, 200–217
- Gouriéroux, C., Monfort, A., (1995). *Statistics and Econometric Models*. Cambridge University Press
- Hansen P, Lunde A. (2006), *Consistent ranking of volatility models*. *J. of Econometrics*, 131:97–121
- Laurent S, Rombouts JVK, Violante F. (2013), *On loss functions and ranking forecasting performances of multivariate volatility models*, *J. of Econometrics* 173 1–10
- Patton A. (2011), *Volatility forecast comparison using imperfect volatility proxies*. *J. of Econometrics*, 160
- Patton A, Sheppard K. (2009), *Evaluating volatility and correlation forecasts*. In: Andersen T, Davis R, Kreiss J, Mikosch T, eds. *Handbook of Financial Time Series*

Tests of Forecast Comparison (absolute and conditional predictive accuracy)

- Clark, T. and M. McCracken (2011), *Advances in Forecast Evaluation*, in: G. Elliott and A. Timmermann (eds.), *Handbook of Economic Forecasting Vol. 2*

- Diebold, F. and R. Mariano (1995), *Comparing Predictive Accuracy*, *J. of Business and Economic Statistics* 13
- Giacomini, R. and H. White (2006), *Tests of Conditional Predictive Ability*, *Econometrica* 74(6).
- Hansen P. (2006) *A test for superior predictive ability*, *J. Business and Economic Statistics*, 23:365–380.
- Hansen P, Lunde A, Nason J. (2011) *The model confidence set*, *Econometrica*, 79:453–497.
- Mincer, J. and V. Zarnowitz (1969), *The Evaluation of Economic Forecasts*, in J. Mincer, ed., *Economic Forecasts and Expectations*, 3-46
- West, K. (1996), *Asymptotic Inference about Predictive Ability*, *Econometrica* 64, 1067-1084.
- West, K. (2006), *Forecast Evaluation*, in: Granger, C., G. Elliott and A. Timmermann (eds.), *Handbook of Economic Forecasting Vol. 1*
- West K, McCracken M. (1998), *Regression-Based Tests of Predictive Ability*, *Int. Economic Review* 39, 817-40
- White H. (2000) *Reality check for data snooping*. *Econometrica*, 68:1097–1126

Nested models and Parameter instabilities

- Clark, T. and M. McCracken (2015), *Nested Forecast Model Comparisons: A New Approach to Testing Equal Accuracy*, *J. of Econometrics*, Vol. 186, 160-177
- Clark, T. and M. McCracken (2005), *The Power of Tests of Predictive Ability in the Presence of Structural Breaks*, *J. of Econometrics* 124(1), 1-31
- Clark T, McCracken M. (2001) *Tests of equal forecast accuracy and encompassing for nested models*. *J. of Econometrics*, 105:85–110
- Clark T, West K. (2007) *Approximately normal tests for equal predictive accuracy in nested models*. *J. of Econometrics* 138:291–311
- Elliott G., Timmermann A, (2008). *Economic forecasting*. *J. of Economic Literature* 46, 3–56.
- Giacomini, R. and B. Rossi (2010), *Forecast Comparisons in Unstable Environments*, *J. of Applied Econometrics* 25(4) 595-620
- McCracken M. (2000) *Robust out-of-sample inference*. *J. of Econometrics*, 99:195–223
- Rossi B. (2011) *Advances in Forecasting under Model Instabilities*, in: G. Elliott and A. Timmermann (eds.), *Handbook of Economic Forecasting Vol. 2*

Non-parametric variance estimators

- Andersen T, Bollerslev T, Diebold F, Labys P. (2003) *Modeling and forecasting realized volatility*. *Econometrica* 71, 579–625
- Barndorff-Nielsen O, Hansen P, Lunde A, Shephard N. (2008) *Designing realized kernels to measure the ex post variation of equity prices in the presence of noise*. *Econometrica*, 76:1481–1536
- Barndorff-Nielsen O, Shephard N. (2002) *Estimating quadratic variation using realized volatility*. *J. of Applied Econometrics*, 17:457–477
- Barndorff-Nielsen O, Shephard N, Winkel M. (2006) *Limit theorems for multipower variation in the presence of jumps*, *Stochastic Processes and their Applications*, Vol. 116(5) 796-806
- Hansen P, Lunde A. (April 2006) *Realized variance and market microstructure noise*. *J. of Business and Economic Statistics*. 24: 127–218
- Mancini C. (2009). *Non-parametric Threshold estimation for models with stochastic diffusion coefficient and jumps*. *Scandinavian Journal of Statistics*, vol. 36, pp. 270-296
- Zhang L, Mykland P, Ait-Sahalia Y. (2004) *A tale of two time scales: determining integrated volatility with noisy high frequency data*. *J. of the American Statistical Association*, 100:1394–1411

Predictive Densities

- Diebold, F., Gunther and Tay (1998) *Evaluating Density Forecasts with Applications to Financial Risk*. *International Economic Review* 39(4)
- Corradi, V. and N. Swanson (2001) *Predictive Density Evaluation*, in: Granger, C., G. Elliott and A. Timmermann (eds.), *Handbook of Economic Forecasting Vol. 1*
- Amisano, G. and R. Giacomini (2007), *Comparing Density Forecasts via Weighted Likelihood Ratio Tests*, *J. of Business and Economic Statistics* 25, 177-190