An Introduction to the PRObability FORecasting (PROFOR) Toolbox for MATLAB

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What is PROFOR?

- PROFOR provides macro models, estimation algorithms, techniques for forecast combination, forecast evaluation tools and real-time data suitable for short-term quarterly (or monthly) predictions.

- Trial version (TBR via WBS website, Dec 2014) packages together many best practice forecasting methods.

- A network of practitioners and academics supports project and trial version of PROFOR.
Summary of application

- UK macroeconomic forecasting application based on the (potentially) asymmetric predictive densities published by the Bank of England for inflation

- Forecast evaluation methods include examining calibration, predictive scores, and decision-theoretic forecast evaluation

- How much better is the BOE approach (one step ahead) than, say, an AR(1) benchmark?

- Tomorrow’s session replicates analysis in live PROFOR session and provides further examples (models estimated, forecasts combined, then evaluated)
What does PROFOR aim to do?

- Platform to produce real-time macro density forecasts
- Easy to modify/scalable, object oriented, well documented, examples, manual etc.
- No commercial value, released as freeware via WBS website; released under the GNU v 3 license
What’s in PROFOR?

▶ Models: ARs, VARs, IMA, TVP and regime switching VARs (plus stochastic volatility variants, Bayesian simulation options)

▶ Forecasts: iterative, quarterly and monthly

▶ Combinations: equal, log score, and CRPS weights for Linear Opinion Pools

▶ Evaluations: log scores, Brier scores and decomposition, CRPS, PITS (with one-shot tests), simple loss functions

▶ Data: real-time data (from FRED and/or xls), BOE and NB forecast data, external (e.g. user’s) forecast densities
Who’s in the PROFOR team?

- Researchers: Craig and Leif Anders; Shaun Vahey, Liz Wakerly and Anthony Garratt

- Partner investigators: Michael Smith (Melbourne), Simon van Norden (HEC Montreal and CIRANO), Rodney Strachan (Queensland), Domenico Giannone (ULB)

- Advisory board: Francesco Ravazzolo (NB) and Simon Price (BOE)

- Partner research centres: CAMP, KOF, CIRANO, CAMA, Veissmann Research Centre, RPF at GWU

- Partner orgs: BOE, NB and WBS
PROFOR timeline

- Sep-Nov 2014 trial version of toolbox preview to NB and BOE (feedback’d help!)
- Dec 2014 trial toolbox release on WBS website
- Mar 2015 Documentation for trial version complete (2 papers, plus user manual)
- Apr 2015 Next phase begins (non-Gaussian modelling, non-linear methods, mixed frequency)
An Example: BOE fan charts

- Two “experts”, BOE and AR(1); see Gneiting and Ranjan (2011, JBES)

- Look at a bake-off between the two experts 2004Q1 through 2013Q4 consider calibration (via PITS), log scores and cost-loss ratio

- In this example, the policymaker would prefer BOE fan charts to call inflation events one step ahead? How much better is it though?
“Given ... (the) asymmetric costs or benefits of particular outcomes, a central bank needs to consider not only the most likely future path for the economy, but also the distribution of possible outcomes about that path. The decision-makers then need to reach a judgment about the probabilities, costs, and benefits of the various possible outcomes ...”

To the Governor, exceeding the inflation target (even in the short term) results in a substantial economic cost.

If inflation deviates from central target (2 percent) by more than 1 percentage point, the Governor must send an open letter to the Chancellor.

The Governor sent letters to Chancellor between April 2007 and February 2012, all gave reasons for high inflation in short term; preceding Inflation Report forewarned of the target breach in each case.
For example, the Governor’s “Opening Remarks” to the Bank of England’s *Inflation Report* Press Conference in February 2010 stressed

“The January figure for CPI inflation is likely to have exceeded 3% . . . This would be the third episode when inflation has temporarily moved above the target . . . requiring me to write an open letter to the Chancellor.”
Cost-loss approach with high inflation events, $\pi_t > \bar{\pi}$

- Following eg Granger and Pesaran (2000), Berrocal et al (2010), relative cost of unanticipated inflation $R = C/L$, $0 < R < 1$, unknown

- Issue (1-step ahead) inflation event warning iff $Pr(\pi_t > \bar{\pi}) > R$

- Define $TEL = n_{10}L + (n_{01} + n_{00})C$

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<th>Event Observed</th>
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Some questions of interest

► Can log score based evaluations of forecast densities mask predictive content? Yep: log score differentials aren’t sufficient to indicate that policymaker can use expert in real time to give an early warning indicator

► What additional steps—beyond log scores—might be useful to analyse forecast performance? Some tricks from PROFOR toolbox (spvahey@gmail.com)
Toolbox tricks


- Utilise loss function (if you know it!) Granger-Pesaran (2000a, 2000b)
In summary

- Example shows that in terms of one step ahead forecasts, the Bank’s forecasts are substantially better for early warning signals of inflationary pressures. We can quantify the magnitude using a loss function.

- But, there are issues. PITS reveal forecast densities are too diffuse.

- AR(1) benchmark too narrow (usually, and lagging), implying gains from combination
Figure 5: Forecast densities of inflation from using vintage 2009:Q2 data with forecast origin 2009:Q1. Panel (a) is for $h = 1$ quarter ahead (i.e., the nowcast), panel (b) for $h = 2$ quarters ahead (2009:Q3), panel (c) if for $h = 4$ quarters ahead (2010:Q1), and panel (d) is for $h = 8$ quarters ahead (2011:Q1). Forecast densities are from the BVAR (blue line), BVAR-SV (black dashed line), Coupla & EDF margins (blue dashed line) and Copula & Skew t margins (black line). The outturn values for each quarter are also reported.
John Kay (FT, September 21 2010):

“There will always be a demand for forecasts, so there will always be a supply. But the reputation of economic forecasters, like other quacks and charlatans, depends more on the slickness of their presentations than the value of their work”