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OxMetrics news

SEPTEMBER 2008 ISSUE 8

New Release: OxMetrics™5.1

1. Introduction to main improvements - OxMetrics™5.1

by Jurgen A. Doornik

There are two aspects to the release of OxMetrics 5.1. For existing users of OxMetrics 5.0, it is mainly a bug-fix upgrade. On the other hand, there is a range of new platforms that is now supported, which may be of interest to current as well as new users.

1.1 Upgrade

Each program in the OxMetrics family, the OxMetrics front-end, Ox, G@RCH, PcGive and STAMP has a few bugs fixed, and some minor improvements.

The main fix in the OxMetrics front-end is that .emf files for graphics work again. A welcome improvement is that we found a way around the annoying ActiveX warning that Internet Explorer gave when opening the help system. One further change that is immediately visible is that Ox files are now loaded with line numbers shown by default (this is an extension to both OxMetrics and OxEdit).

In addition to a couple of bug-fixes in G@RCH, there is now support for the DECO (Dynamic EquiCOrrelation) model (but not yet documented) and several new tests have been added to the descriptive statistics.

The fixes in STAMP are mainly related to Batch use and models with time-varying coefficients.

The fixes in PcGive relate to giving misleading names to combined dummies generated by Autometrics, and generated Ox code: the GARCH code would not run and observations withheld for forecasting were not allowed for. PcNaive can now use the PcGive-based code (instead of the PcFiml class), and has some limited possibility to run Autometrics based model selection experiments.

More detailed information on the changes can be found in the help systems of the programs.

1.2 New Platforms

Whereas OxMetrics 5.0 was only available on one platform, the new version is available for no less than 5 different platforms:

- **Windows Vista, Windows XP, Windows 2000**
  The 32-bit platforms that were already supported by OxMetrics 5.0 and earlier.
- **Windows Vista 64-bit, Windows XP x64**
  All executables in this version are 64-bit, allowing for larger memory use. The 32-bit version can also be used here, but would not allow for full use of available memory - Help/About OxMetrics will show '64-bit edition' when running the 64-bit version.
- **OS X**
  Development has focussed on OS X Leopard (the current version 10.5) on Intel-based computers, but Tiger (OS X version 10.4) is also supported on Intel Macs. (The programs should also run on older Power PC Macs running 10.4 or 10.5, but we have not yet been able to test this.) OxMetrics for the Mac has the OS X look-and-feel, while maintaining all the functionality of the Windows version.
- **Linux 32-bit**
  On Intel and AMD (i386, i686) processors.
- **Linux 64-bit**
  On Intel and AMD (x86_64) 64-bit processors.

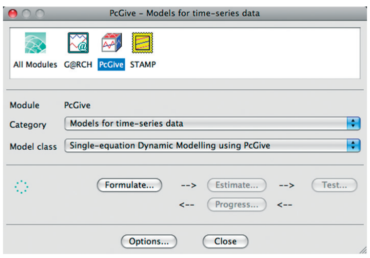
The exception is X12ARIMA, which is currently only supported on Windows.

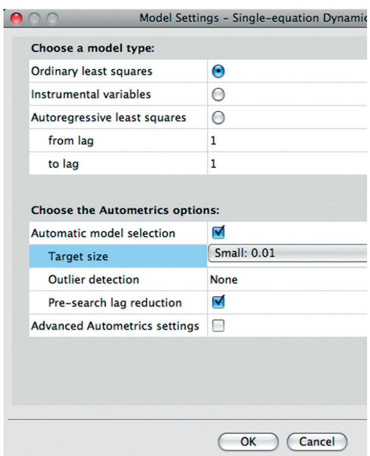
1.3 Ox Console 5.1

Ox Console 5.1 is now available for OS X and Linux. These installations include OxEdit, bringing it in line with the Windows version. There is no 64-bit Windows version of Ox Console.

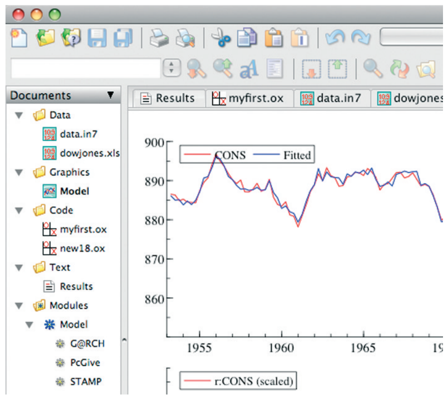
1.4 OS X examples

The following screen captures show econometric modelling using PcGive on OS X 10.5:



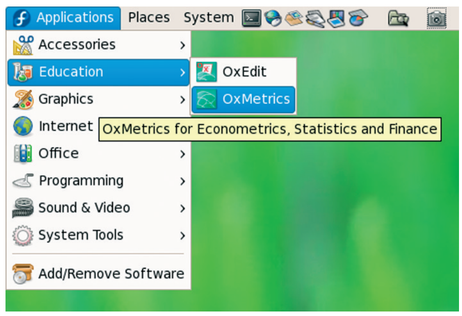


Part of the graphical output is shown in the following section of the OxMetrics front-end (as in all OS X applications, the menu bar is at the top of the screen and not shown here):

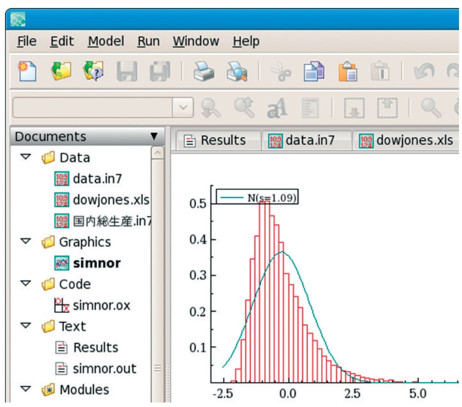


1.5 Linux examples

Shortcuts to OxMetrics and OxEdit are added under Education as well as Programming, as shown here under GNOME (on 64-bit Fedora):



This is what (a part of) OxMetrics looks like:



Fitting the term-structure in STAMP 8.10

by Siem Jan Koopman

1 Introducting STAMP 8.10

In the Summer of 2008 we have upgraded STAMP to version 8.10 which is the current release version. The new items in version 8.10 are relatively small. For example, the forecasting dialog allows the forecasting of the unobserved components as well as the future observations. Furthermore, various errors have been removed from the program and some improvements have been introduced. Most notably, the batch facilities have improved and some bugs in the routines for models with explanatory variables and intervention variables have been solved. Finally, the automatic outlier and break detection procedure has been optimized further.

Below we present an econometric analysis of the interest rate term structure or yield curve. This topic has generated much interest over the years. To emphasize the powerful options available in STAMP 8.10, we will present a multivariate analysis of the interest rate term structure in this OxMetrics Newsletter.

2 Fitting the term-structure in STAMP 8.10

Fitting and predicting time series of a cross-section of yields has proven to be a challenging task. For many decades work on the term structure of interest rates has mainly been theoretical in nature. In the early years work focused on the class of affine term structure models, see Vasicek (1977) and Cox et al. (1985). It has been shown that the forecasts obtained from this class of models do not outperform the basic random walk forecasts, see for example Duffee (2002). These findings may not be very surprising given their focus on the cross-section dimension of yields without a reference to the time series dimension. Time series models aim to describe the dynamical properties and are therefore more suited for forecasting.

The papers of Diebold and Li (2006), DL, and Diebold et al. (2006), DRA, have recently shifted attention to the time series dimension by generalizing the Nelson and Siegel (1987) model. DL and DRA introduce the dynamic Nelson-Siegel model as a statistical three factor model to describe the yield curve over time. The three factors represent level, slope and curvature of the yield curve and thus carry some level of economical interpretation. More importantly, DL and DRA show that the model-based forecasts outperform many other models including standard time series models such as vector autoregressive models and dynamic error-correction models. In DRA, the Nelson-Siegel framework is extended to include non-latent factors such as inflation. Further they frame the Nelson-Siegel model as a multivariate unobserved components time series model with three common factors which are modeled by vector autoregressive processes. A wide range of statistical methods associated with the state space model can be exploited for maximum likelihood estimation and signal extraction, see Durbin and Koopman (2001). We will follow their approach to some extent and show that STAMP 8.10 can be used for a yield-curve analysis of different interest rates associated with different maturities.

3 The STAMP model for the yield curve

Interest rates are denoted by $y_t(\tau)$ at time t and maturity τ. For a given time t, the yield curve $\theta_t(\tau)$ is some smooth function representing the interest rates (yields) as a function of maturity τ. A parsimonious functional description of the yield curve is proposed by Nelson and Siegel (1987) and is based on three common factors with pre-set weights for each maturity such that the factors can be interpreted as the level, slope and curvature of the yield curve. In our STAMP analysis, we also adopt three unobserved common levels (factors).

In case we observe a series of interest rates $y_t(\tau_i)$ for a set of N different maturities $\tau_1 < \ldots < \tau_N$ available at a given time t, STAMP can estimate the yield curve for the multivariate model

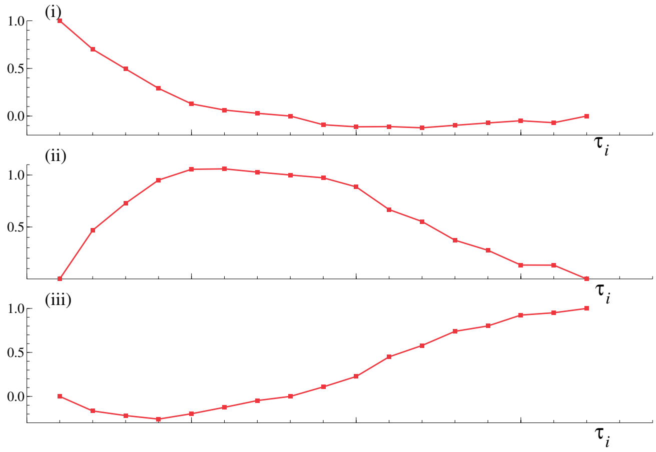
$$y_t(\tau_i) = \mu_i + \lambda_{1i}\beta_{1t} + \lambda_{2i}\beta_{2t} + \lambda_{3i}\beta_{3t} + \varepsilon_{it}, \qquad (1)$$

for $i = 1, \ldots, N$, where μ_i is a constant, β_{jt} is the jth factor (at time t) and λ_{ji} is the weight for the jth factor associated with the ith maturity. The disturbances $\varepsilon_{1t}, \ldots, \varepsilon_{Nt}$ are assumed to be independently distributed with mean zero and constant variance σ_i^2. In the Nelson-Siegel framework, the weights are restricted. In STAMP we estimate the weights λ_{ji} by maximum likelihood.

The three factors in the vector $\beta_t = (\beta_{1t}, \beta_{2t}, \beta_{3t})'$ can be modeled by the vector autoregressive (VAR) process as in DL and DRA. In empirical work on the yield curve, the factors of the term structure are often found to be very persistent. Therefore, we consider a random walk process for β_t as given by

$$\beta_{t+1} = \beta_t + \eta_t, \qquad \eta_t \sim NID(0, \Sigma_\eta), \qquad (2)$$

for $t = 1, \ldots, n$, with variance matrix Σ_η and initial condition $\beta_1 \sim N(0, \kappa I)$ where $\kappa \to \infty$. Further details of the model are discussed in the STAMP manual.



4 Data

For our STAMP analysis of yield curves, we consider the unsmoothed Fama-Bliss zero-coupon yields dataset, obtained from the CRSP unsmoothed Fama and Bliss (1987) forward rates. We analyze monthly U.S. Treasury yields with maturities of 3m, 6m, 9m, 12m, 15m, 18m, 21m, 24m, 30m, 3y, 4y, 5y, 6y, 7y, 8y, 9y and 10y (m=months, y=years) over the period from January 1972 to December 2000. This dataset is the same as the one analyzed by DL and DRA. We notice that for our dataset, we require model (1) and (2) with $n = 348$ and $N = 17$. This illustration shows that STAMP can handle such a high-dimensional model and is able to estimate the parameters by maximum likelihood.

5 Results from STAMP

We follow section 6.4 of the STAMP manual since our yield curve model (1) and (2) is similar to the model in equation (6.3) of the manual. STAMP is used first to estimate the coefficients λ_{ji} for $j = 1, 2, 3$ and $i = 1, \ldots, N$ (51 parameters), the variances σ_i^2 (17 parameters) and variance matrix Σ_η (6 parameters). For identification purposes, the weights are restricted as implied by equation (6.4) in the manual. In our case, the weights of the three factors and for the maturities 3m, 24m and 10y are restricted to be $1, 0, 0$ and $0, 1, 0$ and $0, 0, 1$, respectively. The 3m yield is therefore exclusively related to the first factor while the 24m and 10y yields are exclusively associated with the second and third factors, respectively. We estimate the parameters (in total 65) by the method of maximum likelihood. The constants μ_i and the factors β_{it} are estimated via the Kalman filter smoothing algorithms which are computational efficiently implemented in STAMP.

Although much output is presented in STAMP, here we can only present a selection. The estimated weights associated with the factors β_{1t}, β_{2t} and β_{3t} are displayed in Figure 1. The maximum likelihood estimates of the weights for a particular factor are presented against maturity and these appear quite smooth. We therefore observe that the weights (or loadings) for the first factor are associated mostly with the short term (3m – 15m) maturities. In the same way, we conclude that the second factor is mostly associated with the medium term (1y – 4y) maturities and the third factor represents the interest rates for (5y – 10y). We conclude by observing that the weights of the second and third factors appear very similar to the restricted weights of second and third factors of the Nelson-Siegel model, respectively.

The estimate of the variance matrix of the disturbances η_t in (2) is represented by

$$\widehat{\Sigma}_\eta = \left[\begin{array}{cccc} & 3m & 24m & 10y \\ 3m & 0.3720 & 0.8378 & 0.6265 \\ 24m & 0.2638 & 0.2664 & 0.8685 \\ 10y & 0.1306 & 0.1533 & 0.1169 \end{array} \right],$$

where the diagonal contains the variances, the lower triangular contains the covariances and the upper triangular contains the correlations. The three factors are all correlated with each other. The correlations between the short-term and medium-term factors and the medium-term and long-term factors are higher compared to the correlation the correlation between the short-term and long-term factors.

The smoothed estimates of the three factors (obtained from the Kalman filter and smoothing algotithm implemented in `STAMP`) are presented in Figure 2. The three estimated factors look similar although there are local differences. By observing the three estimated factors over time, the variability of the short-term factor is higher than the long-term variability.

Finally, `STAMP` is, and has always been, used to forecast time series (as part of the modeling and analysis process). In case of our illustration, we present the one-step ahead predictions of the 17 yields in 2000 in Figure 3. It is encouraging that our basic model for the yields, provides an accurate set of predictions for each month and for most of the 17 maturities.

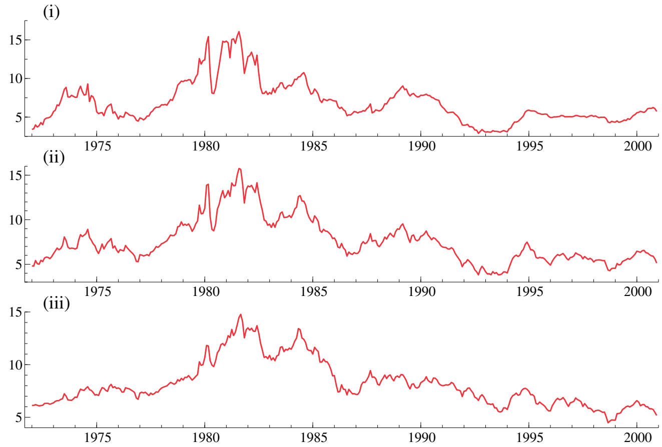


Figure 2: The three estimated factors: (i) $\hat{\beta}_{1t}$, (ii) $\hat{\beta}_{2t}$, (iii) $\hat{\beta}_{3t}$

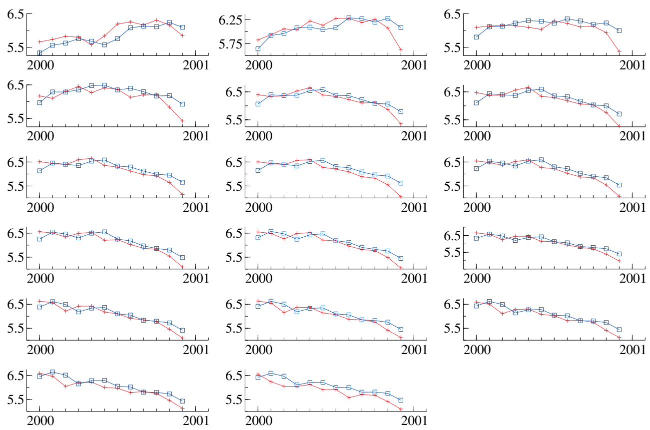


Figure 3: One-step ahead forecasts of US forward rates in 2000 for the 17 maturi

References

Cox, J. C., J. E. Ingersoll, and S. A. Ross (1985). A theory of the term structure of interest rates. *Econometrica 53*, 385–407.

Diebold, F. and C. Li (2006). Forecasting the Term Structure of Government Bond Yields. *J. Econometrics 130*, 337–364.

Diebold, F., S. Rudebusch, and S. Aruoba (2006). The Macroeconomy and the Yield Curve. *J. Econometrics 131*, 309–338.

Duffee, G. (2002). Term Premia and Interest Rate Forecasts in Affine Models. *J. Finance 57*, 405–443.

Durbin, J. and S. J. Koopman (2001). *Time Series Analysis by State Space Methods*. Oxford: Oxford University Press.

Fama, E. F. and R. R. Bliss (1987). The Information in Long-Maturity Forward Rates. *American Economic Review 77*, 680–692.

Nelson, C. and A. Siegel (1987). Parsimonious Modelling of Yield Curves. *Journal of Business 60-4*, 473–489.

Vasicek, O. (1977). An Equilibrium Characterization of the Term Structure. *J. Financial Economics 5*, 177–188.

`SsfPack` of state space time series analysis using `OxMetrics`

by Siem Jan Koopman

1 Introducting SsfPack 3

In the Summer of 2008 we have released the long-awaited `SsfPack 3` version for the professional use of state space methods in econometric, statistical and general time series analysis. The state space form provides an unified representation of a wide range of linear Gaussian time series models including autoregressive moving average (ARMA) models, time-varying regression models, dynamic linear models and unobserved components time series models. State space methods are used in many different fields including forecasting, signal extraction, seasonal adjustment, business cycle analysis, macroeconomic models, option pricing, financial analysis based volatility, interest rate term-structures (yield curve) and many more.

The `OxMetrics` package `SsfPack` provides a complete set of routines to carry out a full state space analysis. The package includes a library of functions that can be used within `OxMetrics`. It provides many example `Ox` programs for a range of state space analyses that treat both basic and intricate cases. The `SsfPack` package is completed with a comprehensive manual. The book is the official documentation of `SsfPack` which carries out computations for the statistical analysis of general univariate and multivariate state space models. It allows for a full range of different state space forms: from a simple univariate autoregressive model to a complicated time-varying model for aggregated variables. Furthermore it provides tools for both linear Gaussian and nonlinear non- Gaussian state space models. In short, `SsfPack` can be used in many areas of econometrics, statistics and beyond.

Various statistical and econometric packages have canned options for the fitting of state space models. However, when we work on professional applications and new areas of time series analysis it is important to have generic programming tools which offer complete flexibility to carry out the computational problem. `SsfPack` provides such a tool, in the form of filtering, moment smoothing and simulation smoothing routines which are general, fast, and easy to use. The current Version 3 of `SsfPack` has improved over previous versions in many different ways. New functions are introduced that are computationally faster and more stable.

`SsfPack` 3 has two versions. The functions in `SsfPack Basic` are the same as in `SsfPack` version 2.2 and documented in Koopman et al. (1999). The algorithms have been updated and are numerically more stable. `SsfPack Extended` provides new and modified functions for state space analysis. The `SsfPack Basic` version is free and can be downloaded from our webpage `www.ssfpack.com`. The new `SsfPack Extended` version is distributed by Timberlake Consultants.

The most essential improvements in `SsfPack Extended` are three-fold: (i) an exact treatment for the diffuse initial conditions of linear Gaussian state space models, (ii) allowing for sparse structures in the state space system matrices in order to avoid multiplications by zero and unity values, and (iii) the univariate treatment of filtering and smoothing computations for multivariate state space models. These modifications in `SsfPack Extended` lead to computationally faster and numerically more stable computations. Furthermore, they imply that the analyses based on large and more complex time series models in a professional setting become feasible.

The local level example

To illustrate how `SsfPack` can be used in a time series analysis, we consider the local level model that is formulated for an observed time series $y_1, \ldots, y_T$ and is given by

$$y_t = \mu_t + \varepsilon_t, \qquad \varepsilon_t \sim NID(0, \sigma_\varepsilon^2),$$

for $t = 1, \ldots, T$ and where the level μ_t is stochastically varying over time as a random walk processes, that is

$$\mu_{t+1} = \mu_t + \eta_t, \qquad \eta_t \sim NID(0, \sigma_\eta^2).$$

A more detailed discussion on the local level model is given by Harvey (1989). In effect, the observed time series y_t is decomposed into a random walk trend plus irregular noise. The state space representation of the model is based on the state vector α_t which in our case is simply $\alpha_t = \mu_t$. The state space model is given by

$$y_t = Z_t\alpha_t + \varepsilon_t, \qquad \alpha_{t+1} = T_t\alpha_t + \xi_t, \qquad \xi_t \sim NID(0, Q_t),$$

where $\xi_t = \eta_t$ and with

$$Z_t = 1, \qquad T_t = 1, \qquad Q_t = \sigma_\eta^2.$$

For more general models, y_t and α_t can be vectors while the state space variables Z_t, T_t and Q_t can be deterministically time-varying matrices. In `SsfPack`, the model is conveniently represented as a single equation with

$$\begin{pmatrix} \alpha_{t+1} \\ y_t \end{pmatrix} = \Phi_t \alpha_t + u_t, \qquad u_t \sim NID(0, \Omega),$$

where

$$\Phi_t = \begin{bmatrix} T_t \\ Z_t \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \qquad \Omega = \begin{bmatrix} Q & 0 \\ 0 & \sigma_\varepsilon^2 \end{bmatrix} = \begin{bmatrix} \sigma_\eta^2 & 0 \\ 0 & \sigma_\varepsilon^2 \end{bmatrix}.$$

As a result, the local level model with $\sigma_\varepsilon^2 = 1$ and $\sigma_\eta^2 = 0.1$ is in `Ox` simply introduced by the commands

```
decl dvareps = 1, dvareta = 0.1;
decl mPhi    = 1 | 1;
decl mOmega = diag(dvareta ~ dvareps);
```

Decomposing US inflation using state space methods

The Kalman filter can be applied to any time series model that can be represented in state space form and it produces one-step ahead estimates of the state vector. It also can produce estimates based on past and concurrent observations. In case of the local level model, the state vector only contains the level μ_t. `SsfPack` can be used to obtain these estimates for μ_t. It has implemented the Kalman filter and associated algorithms in a numerically stable manner. For example, the algorithms are initialized based on exact (possibly diffuse) initial conditions, missing values can be treated, many multiplications are avoided via the recognition of unity and zero values in the system matrices, the filtering and smoothing methods for multivariate models are implemented based on univariate updating methods. In short, most devices discussed in Durbin and Koopman (2001) are implemented in this new version of `SsfPack`. The user does not need to be concerned with numerical problems during the implementation of a state space time series analysis. It can focus on the formulation of the model and the empirical results.

To illustrate the convenience of working with `SsfPack` in practice and in conjunction with `OxMetrics`, we consider a time series of U.S. of quarterly inflation. We have written an `Ox` program which is listed below. The inflation series for the period 1947Q1–2007Q2 is obtained by the `Ox` function `loadmat` and is graphically displayed in Figure 1. The local level model is represented in

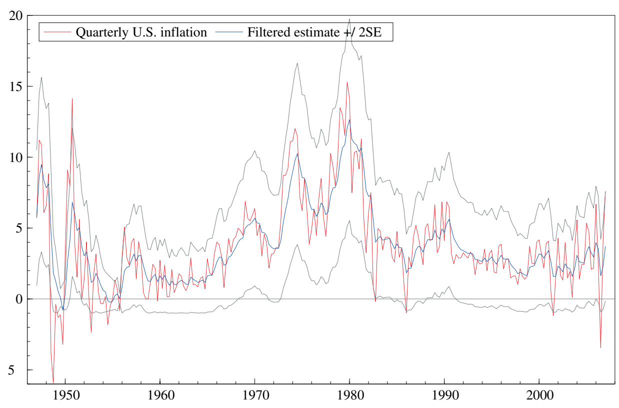


Figure 1: Quarterly U.S. inflation with filtered estimates of the underlying level.

`SsfPack` notation via matrices `mPhi` (Φ) and `mOmega` (Ω). The Kalman filter algorithm is implemented within the `SsfPack` function `SsfMomentEstEx`. To ensure that the function returns the filtered estimates of the state, the constant `ST_FIL` is given as input. The filtered estimates (and the corresponding mean square errors) are stored in the matrix `mest`. The graphical functions of `Ox` create the graph presented in Figure 1. This basic `Ox` program provides an illustration of how a state space time series analysis can be implemented in practice.

```
#include <oxstd.h>
#include <oxdraw.h>
#include <packages/ssfpack/ssfpack.h>

main()
{
    // load quarterly U.S. inflation series
    decl my = loadmat("USinflation.in7")';
    // local level model in ssfpack notation
    decl dvareps = 1, dvareta = 0.1;
    decl mPhi    = 1 | 1;
    decl mOmega = diag(dvareta ~ dvareps);
    // request Kalman filter estimates via ST_FIL
    decl mp, mest;
    mp = SsfMomentEstEx(ST_FIL, &mest, my, mPhi, mOmega);
    // present graphs
    DrawTMatrix(0, my, {"Quarterly U.S. inflation"}, 1947, 1, 4);
    DrawTMatrix(0, mest[0][], {"Filtered estimate"}, 1947, 1, 4);
    DrawZ(sqrt(mest[1][]), "", ZMODE_BAND, 2.0, 14);
    ShowDrawWindow();
}
```

Forecasting US inflation

Empirical time series analysis is often (partially) motivated to forecast the time series. In `SsfPack 3` a new function is created for this purpose: `SsfForecast`. Without additional effort, the forecasts can be printed or graphically presented. The two `Ox/SsfPack` commands below carry out the necessary calculations to present the forecasts as in Figure 2. Instead of providing the constant `ST_FIL` to the function `SsfMomentEstEx`, for forecasting we need to provide the constant `ST_PRED` to obtain the appropriate input for the function `SsfForecast`.

```
mp   = SsfMomentEstEx(ST_PRED, &mest, my, mPhi, mOmega);
mfor = SsfForecast(zeros(1, 20), mPhi, mOmega, mp);
```

Synopsis

`SsfPack 3` provides an excellent environment for the implementation of state space methods in practice. It carries out all necessary and sometimes intricate computations for the statistical analysis of general univariate and multivariate state space models. `SsfPack 3` allows for a full range of different state space forms: from a simple univariate autoregressive model to a complicated time-varying model for aggregated variables. Furthermore, it provides tools for both linear Gaussian and nonlinear non-Gaussian state space models. `SsfPack 3` can be used in many areas of econometrics, statistics and beyond as become apparent from the extensive manual in which many illustrations are given. The example `Ox` code in the manual is available as part of the package and from the website `www.ssfpack.com`. In addition, the `Ox` code for all extensive illustrations in the introductory textbook on state space time series analysis by Commandeur and Koopman (2007) is available too.

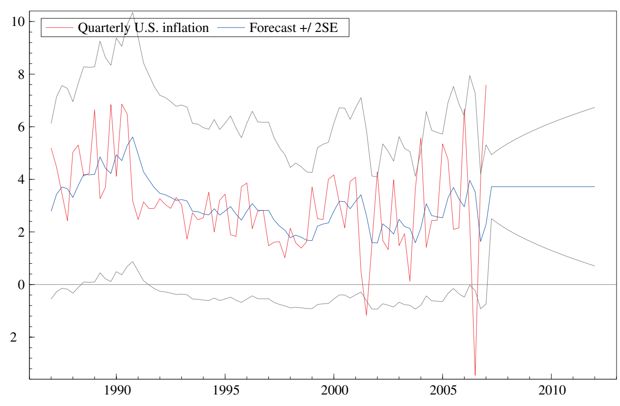


Figure 2: Five-year forecasts of quarterly U.S. inflation.

References

Commandeur, J. J. F. and S. J. Koopman (2007). *An Introduction to State Space Time Series Analysis*. Oxford: Oxford University Press.

Durbin, J. and S. J. Koopman (2001). *Time Series Analysis by State Space Methods*. Oxford: Oxford University Press.

Harvey, A. C. (1989). *Forecasting, Structural Time Series Models and the Kalman Filter*. Cambridge: Cambridge University Press.

Koopman, S. J., N. Shephard, and J. A. Doornik (1999). Statistical algorithms for models in state space form using SsfPack 2.2. *Econometrics Journal 2*, 113–66. http://www.ssfpack.com/.

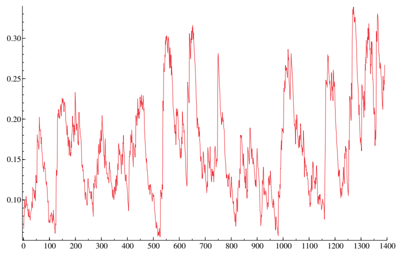
2. G@ARCH™ 5.1

by Sebastien Laurent

2.1 What is new in G@ARCH™ 5.1

G@RCH 5.1 is not only a bug-fix upgrade but includes new tests, a new model and several new example files. Importantly, G@RCH is now available on a range of new platforms.

- The Mac OSX and Linux versions of G@RCH 5.1 are now available.
- The DECO (Dynamic EquiCOrrelation) model of Engle and Kelly (2007) has been added to MG@RCH (but is not yet documented). This model is designed to allow the estimation MGARCH model on a very large number of series (the authors estimate a DECO model on 484 US stocks). As an example, the conditional equicorrelation of 30 Asian stocks is plotted in the next figure. Part of the output of the DECO model is also reported below.




```
** MG@RCH( 1) SPECIFICATIONS **

Conditional Variance : Dynamic Equicorrelation
Multivariate Normal distribution.

Strong convergence using numerical
derivatives
Log-likelihood = -88993.2
Please wait : Computing the Std Errors ...

  Robust Standard Errors (Sandwich formula)
                          Coefficient   t-prob
rho                         0.064185    0.7149
alpha                       0.056583    0.0081
beta                        0.943407    0.0000
No. Observations :            1391
No. Series       :              30
```

We see that while the unconditional equicorrelation is not significantly different from zero there is evidence of dynamics and strong persistence of a shock on the equicorrelation.

- Several tests have been added to the menu 'Descriptive Statistics', i.e. the Variance Ratio test of Lo and MacKinlay (1988), the Runs test originally used by Fama (1965) and the Rescaled Range Tests of Mandelbrot (1972) and Lo (1991). The html documentation now includes a comprehensive Monte Carlo study of the size and power of these tests. The Ox codes used for these simulations is available in the folder packages/Garch5/samples/
- Bug fixed (thanks to Stefan De Wachter): Time-axis did not show the right time period when selecting a subsample. The time-axis started from the beginning of the dataset, regardless of what the selected estimation sample was.
- Problem fixed: annoying Internet Explorer 7 warning about running ActiveX controls when running the OxMetrics help.
- Thanks to Robert A. Yaffee, failure rates for short positions in the output of the Kupiec LR test are now labelled success rates.
- Thanks to Christian Conrad, non-negativity conditions for FIGARCH and HYGARCH models are implemented (or imposed during the estimation) for a FIGARCH and HYGARCH $(1, d, 1)$ (see Conrad and Haag, 2006 and Conrad, 2007).
- Bug fixed: Explanatory variables in the intraday seasonality FFF_ filter, i.e. procedure FFF filter(), were not taken into account. The example file `FFF.ox` has been extended and can now be run using the simulated dataset `FX_USD_1990_1994.in7`. Furthermore, the normalizing constant N_2 has been changed. Indeed, the analytic solution for a sum of squares of integers $\sum_{k=1}^{N} k^2 = (2N^3 + 3N^2 + N)/6$ which leads the value $N_2 = (2N^2+3N+1)/6$ and not $N_2 = (N+1)(N+2)/6$ as in Andersen and Bollerslev (1997) when computing the mean instead of the sum.
- New function in MG@RCH: GetParEst(). The version without argument returns a $K \times 3$ matrix with respectively the estimated parameters, standard errors and t-statistics. The example with one argument equal to 1, i.e. Get-ParEst (1) returns the names of the estimated parameters and the $K \times 3$ matrix explained above. An example is provided in the file `MGarchEstim GetParEst.ox`.

2.2 Work in progress

The recent widespread availability of databases providing the intradaily prices of financial assets (stocks, stock indexes, bonds, currencies, . . .) has led to new developments in applied econometrics and quantitative finance to model daily and intradaily volatility.

Realized volatility (RV), computed as the sum of squared intraday returns, has now become the most commonly used measure of ex-post volatility to judge the quality of the GARCH forecasts (see Andersen and Bollerslev, 1998). It is also used as endogenous variable in a time series model to directly forecast future values of the volatility. Several authors have studied the properties of the RV and have shown that under some suitable assumptions it is a consistent estimate of the quadratic variation and of the integrated volatility in the absence of jumps. In the presence of jumps some alternative measures are needed to consistently estimate the smooth (or continuous) part of the volatility (the most widespread one is the so-called bi-power variation of Barndorff-Nielsen and Shephard, 2004). Several methods (tests) have been proposed in the literature to quantify theses jumps at a daily and even intradaily level.

G@RCH 5.0 already contained a set of procedures devoted to the computation of these nonparametric estimates of the volatility and to identify jumps. The novelty in the next release of G@RCH will be the creation of a new module called RE@LIZED entirely focused on the most recent theoretical developments in the field of realized volatility. An alternative to the bi-power variation and to the Lee and Mykland test for jumps will be available. Finally, extensions of theses concepts in a multivariate framework will also be available.

Several examples will be provided to simulate continuous-time diffusion models and to calculate different non-parametric estimates of the volatility based on intraday-data. Like the other modules in G@RCH, RE@LIZED will have a menu-driven application and a class so that an Ox program that imports the Realized class can be written to load the data, compute the relevant estimates, make some graphs, etc.

2.3 References

ANDERSEN, T. G., AND T. BOLLERSLEV (1997): "Intraday Periodicity and Volatility Persistence in Financial Markets," *Journal of Empirical Finance*, 4, 115–158.

(1998): "Answering the Skeptics: Yes, Standard Volatility Models do Provide Accurate Forecasts, "*International Economic Review*, 39, 885–905.

BARNDORFF-NIELSEN, O., AND N. SHEPHARD (2004): "Power and bipower variation with stochastic volatility and jumps (with discussion), "*Journal of Financial Econometrics*, 2, 1– 48.

CONRAD, C. (2007): "Non-negativity conditions for the hyperbolic GARCH model," KOF Working Papers No. 162, ETH Zrich.

CONRAD, C., AND B. HAAG (2006): "Inequality constraints in the fractionally integrated GARCH model, "*Journal of Financial Econometrics*, 4, 413–449.

ENGLE, R., AND B. KELLY (2007): "Dynamic Equicorrelation,"Mimeo, The Stern School, New York University.

FAMA, E. F. (1965): "The Behaviour of Stock Market Prices, "*Journal of Business*, 38, 34–105.

LO, A. (1991): "Long-term memory in stock market prices, "*Econometrica*, 59, 1279–1313.

LO, A. W., AND C. MACKINLAY (1988): "Stock Market Prices Do Not Follow Random Walks:Evidence from a Simple Specification Test," *Review of Financial Studies*, 1, 41–66.

MANDELBROT, B. (1972): "A Statistical Methodology for Non-periodic Cycles: From the Covariance to R/S Analysis, "*Annals of Economic and Social Measurement*, 1, 259–290.

Conference in Japan Inernational Conference on Econometrics and the World Economy

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The newly established research institute, the Center for Advanced Economic Study (CAES) at Fukuoka University, is hosting an international conference on econometrics and the world economy. The conference will take place at Fukuoka University on 23rd and 24th March 2009. The objective of the conference is to provide a forum for the presentation and discussion of research papers in the fields of econometrics and the world economy. The conference welcomes both theoretical and applied contributions.

The keynote speakers will be:
Dr Shaohua Chen
(Senior Statistician, Senior Information Officer, World Bank)
Dr Jurgen A. Doornik
(Research Fellow in Economics, University of Oxford)
Prof. David F. Hendry
(Professor of Economics, University of Oxford)
Prof. Charles Y. Horioka
(Professor of Economics, Osaka University)
Prof. Siem Jan Koopman
(Professor of Econometrics, Vrije Universiteit Amsterdam)
Prof. Shi Li
(Professor of Economics, Director of Income and Inequality and Poverty Research Centre, Beijing Normal University)

Submission of Abstracts/Full Papers
Please submit an abstract (up to 200 words) on any topic that contributes to the conference themes to the following email address: icewe@econ.fukuoka-u.ac.jp
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OxMetrics Training and Consultancy

Timberlake Consultants Limited has a strong team of consultants to provide training (public attendance or onsite) and consultancy projects requiring the OxMetrics software. The main language used in the courses is English. However, we can also provide some of the courses in other languages, **e.g. French, Dutch, Italian, German, Spanish, Portuguese, Polish and Japanese.**

Advanced Time Series Techniques using OxMetrics™ (4-day course)
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Financial and Econometric Modelling Using OxMetrics™ (3-day course)
The course aims to provide delegates with background on econometric modelling methods and demonstrate, using financial data, how to interpret and report the results. Several modules of OxMetrics are used during this course.

Macroeconometric modelling using PcGive™ – an advanced course (2-day course)
The course aims to provide delegates with background on advanced methods used in macroeconometric modelling and demonstrate, using financial data, how to interpret and report the results.

Programming with Ox (2-day course)
Object-oriented programming has turned out to be very useful also for econometric and statistical applications. Many Ox packages are successfully built on top of the pre-programmed classes for model estimation and simulation. During the first day, the relevant aspects of object-oriented programming, leading up to the ability to develop new classes. The second day focuses on extending Ox using dynamic link libraries, and developing user-friendly applications with Ox.

Measuring and Forecasting Volatility with OxMetrics™ (2-day course)
This course aims to provide delegates with background on financial econometric modelling methods and demonstrate, using financial data, how to interpret and report the results. The software G@RCH - the most recent module of OxMetrics - will be used throughout the course to demonstrate when and how to model and interpret GARCH models.

Econometric Modelling with PcGive™ and Autometrics™ - an intensive course (2-day course)
The course is an intensive course providing an overview of the OxMetrics system and the econometric features of **PcGive**. Special attention is given to Autometrics, which implements automatic model selection. The objective is to allow the user to make effective use of the many facilities provided. Some hands-on experience forms part of the course. No experience with OxMetrics is required, but a reasonable level of econometrics will be assumed.

6th OxMetrics™ User Conference 17 - 18 Sept 2008 - Agenda

(subject to minor changes)

Cass Business School , 106 Bunhill Row, London , EC1Y 8TZ (U.K.)

Wednesday, 17 September 2008

Session 1: JUMPS AND COBREAKING
Chairperson: Lorenzo Trapani

- **A modified Lee-Mykland test for jumps in the presence of seasonality**
  Sebastien Laurent (CeReFiM, University of Namur and CORE, Belgium)
  (with Kris Boudt and Christophe Croux).
- **Jumps in the US Treasury Market: An Empirical Comparison between Alternative Tests to Detect Jumps.**
  Ana-Maria Dumitri (University of Bergamo , Italy and Centre for Econometric Analysis, Cass Business School London , U.K.)
- **Co-breaking, Cointegration, and Weak Exogeneity: Modelling Aggregate Consumption in Japan**
  Takamitsu Kurita (Faculty of Economics, Fukuoka University , Japan)

Session 2: IMPULSE SATURATION
Chairperson: Sebastien Laurent

- **An Automatic Test of Super Exogeneity**
  David F. Hendry (Economics Department, Oxford University , UK)
  (with Carlos Santos)
- **Further Applications of Econometric Modelling With More Variables Than Observations**
  Jurgen Doornik (Economics Department, Oxford University , UK)
- **Impulse Saturation and the Choice of an Estimation Window for Forecasting**
  Hildegart A. Ahumada (Di Tella University , Buenos Aires , Argentina)

Session 3: FORECASTING AND ENERGY MARKETS
Chairperson: Jurgen Doornik

- **Prediction and Forecasting in Linear Autoregressive Models with Measurement Error**
  Yorghos Tripodis (Department of Mathematics & Statistics, University of Massachusetts , USA)((with J. P. Buonaccorsi)
- **Forecasting Volatility and Value at Risk of United Kingdom Natural Gas Futures Prices**
  Robert A. Yaffee (Silver School of Social Work, New York University , USA) et al.
- **Oil Markets and VLCC Tanker Market: The West African-U.S. Gulf of Mexico Market**
  Fred Joutz (Department of Economics, The George Washington University , USA) (with Al Wood)

Session 4: MODELLING THE TERM STRUCTURE
Chairperson: Giovanni Urga

- **Analyzing the Term Structure of Interest Rates using the Dynamic Nelson-SiegelModel with Time-Varying Parameters**
  Siem Jan Koopman (Vrije Universiteit Amsterdam and the Tinbergen Institute, Netherlands) (with Max Mallee and Michel van der Wel)
- **Estimation of Factors for Term Structures with Dependence Clusters**
  Dennis Philip (Centre for Econometric Analysis, Cass Business School , London , UK)

Session 5: OXMETRICS DEVELOPMENTS
Chairperson: Lorenzo Trapani

Round Table Discussion with OxMetrics Developers.

Following a 5-10 minute introduction each from Jurgen Doornik, David Hendry, Siem Jan Koopman, Sebastien Laurent, and Melvyn Weeks the main aim of the round table is to provide a forum for an exchange

CONFERENCE DINNER

Thursday, 18 September 2008

Session 6: COPULAS AND MICROECONOMETRICS
Chairperson: Siem Jan Koopman

- **Dynamic Distributions and Changing Copulas**
  Andrew Harvey (Faculty of Economics, University of Cambridge UK)
- **Regulation in Oligopolistic Markets with Differentiated Products: The Demand for New Cars**
  Melvyn Weeks (Faculty of Economics, University of Cambridge , UK)

Session 7: GARCH MODELS AND VOLATILTY
Chairperson: Melvyn Weeks

- **Optimal Portfolio Allocation using Daily Correlation Modelling**
  Charles Bos (Department of Econometrics, Vrije Universiteit Amsterdam , The Netherlands) (with Roman Kraussl)
- **Negative Volatility Spillovers in the Unrestricted ECCC-GARCH Model**
  Menelaos Karanasos (Department of Economics and Finance, Brunel University , West London , UK) (with Christian Conrad)
- **Outlyingness Weighted Quadratic Covariation**
  Kris Boudt (Faculty of Business and Economics, K.U.Leuven , Belgium) (with Christophe Croux, and Sebastien Laurent)

Session 8: MIXED
Chairperson: Charles Bos

- **Synchronization Across Full and Country-Specific Business Cycles in the Euro Zone**
  Carmine Pappalardo (ISAE - Institute for Studies and Economic Analyses, Rome , Italy)
- **Gamma Approximation Cointegration (GAC). Documentation and User Manual**
  Havard Hungnes (Research Department, Statistics Norway , Norway)