The RATSletter

Estima

RATS Version 10.0!!

We're pleased to announce that version 10 of RATS is now available. This is the end of a multi-year up-date cycle which has included the many additions that came with versions 9.1 and 9.2. Below, we list primarily what's new with 10 (versus 9.2), but if you're only familiar with an earlier version of RATS, there is much more that's not described here. You can check the "What You Might Have Missed" story or https://estima.com/ratslatest.shtml for a fuller list of changes over the past several updates.

Updated Manuals

With each new major version, we need to decide what's new and needs to be explained, what's important and needs greater emphasis, and what's no longer topical and can be moved out of the main documentation. With version 10, we've largely re-written the "GARCH" chapter, and made significant changes to the "Structural Breaks and Switching Models" chapter, substantially changed the "Nonlinear Estimation" chapter to include the newer optimization algorithms and better describe how to choose the proper algorithm, and added information to "Hypothesis Testing" chapter to cover common errors in using and interpreting tests. The manuals are much more extensively cross-referenced both within the documentation and to the on-line help.

On-Line Help

The on-line help now includes full listings for procedures, examples, paper replications, error messages and functions, several of which used to be (less usefully) included in the documentation. Almost all the procedures have detailed syntax descriptions in the help (so you don't have to read the file headers), and many of the examples and paper replications have very detailed descriptions of what each is doing and what changes would need to be made to adapt the analysis to a different data set. This is in addition to the full descriptions of each instruction (including some very old ones that are rarely used in modern programs but might be present in older ones).

Changes to the Interface

- A new method for mapping entries in data sets with irregular date schemes to actual dates has been added (typically for daily data with non-trading days left out). This allows irregular dates to be used both for input and output. The date information can either be the standard dates on a spreadsheet file, or information coded into either single numbers (such as 19970513) (using the new function `%julianfromcoded`) or as separate year, month, day fields (using `%julianfromymd`).

- The two GARCH wizards (univariate and multivariate) and the Box-Jenkins wizard have been reworked to use tabs to reduce clutter, and some additional options have been added to cover more of the instructions.

- The *Data(Other Formats)* wizard includes handling of name overrrides if the names on the file itself are illegal RATS names (such as names with embedded spaces), duplicate RATS reserved names (such as `T` or `INV`) or are otherwise not what you would like (such as strange database names rather than descriptive names)

- The **CALENDAR** *wizard/Start Date Dialog* now "spins" through dates, allowing you to easily shift from one month to the next, and also displays the day of the week for year-month-day combinations, making it easier to choose (for instance) the first Wednesday in the data set in compacting daily data to weekly.

Changes to Instructions

- **GARCH** permits use of an extension of GED to multivariate models as an alternative to Normal and *t* as the conditional distribution of the residuals. (GED has been available for univariate models since the introduction of the instruction). There are new `DCC` and `QBAR` options to control the form of the DCC recursion. Engle's recursion on the standardized residuals is now one of three choices, along with a recursion on the non-standardized residuals, and a "corrected DCC" choice based upon Aielli(2013), "Dynamic Conditional Correlation: On Properties and Estimation," *Journal of Business & Economic Statistics*, 31(3), pp, 282–299.

- **FILTER** has a new `TYPE=HPDETREND` to get the series with the Hodrick-Prescott trend removed.

- **HISTORY** has a new pair of options which make it easier to handle the output. The old `RESULTS` option (which is still available) included both the base forecast and the effects of shocks in a single matrix of series. (It was based upon the even older

New and Updated Programs

Many of the examples and paper replications have had at least minor updates to use new features or to be made more adaptable to new specifications and data sets. These are ones that are either new, or more substantially revised.

garchuv.rpf
garchmv.rpf

These standard examples from the manual have been extended to cover even more of the GARCH model types.

history.rpf

This has been reworked to use the newer options for the **HISTORY** instruction (BASE and EFFECTS). If you use historical decompositions, you probably should look over how this now works, as it makes organizing graphical output much simpler. (All of our other examples which use **HISTORY** have also been redone to use the improved instruction).

jordaaer2005.zip

This is a replication file for one of the examples from Jorda(2005), "Estimation and Inference of Impulse Responses by Local Projections", *American Economic Review*, 95(1), pp 161-182. This estimates multiple-step impulse responses in a VAR by direct estimation—h step responses are estimated by regressing on lags h, $h+1$, etc. with the standard errors computed using system-wide HAC standard errors.

matheson_stavrev_el2013.zip

This replicates Matheson and Stavrev(2013), "The Great Recession and the Inflation Puzzle," *Economics Letters*, 120(3), pp 468-472, which estimates a NAIRU-GAP state-space model with time-varying coefficients and inequality-constrained states. Because of the constraints on the states, this is a rather complicated calculation, which is subject to approximation error. It is covered in detail as part of the 2nd edition of the *State-Space Models and DSGE* e-course.

vecmgarch.rpf

This estimates a vector error correction model (VECM) with a GARCH error process, based loosely upon Pardo and Torro(2007), "Trading with asymmetric volatility spillovers", *Journal of Business, Finance and Accounting*, vol. 34, no 9-10, pp 1548-1568 with a different data set. The GARCH model is an asymmetric BEKK. The example includes tests for causality in the mean model (overall and long-run), and for non-diagonality in the BEKK GARCH model. It also computes and graphs impact surfaces for the residuals on the variances and covariance.

E-Course Materials

In the past several years, we've updated to a 2nd edition our four most popular e-courses: *Vector Autoregressions*, *Structural Breaks and Switching Models*, *State-Space Models and DSGE*'s, and *ARCH/GARCH and Volatility Models*. Quite a few of the changes to the software over the version 9 to 10 revision cycle have been driven by the work on these.

For instance, the even broader searching non-linear estimation algorithms (simulated annealing and genetic annealing) were added to allow a deeper look into the likelihood functions of Markov Switching GARCH models for the *Structural Breaks and Switching Models*. Markov Switching models in general can have problems with multiple modes, so an alternative method which can do a deep search can help to either locate those or (one hopes!) largely remove any doubt about their existence.

For the *State-Space Models and DSGE* course, a number of additions were made to the **DLM** instruction to allow (approximate) solutions for models with inequality constraints on states (as used in the Matheson-Stavrev(2013) replication, described in the "New and Updated Programs" story). Other changes were made to simplify calculations of state-space models with more than one observable such as the very commonly used NAIRU-GAP models. That particular model type is given a great deal of new coverage starting with different forms for univariate cycle models through the methods of combining them with a second observable.

And the **GARCH** instruction has seen quite a few improvements to implement new ideas described in the ARCH/GARCH course.

All of these have also included new examples, and new or updated procedures. For instance, the Markov Switching support procedures were reworked for the *Structural Breaks and Switching Models* course.

The courses are just $50 each—for a combination of theory and practice in each topic which is hard to find elsewhere. For more information on ordering see:

https://estima.com/courses_completed.shtml

New Textbook Examples

Kilian and Lütkepohl(2017)
Structural Vector Autoregressive Analysis. Cambridge Univ. Press.

This is an advanced book on Vector Autoregressions in general, and Structural Vector Autoregressions in particular. Among the topics covered which generally haven't made it into other texts: (short- and long-run restrictions, sign restrictions and various methods of computing error bands (bootstrapping, Monte Carlo methods, delta method).

The RATS examples for this are a work in progress.. The authors provide Matlab code for the examples, but some are actually a bit removed from the source data—several example graphs take as input a set of simulated impulse responses which are generated for one of the authors' papers, but the model itself is beyond the scope of the text (and not provided). They use these to demonstrate different ways of presenting information about impulse responses, particularly in sign-restricted models. For instance, they use "shotgun" graphs of simulated IRF paths to overcome the objection that the standard graph of the median of the "cloud" of accepted responses isn't necessarily representative of any one actual model response.

We would suggest that you use this together with the RATS *Vector Autoregressions* e-course. The RATS course covers most of the topics from a more applied standpoint and you can use the text for a "deeper dive" into the underlying theory and literature.

Franses, Van Dijk, Opschoor(2014)
Time Series Models for Business and Economic Forecasting (2nd ed), Cambridge Univ Press.

This is an introductory book on time series models. From the Preface, "...it is our purpose that the readers should be able to generate their own forecasts from time series models that adequately describe the key features of the data, to evaluate these forecasts and to come up with suggestions for possible modifications if necessary."

Compared with other books aimed at a similar audience, it has a greater emphasis on seasonality, and on "aberrant observations" (outliers and breaks)—the central chapters of the book are on trends, seasonals and aberrant observations, and how they should be handled. The final roughly 1/3 of the book includes GARCH models, non-linear models (mainly TAR and STAR) and VAR's and VECM's.

If you're looking for a book that covers Box-Jenkins (ARIMA models) in detail, this isn't the one—it doesn't assume you have access to a program that can estimate relatively general ARMA models. That may be a carryover from the 1st edition, which is from 1998.

What You Might Have Missed

Most of this newsletter describes changes that were added with version 10 itself. Some of the highlights that were added with versions 9.1 and 9.2 are:

- You can read data directly from the St. Louis Federal Reserve's FRED database into any release of RATS (not just Professional as was the case earlier).

- You can download the entire OECD MEI database as a collection of RATS format files.

- You can save graphs directly in PDF or PNG formats. Under Windows, you can save in WMF or copy and paste using WMF, including high-resolution dashed line patterns.

- You can save or copy reports and spreadsheets as RTF (in addition to TeX, XLS, XLSX, DIF and others).

- The **DATA** instruction will read data with reversed date order (most recent at the top), You can also force a particular **CALENDAR** scheme on a data set which can allow you to compact or expand data from a file which either has no dates without having to read in and then export the data with proper dates, or has very intermittent dates.

- The **DATA** instruction will allow you to override the name of a column on a spreadsheet or external database (such as FRED) if it's an illegal name for RATS or too long or too confusing to be useful directly. (Version 10 added support for this to the wizard).

- **GARCH** will accept models with error correction terms, simplifying the process of estimating VECM-GARCH models. It also adds an XBEKK option to control the handling of variance shifts in bekk models, and adds DENSITY and PARMSET options to allow for non-standard conditional distributions of the residuals.

- The **GRAPH** and **SCATTER** instructions no longer have a limit on the number of series graphed. In particular, this allows for "shotgun" graphs of impulse response functions.

- **GRPARM** has a DEFINE option which allows for a simpler method of overriding graph styles, CMLABELS, SMLABELS and LMLABELS for customizing the month labeling on time-series graphs, and SHADING and GRID options for overriding the styles for background shading and grid lines.

- Two new optimization methods were added to just about all the non-linear estimation instructions. Simulated annealing and genetic annealing are computationally intensive algorithms which can be useful in dealing with difficult problems—for instance, we used them in carefully analyzing Markov Switching GARCH models, which proved to have issues with multiple modes.

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method from 20 years ago of using blocks of series created off the supplementary cards). It now has separate options **BASE** and **EFFECTS** which split up the base forecasts and the cumulative effects of the shocks into two easier-to-handle sets of series.

· The forecasting instructions (**FORECAST**, **HISTORY**, **SIMULATE**, **STEPS** and **UFORECAST**) now define the variables %FSTART and %FEND for the forecast range. This can make it simpler to write general programs when the forecast range is being computed automatically off the range of the previous regression plus a STEPS option on the forecast instruction.

· A MODEL can now include simple FRML's that are clearly linear in situations where the model analyzed needs to be linear (such as for **IMPULSE** and **ERRORS**).

New Functions

%chol(S) returns the Cholesky decomposition of a SYMMETRIC matrix. (This is the same as the (still) existing %DECOMP, just a clearer name for it).

%girfmatrix(S) returns the shock matrix generated from a SYMMETRIC matrix that will give the "Generalized" Impulse Response Function. Note that this is not a factor of S, and should not be used as the basis for calculating the decomposition of variance.

%invztest(p) returns the *x* for which the two-tailed probability of a Normal distribution is **p**.

%julianfromcoded(x,codeformat) returns the RATS julian date corresponding to the value x where the date is coded numerically according to the string codeformat. For instance, if dates are coded as numbers with digits yyyymmdd, then you would use %julianfromcoded(x,"yyyymmdd").

%julianfromymd(y,m,d) returns the RATS julian date (number of days since January 1st, 0001, acting as if the Gregorian calendar extends back) for the date y:m:d.

%ransign() returns random signs (only values +1 and -1) drawn with equal probability.

%regtable() returns a RECTANGULAR[INTEGER] array listing the explanatory variables (series and lag in the two rows) in the most recent regression.

%vech(S) returns a VECTOR containing the values of array S. If **S** is SYMMETRIC or PACKED, the target is created by running through the the rows of the lower triangle. (This is actually the same as %VEC, but since stringing out a symmetric matrix by lower triangle is generally referred to as a "vech" operation, we've added a function by that name).

Prices and Ordering

Users with update subscriptions through version 10.0 (or through July 31, 2018 or later if it's on an annual contract) will automatically receive version 10.0. Note that the downloadable software is available several weeks before the printed manuals, so if you have arranged for full documentation, you may still want to get the download first.

Any single-user license version 9.2 or earlier can be updated to version 10 for just $150. You don't need the older software still installed in order to get an update. You *do* need to have the serial number. If you cannot find your serial number, contact us at sales@estima.com before placing your order. You can get the update either with or without printed manuals—the latter avoids shipping charges. In either case, the software ships with PDF versions of all of the manuals.

If you have the standard version of RATS (a WE or MP serial number) you can upgrade to the Professional version for an additional $150. The Pro version gives you the X12 seasonal adjustment capability, as well as support for reading ODBC/SQL, FAME, and CRSP databases. Under Windows, the Pro version also includes a 64-bit executable in addition to the 32-bit—the 64-bit has almost unlimited capacity, and runs somewhat faster than the 32-bit.

If you would like to switch from Windows to Macintosh (or vice versa), there's no additional charge when you are doing a major update like this.

The prices for updating a single-user license for Windows or Macintosh are shown below. Please contact us if you have questions, or need to update a multi-user or UNIX/Linux license.

	What you want:	
What you have:	10.0 Std	10.0 Pro
RATS Pro (9.2 or earlier)	—	$150
RATS Std (9.2 or earlier)	$150	$300

The direct link for ordering a single user update is

https://estima.com/shopcart/rats_update.shtml

While you're placing your order, you might want to look into ordering one or more of the "e-courses". All of these have proven to be very popular and can be a great help in understanding both the theory and practice of the covered subjects.