RATS Version 5.10!!

As you'll see from the variety of stories included in this newsletter, RATS 5.10 is loaded with new features which make RATS more powerful, easier to use, and often both at the same time. The big advance can be seen in the column to the right: RATS will now allow you to define functions which can be called directly from an expression. The new **REPORT** instruction (page 2) is a real productivity enhancer, allowing you to avoid time-consuming and error-prone retyping of numbers. The additions to the user interface (page 2) are also aimed at improving your productivity, by making it quicker to get data in and organized.

Monte Carlo, bootstrapping and other simulation-based techniques have become increasingly popular in mainstream econometrics. To that end, we've added quite a few new random number functions (page 3). The updated (PDF) manual has a substantially enlarged and rewritten chapter 13 (Simulations/Bootstrapping).

For single-user licenses, an update to RATS 5.10 from version 5 of WinRATS-32 or MacRATS PPC is just $40. It's $125 to update a version 4 of either product, or any other RATS v5, and $200 for any older version. The most cost-effective way to get RATS 5.10 is to get the **maintenance contract**, which will give you 5.10 now, and version 6 when it becomes available later this year. For a single-user (up-to-date) license, this is $150 (plus shipping outside the U.S.), which will be the cost of a version 6 update alone. You can get the advantages of RATS 5.10 now, and will be at the head of the queue when version 6 comes out later this year. This is especially attractive for users with RATS 4 or earlier. For $225, you'll get RATS 5.10 *and* RATS 6 for what is likely to be the price for RATS 6 alone.

If you have a multi-user or network license, call or e-mail for pricing. Note, by the way, that we're planning to increase the multi-user license pricing when version 6 comes out. If you're thinking of getting a network license, or need to upgrade the number of users on your license, you'll save money by doing it now at the current prices.

Contents

Callable Functions

This is the most important step for expanding the scope of optimization problems that can be done using RATS since the introduction of the **MAXIMIZE** instruction. The RATS **PROCEDURE** is a very powerful tool, but it has one drawback: it's designed to mimic a RATS instruction, and so cannot be called from inside an expression. This is a problem if you want to use a complex calculation (such as a numerical integral) inside a **FRML** to be used with **MAXIMIZE**, **NLSYSTEM** or **NLLS**. While it is often possible to generate a formula which does the trick, using the **%DO** and **%IF** functions, the resulting code can be hard to follow.

Enter the close cousin of the **PROCEDURE**: the new RATS **FUNCTION**. It's very similar to the **PROCEDURE**: the only restriction is that a **FUNCTION** cannot have options. You create it with a **FUNCTION** statement, and use the **TYPE** instruction to set the return type. (The default is REAL). The function is called just like one of the pre-defined functions like **INV** or **%CHISQR**, that is, "name(parameters separated by commas)".

If you need multiple return items, you can have parameters called by reference, just like in a **PROCEDURE**.

As an example, the program BONDS.PRG fits a yield curve to a set of bonds. With RATS 5.0, this was done with **FIND**, because the calculation of the values of bonds with varying maturities and coupons can't easily be handled as a RATS formula. However, with the help of **FUNCTION**, this can be rewritten to use **NLLS**, which can compute standard errors for the estimated coefficients, do heteroscedasticity corrections, etc.

```
nonlin a0 a1 a2
compute a0=.030,a1=a2=0.0
compute cusp=2.0
*
*
function BondPV bond
type real BondPV
type integer bond
*
local real mdate cdate
*
compute mdate=maturity(bond)
compute BondPV=100.0 * $
   exp(-mdate*(a0+mdate*a1+$
     %max(mdate-cusp,0.0)*a2))
*
*  Walk backwards through the coupons.
*
```

Report Generator

One thing became clear when working through five text-books of examples: the process of accurately transferring numerical information from the silicon monster to paper isn't easy. Whether it's due to a digit being duplicated or rounded incorrectly, or even pulling the wrong value entirely, work that's done correctly doesn't always read that way.

RATS 5.1 adds a new tool which can help with this: the **RE-PORT** instruction. Long-time RATS users may remember a post-processing tool called COLLECT, which we discontinued after a major change in the format of the output. **RE-PORT** does just about everything COLLECT did, and more. The following table was generated with the help of **REPORT** with just a few minutes work.

R^2	0.8412	0.8467	0.8516
s	1.1149	1.0966	1.0797
LogL	-62.0381	-51.5806	-41.7167
Constant	1.7635	1.7354	1.7188
	(0.0924)	(0.0911)	(0.0898)
r	0.4752	0.4943	0.3637
	(0.1081)	(0.1065)	(0.1089)
r_{t-1}	-0.1006	-0.1325	0.0681
	(0.1853)	(0.1824)	(0.1851)
r_{t-2}	0.0718	0.0996	-0.0136
	(0.1973)	(0.1941)	(0.1928)
r_{t-3}	0.0758	-0.0480	0.0124
	(0.1973)	(0.1959)	(0.1934)
r_{t-4}	-0.1578	0.1492	0.0178
	(0.1853)	(0.1942)	(0.1934)
r_{t-5}	0.5214	-0.1585	0.1579
	(0.1080)	(0.1825)	(0.1933)
r_{t-6}		0.4876	-0.1959
		(0.1064)	(0.1861)
r_{t-7}			0.4852
			(0.1092)

The RATS instructions which generate this (actually with several more columns that we don't show) are

```
cmom
# constant shortrate{0 to 24} longrate
report(act=define,vlab=||'R**2','s','LogL'||)
do maxlag=5,10
   linreg(cmom,noprint) longrate
   # constant shortrate{0 to maxlag}
   report(regressors)
   report(column=curr,atrow=1) %rsquared
   report(column=curr,atrow=2) sqrt(%seesq)
   report(column=curr,atrow=3) $
      -.5*%nobs*log(%rss/%nobs)
end do
report(action=format,picture='*.####')
report(action=show,window='DL')
```

The first **REPORT** instruction initiates the report and defines labels for the first three rows, which will be used for summary statistics. **REPORT(REGRESSORS)** adds a column to

Interface

We've been steadily working on improvements to the user interface. The last few minor releases included several new toolbar icons, and the "Insert Function" button to provide syntax help with the roughly 200 functions. With 5.10, we've made much more obvious changes.

For instance, most of the operations of the RATSDATA program have been included in RATS. The *Open RATS–DATA* operation on the *File* menu now actually opens the file, displaying a list of the series on the file, their recording frequency and date range, and comments. You can do point and click data editing, and some simple graphs and basic statistics directly from that window. You can also restrict the list to names which have a specific form, or comments which contain certain key phrases. We've found this to be very handy in locating specific series in very large databases like the Haver USECON or the OECD files.

In addition, we've hooked up the same basic graph and statistics instructions that have been available in RATSDATA to a window which shows the series in working memory. Now you can do your preliminary examination of the data without typing RATS instructions.

And we've added several more "wizards" to the program. The most useful of these is the "Data" wizard, which takes a data file and (with your assistance) figures out the appropriate **CALENDAR**, **ALLOCATE** and **DATA** instructions needed to process the file. It will even warn about a potential problem with a series name from the file.

For "power users" there have been improvements to the **QUERY** instruction, which will now allow you to verify input before the user can dismiss the box, and **MEDIT**, which can be set up to allow selection of rows from the matrix.

Web Site Revamp

As you may have noticed, we rolled out an updated version of our website (at www.estima.com) in mid-June. Our goals were to provide a little cleaner and faster-loading layout, organize information a little better (particularly the RATS product information), and generally make it easier to find the information you need.

If you visit the site, you will find the main menu positioned along the left side of the screen as before, with links to major sections of the site. The main "body" of each page resides in the middle of the screen. Many pages also feature a "sub menu" at the right side of the page. In some cases, these menu items link to sections within that page. In other cases, the right-side menu links take you to pages with additional related information. For example, the RATS product information pages all share the same right-side menu, with links to other pages with additional information on RATS.

We hope you find the new layout useful. If you have any problems, or if the site doesn't look right on your computer for some reason, let us know (*estima@estima.com*). Thanks!

Improved Support for Monte Carlo Integration and Bootstrapping

We have added quite a few new functions, most of them for improving readability and efficiency in programs which require simulations or bootstrapping. Although these can all be done fairly readily with the other random draw functions (`%RAN`, `%UNIFORM`, `%RANGAMMA` and `%RANWISHART`), the direct function calls will be easier to understand.

`%RANCHISQR(degrees)` returns a single random chi-squared deviate, or fills a matrix, depending upon the context.

`%RANBETA(a,b)` returns a single draw or matrix of independent draws from a Beta distribution.

`%RANMVNORMAL(F)` returns a draw from a multivariate Normal with mean 0 and covariance matrix $\mathbf{FF'}$.

`%RANWISHARTF(F,x)` draws a Wishart with degrees x and scale matrix $\mathbf{FF'}$; if k is the dimension of the matrix, the kernel of the density for $\mathbf{W}$ is

$$|\mathbf{W}|^{(1/2)(x-k-1)} \exp(-\frac{1}{2} tr(\mathbf{FF'})^{-1} \mathbf{W})$$

`%RANWISHARTI(F,x)` draws an inverse Wishart, the inverse of a Wishart draw with degrees x and scale matrix $\mathbf{FF'}$.

For resampling operations of various kinds:

`%RANINTEGER(L,U)` returns a random integer in the range {L,...U}

`%RANPERMUTE(n)` returns a random permutation of {1,...,n}

`%RANCOMBO(n,k)` returns a random combination (sample without replacement) of k items from {1,...,n}

`%RANBRANCH(p)` returns a random integer from {1,...,dim($\mathbf{p}$)} based upon the (unscaled) probabilities in the vector $\mathbf{p}$.

We've also added the function `%WFRACTILES(A,W,f)` which computes fractiles for the elements of $\mathbf{A}$ with draw weights of $\mathbf{W}$. As described in the November 2002 RATSletter, this can be a rather time-consuming operation. This function replaces the WFRACTILES procedure which we announced then. And we've added a `WEIGHT` option to the **DENSITY** instruction to allow estimation of density functions when importance sampling is employed.

The PDF version of the manual which comes with version 5.10 has a completely rewritten Chapter 13 (Simulations/Bootstrapping) with several new examples and improvements of the existing ones.

Other Changes

We've added a number of additional lag window estimators for handling serial correlation in covariance matrix calculations and GMM weight matrix calculations. The instructions **MCOV**, **LINREG**, **NLLS**, **NLSYSTEM**, **MAXIMIZE**, **LGT** and **PRB** now have the options `LWINDOW` and `LWFORM`. `LWINDOW` selects a standard window (`BARTLETT` or `NEWEYWEST`, `PARZEN` or `QUADRATIC` (for quadratic spectral), and `LWFORM` allows the input of any other lag window. **MCOV** has been improved to allow an asymmetrical lag window via the `LWFORM` option; this is required for doing fully modified LS.

NLSYSTEM has had some minor changes. It now includes a `RESIDS` option to get a `VECTOR[SERIES]` of residuals, and, if you use the `MASK` option to use different instruments for different equations, it will allow calculation of the weight matrix with `NOZUDEP`.

In addition to the new functions listed in the Monte Carlo story, there are some other new ones

```
%MATPEEK(A,coords)
%MATPOKE(A,coords,v)
```

pull values out of, and puts values into, a matrix $\mathbf{A}$ at the locations given by the `RECT[INTEGER]` coords. These are handy for working with sparse matrices.

```
%PARMSPEEK(P)
%PARMSPOKE(P,v)
```

pulls the values out of or puts values into a `PARMSET`. These are very useful for doing Monte Carlo with non-linear models, as you can do natural parameterizations of the parameters for estimation purposes, but then work with them in vector form.

New Procedures

We have several new procedures which you can download from the web site.

APTEST.SRC includes the **APBreakTest** procedure which does Andrews-Ploberger or Andrews-Quandt structural stability tests. Thanks to Todd Clark from the Federal Reserve Bank in Kansas City for providing the base code for this.

GIBBSVAR.PRG does Gibbs sampling for a Bayesian VAR.

EQNTOACF.SRC produces a theoretical autocorrelation or autocovariance function for an input ARMA model.

LSDVC.SRC does bias-corrected estimates for least squares dummy variable (fixed effects) in a panel data model with a lagged dependent variable.

Textbook Examples

We've added James Hamilton's *Time Series Analysis* and Fumio Hayashi's *Econometrics* (both from Princeton University Press) to the collection of texts for which we have worked examples in RATS. We have all the empirical examples from each; in the case of the Hamilton book, we've added a few "bonus" examples where techniques are covered in the book but no numerical example is provided. While Hayashi's book includes an extensive collection of "RATS Tips", they were written for RATS 4, and in some cases can be done in a much simpler fashion using RATS 5.

Among the highlights, we have the exact data set used for Hamilton's Markov Switching model, and the code has been improved (from that provided in the RATS example file HAMILTON.PRG) to initialize the Markov chain with the stationary probabilities instead of equal probabilities.

You can download the examples for either book as a zip file, or individually. Just go to www.estima.com and click on the "Procedures & Examples" link. From the "Procs" page, use the links on the right-side menu to go to the page for the book you are interested in. You will be able to view the individual programs from that book, or download the corresponding zip file, which will include the programs, data files, and any required procedures.

Our thanks to Jim and Fumio for providing their RATS programs to use as a base.

With the help of the new wizards (see the "Interface" story on page 2), we've been able to work through other examples much faster than before. We should have the examples from Greene's popular *Econometric Analysis* (5th ed) done by early August. Check the web site for details.

Report Generator, *continued from 2*

the report and (by default), puts each coefficient into the table with its standard error below it. These are organized so the same regressor (same label and lag) goes into the same rows in each of the columns. The other three **REPORT** instructions in the loop put the three desired summary statistics into the first three rows.

Outside the loop, the first instruction formats all the numerical data to four digits right of the decimal. This formatting can also be targeted to specific rows and columns if you have some numbers that need a different format. The final instruction shows the report in a window on the screen. From there, you can export to a spreadsheet or text file, or copy and paste. Note that, if you copy and paste to a spreadsheet, the full precision of the data will be transferred: the formatting applies only to text transfers.

The only editing required after a copy and paste to a word processor was to replace the RATS regressor labels (which are SHORTRATE, SHORTRATE{1},...) with the subscripted labels shown.

REPORT can be used to build up many different types of reports, not just tables for estimated regressions.

RATS Training

We've had a number of questions about the availability of training courses for RATS. We are expecting to have regularly scheduled classes beginning this fall in the Chicago area, and will likely have others at various locations, depending upon demand. If you might be interested, contact us at *sales@estima.com*.

If you have a large enough base of RATS users, the most cost-effective method of training would be at your site. Aside from reducing travel expenses, it will also allow you to request a focus upon the topics of greatest interest to your own users.

Applied Econometric Time Series, 2nd Edition

The 2nd edition of Walter Enders' best-selling *Applied Econometric Time Series* (Wiley) is due out in mid-July. This substantially increases the coverage of non-linear time-series models, and includes Monte Carlo analysis and bootstrapping. The text also makes numerous references to Walter's *RATS Programming Manual*, which you can download for free at www.estima.com. Order your copy today—for now, we're keeping the same $80 price.

Callable Functions, *continued from 1*

```
compute cdate=mdate
while (cdate > 0.0) {
  compute BondPV=BondPV + coupon(bond) * $
    exp(-cdate*(a0+cdate*a1+$
    %max(cdate-cusp,0.0)*a2))
  compute cdate=cdate-1
}
*
*  Adjust for simple interest payable by
*  the purchaser for the initial coupon.
*  cdate will be -(fraction of period).
*
compute BondPV=BondPV+coupon(bond)*cdate
end
*
```

With the evaluating function defined, this set up for using **NLLS** is quite simple:

```
frml BondPrice value = BondPV(t)
*
nlls(robust,trace,frml=BondPrice) value
```

Other examples which we've done recently with the help of **FUNCTION** are semi-parametric GARCH and a cleaner rewrite of Hamilton's Markov switching model.