Package ‘AutoSEARCH’

February 19, 2015

Type Package
Title General-to-Specific (GETS) Model Selection
Version 1.4
Depends R (>= 2.4.1), zoo, gets, lgarch
Date 2014-12-22
Author Genaro Sucarrat
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Description Automated multi-path General-to-Specific (GETS) model selection of either an AR-
X model with log-ARCH-X errors, or of a log-ARCH-X model of the error. NOTE: The pack-
age has been succeeded by the package gets, also available on the CRAN, which is in-
tended to be more user-friendly, faster and easier to extend. AutoSEARCH will con-
tinue to be maintained, but the development focus will switch to gets. Users are therefore encour-
eged to consider gets instead.
License GPL-2
NeedsCompilation no
Repository CRAN
Date/Publication 2014-12-22 13:42:26

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Description

Automated multi-path GETS model selection of either an AR-X model with log-ARCH-X errors, or of a log-ARCH-X model of the error.

NOTE: The package has been succeeded by the package gets, also available on the CRAN, which is intended to be more user-friendly, faster and easier to extend. AutoSEARCH will continue to be maintained, but the development focus will switch to gets. Users are therefore encouraged to consider gets instead.

Details

Package: AutoSEARCH
Type: Package
Version: 1.4
Date: 2014-12-22
License: GPL-2
LazyLoad: yes


Author(s)

Genaro Sucarrat, http://www.sucarrat.net/

References


See Also

AutoSEARCH package: sm, gets.mean, gets.vol
gets package: arx, getsm, getsv

Examples

#Generate from AR(1) model:
set.seed(123)
y <- arima.sim(list(ar=0.4), 200)
# Estimate AR(2) with intercept as mean specification
# and log-ARCH(4) as log-volatility specification:
sm(y, mc=TRUE, ar=1:2, arch=1:4)

# General-to-Specific model selection of the mean:
Mymodel <- gets.mean(y, mc=TRUE, ar=1:2, arch=1:4)

# General-to-Specific model selection of the
# simplified mean specification:
gets.vol(Mymodel$resids, arch=1:4)

---

gedestp Estimate and compute log-likelihood of the standardised Generalised Error Distribution (GED)

**Description**

gedestp and gedolgl are auxiliary functions called by gets.mean and gets.vol.

The gedestp function estimates the shape parameter of a standardised (zero mean, unit variance) GED. The estimation method is based on an index of kurtosis approach, and the code is based on the estimatep function from the normalp package by Angelo M. Mineo.

The gedolgl function computes the log-likelihood of a standardised GED with shape parameter \( p \).

**Usage**

gedestp(x, method = c("inverse", "direct"))
gedolgl(z, p = 2)

**Arguments**

- **x** numeric vector
- **z** numeric vector
- **method** "inverse" or "direct"
- **p** numeric value, the shape parameter

**Value**

numeric, either an estimate of the shape parameter or the log-likelihood

**Author(s)**

Genaro Sucarrat (http://www.sucarrat.net/)
References


See Also

gets.mean, gets.vol

Examples

#estimate p of a standard normal:
set.seed(123)
x <- rnorm(200)
gedestp(x)

#log-likelihood of the standard normal series:
gedlogl(x, p=2)

##

gets.mean  \hspace{1cm} \textit{General-to-Specific (GETS) Model Selection of an AR-X model with log-ARCH-X errors}

Description

The starting model is referred to as the General Unrestricted Model (GUM). The \texttt{gets.mean} function undertakes multi-path GETS model selection of the mean specification, whereas \texttt{gets.vol} does the same for the log-variance specification.

Usage

\begin{verbatim}
gets.mean(y, mc = NULL, ar = NULL, ewma = NULL, mx = NULL,
arch = NULL, asym = NULL, log.ewma = NULL, vx = NULL,
keep = NULL, p = 2, varcov.mat = c("ordinary", "white"),
t.pval = 0.05, do.pet = TRUE, wald.pval = 0.05,
ar.LjungB = c(2, 0.025), arch.LjungB = c(2, 0.025),
tau = 2, info.method = c("sc", "aic", "hq"),
info.resids = c("mean", "standardised"),
inclusion.empty = FALSE, zero.adj = 0.1, vc.adj = TRUE,
tol = 1e-07, LAPACK = FALSE, max.regs = 1000,
verbose = TRUE, smpl = NULL, alarm = FALSE)
\end{verbatim}

\begin{verbatim}
gets.vol(e, arch=NULL, asym=NULL, log.ewma=NULL, vx=NULL,
p=2, keep=c(1), t.pval=0.05, wald.pval=0.05, do.pet=TRUE,
ar.LjungB=c(1, 0.025), arch.LjungB=c(1, 0.025), tau=2,
info.method=c("sc", "aic", "hq"),
info.resids=c("standardised", "log-sigma"), include.empty=FALSE,
zero.adj=0.1, vc.adj=TRUE, tol=1e-07, LAPACK=FALSE, max.regs=1000,
verbose=TRUE, alarm=FALSE, smpl=NULL)
\end{verbatim}
Arguments

\( y \) numeric vector, time-series or zoo object. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the `na.trim` command from the zoo package

\( e \) numeric vector, time-series or zoo object. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the `na.trim` command from the zoo package

\( mc \) logical, TRUE or FALSE (default). TRUE includes intercept in the mean specification, FALSE does not

\( ar \) integer vector, say, c(2,4) or 1:4. The AR-lags to include in the specification

\( ewma \) either NULL (default) or a list with arguments sent to the `eqwma` function. In the latter case a lagged moving average of \( y \) is included as a regressor

\( mx \) numeric matrix, time-series or zoo object of conditioning covariates. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the `na.trim` command from the zoo package

\( arch \) integer vector, say, c(1,3) or 2:5. The log-ARCH terms to include in the log-volatility specification

\( asym \) integer vector, say, c(1) or 1:3. The asymmetry or leverage terms to include in the log-volatility specification

\( log.ewma \) NULL (default) or a list. If NULL then \( \log(\text{EWMA}) \) is not included as volatility proxy. If a list, then \( \log(\text{EWMA}) \) is included as a volatility proxy.

\( vx \) numeric matrix, time-series or zoo object of conditioning covariates. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the `na.trim` command from the zoo package

\( keep \) NULL (default) or an integer vector. If `keep = NULL`, then no regressors are excluded from removal. Otherwise, the regressors associated with the numbers in `keep` are excluded from the removal space. For example, `keep=c(1)` excludes the constant from removal. The regressor numbering is contained in the `reg.no` column of the `gum.mean` data frame (see below)

\( p \) numeric value greater than zero. The power of the log-volatility specification

\( varcov.mat \) character vector, "ordinary" or "white". If "ordinary" then the ordinary variance-covariance matrix is used for inference. Otherwise the White (1980) heteroscedasticity robust matrix is used

\( t.pval \) numeric value between 0 and 1. The significance level used for the two-sided regressor significance tests

\( do.pet \) logical, TRUE (default) or FALSE. If TRUE then a Parsimonious Encompassing Test (PET) against the GUM is undertaken at each regressor removal for the joint significance of all the deleted regressors along the current path

\( wald.pval \) numeric value between 0 and 1. The significance level used for the PETs

\( ar.LjungB \) NULL or a two-element vector where the first element contains the order of a Ljung and Box (1979) test for serial correlation in the standardised residuals, and where the second element contains the significance level. If NULL, then the standardised residuals are not checked for serial correlation after each removal. The default is c(2, 0.025)
arch.LjungB  NULL or a two-element vector where the first element contains the order of a Ljung and Box (1979) test for ARCH (serial correlation in the squared standardised residuals), and where the second element contains the significance level. If NULL, then the standardised residuals are not checked for ARCH after each removal. The default is c(2, 0.025)

tau  NULL or a numeric value greater than 1. If NULL, then the shape parameter in a Generalised Error Distribution (GED) of the standardised residuals is estimated for the log-likelihood used in the calculation of the information criterion. If tau is equal to a numeric value, a GED(tau) is used. Default: tau=2 (i.e. the standard normal density)

info.method  character string, "sc" (default), "aic" or "hq", which determines the information criterion used to select among terminal models. The abbreviations are short for the Schwarz or Bayesian information criterion (sc), the Akaike information criterion (aic) and the Hannan-Quinn (hq) information criterion

info.resids  character string, "mean" (default) or "standardised" which sets the residuals to be used in the computation of the information criterion

include.empty  logical, TRUE or FALSE (default). If TRUE then an empty model is included among the terminal models, if it passes the diagnostic tests, even if it is not equal to one of the terminals

zero.adj  numeric value between 0 and 1. The quantile adjustment for zero values. The default 0.1 means that the zero residuals are replaced by means of the 10 percent quantile of the absolute residuals before taking the logarithm

vc.adj  logical, TRUE (default) or FALSE. If true then the log-volatility constant is adjusted by means of the estimate of E[log(z^2)]. This adjustment is needed for the standardised residuals to have unit variance. If FALSE then the log-volatility constant is not adjusted

tol  numeric value (default = 1e-07). The tolerance for detecting linear dependencies in the columns of the regressors (see qr() function). Only used if LAPACK is FALSE

LAPACK  logical, TRUE or FALSE (default). If true use LAPACK otherwise use LINPACK (see qr() function)

max.regs  integer value, sets the maximum number of regressions along a deletion path. Default: max.regs=1000

verbose  logical, TRUE (default) or FALSE. FALSE returns less output and is therefore faster

smpl  Either NULL (default; the whole sample is used for estimation) or a two-element vector of dates with the start and end dates of the sample to be used in estimation. For example, smpl=c("2001-01-01", "2009-12-31")

alarm  Logical, either TRUE or FALSE (default). If TRUE, then a sound or beep is emitted when the specification search terminates in order to alert the user

**Details**

See Sucarrat and Escribano (2012)
**Value**

A list with a subset of the following:

- `volatility.fit` zoo-object with the fitted values of the volatility ($\sigma^p$) of the final log-volatility specification
- `resids.ustar` zoo-object with the residuals of the AR-representation of the final log-volatility specification
- `resids` zoo-object with the residuals of the final mean specification
- `resids.std` zoo-object with the standardised residuals
- `Elogzp` estimate of $E[\log(z^p)]$
- `call` the function call
- `gum.mean` a data frame with the estimation results of the GUM
- `gum.volatility` a data frame with the estimation results of the log-volatility GUM
- `gum.diagnostics` data frame with selected diagnostics of the GUM
- `keep` if any, the regressors that are excluded from deletion
- `insigs.in.gum` a numeric integer vector with the insignificant regressors of the GUM
- `paths` a list containing the simplification paths, that is, the sequences of deleted regressors
- `terminals` the distinct terminal models
- `terminals.results` the value and type of the information criterion (info) used in selecting among terminal specifications, and the number of observations ($T$) and parameters ($k$) used in the calculation of the information criterion
- `specific.mean` data frame with the estimation results of the final mean specification
- `specific.volatility` data frame with the estimation results of the final log-volatility specification
- `specific.diagnostics` data frame with selected diagnostics of the standardised residuals

**Author(s)**

Genaro Sucarrat (http://www.sucarrat.net/)

**References**


See Also

AutoSEARCH package: sm
gets package: arx, getsm, getsv

Examples

#Generate AR(1) model and four independent normal regressors:
set.seed(123)
y <- arima.sim(list(ar=0.4), 200)
xregs <- matrix(rnorm(4*200), 200, 4)

#General-to-Specific model selection of the mean:
mymodel <- gets.mean(y, mc=TRUE, ar=1:5, mx=xregs)

#General-to-Specific model selection of the mean
#with the intercept excluded from removal:
mymodel <- gets.mean(y, mc=TRUE, ar=1:5, mx=xregs, keep=1)

#General-to-Specific model selection of the mean
#with no intercept and with a log-ARCH(4) specification
#in the log-volatility using the standardised residuals
#when computing the log-likelihood for the information
#criterion:
mymodel <- gets.mean(y, mc=FALSE, ar=1:5, mx=xregs, arch=1:4, info.resids="standardised")

#General-to-Specific model selection of the mean with
#non-default serial-correlation diagnostics settings:
mymodel <- gets.mean(y, mc=TRUE, ar=1:5, mx=xregs, ar.LjungB=c(6, 0.05))

#General-to-Specific model selection of the mean with
#very liberal (i.e. 20 percent) significance levels (20 percent):
mymodel <- gets.mean(y, mc=TRUE, ar=1:5, mx=xregs, t.pval=0.2, wald.pval=0.2)

#Generate iid normal residuals and a matrix of independent
#normals:
set.seed(123)
e <- rnorm(200)
xregs <- matrix(rnorm(4*200), 200, 4)

#General-to-Specific model selection of log-volatility:
mymodel <- gets.vol(e, arch=1:5, vx=log(xregs^2))

#General-to-Specific model selection of log-volatility
#with the log-ARCH(1) term excluded from removal:
mymodel <- gets.vol(e, arch=1:5, vx=log(xregs^2), keep=2)

#General-to-Specific model selection of log-volatility
#with all the log-ARCH terms excluded from removal:
mymodel <- gets.vol(e, arch=1:5, vx=log(xregs^2), asym=1:2,
log.ewma=list(length=5), keep=2:6)

#If e is a daily (weekends excluded) financial return series,
#then the following specification includes a lagged volatility
#proxy both for the week (5-day average of squared return) and
#for the month (20-day average of squared returns), in addition
#to five log-ARCH terms:
mymodel <- gets.vol(e, arch=1:5, log.ewma=list(length=c(5,20)) )

#General-to-Specific model selection with very liberal
#(20 percent) significance levels:
mymodel <- gets.vol(e, arch=1:5, vx=log(xregs^2), t.pval=0.2,
            wald.pval=0.2)

---

**gLag**

**Lag a series**

**Description**

A wrapper to the `glag` function in the `lgarch` package.

**Usage**

```r
gLag(y, k=1, na.value=NA)
```

**Arguments**

- `y` numeric vector, time-series or zoo object
- `k` integer equal to or greater than 1. Default: `k=1`
- `na.value` the value to replace the lost values with. Default: `na.replace=NA`

**Value**

the lagged vector, time series or zoo object

**Author(s)**

Genaro Sucarrat (http://www.sucarrat.net/)

**See Also**

`glag`
Description

Adjusts a series called e - typically a series of residuals or financial returns - for zero values, so that the logarithm can be applied on the absolute pth exponentiated values. Next, \( \log(\text{abs}(e)^p) \) is computed.

Usage

gLog.ep(e, zero.adj=0.1, p=2, na.replace=NA)

Arguments

- **e**: numeric vector, time series or `zoo` object
- **zero.adj**: numeric value between 0 and 1 (the quantile adjustment for zero values). The default 0.1 means zeros are replaced by the 10 percent quantile of \( \text{abs}(e) \) before taking the logarithm.
- **p**: numeric value greater than zero. The power of the log-volatility specification.
- **na.replace**: the value to replace NA values with. Default: `na.replace=NA`.

Value

\( \log(\text{abs}(e)^p) \), a numeric, where the zeros in \( e \) have been adjusted.

Author(s)

Genaro Sucarrat, [http://www.sucarrat.net/](http://www.sucarrat.net/)

ols.fit1

Fast and accurate OLS estimation by means of QR decomposition

Description

ols.fit1 and ols.fit2 are auxiliary functions called by `sm`, `gets.mean` and `gets.vol`. The ols.fit2 function returns slightly more information than ols.fit1, which makes the latter faster. However, variance-covariance are to be needed in a second step, then ols.fit2 is faster due to the additional information provided by it.

Usage

- ols.fit1(y, x, tol=1e-07, LAPACK=FALSE)
- ols.fit2(y, x, tol=1e-07, LAPACK=FALSE)
**Arguments**

- **y**: numeric vector, the regressand
- **x**: numeric matrix, the regressors
- **tol**: numeric value (default = 1e-07). The tolerance for detecting linear dependencies in the columns of the regressors (see qr() function). Only used if LAPACK is FALSE
- **LAPACK**: logical, TRUE or FALSE (default). If true use LAPACK otherwise use LINPACK (see qr() function)

**Value**

A list that contains some or all of the following elements:

- **qr**
- **rank**
- **qraux**
- **pivot**
- **xtxinv**
- **xtx**
- **xty**
- **coefficients**

**Author(s)**

Genaro Sucarrat (http://www.sucarrat.net/)

**See Also**

- **qr**, **solve**

---

**Description**

Creates the regressors of an AR-X model, see **sm**.

**Usage**

```r
regs.mean.sm(y, mc=NULL, ar=NULL, ewma=NULL, mx=NULL)
```
Arguments

- **y**: numeric vector, time-series or zoo object. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the na.trim command from the zoo package.

- **mc**: logical, TRUE or FALSE (default). TRUE includes intercept in the specification, FALSE does not.

- **ar**: integer vector, say, c(2,4) or 1:4. The AR-lags to include in the specification.

- **ewma**: NULL or a list of arguments sent to the eqwma function.

- **mx**: numeric matrix, time-series or zoo object of conditioning covariates. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the na.trim command from the zoo package.

Value

Matrix with regressors

Author(s)

Genaro Sucarrat (http://www.sucarrat.net/)

See Also

AutoSEARCH package: sm, regs.vol.sm

Description

Creates the regressors of a log-ARCH-X model, see sm and gets.vol

Usage

```r
regs.vol.sm(e, vc=TRUE, arch=NULL, asym=NULL, log.ewma=NULL, vx=NULL, p=2,
zero.adj=0.1)
```

Arguments

- **e**: numeric vector, time-series or zoo object. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the na.trim command from the zoo package.

- **vc**: logical, TRUE (default) or FALSE. TRUE creates an intercept, FALSE does not.

- **arch**: integer vector, say, c(1,3) or 2:5. The ARCH-lags to include in the log-volatility specification.
asym  integer vector, say, c(1) or 1:3. The asymmetry or leverage terms to include in the log-volatility specification

log.ewma NULL (default) or a list. If NULL then log(EWMA) is not included as volatility proxy. If a list, then log(EWMA) is included as a volatility proxy.

vx numeric matrix, time-series or zoo object of conditioning covariates. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the na.trim command from the zoo package

p numeric value greater than zero. The power of the log-volatility specification.

zero.adj numeric value between 0 and 1. The quantile adjustment for zero values. The default 0.1 means that the zero residuals are replaced by means of the 10 percent quantile of the absolute residuals before taking the logarithm

Value
Matrix with regressors

Author(s)
Genaro Sucarrat (http://www.sucarrat.net/)

See Also
AutoSEARCH package: sm, regs.mean.sm

Estimate an AR-X model with log-ARCH-X errors

Description
Estimation is by OLS in two steps. In the first the AR-X mean specification is estimated, whereas in the second step the residuals from the first are used to fit a log-ARCH-X model to the log-variance. The natural logarithm of the squared residuals constitutes the regressand in the second step.

The AR-X mean specification can contain an intercept, AR-terms, lagged moving averages of the regressand and other conditioning covariates ('X'). The log-variance specification can contain log-ARCH terms, asymmetry or 'leverage' terms, log(EqWMA) where EqWMA is a lagged equally weighted moving average of past squared residuals (a volatility proxy) and other conditioning covariates ('X').

Usage
sm(y, mc=NULL, ar=NULL, ewma=NULL, mx=NULL, arch=NULL, asym=NULL, log.ewma=NULL, vx=NULL, p=2, zero.adj=0.1, vc.adj=TRUE, varcov.mat=c("ordinary", "white"), qstat.options=NULL, tol=1e-07, LAPACK=FALSE, verbose=TRUE, smpl=NULL)
Arguments

\( y \) numeric vector, time-series or zoo object. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the na.trim command from the zoo package.

\( mc \) logical, TRUE or FALSE (default). TRUE includes intercept in the specification, FALSE does not.

\( ar \) integer vector, say, c(2,4) or 1:4. The AR-lags to include in the specification.

\( ewma \) list of arguments sent to the leqwma function.

\( mx \) numeric matrix, time-series or zoo object of conditioning covariates. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the na.trim command from the zoo package.

\( arch \) integer vector, say, c(1,3) or 2:5. The ARCH-lags to include in the log-volatility specification.

\( asym \) integer vector, say, c(1) or 1:3. The asymmetry or leverage terms to include in the log-volatility specification.

\( log.ewma \) NULL (default) or a list. If NULL then log(EWMA) is not included as volatility proxy. If a list, then log(EWMA) is included as a volatility proxy.

\( vx \) numeric matrix, time-series or zoo object of conditioning covariates. Note that missing values in the beginning or at the end of the series is allowed, as they are removed with the na.trim command from the zoo package.

\( p \) numeric value greater than zero. The power of the log-volatility specification.

\( zero.adj \) numeric value between 0 and 1. The quantile adjustment for zero values. The default 0.1 means that the zero residuals are replaced by means of the 10 percent quantile of the absolute residuals before taking the logarithm.

\( vc.adj \) logical, TRUE (default) or FALSE. If true then the log-volatility constant is adjusted by means of the estimate of E[log(z^2)]. This adjustment is needed for the standardised residuals to have unit variance. If FALSE then the log-volatility constant is not adjusted.

\( varcov.mat \) character vector, "ordinary" or "white". If "ordinary" then the ordinary variance-covariance matrix is used for inference. Otherwise the White (1980) heteroscedasticity robust matrix is used.

\( qstat.options \) NULL or an integer vector of length two, say, c(2,5). The first value sets the order of the AR diagnostic test, whereas the second value sets the order of the ARCH diagnostic test. NULL (default) sets the vector to c(1,1).

\( tol \) numeric value (default = 1e-07). The tolerance for detecting linear dependencies in the columns of the regressors (see qr() function). Only used if LAPACK is FALSE.

\( LAPACK \) logical, TRUE or FALSE (default). If true use LAPACK otherwise use LINPACK (see qr() function).

\( verbose \) logical, TRUE (default) or FALSE. FALSE returns less output and is therefore faster.

\( smpl \) Either NULL (default; the whole sample is used for estimation) or a two-element vector of dates with the start and end dates of the sample to be used in estimation. For example, smpl=c(“2001-01-01”, ”2009-12-31”)
Details

See Sucarrat and Escribano (2012)

Value

A list with the following elements:

- `call` the function call
- `mean.fit` zoo-object with the fitted values of the mean specification
- `resids` zoo-object with the residuals of the mean specification
- `volatility.fit` zoo-object with the fitted values of the volatility (\(\sigma^p\)) specification
- `resids.ustar` zoo-object with the residuals of the AR-representation of the log-volatility specification
- `resids.std` zoo-object with the standardised residuals
- `Elogzp` estimate of \(E(\log(z^p))\)
- `mean.results` data frame with the estimation results of the mean specification
- `volatility.results` data frame with the estimation results of the log-volatility specification
- `diagnostics` data frame with selected diagnostics of the standardised residuals

Author(s)

Genaro Sucarrat (http://www.sucarrat.net/)

References


See Also

AutoSEARCH package: gets.mean, gets.vol
gets package: arx, getsm, getsv

Examples

```r
#Generate AR(1) model and independent normal regressors:
set.seed(123)
y <- arima.sim(list(ar=0.4), 200)
xregs <- matrix(rnorm(4*200), 200, 4)

#estimate AR(2) with intercept:
sm(y, mc=TRUE, ar=1:2)
```
estimate AR(2) with intercept and four conditioning regressors
in the mean:
sm(y, mc=TRUE, ar=1:2, mx=xregs)

estimate a log-volatility specification with a log-ARCH(4)
structure:
sm(y, arch=1:4)

estimate a log-volatility specification with a log-ARCH(4)
structure and an asymmetry or leverage term:
sm(y, arch=1:4, asym=1)

estimate a log-volatility specification with a log-ARCH(4)
structure, an asymmetry or leverage term, a 30-period log(EWMA) as
volatility proxy, and the squareds of the conditioning regressors
in the log-volatility specification:
sm(y, arch=1:4, asym=1, log.ewma=list(length=30), vx=log(xregs^2))

estimate AR(2) with intercept and four conditioning regressors
in the mean, and a log-volatility specification with a log-ARCH(4)
structure, an asymmetry or leverage term, a 30-period log(EWMA) as
volatility proxy, and the squareds of the conditioning regressors
in the log-volatility specification:
sm(y, mc=TRUE, ar=1:2, mx=xregs, arch=1:4, asym=1,
   log.ewma=list(length=30), vx=log(xregs^2))
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