Package ‘strucvol’

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Type Package

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Title Structural stochastic volatility models.

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Description Estimation and inference for structural stochastic volatility models.

License GPL (>= 2)

Imports Rcpp (>= 1.0.10),
FKF,
Rsolnp

LinkingTo Rcpp

Depends R (>= 2.10)

LazyData true

RoxygenNote 7.2.3

R topics documented:

strucvol-package *Estimate and test structural stochastic volatility models.*

Description

This package implements routines for estimation and misspecification testing in the context of structural stochastic volatility models. In addition, it can be used to model other stochastic volatility models with dependent variables in the state equation of the underlying state space system.

Details

The Monte Carlo maximum likelihood method in Sandmann and Koopmann (1998) is implemented to estimate the standard ARSV model and the extended model. The multivariate model is implemented using a quasi-maximum likelihood approach. The simulation functions make it possible to analyze the joint behaviour of a stock and a market index using a multivariate structural stochastic volatility model. Misspecification tests include: 1. Regression-based LM-type test of a null ARSV model vs. a model with a dependent variable in the state equation. 2. Regression-based LM-type test for (remaining) volatility asymmetry ("the leverage effect"). 3. Log likelihood test for testing nested models against each other, presumably ARSV against an extended model.

Author(s)

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References

Back, Alexander (2023). Structurally motivated stochastic volatility models. Unpublished manuscript.

Sandmann, Gleb and Koopman, Siem Jan, (1998). Estimation of stochastic volatility models via Monte Carlo maximum likelihood. Journal of Econometrics, 87, issue 2, p. 271-301. https://EconPapers.repec.org/RePEc:eee:econom:v:87:y:1998:i:2:p:271-301.

Wooldridge, Jeffrey M. (1990). A Unified Approach to Robust, Regression-Based Specification Tests. Econometric Theory, 6, issue 1, p. 17–43. http://www.jstor.org/stable/3532053.

See Also

...

Examples

```
  ## Not run:
     ## Try using the function fitsv() on the first column in the dataframe "df".

## End(Not run)
```

fitmssv — *Fit a bivariate structural stochastic volatility model.*

Description

Fit a bivariate structural stochastic volatility model.

Usage

```
fitmssv(y, x, start = c(0.95, 0.95, 0.3, 0.3, 0.02))
```

Arguments

`y`	a bivariate numeric or time series containing log returns. The first column should contain the "structural" series, while the second corresponds to the market.
`x`	an explanatory variable, presumably the log of a leverage multiplier.
`start`	starting parameters for the optimization.

Value

A list containing the output from the solver ("model") and the outputs from the Kalman filter ("fit").

fitssv — *Fit a structural stochastic volatility model.*

Description

Fit a structural stochastic volatility model.

Usage

```
fitssv(y, x, N = 5, start = c(0.95, 0.3))
```

Arguments

`y`	a numeric vector or time series containing log returns.
`x`	an explanatory variable, presumably the log of a leverage multiplier.
`N`	number of importance samples to draw for the Monte Carlo ll evaluation.
`start`	starting parameters for the optimization.

Value

A list containing the output from the solver ("model") and the outputs from the Kalman filter and monte carlo evaluation routine ("fit").

`fitsv` *Fit a standard stochastic volatility model.*

Description

Fit a standard stochastic volatility model.

Usage

```
fitsv(y, N = 5, start = c(0.95, 0.3))
```

Arguments

`y`	a numeric vector or time series containing log returns.
`N`	number of importance samples to draw for the Monte Carlo ll evaluation.
`start`	starting parameters for the optimization.

Value

A list containing the output from the solver (model) and the outputs from the Kalman filter and monte carlo evaluation routine (fit).

`levmulttest` *Test for misspecification in the form of an excluded leverage multiplier.*

Description

Test for misspecification in the form of an excluded leverage multiplier.

Usage

```
levmulttest(data, lmt, model)
```

Arguments

`data`	The data to be tested.
`model`	The null model.

Value

A test statistic with an asymptotic chi^2(1) distribution under the null model.

`llevtest` — *Test for a leverage effect in the data.*

Description

Test for a leverage effect in the data.

Usage

```
llevtest(data, model)
```

Arguments

`data`	The data to be tested.
`model`	The null model.

Value

A test statistic with an asymptotic chi^2(1) distribution under the null model.

`llratiotest` — *Likelihood ratio test for two competing stochastic volatility models.*

Description

Likelihood ratio test for two competing stochastic volatility models.

Usage

```
llratiotest(model0, model1)
```

Arguments

`model0`	The null model
`model1`	The alternative model

Value

The likelihood ratio test statistic, here presumably asymptotically distributed as chi^2(1) under the null.

mssverrors — *MSSV Errors*

Description

Calculate numerical "sandwich" variance-covariance errors of a multivariate stochastic volatility model.

Usage

```
mssverrors(model, y, x)
```

Arguments

`model`	Output "model" from function "fitmssv".
`y`	The bivariate time series of log returns that the model has been fitted to.
`x`	The explanatory variable for the model of the first column in y, presumably a log leverage multiplier.

simdevent — *simdevent*

Description

Simulate the minimum leverage ratio during some period given inputs.

Usage

```
simdevent(
  N = 1000,
  len = 500,
  pars = c(-10, 0.95, 0.3, -12, 0.9, 0.2, 0.9, 1),
  Ain = 80,
  Ein = 60,
  K = 60,
  r = 0.001,
  uv = 5e-04,
  ttv = 5,
  thd = 0.8,
  plot = T
)
```

Arguments

`N`	Integer, the number of time series to use for the simulation.
`len`	Integer, the length of the simulated time period.
`pars`	A vector with the parameter values of the structural multivariate stochastic volatility model. Should be in the order: c(mu_1, beta_1, sigma_1, mu_2, beta_2, sigma_2, rho, phi), where subscript 1 corresponds to the "structural" series that has an explanatory variable in the state equation.

Ain	Numeric, initial asset value.
Ein	Numeric, initial equity value.
K	Numeric, debt value over the time period.
r	Numeric, the risk-free rate of interest
uv	Numeric, the daily unconditional variance of the assets over the period.
ttv	Numeric, time to maturity of the debt over the period (measured in years).
thd	Numeric, specifies a threshold leverage ratio that the user wants to monitor. Used to draw a vertical abline in the histogram.
plot	Boolean, should a plot be created (T) or not (F)?

Value

Plots the histogram with a vertical abline for a user-specified threshold and returns the simulated minimum leverage ratios.

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simintprob *simintprob*

Description

Simulate the probability that leverage ratio lies in some range at the end of the period.

Usage

```
simintprob(
  N = 1000,
  len = 500,
  pars = c(-10, 0.95, 0.3, -12, 0.9, 0.2, 0.9, 1),
  Ain = 80,
  Ein = 60,
  K = 60,
  r = 0.001,
  uv = 5e-04,
  ttv = 5,
  lower = 0.4,
  upper = 0.6,
  seed = 123
)
```

Arguments

len	Integer, the length of the simulated time period.
pars	A vector with the parameter values of the structural multivariate stochastic volatility model.
Ain	Numeric, initial asset value.
Ein	Numeric, initial equity value.
K	Numeric, debt value over the time period.
r	Numeric, the risk-free rate of interest
uv	Numeric, the daily unconditional variance of the assets over the period.
ttv	Numeric, time to maturity of the debt over the period (measured in years).

Value

The probability that the leverage ratio lies in the specified range at the end of the period.

---

simstrucsystem *simstrucsystem*

Description

Simulate a bivariate structural volatility model.

Usage

```
simstrucsystem(
  len = 30,
  pars = c(-10, 0.95, 0.3, -12, 0.9, 0.2, 0.6, 1),
  Ain = 100,
  Ein = 80,
  K = 20,
  r = 0.001,
  uv = 5e-04,
  ttv = 5,
  crisis_sim = F,
  crisisret = -0.1
)
```

Arguments

len	Integer, the length of the simulated time period.
pars	A vector with the parameter values of the structural multivariate stochastic volatility model.
Ain	Numeric, initial asset value.
Ein	Numeric, initial equity value.
K	Numeric, debt value over the time period.
r	Numeric, the risk-free rate of interest
uv	Numeric, the daily unconditional variance of the assets over the period.
ttv	Numeric, time to maturity of the debt over the period (measured in years).

Value

A list containing relevant simulated quantities.

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