

Package ‘varmapack’

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Type Package

Title Burn-in-Free Simulation and Analysis of Gaussian VARMA Models

Version 0.1.1

Description Simulates Gaussian vector autoregressive-moving-average time-series models without a burn-in period by drawing startup shocks from their model-implied conditional distribution. Also provides model test cases, autocovariances, spectral radii, and impulse responses.

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Encoding UTF-8

Depends R (>= 4.0.0)

Imports R6, randompack (>= 0.1.10)

LinkingTo randompack

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

VignetteBuilder knitr

Config/testthat/edition 3

RoxygenNote 7.3.2

URL <https://github.com/jonasson2/varmapack>

BugReports <https://github.com/jonasson2/varmapack/issues>

NeedsCompilation yes

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varmapack_autocov	<i>Sample autocovariances of an observed series</i>
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Description

Compute sample autocovariance matrices up to a specified lag for a numeric time-series matrix with variables in rows and observations in columns.

Usage

```
varmapack_autocov(X, maxlag, norm = "ML")
```

Arguments

X	Numeric r by n observed time-series matrix.
maxlag	Largest lag to compute, between zero and n - 1.
norm	Either "ML", which divides every lag by n, or "C", which divides the lag-k covariance by n - k.

Value

An r by r by maxlag + 1 array. Its k + 1 plane estimates $\text{Cov}(x_t, x_{t-k})$.

Examples

```
X <- rbind(1:10, (1:10)^2)
varmapack_autocov(X, maxlag = 2)
```

varmapack_cov2corr	<i>Convert covariances to correlations</i>
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Description

Convert a covariance matrix or sequence of autocovariance matrices to correlations using the marginal standard deviations at lag zero.

Usage

```
varmapack_cov2corr(cov)
```

Arguments

cov	A finite numeric r by r matrix or r by r by maxlag + 1 array. The diagonal entries of its lag-zero matrix must be positive.
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Value

A numeric array with the same dimensions as cov. Lag-zero diagonal entries are exactly one. Other entries are not clipped to $[-1, 1]$.

Examples

```
cov <- array(c(4, 3, 3, 9, 2, 6, -3, 1.5), dim = c(2, 2, 2))
varmapack_cov2corr(cov)
```

varmapack_model	<i>Create a VARMA or VARMAX model</i>
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Description

Create a model object for simulation of a Gaussian VAR, VMA, VARMA, or VARMAX time series. The object stores model parameters and provides a `$sim()` method for generating one or more independent series.

Usage

```
varmapack_model(A = NULL, B = NULL, C = NULL, Sig, mu = NULL)
```

Arguments

- | | |
|-----|---|
| A | Autoregressive coefficient matrices as an r by r matrix or an r by r by p array. NULL gives no autoregressive terms. |
| B | Moving-average coefficient matrices as an r by r matrix or an r by r by q array. NULL gives no moving-average terms. |
| C | Exogenous coefficient matrices as an r by d matrix or an r by d by s array. NULL gives a VARMA model rather than VARMAX. |
| Sig | r by r innovation covariance matrix. |
| mu | Optional r vector or r by nmu matrix of time-series means. The last mean vector repeats for the rest of each series. Means are not supported for VARMAX models. |

Value

A `VarmapackModel` object.

Simulation

`model$sim(length, nrep = 1L, X0 = NULL, z = NULL, rng = NULL, return_shocks = FALSE)` simulates `nrep` independent series of the supplied length.

For VARMA models, `X0` is optional. If provided, it is an `r` by `nX0` matrix or an `r` by `nX0` by `nrep` array. Its second dimension must be at least $\max(p, q)$, and its third dimension, when present, must be 1 or `nrep`. Nonstationary VARMA models require `X0`; with MA terms, `Sig` must be positive definite and startup shocks are conditioned on the residual equations implied by the supplied history.

For VARMAX models, `z` is required. `X0` has the same form and its second dimension must be at least $\max(p, q, s - 1)$. It may be omitted when this minimum is zero. The exogenous input `z` is a `d` by `length` matrix or a `d` by `length` by `nrep` array. Its third dimension, when present, must be 1 or `nrep`.

Pass a `randompack::randompack_rng()` object through `rng` to control the random stream. When it is omitted, `Varmapack` uses a temporary randomized default `Randompack` generator. With `return_shocks = FALSE`, the result is an `r` by `length` by `nrep` array. With `return_shocks = TRUE`, it is a list with components `X` and `E`, each with that shape.

Model analysis

`model$acvf(maxlag)` returns theoretical VARMA autocovariances, `model$psi(maxlag)` returns impulse-response matrices, and `model$irf(maxlag)` returns orthogonalized impulse-response matrices. `model$specrad()` and `model$ma_specrad()` return the AR and MA spectral radii, respectively. Theoretical autocovariances are not available for VARMAX models with exogenous terms.

Examples

```
A <- matrix(c(0.4, 0.1, -0.2, 0.3), 2, 2)
model <- varmapack_model(A = A, Sig = diag(2))
X <- model$sim(100)

rng <- randompack::randompack_rng()
rng$seed(123)
X <- model$sim(100, nrep = 3, rng = rng)
```

varmapack_testcase	Create a VARMA testcase model
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Description

Create a built-in named testcase or an unnamed random, deterministic, or spectral-radius-controlled VARMA testcase.

Usage

```
varmapack_testcase(
  which = "random",
  p = NULL,
  q = NULL,
  r = NULL,
  rho = 0,
  rng = NULL
)
```

Arguments

<code>which</code>	A built-in testcase name, a one-based built-in testcase index, or one of "random", "deterministic", and "rho".
<code>p, q, r</code>	Required AR order, MA order, and series dimension for unnamed testcases.
<code>rho</code>	Target spectral radius when <code>which = "rho"</code> .
<code>rng</code>	Optional <code>randpack::randpack_rng()</code> used for a random testcase.

Value

A `VarmapackModel` object.

Examples

```
model <- varmapack_testcase("smallARMA1")
model <- varmapack_testcase("rho", p = 3, q = 1, r = 2, rho = 0.8)
```

<code>varmapack_testcases</code>	<i>List named VARMA testcases</i>
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Description

List named VARMA testcases

Usage

```
varmapack_testcases()
```

Value

A data frame with columns `index`, `name`, `p`, `q`, and `r`.

Examples

```
varmapack_testcases()
```

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