Package: varmapack (via r-universe)

October 16, 2026

Type Package

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

Version 0.1.2

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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Repository https://cran.r-universe.dev

Date/Publication 2026-09-15 22:10:02 UTC

RemoteUrl https://github.com/cran/varmapack

RemoteRef HEAD

RemoteSha 40808f90c9614347b58ea906052d7d1a4377e61d

Contents

varmapack_autocov 2
varmapack_cov2corr 3
varmapack_model 3
varmapack_testcase 5
varmapack_testcases 6

Index **7**

`varmapack_autocov` *Sample autocovariances of an observed series*

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 `Cov(x_t, x_{t-k})`.

Examples

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

varmapack_cov2corr *Convert covariances to correlations*

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.

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 *Create a VARMA or VARMAX model*

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*

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

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

`varmapack_testcases` *List named VARMA testcases*

Description

List named VARMA testcases

Usage

```
varmapack_testcases()
```

Value

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

Examples

```
varmapack_testcases()
```

Index

varmapack_autocov, 2
varmapack_cov2corr, 3
varmapack_model, 3
varmapack_testcase, 5
varmapack_testcases, 6