Package ‘tmvtnsim’

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Author Kaifeng Lu
Maintainer Kaifeng Lu <kaifenglu@gmail.com>
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Description

Simulation of random vectors from truncated multivariate normal and t distributions based on the algorithms proposed by Yifang Li and Sujit K. Ghosh (2015) <doi:10.1080/15598608.2014.996690>. We allow the mean, lower and upper bounds to differ across samples to accommodate regression problems. The algorithms are implemented in C++ and hence are highly efficient.

Author(s)

Kaifeng Lu, <kaifenglu@gmail.com>

References


rtmvnorm

Random Generation for Truncated Multivariate Normal

Description

Draws from truncated multivariate normal distribution subject to linear inequality constraints represented by a matrix.

Usage

rtmvnorm(
  mean = mean,
  sigma = sigma,
  blc = NULL,
  lower = lower,
  upper = upper,
  init = NULL,
  burn = 10,
  n = NULL
)
**Arguments**

- **mean**: \( n \times p \) matrix of means. The number of rows is the number of observations. The number of columns is the dimension of the problem.
- **sigma**: \( p \times p \) covariance matrix.
- **blc**: \( m \times p \) matrix of coefficients for linear inequality constraints. If **NULL**, the \( p \times p \) identity matrix will be used.
- **lower**: \( n \times m \) or \( 1 \times m \) matrix of lower bounds for truncation.
- **upper**: \( n \times m \) or \( 1 \times m \) matrix of upper bounds for truncation.
- **init**: \( n \times p \) or \( 1 \times p \) matrix of initial values. If **NULL**, default initial values will be generated.
- **burn**: number of burn-in iterations. Defaults to 10.
- **n**: number of random samples when **mean** is a vector.

**Value**

Returns an \( n \times p \) matrix of random numbers following the specified truncated multivariate normal distribution.

**Examples**

```r
# Example 1: full rank blc
d = 3;
rho = 0.9;
sigma = matrix(0, d, d);
sigma = rho^abs(row(sigma) - col(sigma));
blc = diag(1,d);
n = 1000;
mean = matrix(rep(1:d,n), nrow=n, ncol=d, byrow=TRUE);
set.seed(1203)
result = rtmvnorm(mean, sigma, blc, -1, 1, burn=50)
apply(result, 2, summary)

# Example 2: use the alternative form of input
set.seed(1203)
result = rtmvnorm(mean=1:d, sigma, blc, -1, 1, burn=50, n=1000)
apply(result, 2, summary)

# Example 3: non-full rank blc, invalid initial values
d = 3;
rho = 0.5;
sigma = matrix(0, d, d);
sigma = rho^abs(row(sigma) - col(sigma));
blc = matrix(c(1,1,0,1,0,1,0,1,1), ncol=d);
n = 100;
mean = matrix(rep(1:d,n), nrow=n, ncol=d, byrow=TRUE);
set.seed(1228)
result = rtmvnorm(mean, sigma, blc, -1, 1, burn=10)
apply(result, 2, summary)
```
# Example 4: non-full rank blc, alternative form of input
set.seed(1228)
result = rtmvnorm(mean=1:d, sigma, blc, -1, 1, burn=10, n=100)
apply(result, 2, summary)

# Example 5: means, lower, or upper bounds differ across samples
d = 3;
rho = 0.5;
sigma = matrix(0, d, d);
sigma = rho^abs(row(sigma) - col(sigma));
blc = matrix(c(1,0,1,1,1,0), ncol=d, byrow=TRUE)
n = 100;
set.seed(3084)
mean = matrix(runif(n*d), nrow=n, ncol=d);
result = rtmvnorm(mean, sigma, blc, -1, 1, burn=50)
apply(result, 2, summary)

---

rtmvt

Random Generation for Truncated Multivariate t

Description

Draws from truncated multivariate t distribution subject to linear inequality constraints represented by a matrix.

Usage

```r
rtmvt(
mean = mean,
sigma = sigma,
nu = nu,
blc = NULL,
lower = lower,
upper = upper,
init = NULL,
burn = 10,
n = NULL
)
```

Arguments

- **mean**: n x p matrix of means. The number of rows is the number of observations. The number of columns is the dimension of the problem.
- **sigma**: p x p covariance matrix.
- **nu**: degrees of freedom for Student-t distribution.
- **blc**: m x p matrix of coefficients for linear inequality constraints. If NULL, the p x p identity matrix will be used.
rtmvt

lower

n \times m \text{ or } 1 \times m \text{ matrix of lower bounds for truncation.}

upper

n \times m \text{ or } 1 \times m \text{ matrix of upper bounds for truncation.}

init

n \times p \text{ or } 1 \times p \text{ matrix of initial values. If } \text{NULL, default initial values will be generated.}

burn

number of burn-in iterations. Defaults to 10.

n

number of random samples when mean is a vector.

Value

Returns an $n \times p$ matrix of random numbers following the specified truncated multivariate t distribution.

Examples

# Example 1: full rank blc
d = 3;
rho = 0.5;
sigma = matrix(0, d, d);
sigma = rho^abs(row(sigma) - col(sigma));
nu = 10;
blc = diag(1, d);
n = 1000;
mean = matrix(rep(1:d, n), nrow=n, ncol=d, byrow=TRUE);
set.seed(1203)
result = rtmvt(mean, sigma, nu, blc, -1, 1, burn=50)
apply(result, 2, summary)

# Example 2: use the alternative form of input
set.seed(1203)
result = rtmvt(mean=1:d, sigma, nu, blc, -1, 1, burn=50, n)
apply(result, 2, summary)

# Example 3: non-full rank blc, different means
d = 3;
rho = 0.5;
sigma = matrix(0, d, d);
sigma = rho^abs(row(sigma) - col(sigma));
nu = 10;
blc = matrix(c(1,0,1,1,0), nrow=d-1, ncol=d, byrow=TRUE)
n = 100;
set.seed(3084)
mean = matrix(runif(n*d), nrow=n, ncol=d);
result = rtmvt(mean, sigma, nu, blc, -1, 1, burn=50)
apply(result, 2, summary)
Description

Draws from truncated univariate normal distribution within an interval.

Usage

\texttt{rtnorm(mean = mean, sd = sd, lower = lower, upper = upper, n = NULL)}

Arguments

- \texttt{mean} vector of means. The length is the number of observations.
- \texttt{sd} standard deviation. Defaults to 1.
- \texttt{lower} a scalar of lower bound for truncation, or a vector of lower bounds with the same length as \texttt{mean}.
- \texttt{upper} a scalar of upper bound for truncation, or a vector of upper bounds with the same length as \texttt{mean}.
- \texttt{n} number of random samples when \texttt{mean} is a scalar.

Value

Returns a vector of random numbers following the specified truncated univariate normal distribution.

Examples

\begin{verbatim}
set.seed(1203)
x = rtnorm(mean=rep(1,1000), sd=2, lower=-2, upper=3)
summary(x)

# use the alternative form of input
set.seed(1203)
x = rtnorm(mean=1, sd=2, lower=-2, upper=3, n=1000)
summary(x)
\end{verbatim}
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