Package ‘condTruncMVN’

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condtMVN .............................................................. 2
dcmvtruncnorm ...................................................... 4
pcmvtruncnorm ....................................................... 5
rcmvtruncnorm ....................................................... 7
Description

Suppose that $Z = (X, Y)$ is from a fully-joint multivariate normal distribution of dimension $n$ with mean and covariance matrix $\sigma$ truncated between lower and upper. This function provides the parameters for the conditional mean and covariance matrix of $Y$ given $X$. See the vignette for more information.

Usage

```r
condtMVN(mean, sigma, lower, upper, dependent.ind, given.ind, X.given, init = rep(0, length(mean))
)
```

Arguments

- `mean`: the mean vector for $Z$ of length of $n$
- `sigma`: the symmetric and positive-definite covariance matrix of dimension $n \times n$ of $Z$.
- `lower`: a vector of lower bounds of length $n$ that truncate $Z$
- `upper`: a vector of upper bounds of length $n$ that truncate $Z$
- `dependent.ind`: a vector of integers denoting the indices of dependent variable $Y$.
- `given.ind`: a vector of integers denoting the indices of conditioning variable $X$. If specified as integer vector of length zero or left unspecified, the unconditional density is returned.
- `X.given`: a vector of reals denoting the conditioning value of $X$. This should be of the same length as `given.ind`
- `init`: initial value used for random generation of truncated multivariate normal in a Gibbs sampler. Default: A vector of zeros, equal to the number of components. For details, see `tmvmixnorm::rtmvn()`.

Details

The first four arguments are the parameters of multivariate normal and the truncation space. `dependent.ind`, `given.ind`, `X.given`, `init` are all arguments that determines the conditional truncated MVN.

Using the full data $Z$, the conditional mean and conditional variance of $Y|X$ are determined (Wang, 2006). Additionally, to reflect the reduced dimension of $Y|X$, the truncation limits are also adjusted.

See the vignette for more information.
condtMVN

Value

Returns a list of:

- condMean - conditional mean of Y|X
- condVar - conditional variance of Y|X
- condLower - the lower bound of Y|X
- condUpper - the upper bound of Y|X
- condInit - the initial values adjusted to match the dimension of Y|X. These are used to randomly generate the truncated multivariate normal rcomvtruncnorm.

Note

This function is based on condMVN from the condMVNorm package.

References


See Also

cmvnorm, pmvnorm, Mvnorm

Examples

# Suppose X2,X3,X5|X2,X4 ~ N_3(1, Sigma) and truncated between -10 and 10.
d <- 5
rho <- 0.9
Sigma <- matrix(0, nrow = d, ncol = d)
Sigma <- rho^abs(row(Sigma) - col(Sigma))

# Conditional Truncated Normal Parameters
condtMVN(mean = rep(1, d),
         sigma = Sigma,
         lower = rep(-10, d),
         upper = rep(10, d),
         dependent.ind = c(2, 3, 5),
         given.ind = c(1, 4), X.given = c(1, -1))
Density of the Conditional Truncated Multivariate Normal

dcmvtruncnorm

Description

Calculates the density of truncated conditional multivariate normal Y|X: \( f(Y = y|X = X.given) \). See the vignette for more information.

Usage

dcmvtruncnorm(
  y,
  mean,
  sigma,
  lower,
  upper,
  dependent.ind,
  given.ind,
  X.given,
  log = FALSE
)

Arguments

- **y**: vector or matrix of quantiles of Y. If a matrix, each row is taken to be a quantile. This is the quantity that the density is calculated from.
- **mean**: the mean vector for Z of length of n
- **sigma**: the symmetric and positive-definite covariance matrix of dimension n x n of Z.
- **lower**: a vector of lower bounds of length n that truncate Z
- **upper**: a vector of upper bounds of length n that truncate Z
- **dependent.ind**: a vector of integers denoting the indices of dependent variable Y.
- **given.ind**: a vector of integers denoting the indices of conditioning variable X. If specified as integer vector of length zero or left unspecified, the unconditional density is returned.
- **X.given**: a vector of reals denoting the conditioning value of X. This should be of the same length as given.ind
- **log**: logical; if TRUE, densities d are given as log(d).

References

Examples

# Example 1: X2,X3,X5|X2,X4 ~ N_3(1, Sigma)
# truncated between -10 and 10.
d <- 5
rho <- 0.9
Sigma <- matrix(0, nrow = d, ncol = d)
Sigma <- rho^abs(row(Sigma) - col(Sigma))

# Log-density of 0
dcmvtruncnorm(
  rep(0, 3),
  mean = rep(1, 5),
  sigma = Sigma,
  lower = rep(-10, 5),
  upper = rep(10, d),
  dependent.ind = c(2, 3, 5),
  given.ind = c(1, 4), X.given = c(1, -1),
  log = TRUE
)

pcmvtruncnorm  
CDF for the Conditional Truncated Multivariate Normal

Description

Computes the distribution function for a conditional truncated multivariate normal random variate Y|X.

Usage

pcmvtruncnorm(
  lowerY,  
  upperY,  
  mean,  
  sigma,  
  lower,  
  upper,  
  dependent.ind,  
  given.ind,  
  X.given,  
  ...  
)

Arguments

lowerY  
the vector of lower limits for Y|X. Passed to tmvtnorm::ptmvnorm().

upperY  
the vector of upper limits for Y|X. Must be greater than lowerY. Passed to tmvtnorm::ptmvnorm().
pmvtruncnorm

mean: the mean vector for Z of length of n
sigma: the symmetric and positive-definite covariance matrix of dimension n x n of Z.
lower: a vector of lower bounds of length n that truncate Z
upper: a vector of upper bounds of length n that truncate Z
dependent.ind: a vector of integers denoting the indices of dependent variable Y.
given.ind: a vector of integers denoting the indices of conditioning variable X. If specified as integer vector of length zero or left unspecified, the unconditional density is returned.
X.given: a vector of reals denoting the conditioning value of X. This should be of the same length as given.ind
...
Additional arguments passed to tmvnorm::ptmvnorm(). The CDF is calculated using the Genz algorithm based on these arguments: maxpts, abseps, and releps.

Details
Calculates the probability that \( Y|X \) is between \( \text{lower}_Y \) and \( \text{upper}_Y \). \( Z = (X, Y) \) is the fully joint multivariate normal distribution with mean equal mean and covariance matrix sigma, truncated between lower and upper. See the vignette for more information.

Note
For one-dimension conditionals \( Y|X \), this function uses the ptruncnorm() function in the truncnorm package. Otherwise, this function uses tmvnorm::ptmvnorm().

Examples

# Example 1: Let \( X_2,X_3,X_5|X_2,X_4 \sim N_3(1, \Sigma) \)
# truncated between -10 and 10.
d <- 5
rho <- 0.9
Sigma <- matrix(0, nrow = d, ncol = d)
Sigma <- rho^abs(row(Sigma) - col(Sigma))

# Find \( P(-0.5 < X_2,X_3,X_5 < 0 | X_2,X_4) \)
pcmvtruncnorm(rep(-0.5, 3), rep(0, 3),
mean = rep(1, d),
sigma = Sigma,
lower = rep(-10, d),
upper = rep(10, d),
dependent.ind = c(2, 3, 5),
given.ind = c(1, 4), X.given = c(1, -1)
)

# Example 2: Let \( X_1| X_2 = 1, X_3 = -1, X_4 = 1, X_5 = -1 \sim N(1, \Sigma) \) truncated between -10 and 10. Find \( P(-0.5 < X_1 < 0 | X_2 = 1, X_3 = -1, X_4 = 1, X_5 = -1) \).
pcmvtruncnorm(-0.5, 0,
mean = rep(1, d),
sigma = Sigma,
lower = rep(-10, d),
Random Sample from Conditional Truncated Multivariate Normal

Description

Randomly samples from conditional truncated multivariate normal distribution variate, \( \mathbf{Y} | \mathbf{X} \), where \( \mathbf{Z} = (\mathbf{X}, \mathbf{Y}) \) is the fully joint multivariate normal distribution with mean, covariance matrix \( \mathbf{\Sigma} \), and truncated between \( \mathbf{lower} \) and \( \mathbf{upper} \). See the vignette for more information.

Usage

```r
rcmvtruncnorm(
  n, mean, sigma, lower, upper, dependent.ind, given.ind, X.given,
  init = rep(0, length(mean)), burn = 10L, thin = 1
)
```

Arguments

- **n**: number of random samples desired (sample size).
- **mean**: the mean vector for \( \mathbf{Z} \) of length of \( n \).
- **sigma**: the symmetric and positive-definite covariance matrix of dimension \( n \times n \) of \( \mathbf{Z} \).
- **lower**: a vector of lower bounds of length \( n \) that truncate \( \mathbf{Z} \).
- **upper**: a vector of upper bounds of length \( n \) that truncate \( \mathbf{Z} \).
- **dependent.ind**: a vector of integers denoting the indices of dependent variable \( \mathbf{Y} \).
- **given.ind**: a vector of integers denoting the indices of conditioning variable \( \mathbf{X} \). If specified as integer vector of length zero or left unspecified, the unconditional density is returned.
- **X.given**: a vector of reals denoting the conditioning value of \( \mathbf{X} \). This should be of the same length as \( \text{given.ind} \).
- **init**: initial value used for random generation of truncated multivariate normal in a Gibbs sampler. Default: A vector of zeros, equal to the number of components. For details, see \text{tmvmixnorm}\::\text{rtmvn}().
rcmvtruncnorm

burn the burn-in, which is the number of initial iterations to be discarded. Default: 10. Passed to rtmvn().

thin thinning lag (default as 1).

Note

Uses rtmvn from the tmvmixnorm package to find the random variate.

Examples

# Generate 2 random numbers from X2,X3,X5|X2,X4 ~ N_3(1, Sigma) # truncated between -10 and 10.
set.seed(2342)
rcmvtruncnorm(2,
  mean = rep(1, d),
  sigma = Sigma,
  lower = rep(-10, d),
  upper = rep(10, d),
  dependent.ind = c(2, 3, 5),
  given.ind = c(1, 4), X.given = c(1, -1)
)

# Example 2: Generate two random numbers from # X1|X2, X3, X4, X5 ~ N(1, Sigma) truncated between -10 and 10.
set.seed(2342)
rcmvtruncnorm(2,
  mean = rep(1, d),
  sigma = Sigma,
  lower = rep(-10, d),
  upper = rep(10, d),
  dependent.ind = 1,
  given.ind = 2:5, X.given = c(1, -1, 1, -1)
)
Index

cmvnorm, 3
condMVN, 3
condtMVN, 2
dcmvtruncnorm, 4
Mvnorm, 3
pcmvtruncnorm, 5
pmvnorm, 3
ptmvnorm, 5, 6
rcmvtruncnorm, 3, 7
rtmvn, 2, 7, 8