Package 'symmoments'

February 21, 2012

Title Symbolic Central Moments of the Multivariate Normal Distribution

Version 1.0

Date 2010-01-31

Author Kem Phillips

Maintainer Kem Phillips <kemphillips@comcast.net>

Depends mvtnorm

Description Symbolic central moments of the multivariate normal distribution. Computes a standard representation, LateX code,and values at specified covariance matrices.

License GPL-2

Repository CRAN

Date/Publication 2010-02-02 00:21:03

R topics documented:

symmoments-package 2
callmultmoments 3
evaluate 4
multmoments 6
print.moment 7
simulate.moment 8
toLatex.moment 9

Index **11**

`symmoments-package` *Symbolically compute multivariate normal central moments*

Description

Symbolically computes multivariate normal central moments E[X1**2 *...* Xn**n], where (X1,...,Xn) ~ N(0,S), in terms of S elements.

Produces Latex code for the moment.

Computes numerical moments at specified covariance matrices.

Details

Package:	symmoments
Type:	Package
Version:	1.0
Date:	2010-01-20
License:	GPL 2
LazyLoad:	yes

A representation of a central moment of the multivariate normal distribution, given by a positive integer vector c(k1,k2,...,kn), is obtained from the function callmultmoments. This function initializes variables and calls the function multmoments which determines a representation of a multivariate moment using a recursive algorithm. The representation is given class 'moment'.

The print method prints the representation of a multivariate moment.

The toLatex method uses the output of callmultmoments to determine the LaTeX code for the moment sorted lexicographically.

The generic evaluate method uses the output of callmultmoments to determine the value of the moment for a specified covariance matrix.

The simulate method is used to approximate a (possibly non-central) moment using Monte Carlo integration.

Note

The mvtnorm package must be loaded for the simulate method.

Author(s)

Maintainer: Kem Phillips <kemphillips@comcast.net>

References

Phillips K (2010). Symbolic Computation of the Central Moments of the Multivariate Normal Distribution. *Journal of Statistical Software, Code Snippets*, **33**(1), 1–14. http://www.jstatsoft.org/v33/c01/.

Examples

```
# Compute the moment for the 4-dimensional moment c(1,2,3,4):
callmultmoments(c(1,2,3,4))

# Print the representation of the 4-dimensional moment c(1,2,3,4):
print(callmultmoments(c(1,2,3,4)))

# Compute the LaTeX representation of the central moment c(1,2,3,4):
toLatex(callmultmoments(c(1,2,3,4)))

# Write the LaTeX representation to a file using the standard R function (not run):
# writeLines(callmultmoments(c(1,2,3,4))),con="yourfilename", sep = "\n")

# evaluate the moment c(1,2,3,4) at the following variance-covariance matrix
  #  4 2 1 1
  #  2 3 1 1
  #  1 1 2 1

evaluate(callmultmoments(c(1,2,3,4)),c(4,2,1,1,3,1,1,2,1,2))

# Using 10000 samples, estimate the central moment for the moment c(2,4) at the covariance matrix (not run)
#  2 1
#  1 4

# and mean (0,0)
# library(mvtnorm)
# simulate(callmultmoments(c(2,4)),10000,NULL,c(0,0),c(2,1,1,4))
```

`callmultmoments` *Compute multivariate moment symbolically*

Description

Computes a multivariate normal moment by initializing variables, calling multmoments, and constructing output

Usage

```
callmultmoments(moment)
```

Arguments

`moment`	vector c(k1,... ,kn) specifying the moment X1**k1 *...* Xn**kn

Details

Each row of the representation gives the exponents for a single product of covariance terms. For example, (1,2,0) represents S11**1 S12** S22**0, where the Sij are the covariances. The full moment is the sum of these terms multiplied by their respective coefficients. If the sum of the exponents is odd, the moment is 0.

Value

A object of class 'moment', which is a list with three components:

`moment`	the input moment vector
`representation`	a matrix containing the representation in terms of upper-triangular matrices
`coefficients`	the coefficients corresponding to the rows of the representation

If the sum of the exponents is odd, returns -1 and prints "Sum of powers is odd. Moment is 0."

If any exponent is negative, returns -2 and prints "All components of the moment must be non-negative."

If any exponent is not an integer, returns -3 and prints "All components of the moment must be integers."

Author(s)

Kem Phillips <kemphillips@comcast.net>

References

Phillips K (2010). Symbolic Computation of the Central Moments of the Multivariate Normal Distribution. *Journal of Statistical Software, Code Snippets*, **33**(1), 1–14. http://www.jstatsoft.org/v33/c01/.

See Also

multmoments and the methods toLatex, evaluate, and simulate in symmoments

Examples

```
# Compute the moment for the 4-dimensional moment c(1,2,3,4):

m.1234 <- callmultmoments(c(1,2,3,4))
```

`evaluate` *Evaluate a multivariate moment*

Description

Generic method for class moment to compute the numerical value of a moment at a specified covariance matrix from the output of callmultmoments

Usage

```
 ## S3 method for class 'moment'
evaluate(object,sigma)
```

Arguments

object	an object of class 'moment'
sigma	an upper-triangular matrix of covariance terms expressed as a vector at which the moment is to be evaluated

Details

object is normally the output of a call to callmultmoment. This is a list with first component the moment itself, the second component the set of upper-triangular matrices representing the moment, and the third component containing their corresponding coefficients. This is an object of class 'moment'.

Value

numeric value of the moment at the specified covariance matrix

Author(s)

Kem Phillips <kemphillips@comcast.net>

References

Phillips K (2010). Symbolic Computation of the Central Moments of the Multivariate Normal Distribution. *Journal of Statistical Software, Code Snippets*, **33**(1), 1–14. http://www.jstatsoft.org/v33/c01/.

See Also

callmultmoments and the simulate and toLatex methods from the symmoments package

Examples

```
evaluate(callmultmoments(c(1,2,3,4)),c(4,2,1,1,3,1,1,2,1,2))
# evaluates the moment at c(1,2,3,4) at the following covariance matrix
#    4 2 1 1
#    2 3 1 1
#    1 1 2 1
#    1 1 1 2
```

`multmoments` *Recursive function to compute a multivariate moment*

Description

Called by callmultmoments to compute representation of a multivariate normal moment using recursive algorithm

Usage

```
multmoments(moment,current.matrix,current.cell,moment.rep,row_col)
```

Arguments

`moment`	vector c(k1,...,kn) specifying the moment X1**k1 *...* Xn**kn
`current.matrix`	upper-triangular integer matrix under consideration in recursion
`current.cell`	cell in current matrix under consideration in recursion
`moment.rep`	current set of representations; mult.moments adds each satisfying matrix to moment.rep
`row_col`	matrix giving rows and columns for square matrix for each cell

Details

Each row of the representation gives the exponents for a single product of covariance terms. For example, (1,2,0) represents S11**1 S12**2 S22**0, where the Sij are the covariances.

This function would normally only be called by callmultmoments.

Value

moment representation, moment.rep, augmented with additional representations

Author(s)

Kem Phillips <kemphillips@comcast.net>

References

Phillips K (2010). Symbolic Computation of the Central Moments of the Multivariate Normal Distribution. *Journal of Statistical Software, Code Snippets*, **33**(1), 1–14. http://www.jstatsoft.org/v33/c01/.

See Also

callmultmoments (symmoments)

`print.moment` *Print the representation of a multivariate moment*

Description

Prints an object of class 'moment'

Usage

```
 ## S3 method for class 'moment'
print(x,...)
```

Arguments

`x`	an object of class 'moment', usually the output of callmultmoments
`...`	Included only for consistency with generic function

Details

Prints the moment as E[X1**k1 X2**k2 ...]: followed by the lines of the representation with the corresponding coefficient attached

Author(s)

Kem Phillips <kemphillips@comcast.net>

References

Phillips K (2010). Symbolic Computation of the Central Moments of the Multivariate Normal Distribution. *Journal of Statistical Software, Code Snippets*, **33**(1), 1–14. http://www.jstatsoft.org/v33/c01/.

See Also

callmultmoments (symmoments)

Examples

```
print(callmultmoments(c(1,2,3)))
```

`simulate.moment` *Method to compute a multivariate moment using Monte Carlo integration*

Description

Computes a multivariate normal moment by Monte Carlo integration

Usage

```
## S3 method for class 'moment'
simulate(object,nsim,seed,Mean,Sigma,...)
```

Arguments

`object`	object of class 'moment' representing E[X1**k1,...,Xn**kn]
`nsim`	the number of samples to generate in computing the integral
`seed`	integer for random number generator (set.seed)
`Mean`	the mean of (X1,...,Xn)
`Sigma`	covariance of (X1**k1,...,Xn**kn), dimension nXn, expressed as a vector by row
`...`	Included only for consistency with generic function

Value

Approximate value of the moment

Note

Non-central moments can be approximated by specifying Mean. For central moments, set Mean to a vector of 0s.

The mvtnorm package must be loaded for the function rmvnorm.

Author(s)

Kem Phillips <kemphillips@comcast.net>

References

Rizzo ML (2008). Statistical Computing with R. Chapman & Hall/CRC

See Also

callmultmoments and the methods toLatex and evaluate from symmoments

Examples

```
# Using 10000 samples, estimate the central moment for the moment c(2,4) at the covariance matrix
#  2 1
#  1 4

# and mean (0,0)
library(mvtnorm)
simulate(callmultmoments(c(2,4)),10000,NULL,c(0,0),c(2,1,1,4))
```

`toLatex.moment` *LaTeX a multivariate moment*

Description

Computes a LaTeX representation sorted lexicographically of an object of class 'moment'

Usage

```
 ## S3 method for class 'moment'
toLatex(object,...)
```

Arguments

`object`	an object of class 'moment', usually the output of callmultmoments
`...`	Included only for consistency with generic function

Details

The first element of the result is the moment expressed as an expected value (E[...] =). The remaining lines are the LaTex representation broken at appropriate intervals for printing. (Individual terms for high dimensions will still overrun a printed line.) Double backslashes are inserted where LaTeX requires a backslash. These can be reset to single backslashes by writing the output to a file using the R function writeLines from the base package.

Value

Character vector giving the LaTeX code for the symbolic moment

Author(s)

Kem Phillips <kemphillips@comcast.net>

References

Phillips K (2010). Symbolic Computation of the Central Moments of the Multivariate Normal Distribution. *Journal of Statistical Software, Code Snippets*, **33**(1), 1–14. http://www.jstatsoft.org/v33/c01/.

See Also

callmultmoments and the evaluate method (symmoments)

Examples

```
toLatex(callmultmoments(c(1,2,3)))
```

Index

callmultmoments *(callmultmoments)*, 3
evaluate *(evaluate)*, 4
multmoments *(multmoments)*, 6
simulate.moment *(simulate.moment)*, 8
symmoments *(symmoments-package)*, 2
symmoments-package *(symmoments-package)*, 2

callmultmoments, 3

evaluate, 4

multmoments, 6

print.moment, 7
print.moment *(print.moment)*, 7

simulate.moment, 8
symmoments-package, 2

toLatex.moment, 9
toLatex.moment *(toLatex.moment)*, 9