Package ‘SparseGrid’

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Type Package
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Description SparseGrid is a package to create sparse grids for numerical integration, based on code from www.sparse-grids.de
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createIntegrationGrid Create integration grid with the least number of nodes, either using a sparse grid or a product rule grid.

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Description
This function creates nodes and weights that can be used for integration. It is a convenience function that calls createSparseGrid and createProductRuleGrid and returns the grid with the least number of nodes. Typically, a grid created by the product rule will only contain fewer nodes than a sparse grid for very low dimensions.

Usage
createIntegrationGrid(type, dimension, k, sym = FALSE)

Arguments
- **type** String or function for type of 1D integration rule, can take on values
  - "KPU" Nested rule for unweighted integral over [0,1]
  - "KPN" Nested rule for integral with Gaussian weight
  - "GQU" Gaussian quadrature for unweighted integral over [0,1] (Gauss-Legendre)
  - "GQN" Gaussian quadrature for integral with Gaussian weight (Gauss-Hermite)
- **func** any function. Function must accept level k and return a list with two elements nodes and weights for univariate quadrature rule with polynomial exactness 2k-1.
- **dimension** Dimension of the integration problem.
- **k** Accuracy level. The rule will be exact for polynomials up to total order 2k-1.
- **sym** (optional) only used for own 1D quadrature rule (type not "KPU"...). If sym is supplied and not FALSE, the code will run faster but will produce incorrect results if 1D quadrature rule is asymmetric.

Value
The return value contains a list with nodes and weights
- **nodes** matrix with a node in each row
- **weights** vector with corresponding weights

Author(s)
Jelmer Ypma

References

See Also
createSparseGrid createProductRuleGrid createMonteCarloGrid integrate pmvnorm
createMonteCarloGrid

Examples

# load library
library('SparseGrid')

# create integration grid
int.grid <- createIntegrationGrid( 'GQU', dimension=3, k=5 )

createMonteCarloGrid Create a multidimensional grid of nodes and weights for Monte Carlo integration

Description

Simulate nodes using a random number generator supplied by the user, and combine these with a vector of equal weights into a list. Sparse grids can be created with the function createSparseGrid.

Usage

createMonteCarloGrid( rng, dimension, num.sim, ... )

Arguments

rng function that generates random numbers. The first argument of this function should be called n. Examples are the R built-in functions rnorm and runif for random numbers from a standard normal or uniform distribution.

dimension dimension of the integration problem.

num.sim number of simulated integration nodes.

... arguments that will be passed to the random number generator rng.

Value

The return value contains a list with nodes and weights

nodes matrix with a node in each row

weights vector with corresponding weights

Author(s)

Jelmer Ypma

See Also

createSparseGrid createProductRuleGrid createIntegrationGrid integrate pmvnorm
createProductRuleGrid

Create a multidimensional grid of nodes and weights for integration

Description

Creates nodes and weights according to the product rule, combining 1D nodes and weights. Sparse grids can be created with the function createSparseGrid.

Usage

createProductRuleGrid(type, dimension, k, sym = FALSE)

Arguments

type

String or function for type of 1D integration rule, can take on values
"KPU" Nested rule for unweighted integral over [0,1]
"KPN" Nested rule for integral with Gaussian weight
"GQU" Gaussian quadrature for unweighted integral over [0,1] (Gauss-Legendre)
"GQN" Gaussian quadrature for integral with Gaussian weight (Gauss-Hermite)
func any function. Function must accept level k and return a list with two elements nodes and weights for univariate quadrature rule with polynomial exactness 2k-1.

dimension

dimension of the integration problem.

k

Accuracy level. The rule will be exact for polynomial up to total order 2k-1.

sym

(optional) only used for own 1D quadrature rule (type not "KPU",....). If sym is supplied and not FALSE, the code will run faster but will produce incorrect results if 1D quadrature rule is asymmetric.

Examples

# load library
library('SparseGrid')

# set random seed
set.seed( 3141 )

# Create Monte Carlo integration grids
# 1. with draws from a uniform distribution
mc.grid <- createMonteCarloGrid( runif, dimension=2, num.sim=10 )
mc.grid

# 2. with draws from a standard normal distribution
mc.grid <- createMonteCarloGrid( rnorm, dimension=3, num.sim=1000 )

# 3. with draws from a normal distribution with mean=2 and sd=5
mc.grid <- createMonteCarloGrid( rnorm, dimension=3, num.sim=1000, mean=2, sd=5 )
**createProductRuleGrid**

**Value**

The return value contains a list with nodes and weights

- **nodes**: matrix with a node in each row
- **weights**: vector with corresponding weights

**Author(s)**

Jelmer Ypma

**References**


**See Also**

`createSparseGrid`, `createMonteCarloGrid`, `createIntegrationGrid`, `integrate`, `pmvnorm`

**Examples**

```r
# load library
library('SparseGrid')

# define function to be integrated
# g(x) = x[1] * x[2] * ... * x[n]
g <- function( x ) {
  return( prod( x ) )
}

# Create sparse integration grid to approximate integral of a function with uniform weights
#
sp.grid <- createSparseGrid( 'KPU', dimension=3, k=5 )

# number of nodes and weights
length( sp.grid$weights )

# evaluate function g in nodes
gx.sp <- apply( sp.grid$nodes, 1, g )

# take weighted sum to get approximation for the integral
val.sp <- gx.sp %*% sp.grid$weights

# Create integration grid to approximate integral of a function with uniform weights
#
pr.grid <- createProductRuleGrid( 'KPU', dimension=3, k=5 )

# number of nodes and weights
```
createSparseGrid

Description

Creates nodes and weights that can be used for sparse grid integration. Based on Matlab code by Florian Heiss and Viktor Winschel, available from http://www.sparse-grids.de

Usage

createSparseGrid(type, dimension, k, sym = FALSE)

Arguments

type

String or function for type of 1D integration rule, can take on values

"KPU"  Nested rule for unweighted integral over [0,1]
"KPN"  Nested rule for integral with Gaussian weight
"GQU"  Gaussian quadrature for unweighted integral over [0,1] (Gauss-Legendre)
"GQN"  Gaussian quadrature for integral with Gaussian weight (Gauss-Hermite)
func any function. Function must accept level k and return a list with two elements nodes and weights for univariate quadrature rule with polynomial exactness 2k-1.

dimension dimension of the integration problem.
k Accuracy level. The rule will be exact for polynomial up to total order 2k-1.
sym (optional) only used for own 1D quadrature rule (type not "KPU"....). If sym is supplied and not FALSE, the code will run faster but will produce incorrect results if 1D quadrature rule is asymmetric.

Value

The return value contains a list with nodes and weights

nodes matrix with a node in each row
weights vector with corresponding weights

Author(s)
Jelmer Ypma

References

See Also
createProductRuleGrid createMonteCarloGrid createIntegrationGrid integrate pmvnorm

Examples

# load library
library('SparseGrid')

# define function to be integrated
# g(x) = x[1] * x[2] * ... * x[n]
g <- function( x ){
  return( prod( x ) )
}

# Create sparse integration grid to approximate integral of a function with uniform weights
# sp.grid <- createSparseGrid( 'KPU', dimension=3, k=5 )

# number of nodes and weights
length( sp.grid$weights )

# evaluate function g in nodes
readASCGrid

Read integration grid from file

Description

This function reads nodes and weights with the format of the .asc files available from http://www.sparse-grids.de

Usage

readASCGrid(filename, dimension)
Arguments
- filename: name of the file that you want to read. The extension should be included.
- dimension: dimension of the grid that you want to read.

Value
- The return value contains a list with nodes and weights
  - nodes: matrix with a node in each row
  - weights: vector with corresponding weights

Author(s)
- Jelmer Ypma

References

See Also
- `createSparseGrid`, `createProductRuleGrid`, `createIntegrationGrid`, `integrate`, `pmvnorm`

Examples
```R
# load library
library('SparseGrid')

## Not run:
# read file (e.g. after downloading from www.sparse-grids.de)
ReadASCFile(filename='GQU_d3_15.asc', dimension=3)

## End(Not run)
```
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