Package 'DPtree'

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Title Dirichlet-Based Polya Tree

Version 1.0.1

Description Contains functions to perform copula estimation
by the non-parametric Bayesian method,
Dirichlet-based Polya Tree. See Ning (2018) <doi:10.1080/00949655.2017.1421194>.

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R topics documented:

dDPTreeRealize *The disitribution function for realized distribution from D-P tree.*

Description

dDPTreeRealize returns the value of density function of realized distribution from D-P tree at certain given point on copula space.

Usage

```
dDPTreeRealize(d, x)
```

Arguments

d	A 2^m by 2^m matrix, m being the approximating level. Normalized measures for all 2^m by 2^m sub-partititons on copula space given by the realized distribution from D-P tree, as returned by DPTreeDensity.
x	An array of dimension n by 2. The points on copula space for density function evluation. Should be between 0 and 1.

Value

An array of length n. The values of PDF of the input D-P tree distribution evaluated at the input points.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
dDPTreeRealize(DPTreePMeanDensity(DPTreePrior(m=2, z=1)),c(0.5,0.5))
```

DPTreeDensity *Calculating sub-partition probabiltiy measures for a realized distribution from D-P tree.*

Description

DPTreeDensity returns the probablity measures in the finest sub-partitions of a realized distribution from D-P tree prior/posterior.

Usage

```
DPTreeDensity(Z)
```

Arguments

Z	An array of dimension of 2^m by 2^m by m, m being the approximation level. Realized Z's for all partitions at each level, as returned by RealizeDPTree.

Value

A 2^m by 2^m matrix. Normalized measures for all 2^m by 2^m sub-partititons on copula space given by the realized distribution from D-P tree.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
dp.rlz <- RealizeDPTree(DPTreePrior(m=2, z=1))
DPTreeDensity(dp.rlz)
```

DPTreePMeanDensity *Calculating sub-partition probabiltiy measures for the posterior mean distribution from D-P tree.*

Description

DPTreePMeanDensity returns the probablity measures in the finest sub-partitions of the posterior mean from D-P tree.

Usage

```
DPTreePMeanDensity(prior)
```

Arguments

prior	A list. D-P tree specification. Should be in same format as returned from DPTreePrior or DPTreePosterior.

Value

A 2^m by 2^m matrix. Normalized measures for all 2^m by 2^m sub-partititons on copula space given by the posterior mean distribution from D-P tree.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
DPTreePMeanDensity(DPTreePrior(m=2, z=1))
```

`DPTreePosterior` *D-P tree posterior updating from a single copula observation.*

Description

`DPTreePosterior` returns the D-P tree posterior given input copula data.

Usage

```
DPTreePosterior(x, prior, w = 1)
```

Arguments

`x`	An array of length 2. Single copula data observation. Each element should be between 0 and 1.
`prior`	A list. Should be in same format as returned from `DPTreePrior`.
`w`	A positive number. Weight of data for posterior updating. Default 1.

Value

A list.

`a`	An array containing the hyperparameters of D-P trees.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
nsim = 1
rho = 0.9
data1 <- MASS::mvrnorm(n=nsim, mu=rep(0, 2), Sigma=matrix(c(1, rho, rho, 1), 2, 2))
data2 <- stats::pnorm(data1)
DPTreePosterior(x=data2, prior=DPTreePrior(m=4, z=1))
```

`DPTreePosteriorMulti` *D-P tree posterior updating from multiple copula observations.*

Description

`DPTreePosteriorMulti` returns the D-P tree posterior given input copula data.

Usage

```
DPTreePosteriorMulti(x, prior, w = 1)
```

Arguments

`x`	An array of dimension n by 2. Multiple copula data observations, with each row being a bivariate copula observation. All elements should be between 0 and 1.
`prior`	A list. Should be in same format as returned from `DPTreePrior`.
`w`	A positive number or an array of length n. Weight of data for posterior updating. Default 1.

Value

A list.

`a`	An array containing the hyperparameters of D-P trees.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
nsim = 10
rho = 0.9
data1 <- MASS::mvrnorm(n=nsim, mu=rep(0, 2), Sigma=matrix(c(1, rho, rho, 1), 2, 2))
data2 <- stats::pnorm(data1)
DPTreePosteriorMulti(x=data2, prior=DPTreePrior(m=4, z=1))
```

DPTreePrior *Generating the standard D-P Tree prior*

Description

`DPTreePrior` returns a standard D-P Tree prior based on specified hyperparameters.

Usage

```
DPTreePrior(m = 4, z = 1)
```

Arguments

`m`	A positive integer. The finite approximation level for D-P tree. Default m=4.
`z`	A positive number. On i-th level, the hyperparameter for D-P tree prior is $z \times i^2$. Default z=1.

Value

A list.

`a`	An array containing the hyperparameters of D-P trees.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
DPTreePrior(m=6, z=1)
```

pDPTreeRealize *The disitribution function for realized distribution from D-P tree.*

Description

`pDPTreeRealize` returns the value of distribution function of realized distribution from D-P tree at certain given point on copula space.

Usage

```
pDPTreeRealize(d, x)
```

Arguments

d	A 2^m by 2^m matrix, m being the approximating level. Normalized measures for all 2^m by 2^m sub-partititons on copula space given by the realized distribution from D-P tree, as returned by `DPTreeDensity`.
x	An array of dimension n by 2. The points on copula space for distribution function evluation. Should be between 0 and 1.

Value

An array of length n. The values of CDF of the input D-P tree distribution evaluated at the input points.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
pDPTreeRealize(DPTreePMeanDensity(DPTreePrior(m=2, z=1)),c(0.5,0.5))
```

`RealizeDPTree` *Sampling a realized distribution from the D-P Tree.*

Description

`RealizeDPTree` returns a realized (copula) distribtuion sampled from the input D-P Tree.

Usage

```
RealizeDPTree(prior)
```

Arguments

prior	A list. Should be in same format as returned from `DPTreePrior`.

Value

An array of dimension 2^m by 2^m by m. m is the approximation level. Realized Z's for all partitions at each level. Three dimensions reprensent two marginals, and the level respectively.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
RealizeDPTree(DPTreePrior(m=2, z=1))
```

`SampleDPTreeDensity` *Sample a copula observation from a realized distribution from D-P tree.*

Description

`SampleDPTreeDensity` returns a copula sample from a realized distribution from D-P tree.

Usage

```
SampleDPTreeDensity(nsam, d)
```

Arguments

`nsam`	A positive integer. The sample size.
`d`	A 2^m by 2^m matrix, m being the approximating level. Normalized measures for all 2^m by 2^m sub-partititons on copula space given by the realized distribution from D-P tree, as returned by `DPTreeDensity`.

Value

An array of dimension nsam by 2. The values of PDF of the input D-P tree distribution evaluated at the input points.

References

Ning S and Shephard N (2018). "A nonparametric Bayesian approach to copula estimation." *Journal of Statistical Computation and Simulation*, **88**(6), pp. 1081-1105. doi: 10.1080/00949655.2017.1421194.

Examples

```
SampleDPTreeDensity(10, DPTreePMeanDensity(DPTreePrior(m=2, z=1)))
```

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