

Package ‘cubicBsplines’

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Title Computation of a Cubic B-Spline Basis and Its Derivatives

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Version 1.0.0

Description Computation of a cubic B-spline basis for arbitrary knots. It also provides the 1st and 2nd derivatives, as well as the integral of the basis elements. It is used by the author to fit penalized B-spline models, see e.g. Jullion, A. and Lambert, P. (2006) <[doi:10.1016/j.csda.2006.09.027](https://doi.org/10.1016/j.csda.2006.09.027)>, Lambert, P. and Eilers, P.H.C. (2009) <[doi:10.1016/j.csda.2008.11.022](https://doi.org/10.1016/j.csda.2008.11.022)> and, more recently, Lambert, P. (2021) <[doi:10.1016/j.csda.2021.107250](https://doi.org/10.1016/j.csda.2021.107250)>. It is inspired by the algorithm developed by de Boor, C. (1977) <[doi:10.1137/0714026](https://doi.org/10.1137/0714026)>.

URL <http://www.statsoc.ulg.ac.be/>

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Bsplines	<i>Computation of a cubic B-spline basis associated to a given vector of knots</i>
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Description

Computation of a cubic B-spline basis associated to a given vector of knots

Usage

```
Bsplines(x, knots)
```

Arguments

x	vector of values where the B-spline basis must be evaluated.
knots	vector of knots spanning the desired B-spline basis.

Value

A matrix of dimension $\text{length}(x)$ by $(\text{length}(\text{knots})+2)$.
Each column of the matrix corresponds to one cubic B-spline in the basis.

Examples

```
Bsplines(x=runif(20),knots=seq(0,1,length=11))
```

D1Bsplines	<i>Computation of the 1st derivative of a cubic B-spline basis associated to a given vector of knots</i>
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Description

Computation of the 1st derivative of a cubic B-spline basis associated to a given vector of knots

Usage

```
D1Bsplines(x, knots)
```

Arguments

x	vector of values where the 1st derivative of the B-spline basis must be evaluated.
knots	vector of knots spanning the desired B-spline basis.

Value

A matrix of dimension $\text{length}(x)$ by $(\text{length}(\text{knots})+2)$.

Each column corresponds to (the 1st derivative of) one cubic B-spline in the basis.

Examples

```
D1Bsplines(x=runif(20),knots=seq(0,1,length=11))
```

D2Bsplines	<i>Computation of the 2nd derivative of a cubic B-spline basis associated to a given vector of knots</i>
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Description

Computation of the 2nd derivative of a cubic B-spline basis associated to a given vector of knots

Usage

```
D2Bsplines(x, knots)
```

Arguments

x	vector of values where the 2nd derivative of the B-spline basis must be evaluated.
knots	vector of knots spanning the desired B-spline basis.

Value

A matrix of dimension $\text{length}(x)$ by $(\text{length}(\text{knots})+2)$.

Each column of the matrix corresponds to (the 2nd derivative of) one cubic B-spline in the basis.

Examples

```
D2Bsplines(x=runif(20),knots=seq(0,1,length=11))
```

IBsplines	<i>Computation of the integral of a cubic B-spline basis over (t0,x) for a given vector of knots</i>
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Description

Computation of the integral of a cubic B-spline basis over (t0,x) for a given vector of knots

Usage

```
IBsplines(t0, x, knots)
```

Arguments

t0	scalar giving lower value of the integration interval.
x	vector giving the upper values of the integration interval.
knots	vector of knots spanning the desired B-spline basis.

Value

A matrix of dimension length(x) by (length(knots)+2).
Each integrated cubic B-spline is within a given column.

Examples

```
IBsplines(t0=0,x=runif(20),knots=seq(0,1,length=11))
```

trapeze	<i>Trapeze integration from a vector of function values evaluated at quadrature points</i>
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Description

Trapeze integration from a vector of function values evaluated at quadrature points

Usage

```
trapeze(x, fx)
```

Arguments

x	grid of values for the quadrature (vector).
fx	values of the function on the grid (vector).

Value

vector with a numerical approximation of $\int_{\min(x)}^{\max(x)} f(t)dt$ on the grid using the trapeze method.

Examples

```
x = seq(-4,2,length=100) ; fx = dnorm(x) ; res = trapeze(x,fx)
cbind(true=pnorm(x),trapeze=res)
```

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