

Package ‘fctbases’

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Type Package

Title Functional Bases

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Description Easy-to-use, very fast implementation of various functional bases. Easily used together with other packages.

A functional basis is a collection of basis functions $[\phi_1, \dots, \phi_n]$ that can represent a smooth function, i.e. $f(t) = \sum c_k \phi_k(t)$.

First- and second-order derivatives are also included. These are the mathematically correct ones, no approximations applied.

As of version 1.0, this package includes B-splines, Fourier bases and polynomials.

URL <https://github.com/naolsen/fctbases>

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Imports Rcpp ($\geq 0.12.19$)

Suggests knitr, rmarkdown, microbenchmark

VignetteBuilder knitr, rmarkdown

LinkingTo Rcpp, RcppArmadillo

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fctbases-package *fctbases: Functional bases*

Description

fctbases is a fast and easy implementation of functional bases in R. Simply initialize the desired basis, which returns function of class `fctbasis`.

Details

Internally, functions are stored as C++ objects, which are masked by the package. The package maintains the bookkeeping of `fctbasis` objects. Parameters are validated at initialization which also reduces some of the overhead. `fctbases` objects cannot be saved across sessions and must be re-initialised.

Derivatives are provided. These are the mathematically correct ones and are as fast as the non-derivatives.

See Also

[Functional basis function](#)

Functional basis function
Functional basis function

Description

A `fctbases` object is a function of class `fctbasis` which takes three arguments (`t`, `x`, `deriv`)

Arguments

<code>t</code>	time points
<code>x</code>	vector or matrix of coefficients (optional)
<code>deriv</code>	Should the derivative be used and which order? Defaults to FALSE

Details

If `deriv` is zero or FALSE, the function itself is evaluated. If `deriv` is one or TRUE, the first derivative is evaluated. If `deriv` is two, the second derivative is evaluated.

The dimension of `x` must match the number of basis functions.

Value

Returns a matrix of dimension `length(t)` times no. of bases if `x` is missing. If `x` is provided and is a vector, it returns a vector of same length as `t`. If `x` is provided and is a matrix, it returns a matrix of dimension `length(t)` times `ncol(x)`

Examples

```
## Create basis (here a b spline)
bf <- make.bspline.basis(knots = 0:12/12)

## Use a functional basis

bf(0.2)
tt <- seq(0,1, length = 50)
bf(tt) ## evaluates bf in tt
bf(tt, deriv = TRUE) ## evaluates derivative of bf in tt

## Apply bf to some coefficients
set.seed(661)
x <- runif(15)
bf(tt, x) ## Evaluate bf in tt with coefficients x.

bf(0.2, deriv = 2) ## Second derivative.
bf(0.2, x, deriv = 2) ## Second derivative with coefficients x.
```

`make.bspline.basis` *Make B-spline basis*

Description

Make B-spline basis

Usage

```
make.bspline.basis(knots, order = 4)
```

Arguments

<code>knots</code>	Knots of the basis, including endpoints
<code>order</code>	Spline order. Defaults to 4.

Value

Function of class "fctbasis"

See Also

[Functional basis function](#), [make.std.bspline.basis](#)

Examples

```
## B-spline with equidistant knots with 13 basis function
bf <- make.bspline.basis(knots = 0:10, order = 4)

## B-spline of order 2 (ie. a linear approximation) with some uneven knots
bf <- make.bspline.basis(knots = c(-1.3, 0, 0.5, 0.7, 1.1), order = 2)
```

make.fourier.basis *Make fourier basis*

Description

Make fourier basis

Usage

```
make.fourier.basis(range, order, use.trig.id = FALSE)
```

Arguments

range	Left and right end points.
order	Order of harmonics
use.trig.id	Use trigonometrical identities with this function?

Details

The number of basis elements (degrees of freedom) is $2 * \text{order} + 1$.

The basis functions are ordered [1, sin(t), cos(t), sin(2t), cos(2t), ...]

Using trigonometrical identities is faster, but introduces (negligible) round-off errors.

Value

Function of class "fctbasis"

See Also

[Functional basis function](#)

Examples

```
## A fourier basis with period 1 and 11 basis functions.
bf <- make.fourier.basis(c(0,1), order = 5)
```

make.pol.basis *Make polynomial basis*

Description

Make polynomial basis

Usage

```
make.pol.basis(order)
```

Arguments

order Order of polynomial (= degree + 1)

Details

The polynomial basis is ordered [1, t, t², t³, ..., tⁿ]

Value

Function of class "fctbasis"

See Also

[Functional basis function](#)

Examples

```
## A four-degree polynomial  
mypol <- make.pol.basis(order = 5)
```

make.std.bspline.basis
 'Standard' B-spline basis

Description

This initializes a bspline of order 4 with uniformly places knots. df = intervals + 3.

Usage

```
make.std.bspline.basis(range = c(0, 1), intervals)
```

Arguments

range	End points of spline
intervals	Number of intervals

Details

`make.std.bspline.basis` uses a different implementation than `make.bspline.basis`, but is not faster in all uses.

Value

function

See Also

[Functional basis function](#), [make.bspline.basis](#)

Examples

```
## 16 equidistant knots between 0 and 2 (both included)
bf <- make.std.bspline.basis(range = c(0,2), intervals = 15)
```

object.info

Functional basis info

Description

This function returns details about a functional basis.

Usage

```
object.info(fctbasis)
```

Arguments

fctbasis	object of class fctbasis
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Value

A named list including no. of basis, type of basis, and possibly additional information.

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