Package 'wavefunction'

January 5, 2018

Type Package

Title Wave Function Representation of Real Distributions

Version 1.0.0

Date 2018-01-04

Author Madeleine B. Thompson

Maintainer Madeleine B. Thompson <madeleine@empirical.com>

Description Real probability distributions can be represented as the square of an orthogonal sum in the Hermite basis. This representation is formally similar to the representation of quantum mechanical states as wave functions, whose squared modulus is a probability density. This is described in more detail in ``Wave function representation of probability distributions,'' by Madeleine B. Thompson <arXiv:1712.07764>. This package provides a reference implementation of the technique.

License Apache License (== 2.0)

Suggests lintr, testthat

NeedsCompilation no

Repository CRAN

Date/Publication 2018-01-05 12:16:35 UTC

R topics documented:

dwavefunction *Wave Function Density*

Description

Evaluate the density of a wave function model

Usage

```
dwavefunction(x, w, log = FALSE, amplitude = FALSE)
```

Arguments

x	a numeric vector
w	a vector of coefficients from wavefunction_fit
log	if TRUE, returns the log density instead of the density
amplitude	if TRUE, returns the amplitude (or the log of the absolute value of the amplitude) instead of the density. The density is the squared amplitude, but the amplitude may be positive or negative.

Details

The elements of the returned vector p are (when log and amplitude are FALSE):

$$p_i = \left(\sum_{k=0}^{K} \frac{w_{k+1}}{(\sqrt{\pi} 2^k k!)^{1/2}} H_k(x_i) \right)^2 e^{-x_i^2}$$

Here, K is the maximum degree, equal to length(w)-1, and H_k is the Hermite polynomial of degree k. Note that w, being an R vector, is one-indexed, so w_k is associated with the Hermite polynomial of degree $k-1$.

Value

a numeric vector of the same length as x

See Also

Madeleine B. Thompson, "Wave function representation of probability distributions," 2017, https://arxiv.org/abs/1712.07764.

Examples

```
x <- rnorm(100)
w <- wavefunction_fit(x, degree = 6)
p <- dwavefunction(x, w)
```

wavefunction_fit *Fit Wave Function*

Description

Fit wave function coefficients from a sample

Usage

```
wavefunction_fit(x, degree)
```

Arguments

x	a sample from a distribution on the reals
degree	the Hermite polynomial degree to fit

Details

Fits a Hermite wave function density of degree degree. The values will maximize the likelihood under the density specified under dwavefunction. A more accurate representation is obtained for a low degree if the sample is standardized to have mean zero and variance one-half. There are diminishing returns to degree greater than 20 or so due to floating point limitations.

Value

a numeric vector of coefficients of length degree+1

See Also

Madeleine B. Thompson, "Wave function representation of probability distributions," 2017, https://arxiv.org/abs/1712.07764.

Examples

```
x <- rt(100, df = 5)
w <- wavefunction_fit(x, degree = 6)
```

Index