Package ‘wavefunction’

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Type Package

Title Wave Function Representation of Real Distributions

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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.

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Suggests lintr, testthat

NeedsCompilation no

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\textbf{dwavefunction} \hfill Wave Function Density

\textbf{Description}

Evaluate the density of a wave function model

\textbf{Usage}

\texttt{dwavefunction(x, w, log = FALSE, amplitude = FALSE)}

\textbf{Arguments}

- \texttt{x}: a numeric vector
- \texttt{w}: a vector of coefficients from \texttt{wavefunction_fit}
- \texttt{log}: if \texttt{TRUE}, returns the log density instead of the density
- \texttt{amplitude}: if \texttt{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.

\textbf{Details}

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

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

Here, \( K \) is the maximum degree, equal to \texttt{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 \( k - 1 \).

\textbf{Value}

A numeric vector of the same length as \( x \)

\textbf{See Also}


\textbf{Examples}

\begin{verbatim}
x <- rnorm(100)
w <- wavefunction_fit(x, degree = 6)
p <- dwavefunction(x, w)
\end{verbatim}
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


Examples

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