Package: sdf.test (via r-universe)

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Title Nonparametric Two Sample Test for Equality of Spectral Densities

Version 0.0.1.0

Description Nonparametric method for testing the equality of the spectral densities of two time series of possibly different lengths. The time series are preprocessed with the discrete cosine transform and the variance stabilising transform to obtain an approximate Gaussian regression setting for the log-spectral density function. The test statistic is based on the squared L2 norm of the difference between the estimated log-spectral densities. The test returns the result, the statistic value, and the p-value. It also provides the estimated empirical quantile and null distribution under the hypothesis of equal spectral densities. An example using EEG data is included. For details see Nadin, Krivobokova, Enikeeva (2026), <doi:10.48550/arXiv.2602.10774>.

License GPL (>= 3)

Encoding UTF-8

RoxygenNote 7.3.1

Imports dtt, stats

Suggests doParallel, foreach, parallel, testthat (>= 3.0.0)

Config/testthat/edition 3

Depends R (>= 3.5)

LazyData true

NeedsCompilation no

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Contents

`eeg_data` *EEG Signals*

Description

A dataset containing four EEG recordings of a patient under rest or different transcranial Direct Current Stimulations (tDCS).

Usage

```
eeg_data
```

Format

A data frame with columns:

index Integer index of the measurement (frequency of 250 Hz).

condition Can take four values: `"initial_rest"`, devtools::document() `"first_frontal_tDCS"`, `"second_frontal_tDCS"`, `"posterior_tDCS"`.

signal Numeric EEG measurement.

Source

Original: Alexis Pomares, "Dissertation preprocessed EEG dataset", https://www.kaggle.com/datasets/alexispomares/dissertation-preprocessed This version has been preprocessed by selecting specific conditions and removing outliers, for details see (Nadin, Kivobokova, Enikeeva; 2026).

Examples

```
data(eeg_data)
head(eeg_data)
tail(eeg_data)
str(eeg_data)
X1 <- subset(eeg_data, condition == "first_frontal_tDCS")$signal
```

print.test *Print test*

Description

Custom printing function for the class "test".

Usage

```
## S3 method for class 'test'
print(x, ...)
```

Arguments

x	Object of class "test".
...	Further arguments passed to or from other methods.

Value

Invisible x.

Examples

```
test <- sdf.test(
  X1 = rnorm(50), X2 = rnorm(50),
  q1 = 2, method1 = "GCV", Te = 10, alpha = 0.05, N = 1000
)
print(test)
test
```

sdf.test *SDF Test*

Description

Performs the test for equality of spectral densities of two time series.

Usage

```
sdf.test(
  X1,
  X2,
  Te,
  alpha,
  q1 = 4,
```

```
  method1 = "GCV",
  f1_true = NULL,
  q2 = q1,
  method2 = method1,
  f2_true = f1_true,
  N = 10000,
  cores = 1,
  nulldistr = NULL
)
```

Arguments

X1	Longest time series.
X2	Shortest time series.
Te	Integer. Number of bins.
alpha	Numeric. Significance level for the test.
q1	Integer. Penalisation order for X1, q=1,2,3,4,5,6 are available (default 4).
method1	Character. Method for selecting the smoothing parameter for X1 (default "GCV").
f1_true	Vector or NULL. True regression function evaluated at equi-spaced points. Required only if method1 is set to "GCV-oracle" or "ML-oracle".
q2	Integer. Penalization order for X2 (default q1).
method2	Character. Method for selecting the smoothing parameter for X2 (default method1).
f2_true	Vector or NULL. True regression function evaluated at equi-spaced points. Required only if method2 is set to "GCV-oracle" or "ML-oracle" (default f1_true).
N	Integer. Number of iterations for null distribution computa- tion (default 10000).
cores	Integer. Number of cores for parallel computation of null distribution (default 1).
nulldistr	Vector or NULL. Vector of empirical null distribution (default NULL).

Value

An object of class "test", which is a list containing the following components:

- result: Logical. TRUE if the null hypothesis of equality of spectral densities is accepted by the test, FALSE otherwise.
- S: Value of the statistic.
- quantile: Empirical quantile used for the test.
- p-value: p-value of the test according to the empirical null distribution.
- nulldistr: Vector of empirical null distribution.

References

Nadin, Krivobokova, Enikeeva (2026). Nonparametric two sample test of spectral densities. https://arxiv.org/abs/2602.10774

Examples

```
# --- Example 1: Using random data ---
test <- sdf.test(
  X1 = rnorm(100), X2 = rnorm(80),
  q1 = 4, method1 = "GCV", Te = 20, alpha = 0.05, N = 1000
)
test

# --- Example 2: Using random data ---

X1 <- arima.sim(list(order=c(1,0,0),ar=0.5),n = 1200,rand.gen = rnorm, sd = 1)
X2 <- arima.sim(list(order=c(1,0,0),ar=0.8),n = 1000,rand.gen = rnorm, sd = 1)
sdf.test(
  X1 = X1, X2 = X2,
  q1 = 4, method1 = "GCV", Te = 176, alpha = 0.05
)


# --- Example 3: Using EEG dataset ---

data(eeg_data)
X1 <- subset(eeg_data, condition == "first_frontal_tDCS")$signal
X2 <- subset(eeg_data, condition == "second_frontal_tDCS")$signal
test <- sdf.test(
  X1 = X1, X2 = X2,
  q1 = 4, method1 = "ML", Te = 2100, alpha = 0.05, cores = 50
)
test
```

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