Package ‘TSEntropies’

October 12, 2022

Title  Time Series Entropies
Version  0.9
Description  Computes various entropies of given time series. This is the initial version that includes ApEn() and SampEn() functions for calculating approximate entropy and sample entropy. Approximate entropy was proposed by S.M. Pincus in “Approximate entropy as a measure of system complexity”, Proceedings of the National Academy of Sciences of the United States of America, 88, 2297-2301 (March 1991). Sample entropy was proposed by J. S. Richman and J. R. Moorman in “Physiological time-series analysis using approximate entropy and sample entropy”, American Journal of Physiology, Heart and Circulatory Physiology, 278, 2039-2049 (June 2000). This package also contains FastApEn() and FastSampEn() functions for calculating fast approximate entropy and fast sample entropy. These are newly designed very fast algorithms, resulting from the modification of the original algorithms. The calculated values of these entropies are not the same as the original ones, but the entropy trend of the analyzed time series determines equally reliably. Their main advantage is their speed, which is up to a thousand times higher. A scientific article describing their properties has been submitted to The Journal of Supercomputing and in present time it is waiting for the acceptance.

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ApEn

Description
This function computes approximate entropy of given time series.

Usage
ApEn(TS, dim = 2, lag = 1, r = 0.2 * sd(TS))

Arguments
TS - given time series
dim - dimension of given time series, default value is 2
lag - downsampling, default value is 1
r - radius of searched areas, default value is 0.2*sd(TS)

Examples
```r
timser <- rnorm(2000)
ApEn(timser)
ApEn(timser, r = 0.1*sd(timser))
ApEn(timser, dim = 3, r = 0.1*sd(timser))
```
**Description**

This function computes approximate entropy of given time series. It is implemented in C.

**Usage**

\[
\text{ApEn}_C(TS, \text{dim} = 2, \text{lag} = 1, r = 0.2 \times \text{sd}(TS))
\]

**Arguments**

- **TS** - given time series
- **dim** - dimension of given time series, default value is 2
- **lag** - downsampling, default value is 1
- **r** - radius of searched areas, default value is 0.2*sd(TS)

**Examples**

```r
timser <- rnorm(2000)
ApEn_C(timser)
ApEn_C(timser, r = 0.1*sd(timser))
ApEn_C(timser, dim = 3, r = 0.1*sd(timser))
```

---

**Description**

This function computes approximate entropy of given time series. It is implemented in R.

**Usage**

\[
\text{ApEn}_R(TS, \text{dim} = 2, \text{lag} = 1, r = 0.2 \times \text{sd}(TS))
\]

**Arguments**

- **TS** - given time series
- **dim** - dimension of given time series, default value is 2
- **lag** - downsampling, default value is 1
- **r** - radius of searched areas, default value is 0.2*sd(TS)
Examples

```r
timser <- rnorm(2000)
ApEn_R(timser)
ApEn_R(timser, r = 0.1*sd(timser))
ApEn_R(timser, dim = 3, r = 0.1*sd(timser))
```

---

**FastApEn**

Description

This function computes fast approximate entropy of given time series.

Usage

```r
FastApEn(TS, dim = 2, lag = 1, r = 0.15 * sd(TS))
```

Arguments

- **TS** - given time series
- **dim** - dimension of given time series, default value is 2
- **lag** - downsampling, default value is 1
- **r** - radius of searched areas, default value is 0.15*sd(TS)

Examples

```r
timser <- rnorm(2000)
FastApEn(timser)
FastApEn(timser, r = 0.1*sd(timser))
FastApEn(timser, dim = 3, r = 0.1*sd(timser))
```

---

**FastApEn_C**

Description

This function computes fast approximate entropy of given time series. It is implemented in C.

Usage

```r
FastApEn_C(TS, dim = 2, lag = 1, r = 0.15 * sd(TS))
```
FastApEn_R

Arguments

- **TS** - given time series
- **dim** - dimension of given time series, default value is 2
- **lag** - downsampling, default value is 1
- **r** - radius of searched areas, default value is 0.15*sd(TS)

Examples

```r
timser <- rnorm(2000)
FastApEn_C(timser)
FastApEn_C(timser, r = 0.1*sd(timser))
FastApEn_C(timser, dim = 3, r = 0.1*sd(timser))
```

Description

This function computes fast approximate entropy of given time series. It is implemented in R.

Usage

```
FastApEn_R(TS, dim = 2, lag = 1, r = 0.15 * sd(TS))
```

Arguments

- **TS** - given time series
- **dim** - dimension of given time series, default value is 2
- **lag** - downsampling, default value is 1
- **r** - radius of searched areas, default value is 0.15*sd(TS)

Examples

```r
timser <- rnorm(2000)
FastApEn_R(timser)
FastApEn_R(timser, r = 0.1*sd(timser))
FastApEn_R(timser, dim = 3, r = 0.1*sd(timser))
```
**FastSampEn**

**Description**
This function computes fast sample entropy of given time series.

**Usage**

\[
\text{FastSampEn}(\text{TS}, \dim = 2, \text{lag} = 1, r = 0.15 * \text{sd}(\text{TS}))
\]

**Arguments**
- **TS** - given time series
- **dim** - dimension of given time series, default value is 2
- **lag** - downsampling, default value is 1
- **r** - radius of searched areas, default value is 0.15*sd(TS)

**Examples**

```r
\begin{verbatim}
timser <- rnorm(2000)
FastSampEn(timser)
FastSampEn(timser, r = 0.1*sd(timser))
FastSampEn(timser, dim = 3, r = 0.1*sd(timser))
\end{verbatim}
```

**FastSampEn_C**

**Description**
This function computes fast sample entropy of given time series. It is implemented in C.

**Usage**

\[
\text{FastSampEn}_C(\text{TS}, \dim = 2, \text{lag} = 1, r = 0.15 * \text{sd}(\text{TS}))
\]

**Arguments**
- **TS** - given time series
- **dim** - dimension of given time series, default value is 2
- **lag** - downsampling, default value is 1
- **r** - radius of searched areas, default value is 0.15*sd(TS)
Examples

```r
timser <- rnorm(2000)
FastSampEn_C(timser)
FastSampEn_C(timser, r = 0.1*sd(timser))
FastSampEn_C(timser, dim = 3, r = 0.1*sd(timser))
```

Description

This function computes fast sample entropy of given time series. It is implemented in R.

Usage

```r
FastSampEn_R(TS, dim = 2, lag = 1, r = 0.15 * sd(TS))
```

Arguments

- **TS** - given time series
- **dim** - dimension of given time series, default value is 2
- **lag** - downsampling, default value is 1
- **r** - radius of searched areas, default value is 0.15*sd(TS)

Examples

```r
timser <- rnorm(2000)
FastSampEn_R(timser)
FastSampEn_R(timser, r = 0.1*sd(timser))
FastSampEn_R(timser, dim = 3, r = 0.1*sd(timser))
```

SampEn

Description

This function computes sample entropy of given time series.

Usage

```r
SampEn(TS, dim = 2, lag = 1, r = 0.2 * sd(TS))
```
Arguments

- **TS**: given time series
- **dim**: dimension of given time series, default value is 2
- **lag**: downsampling, default value is 1
- **r**: radius of searched areas, default value is 0.2*sd(TS)

Examples

```r
timser <- rnorm(2000)
SampEn(timser)
SampEn(timser, r = 0.1*sd(timser))
SampEn(timser, dim = 3, r = 0.1*sd(timser))
```

Description

This function computes sample entropy of given time series. It is implemented in C.

Usage

```r
SampEn_C(TS, dim = 2, lag = 1, r = 0.2 * sd(TS))
```

Arguments

- **TS**: given time series
- **dim**: dimension of given time series, default value is 2
- **lag**: downsampling, default value is 1
- **r**: radius of searched areas, default value is 0.2*sd(TS)

Examples

```r
timser <- rnorm(2000)
SampEn_C(timser)
SampEn_C(timser, r = 0.1*sd(timser))
SampEn_C(timser, dim = 3, r = 0.1*sd(timser))
```
Description

This function computes sample entropy of given time series. It is implemented in R.

Usage

SampEn_R(TS, dim = 2, lag = 1, r = 0.2 * sd(TS))

Arguments

<table>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS</td>
<td>given time series</td>
</tr>
<tr>
<td>dim</td>
<td>dimension of given time series, default value is 2</td>
</tr>
<tr>
<td>lag</td>
<td>downsampling, default value is 1</td>
</tr>
<tr>
<td>r</td>
<td>radius of searched areas, default value is 0.2*sd(TS)</td>
</tr>
</tbody>
</table>

Examples

timser <- rnorm(2000)
SampEn_R(timser)
SampEn_R(timser, r = 0.1*sd(timser))
SampEn_R(timser, dim = 3, r = 0.1*sd(timser))
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