

Package ‘ActCR’

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Type Package

Title Extract Circadian Rhythms Metrics from Actigraphy Data

Version 0.1.0

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Description Circadian rhythms are rhythms that oscillate about every 24 h, which has been observed in multiple physiological processes including core body temperature, hormone secretion, heart rate, blood pressure, and many others. Measuring circadian rhythm with wearables is based on a principle that there is increased movement during wake periods and reduced movement during sleep periods, and has been shown to be reliable and valid. This package can be used to extract nonparametric circadian metrics like intradaily variability (IV), interdaily stability (IS), and relative amplitude (RA); and parametric cosinor model coefficient. Details can be found in Junrui Di et al (2019) <doi:10.1007/s12561-019-09236-4>.

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Imports zoo, cosinor, cosinor2, dplyr

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Encoding UTF-8

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ActCosinor	<i>Cosinor Model for Circadian Rhythmicity</i>
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Description

A parametric approach to study circadian rhythmicity assuming cosinor shape.

Usage

```
ActCosinor(x, window = 1)
```

Arguments

x	vector vector of dimension n*1440 which represents n days of 1440 minute activity data
window	The calculation needs to understand what is the window size of the data

Value

A list with elements

mes	mesor
amp	amplitude
acro	acrophase in negative radians
acrotime	acrophase in time domain (hour)

Examples

```
count1 = c(t(example_activity_data$count[1,-c(1,2)]))
cos_coeff = ActCosinor(x = count1, window = 1)
```

 ActCosinor_long

Cosinor Model for Circadian Rhythmicity for the Whole Dataset

Description

A parametric approach to study circadian rhythmicity assuming cosinor shape. This function is a whole dataset wrapper for RA.

Usage

```
ActCosinor_long(count.data, window = 1)
```

Arguments

`count.data` data.frame of dimension $n * (p+2)$ containing the p dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either character or numeric. Day has to be numeric indicating the sequence of days within each subject.

`window` since the calculation of M10 and L5 depends on the dimension of data, we need to include window size as an argument.

Value

A data.frame with the following 5 columns

ID	ID
ndays	number of days
mes	mesor
amp	amplitude
acro	acrophase
acrotime	acrophase in time domain (hour)

Examples

```
counts_1 = example_activity_data$count
cos_all_1 = ActCosinor_long(count.data = counts_1, window = 1)
counts_10 = cbind(counts_1[,1:2],
  as.data.frame(t(apply(counts_1[,-c(1:2)], 1,
  FUN = bin_data, window = 10, method = "average"))))
cos_all_10 = ActCosinor_long(count.data = counts_10, window = 10)
```

bin_data	<i>Bin data into longer windows</i>
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Description

Bin minute level data into different time resolutions

Usage

```
bin_data(x = x, window = 1, method = c("average", "sum"))
```

Arguments

x	vector of activity data.
window	window size used to bin the original 1440 dimensional data into. Window size should be an integer factor of 1440
method	character of "sum" or "average", function used to bin the data

Value

a vector of binned data

Examples

```
data(example_activity_data)
count1 = c(t(example_activity_data$count[1,-c(1,2)]))
xbin = bin_data(x = count1, window = 10, method = "average")
```

example_activity_data	<i>Activity/Wear Data from 50 Subjects from NHANES 2003 - 2006</i>
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Description

A list of two data.frames containing the counts and the wear time for 50 NHANES subjects

Usage

```
example_activity_data
```

Format

A list of two data.frames with 1442 columns, which are in the following order:

ID identifier of the person.

Day numeric sequence 1,2,.. indicating the order of days within a subject.

MIN1-MIN1440 counts of activity of that specific minute.

 IS *Interdaily Stability*

Description

This function calculates interdaily stability, a nonparametric metric of circadian rhythmicity

Usage

```
IS(x)
```

Arguments

x data.frame of dimension ndays by p, where p is the dimension of the data.

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. *Statistics in Biosciences*.

Examples

```
data(example_activity_data)
count1 = example_activity_data$count[c(1,2,3),-c(1,2)]
is = IS(x = count1)
```

 IS_long *Interdaily Stability for the Whole Dataset*

Description

This function calculates interdaily stability, a nonparametric metric of circadian rhythmicity. This function is a whole dataset wrapper for IS

Usage

```
IS_long(count.data, window = 1, method = c("average", "sum"))
```

Arguments

count.data data.frame of dimension n * (1440+2) containing the 1440 dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either character or numeric. Day has to be numeric indicating the sequence of days within each subject.

window an integer indicating what is the window to bin the data before the function can be applied to the dataset. For details, see bin_data.

method character of "sum" or "average", function used to bin the data

Value

A data.frame with the following 2 columns

ID	ID
IS	IS

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. *Statistics in Biosciences*.

Examples

```
data(example_activity_data)
count1 = example_activity_data$count
is_subj = IS_long(count.data = count1, window = 10, method = "average")
```

IV *Intradaily Variability*

Description

This function calculate intradaily variability, a nonparametric metric representing fragmentation of circadian rhythmicity

Usage

```
IV(x)
```

Arguments

x vector of activity data

Value

IV

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. *Statistics in Biosciences*.

Examples

```
data(example_activity_data)
count1 = c(t(example_activity_data$count[1,-c(1,2)]))
iv = IV(x = count1)
```

Description

This function calculate intradaily variability, a nonparametric metric representing fragmentation of circadian rhythmicity. This function is a whole dataset wrapper for IV.

Usage

```
IV_long(count.data, window = 1, method = c("average", "sum"))
```

Arguments

count.data	data.frame of dimension n * (1440+2) containing the 1440 dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either character or numeric. Day has to be numeric indicating the sequency of days within each subject.
window	an integer indicating what is the window to bin the data before the function can be apply to the dataset. For details, see bin_data.
method	character of "sum" or "average", function used to bin the data

Value

A data.frame with the following 5 columns

ID	ID
Day	Day
IV	IV

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. *Statistics in Biosciences*.

Examples

```
data(example_activity_data)
count1 = example_activity_data$count
iv_subj = IV_long(count.data = count1, window = 10, method = "average")
```

RA *Relative Amplitude*

Description

This function calculates relative amplitude, a nonparametric metric representing fragmentation of circadian rhythmicity

Usage

```
RA(x, window = 1, method = c("average", "sum"))
```

Arguments

x	vector of activity data
window	since the calculation of M10 and L5 depends on the dimension of data, we need to include window size as an argument.
method	character of "sum" or "average", function used to bin the data

Value

RA

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. *Statistics in Biosciences*.

Examples

```
data(example_activity_data)
count1 = c(t(example_activity_data$count[1,-c(1,2)]))
ra = RA(x = count1, window = 10, method = "average")
```

RA_long *Relative Amplitude for the Whole Dataset*

Description

This function calculates relative amplitude, a nonparametric metric of circadian rhythmicity. This function is a whole dataset wrapper for RA.

Usage

```
RA_long(count.data, window = 1, method = c("average", "sum"))
```

Arguments

count.data	data.frame of dimension $n * (p+2)$ containing the p dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either character or numeric. Day has to be numeric indicating the sequency of days within each subject.
window	since the caculation of M10 and L5 depends on the dimension of data, we need to include window size as an argument. This function is a whole dataset wrapper for RA.
method	character of "sum" or "average", function used to bin the data

Value

A data.frame with the following 3 columns

ID	ID
Day	Day
RA	RA

Examples

```
data(example_activity_data)
count1 = example_activity_data$count
ra_all = RA_long(count.data = count1, window = 10, method = "average")
```

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