Package 'stlnpp'

August 6, 2019

Type Package

Title Spatio-temporal analysis of point patterns on linear networks

Version 0.3.1

Maintainer Mehdi Moradi <m2.moradi@yahoo.com>

Description Statistical analysis of spatio-temporal point processes on linear networks. This packages provides tools to visualise and analyse spatio-temporal point patterns on linear networks using first- and second-order summary statistics.

Depends spatstat, stats

Suggests plot3D, lattice, graphics

License GPL (>= 2)

Encoding UTF-8

LazyData true

RoxygenNote 6.1.1

Author Mehdi Moradi [aut, cre]

R topics documented:

---

as.stlpp   *Convert data to a space-time point pattern on a linear network*

Description

Convert data to a space-time point pattern on a linear network

Usage

```
as.stlpp(x,y,t,L)
```

Arguments

x,y,t	Vectors of cartesian coordinates and time occurance. Alternatively, x can be of classes data.frame, ppp and lpp.
L	Linear network (object of class linnet) on which the points lie.

Details

This function converts data to an object of class stlpp.

Data can be of formats:

- x is of class class data.frame with three columns. Then columns are considered as cartesian coordinates (i.e. x,y,t) and they will be converted to a spatio-temporal point pattern on the linear network L.
- x is a planar point pattern (class ppp). Then x will be converted to a spatio-temporal point pattern on the linear network L and with coresponding time vector t.
- x is a linear point pattern (class lpp). Then x will be converted to a spatio-temporal point pattern on the linear network L and with coresponding time vector t.
- x,y,t are vectors of same length where x,y are living on the corresponding network L.

Value

A spatio-temporal point pattern on a linear network. An object of class stlpp.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

as.stlpp.lpp, runifpointOnLines, as.lpp

Examples

```
data(easynet)
x = runifpointOnLines(40, easynet)
t1 = sample(1:10,40,replace=TRUE)
Y = as.stlpp(x,t=t1,L=easynet)

Z = as.stlpp.lpp(Y)
t2 = sample(1:10,40,replace=TRUE)
W = as.stlpp(Z,t=t2)
```

---

as.stlpp.lpp   *Methods for space-time point patterns on a linear network.*

Description

This function projects an object of class [stlpp](#) to a linear network.

Usage

```
as.stlpp.lpp(x)
```

Arguments

x   an object of class [stlpp](#)

Details

This function projects the space-time point pattern x into the linear network L.

Value

an object of class [lpp](#).

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

[as.stlpp](#), [lpp](#), [as.lpp](#)

Examples

```
data(easynet)
x = runifpointOnLines(40, easynet)
t1 = sample(1:10,40,replace=TRUE)
Y = as.stlpp(x,t=t1,L=easynet)
as.stlpp.lpp(Y)
```

---

as.stlpp.tpp   *Methods for space-time point patterns on a linear network.*

Description

This function converts an object of class stlpp to class tpp.

Usage

```
as.stlpp.tpp(X)
```

Arguments

X   an object of class stlpp

Details

This function projects the space-time point pattern X on L \times T into the time interval T.

Value

an object of class tpp.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

as.stlpp, lpp, as.lpp

---

density.stlpp   *Kernel estimation of intensity of space-time point patterns on a linear network*

Description

Kernel density estimation of a spatio-temporal point pattern on a linear network.

Usage

```
## S3 method for class stlpp
density(X,lbw,tbw,...)
```

Arguments

X	an object of class stlpp
lbw	netwrok smoothing bandwidth
tbw	time smoothing bandwidth
...	arguments passed to density.lpp

Details

Kernel smoothing is applied to the spatio-temporal point pattern X using methods in Moradi et al (2019). If lbw and tbw are not given, then they will be selected using `bw.nrd0` and `bw.scott.iso` respectively.

Value

a vector of intensity values at the data points of X. check the attributes for more accommodated outputs.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

`density`, `density.lpp`, `bw.nrd0`, `bw.scott.iso`

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
density(X)
```

---

density.tpp	*Kernel estimation of intensity of temporal point patterns*

Description

Kernel estimation of intensity of temporal point patterns

Usage

```
## S3 method for class tpp
density(x)
```

Arguments

x   a temporal point pattern (of class `tpp`)

Value

a vector of intensity values at the data points of X. check the attributes for more accommodated outputs.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

density, bw.nrd0

Eastbourne   *Eastbourne traffic accident data*

Description

This dataset represents the spatio-temporal locations of traffic accidents in the down-town of Eastbourne (UK) in the period of 2005-2010. The network was provided by "OS OpenData" at www.ordnancesurvey.co.uk and is usable under the terms of the OS OpenData license. The traffic locations were collected by the UK Department for Transport at www.data.gov.uk and obtained through kaggle at www.kaggle.com.

The dataset Eastbourne is an object of class stlpp.

Usage

```
data(Eastbourne)
```

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

Source

Usability: The network of Eastbourne was provided by OS OpenData and contains OS data © Crown copyright and database right (2018). The traffic accident locations in Eastbourne were collected by the UK Department for Transport and were provided by kaggle.

This data is a part of enitre data which is selected and converted to this format by Mehdi Moradi.

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

stlpp

Examples

```
data(Eastbourne)
plot(Eastbourne)
```

---

easynet   *simple linear network*

Description

A simple and not real network.

Usage

```
data(easynet)
```

Source

Created by Mehdi Moradi

Medellin   *Medellin traffic accident data*

Description

This dataset represents the spatio-temporal locations of traffic accidents in an area near the pontifical bolivarian university in Medell\'in (Colombia) during 2016. The entire data were published in the OpenData portal of Medell\'in Town Hall at https://www.medellin.gov.co/geomedellin/index.hyg.

The dataset Medellin is an object of class stlpp.

Usage

```
data(Medellin)
```

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

Source

This data is a part of enitre data which is selected and converted to this format by Mehdi Moradi.

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

stlpp

Examples

```
data(Medellin)
plot(Medellin)
```

methods.tpp	*Methods for temporal point patterns.*

Description

Methods for temporal point patterns.

Usage

```
## S3 method for class tpp
plot(x)
## S3 method for class tpp
print(x)
## S3 method for class tppint
plot(x)
## S3 method for class tppint
print(x)
```

Arguments

x   an object of class tpp or tppint.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

Examples

```
X <- tpp(sample(c(1:24),200,replace = T))
plot(X)
plot(density(X))
```

plot.stlpp	*Methods for space-time point patterns on a linear network.*

Description

plot objecs of class stlpp.

Usage

```
plot(X,...)
```

Arguments

X   an object of classes stlpp.

...   arguments passed to plot

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

[as.stlpp](#)

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
plot(X)
```

---

plot.stlppint	*Methods for space-time point patterns on a linear network.*

Description

plot an estimated intensity function of a space-time point patterns on a linear network.

Usage

```
plot.stlppint(X)
```

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

[as.stlpp](#), [density.stlpp](#)

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
d = density(X)
plot(d)
```

---

plot.sumstlpp	*Methods for space-time point patterns on a linear network.*

Usage

```
plot(X,style=c("level","contour","perspective"), theta = 35, phi = 10,
facets = FALSE, ticktype = "detailed", resfac = 5,
xlab="r = distance",ylab="t = time",...)
```

Arguments

X	an object of class sumstlpp.
style	type of plot to be exhibited.
...	arguments passed to [levelplot](#),[contour](#) or [persp3D](#) .

Details

This function plots K-function and pair correlation function for spatio-temporal point patterns on linear networks using different styles.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

[levelplot](), [contour](), [persp3D]()

---

print.stlpp   *Methods for space-time point patterns on a linear network.*

Description

Methods to print an object of class [stlpp]().

Usage

```
print.stlpp(x)
```

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

[as.stlpp]()

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
X
```

---

print.stlppint   *Methods for space-time point patterns on a linear network.*

Description

Methods to print an object of class [stlppint]().

Usage

```
print.stlppint(x)
```

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

[as.stlpp](#), [density.stlpp](#)

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
density(X)
```

---

print.sumstlpp	*Methods for space-time point patterns on a linear network.*

Description

Methods to print an object of class [stlpp](#).

Usage

```
print.sumstlpp(x)
```

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

[STLg](#), [STLK](#), [STLginhom](#), [STLKinhom](#)

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
STLK(X)
STLg(X)
```

---

rpoistlpp	*simulating spatio-temporal poisson point processes on a linear network*

Description

simulating a realisation of a spatio-temporal poisson point process on a linear network.

Usage

```
rpoistlpp(lambda,a,b,L,check=FALSE,lmax=NULL,nsim=1)
```

Arguments

lambda	intensity of the point process. It can be either a number or a function of location and time.
a	lower bound of time period.
b	upper bound of time period.
L	a linear network.
check	Logical value indicating whether to check that all the (x,y) points lie inside the specified window. see [ppp]().
lmax	upper bound for the values of labmda. This is optinal.
nsim	number of simulated patterns to generate.

Details

This function generates a realisation of a spatio-temporal poisson point process on a linear network based on intensity function lambda and lower/upper bounds a and b.

Value

an object of class [stlpp]() if nsim=1, otherwise a list of objects of class [stlpp]().

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

[density]()

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
X
```

---

rthin.stlpp   *Random thinning*

Description

Applies independent random thinning to a spatio-temporal point pattern on a linear network.

Usage

```
## S3 method for class stlpp
rthin(X, P = P, nsim = 1)
```

Arguments

X	a spatio-temporal point pattern of class [stlpp]
P	retention probability
nsim	number of simulated realisations to be generated

Details

see [rthin]

Value

An object of the same kind as X if nsim=1, or a list of such objects if nsim > 1.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

[stlpp], [rthin]

Examples

```
data(Medellin)
rthin(Medellin,P=.5)
```

STLg	*spatio-temporal pair correlation function for point processes on linear networks*

Description

spatio-temporal pair correlation function for point processes on linear networks.

Usage

```
STLg(X,seqr=NULL,seqt=NULL)
```

Arguments

X	a realisation of a spatio-temporal point processes on a linear networks.
seqr	values of argument r where pair correlation function will be evaluated. optional.
seqt	values of argument t where pair correlation function will be evaluated. optional.

Details

This function calculates the pair correlation function for a homogeneous spatio-temporal point processes on a linear network.

Value

an object of class [sumstlpp].

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

[pcf](), [STLK]()

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
STLg(X)
```

STLginhom	*spatio-temporal inhomogeneous pair correlation function for point processes on linear networks*

Description

spatio-temporal inhomogeneous pair correlation function for point processes on linear networks.

Usage

```
STLginhom(X,lambda,normalize=FALSE,seqr=NULL,seqt=NULL)
```

Arguments

X	a realisation of a spatio-temporal point processes on a linear networks.
lambda	values of estimated intensity.
normalize	normalization factor to be considered.
seqr	values of argument r where pair correlation function will be evaluated. optional.
seqt	values of argument t where pair correlation function will be evaluated. optional.

Details

This function calculates the inhomogeneous pair correlation function for a spatio-temporal point processes on a linear network.

Value

an object of class [sumstlpp]().

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

STLg, STLK, STLKinhom

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
d = density(X)
STLginhom(X,lambda=d)
```

STLk   *spatio-temporal K-function for point processes on linear networks*

Description

spatio-temporal K-function for point processes on linear networks.

Usage

```
STLk(X,seqr=NULL,seqt=NULL)
```

Arguments

X	a realisation of a spatio-temporal point processes on a linear networks.
seqr	values of argument r where pair correlation function will be evaluated. optional.
seqt	values of argument t where pair correlation function will be evaluated. optional.

Details

This function calculates the K-function for a homogeneous spatio-temporal point processes on a linear network.

Value

an object of class sumstlpp.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

Kest, STLg

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
STLK(X)
```

STLkinhom	*spatio-temporal inhomogeneous K-function for point processes on linear networks*

Description

spatio-temporal inhomogeneous K-function for point processes on linear networks

Usage

```
STLkinhom(X,lambda=lambda,normaliz=FALSE,seqr=NULL,seqt=NULL)
```

Arguments

X	a realisation of a spatio-temporal point processes on a linear networks.
lambda	values of estimated intensity.
normalize	normalization factor to be considered.
seqr	values of argument r where pair correlation function will be evaluated. optional.
seqt	values of argument t where pair correlation function will be evaluated. optional.

Details

This function calculates the inhomogeneous K-function for a spatio-temporal point processes on a linear network.

Value

an object of class `sumstlpp`.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

`STLg`, `STLK`, `STLginhom`

Examples

```
X = rpoistlpp(.2,a=0,b=5,L=easynet)
lambda = density(X)
STLKinhom(X,lambda=lambda)
```

---

stlpp   *Create spatio-temporal point pattern on linear network*

Usage

```
stlpp(X, L, T, ...)
```

Arguments

X	Locations of the points. A matrix or data frame of coordinates, or a point pattern object (of class "ppp") or other data acceptable to as.ppp or lpp
L	linear network (object of class "linnet")
T	time vector
...	ignored

Details

This function creates an object of class stlpp. For details about X see lpp. T represents the time occurrence of data points.

Value

an object of class stlpp.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

as.stlpp, lpp

---

tpp   *Create a temporal point pattern.*

Description

Create an object of class tpp that represents a temporal point pattern.

Usage

```
tpp(X)
```

Arguments

X	an object of class numeric, integer or vector

Details

Create a temporal point pattern.

Value

an object of class tpp.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

See Also

stlpp

---

unique.stlpp	*extract unique points from a spatio-temporal point pattern on a linear network*

Usage

```
## S3 method for class stlpp
unique(X,...)
```

Arguments

X	a realisation of a spatio-temporal point processes on a linear networks.
...	arguments for unique.

Details

This function calculates the inhomogeneous pair correlation function for a spatio-temporal point processes on a linear network.

Value

a spatio-temporal point pattern on a linear network with no duplicated point.

Author(s)

Mehdi Moradi <m2.moradi@yahoo.com>

References

Moradi, M.M. and Mateu, J. (2019). First and second-order characteristics of spatio-temporal point processes on linear networks.

See Also

unique

Examples

```
X =  rpoistlpp(0.1,0,5,L=easynet)
df = as.data.frame(X)
df_dup = df[sample(nrow(df), 20,replace = T), ]
Y = as.stlpp(df_dup,L=easynet)
npoints(Y)
npoints(unique(Y))
```

Index