# Package ‘poisson’

October 23, 2015

**Type**  Package

**Title**  Simulating Homogenous & Non-Homogenous Poisson Processes

**Version**  1.0

**Date**  2015-10-01

**Author**  Kristian Brock [aut] &lt;kristian.brock@gmail.com&gt;, Daniel Slade [ctb]

**Maintainer**  Daniel Slade &lt;sladeD@bham.ac.uk&gt;

**Depends**  methods

**Description**  Contains functions and classes for simulating, plotting and analysing homogenous and non-homogenous Poisson processes.

**License**  GPL-2

**NeedsCompilation**  no

**Repository**  CRAN

**Date/Publication**  2015-10-23 16:23:14

## R topics documented:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>poisson-package</td>
<td>2</td>
</tr>
<tr>
<td>hpp.event.times</td>
<td>3</td>
</tr>
<tr>
<td>hpp.lik</td>
<td>4</td>
</tr>
<tr>
<td>hpp.mean</td>
<td>5</td>
</tr>
<tr>
<td>hpp.mean.event.times</td>
<td>6</td>
</tr>
<tr>
<td>hpp.mle</td>
<td>6</td>
</tr>
<tr>
<td>hpp.plot</td>
<td>7</td>
</tr>
<tr>
<td>hpp.scenario</td>
<td>8</td>
</tr>
<tr>
<td>hpp.sim</td>
<td>9</td>
</tr>
<tr>
<td>nhpp.event.times</td>
<td>10</td>
</tr>
<tr>
<td>nhpp.lik</td>
<td>11</td>
</tr>
<tr>
<td>nhpp.mean</td>
<td>12</td>
</tr>
<tr>
<td>nhpp.mean.event.times</td>
<td>13</td>
</tr>
<tr>
<td>nhpp.mle</td>
<td>14</td>
</tr>
<tr>
<td>nhpp.plot</td>
<td>15</td>
</tr>
</tbody>
</table>
Description

This package contains functions and classes for simulating, plotting and analysing homogenous and non-homogenous Poisson processes.

Details

Package: poisson
Type: Package
Version: 1.0
Date: 2015-10-01
License: GPL-2

The original motivation for this package was modelling recruitment to clinical trials. The gap between patients registering is random. There were examples where we expected that gap to be the same, on average, throughout the trial and for this problem, we simulated patient arrival times as homogeneous Poisson processes. In multi-centre trials, however, we expected that gap to be large at the start of the trial but get smaller as more recruitment centres opened. This scenario required non-homogeneous Poisson processes. Though this package appeared through a medical statistics application, the ability to simulate and analyse Poisson processes is helpful in lots of fields.

The most useful methods are those that simulate scenarios. A scenario consists of many simulated processes, a mean process, and quantile processes. The mean process shows the average number of events through time, i.e. the most likely process path. The simulated paths and the quantile processes inform the analyst about the level of variance about this mean, allowing inference on best and worst outcomes, as well as the most likely outcome.

Imagine a scenario where we expect 5 events per unit of time, on average, and don’t expect that average to change. We want to analyse the distribution of paths and hitting times of observing 20 events. To simulate and view the scenario, run:

```r
scen = hpp.scenario(rate = 5, num.events = 20, num.sims = 100)
plot(scen, main='My HPP Scenario')
```

The mean process values are in `scen@x.bar` and the quantile processes are in `scen@x.q`.
In contrast, let us now assume that the rate of events will be time-varying. Say we expect the event intensity to start at zero and increase linearly to 100% after three units of time. When event intensity is at 100%, we expect 10 events per unit time. To simulate this scenario, we run:

```r
intensity <- function(t) pmin(t/3, 1)
rate <- 10
num.events <- 100
scen = nhpp.scenario(rate, num.events, num.sims = 100, prob.func=intensity)
plot(scen, main='My NHPP Scenario')
```

**Author(s)**

Kristian Brock [aut], Daniel Slade [ctb]

Maintainer: Daniel Slade <sladeD@bham.ac.uk>

---

### hpp.event.times

**Simulate homogeneous Poisson process event times**

**Description**

Randomly sample the num.events consecutive event times of a random homogeneous poisson process with given rate. Note: the rate parameter is often referred to as lambda.

**Usage**

```r
hpp.event.times(rate, num.events, num.sims = 1, t0 = 0)
```

**Arguments**

- `rate` The rate at which events occur in the Poisson process, aka lambda
- `num.events` Number of event times to simulate in each process
- `num.sims` Number of simulated paths to create
- `t0` start time

**Value**

A numeric vector of length num.events if num.sims=1, else, a num.events by num.sims matrix

**Author(s)**

Kristian Brock - Author, Daniel Slade - Contributor

**See Also**

`hpp.mean.event.times, hpp.scenario, nhpp.event.times`
Examples
rate <- 10
target <- 50
hpp.event.times(rate, target)

hpp.lik  Homogeneous Poisson process likelihood

Description
Get the likelihood of a rate parameter at a specific time for observed HPP event times.

Usage
hpp.lik(x, T1, rate)

Arguments
x  a vector of HPP event times
T1 Calculate likelihood at this time
rate the putative HPP event rate

Value
Returns a numerical value for the likelihood.

Author(s)
Kristian Brock - Author, Daniel Slade - Contributor

See Also
hpp.mle, nhpp.lik

Examples
X = c(0.17, 0.39, 0.63, 0.78, 0.99)
hpp.lik(X, T1 = 1, rate = 4)
hpp.lik(X, T1 = 1, rate = 5)
hpp.lik(X, T1 = 1, rate = 6)
# 5 is the most likely of these three rates
**hpp.mean**

*Expected value of an homogeneous Poisson process.*

### Description

Calculate the expected value of an homogeneous Poisson process at regular points in time.

### Usage

```r
hpp.mean(rate, t0 = 0, t1 = 1, num.points = 100, maximum = NULL)
```

### Arguments

- `rate` - The rate at which events occur in the Poisson process, aka lambda
- `t0` - Start time
- `t1` - End time
- `num.points` - Number of points to use between t0 and t1 in calculating the mean
- `maximum` - The optional maximum value that the process should take

### Value

A numeric vector of length `num.points`

### Author(s)

Kristian Brock - Author, Daniel Slade - Contributor

### See Also

- `hpp.scenario`, `nhpp.mean`

### Examples

```r
hpp.mean(rate = 20, t1 = 5, maximum = 50)
```
### hpp.mean.event.times

*Expected event times of an homogeneous Poisson process.*

**Description**

Calculate the expected event times of an homogeneous Poisson process.

**Usage**

```r
hpp.mean.event.times(rate, num.events)
```

**Arguments**

- `rate` The rate at which events occur in the Poisson process, aka lambda
- `num.events` Observe mean event times at this many points

**Value**

A vector of length `num.events` giving the expected times

**Author(s)**

Kristian Brock - Author, Daniel Slade - Contributor

**See Also**

`hpp.scenario`, `nhpp.mean.event.times`

**Examples**

```r
c <- 10
hpp.mean.event.times(c, 50)
```

---

### hpp.mle

*Get the maximum-likelihood rate parameter of an HPP (homogenous Poisson process)*

**Description**

Get the maximum-likelihood rate parameter for given HPP event times.

**Usage**

```r
hpp.mle(x, T1)
```
**hpp.plot**

**Arguments**

- **x** a vector of HPP event times
- **T1** Calculate MLE at this time

**Value**

Returns a numeric value, the maximum-likelihood rate parameter

**Author(s)**

Kristian Brock - Author, Daniel Slade - Contributor

**See Also**

hpp.lik, nhpp.mle

**Examples**

```r
x = c(0.17, 0.39, 0.63, 0.78, 0.99)
hpp.mle(x, T1=1)
```

---

**Description**

Simulate and plot simulated homogeneous Poisson processes, also returning the mean and quantile processes.

**Usage**

```r
hpp.plot(rate, num.events, num.sims = 100, t0 = 0, t1 = NULL,
          num.points = 100, quantiles = c(0.025, 0.975), ...)
```

**Arguments**

- **rate** The rate at which events occur in the Poisson process, aka lambda
- **num.events** Number of event times to simulate in each process
- **num.sims** Number of simulated paths to plot
- **t0** Start time
- **t1** End time
- **num.points** Number of points to use in estimating mean and quantile processes
- **quantiles** plot these quantile processes
- **...** further arguments to be passed to methods
hpp.scenario

Value

list

- x Matrix of event times, one process per column
- x.bar Vector of mean process event times
- x.q Matrix of quantile event times, one process per column

Author(s)

Kristian Brock - Author, Daniel Slade - Contributor

See Also

hpp.scenario, nhpp.plot

Examples

```r
hpp.plot(rate = 5, num.events = 20, num.sims = 100, main='My simulated HPPs')
```

---

**hpp.scenario**  
*Simulate an homogeneous Poisson process scenario*

Description

Simulate an homogeneous Poisson process scenario, with sample paths, expected value process, and quantile processes.

Usage

```r
hpp.scenario(rate, num.events, num.sims = 100, t0 = 0, t1 = NULL,
             num.points = 100, quantiles = c(0.025, 0.975), ...)
```

Arguments

- `rate` The rate at which events occur in the Poisson process, aka lambda
- `num.events` Number of event times to simulate in each process
- `num.sims` Number of simulated paths to plot
- `t0` Start time
- `t1` End time
- `num.points` Number of points to use in estimating mean and quantile processes
- `quantiles` plot these quantile processes
- `...` further arguments to be passed to or from methods

Value

Instance of PoissonProcessScenario
**hpp.sim**

**Author(s)**
Kristian Brock - Author, Daniel Slade - Contributor

**See Also**
hpp.scenario, PoissonProcessScenario

**Examples**

```r
scen = hpp.scenario(rate = 5, num.events = 20, num.sims = 100)
scen@x.bar
plot(scen, main='My HPP Scenario')
```

---

**hpp.sim**

*Simulate homogeneous Poisson process(es).*

**Description**
Get the n consecutive event times of an homogeneous poisson process with given rate. Note: the rate parameter is often referred to as lambda.

**Usage**

```r
hpp.sim(rate, num.events, num.sims = 1, t0 = 0, prepend.t0 = T)
```

**Arguments**

- **rate**: The rate at which events occur in the Poisson process, aka lambda
- **num.events**: Number of event times to simulate in each process
- **num.sims**: Number of simulated paths to create
- **t0**: Start time
- **prepend.t0**: TRUE: To include t0 at the start of the process, FALSE: Not include t0 at the start of the process.

**Value**
A numeric vector of length num.events if num.sims=1, else, a num.events by num.sims matrix [num.events+1 if prepend.zero=T]

**Author(s)**
Kristian Brock - Author, Daniel Slade - Contributor

**See Also**
hpp.scenario, nhpp.sim
Examples

```r
rate <- 10
target = 50
hpp.sim(rate,target)
```

---

**nhpp.event.times**  
*Simulate non-homogeneous Poisson process event times*

**Description**

Randomly simulate the `num.events` consecutive event times of a non-homogeneous Poisson process. Events are simulated using an underlying homogeneous process with given rate. An event at time `t` is admitted with probability `prob.func(t)`. Note: The rate parameter of an homogeneous process is often called `lambda`.

**Usage**

```r
nhpp.event.times(rate, num.events, prob.func, num.sims = 1, t0 = 0)
```

**Arguments**

- `rate`: the rate at which events occur in the equivalent homogeneous Poisson process, aka `lambda`
- `num.events`: number of event times to simulate in each process
- `prob.func`: aka intensity function, function that takes time as sole argument and returns value between 0 and 1
- `num.sims`: number of simulated paths to create
- `t0`: the reference start time of all events

**Details**

This method is called 'thinning' by Lewis & Shedler (1978).

**Value**

A numeric vector of length `num.events` if `num.sims`=1, else, a `num.events` by `num.sims` matrix

**Author(s)**

Kristian Brock - Author, Daniel Slade - Contributor

**References**

Lewis & Shedler, Simulation of Non-Homogeneous Poisson Processes by Thinning, 1978
See Also

nhpp.mean.event.times, nhpp.scenario, hpp.event.times

Examples

rate <- 10
target <- 50
intensity <- function(t) pmin(t/3, 1)
nhpp.event.times(rate, target, intensity)

---

nhpp.lik

**Non-homogeneous Poisson process likelihood**

Description

Get the likelihood of a rate parameter at a specific time for observed NHPP event times and given intensity function.

Usage

nhpp.lik(x, T1, rate, prob.func)

Arguments

- `x`: a vector of HPP event times
- `T1`: Calculate likelihood at this time
- `rate`: the putative HPP event rate
- `prob.func`: aka intensity function, function that takes time as sole argument and returns value between 0 and 1

Value

Returns a numerical value for the likelihood.

Author(s)

Kristian Brock - Author, Daniel Slade - Contributor

See Also

nhpp.mle, hpp.lik
Examples

```r
intensity <- function(t) pmin(t/3, 1)
X = c(0.74, 1.50, 1.67, 2.01, 2.27)
nhpp.lik(X, T1 = 2.3, rate = 5, prob.func = intensity)
nhpp.lik(X, T1 = 2.3, rate = 6, prob.func = intensity)
nhpp.lik(X, T1 = 2.3, rate = 7, prob.func = intensity)
# 6 is the most likely of these three rates
```

### nhpp.mean

*Expected value of a non-homogeneous Poisson process.*

**Description**

Calculate the expected value of a non-homogeneous Poisson process at points in time.

**Usage**

```r
nhpp.mean(rate, prob.func, t0 = 0, t1 = 1, num.points = 100, maximum = NULL)
```

**Arguments**

- `rate` the rate at which events occur in the Poisson process, aka lambda
- `prob.func` function that takes time as sole argument and returns value between 0 and 1
- `t0` start time
- `t1` end time
- `num.points` number of points between t0 and t1 to use in estimating mean
- `maximum` the optional maximum value that the process should take

**Value**

A numeric vector of length num.points

**Author(s)**

Kristian Brock - Author, Daniel Slade - Contributor

**See Also**

- `nhpp.scenario`
- `hpp.mean`

**Examples**

```r
intensity <- function(t) pmin(t/3, 1)
nhpp.mean(rate = 20, t1 = 5, maximum = 50, prob.func=intensity)
```
nhpp.mean.event.times

Expected event times of a non-homogeneous Poisson process.

Description

Calculate the expected event times of a non-homogeneous Poisson process.

Usage

nhpp.mean.event.times(rate, num.events, prob.func, max.time = 1000)

Arguments

rate
The rate at which events occur in the Poisson process, aka lambda
num.events
Observe mean event times at this many points
prob.func
aka intensity function, function that takes time as sole argument and returns value between 0 and 1
max.time
Maximum time value to use

Value

A vector of length num.events giving the expected times

Author(s)

Kristian Brock - Author, Daniel Slade - Contributor

See Also

nhpp.event.times, nhpp.scenario, hpp.mean.event.times

Examples

intensity <- function(t) pmin(t/3, 1)
rate <- 10
nhpp.mean.event.times(rate, 50, prob.func = intensity)
nhpp.mle

Get the maximum-likelihood rate parameter of an NHPP (non-homogenous Poisson process)

Description

Get the maximum-likelihood rate parameter for given NHPP event times.

Usage

nhpp.mle(x, T1, prob.func, max.val)

Arguments

- \(x\) : a vector of NHPP event times
- \(T1\) : calculate MLE at this time
- \(\text{prob.func}\) : function that takes time as sole argument and returns value between 0 and 1
- \(\text{max.val}\) : maximum value to consider for MLE of NHPP rate parameter

Value

Returns a numeric value, the maximum-likelihood rate parameter

Author(s)

Kristian Brock - Author, Daniel Slade - Contributor

See Also

nhpp.lik, hpp.mle

Examples

```r
intensity <- function(t) pmin(t/3, 1)
X = c(0.74, 1.50, 1.67, 2.01, 2.27)

nhpp.mle(X, T1=1, prob.func=intensity, max.val = 70)
```
**nhpp.plot**

*Plot simulated non-homogeneous Poisson processes*

**Description**

Plot `num.events` simulated non-homogeneous Poisson processes, plus the mean and quantiles

**Usage**

```r
nhpp.plot(rate, num.events, prob.func, num.sims = 100, t0 = 0, t1 = NULL, num.points = 100, quantiles = c(0.025, 0.975), ...)```

**Arguments**

- `rate`: the rate at which events occur in the Poisson process, aka lambda
- `num.events`: the number of event times to simulate in each process
- `prob.func`: function that takes time as sole argument and returns value between 0 and 1
- `num.sims`: number of simulated paths to plot
- `t0`: start time
- `t1`: end time
- `num.points`: number of points to use in estimating mean and quantile processes
- `quantiles`: plot these quantile processes
- `...`: further arguments to be passed to or from methods

**Value**

- `list`
  - `x`: Matrix of event times, one process per column
  - `x.bar`: Vector of mean process event times
  - `x.q`: Matrix of quantile event times, one process per column

**Author(s)**

Kristian Brock - Author, Daniel Slade - Contributor

**See Also**

- `nhpp.scenario`, `hpp.plot`

**Examples**

```r
intensity <- function(t) pmin(t/3, 1)
nhpp.plot(rate = 5, num.events = 20, num.sims = 100, main='My simulated NHPPs', prob.func=intensity)
```
**nhpp.scenario**

*Simulate a non-homogeneous Poisson process scenario*

**Description**

Simulate a non-homogeneous Poisson process scenario, with sample paths, expected value process, and quantile processes.

**Usage**

```r
mhpp.scenario(rate, num.events, prob.func, num.sims = 100, t0 = 0, t1 = NULL, num.points = 100, quantiles = c(0.025, 0.975), ...)
```

**Arguments**

- `rate` the rate at which events occur in the equivalent homogeneous Poisson process, aka lambda
- `num.events` Number of event times to simulate in each process
- `prob.func` aka intensity function, function that takes time as sole argument and returns value between 0 and 1
- `num.sims` Number of simulated paths to plot
- `t0` Start time
- `t1` End time
- `num.points` Number of points to use in estimating mean and quantile processes
- `quantiles` plot these quantile processes
- `...` further arguments to be passed to or from methods

**Value**

Instance of PoissonProcessScenario

**Author(s)**

Kristian Brock - Author, Daniel Slade - Contributor

**See Also**

```
hpp.scenario, PoissonProcessScenario
```

**Examples**

```r
intensity <- function(t) pmin(t/3, 1)
rate <- 10
num.events <- 100
scen = nhpp.scenario(rate, num.events, num.sims = 100, prob.func=intensity)
scen@x.bar
plot(scen, main='My NHPP Scenario')
```
nhpp.sim

Simulate non-homogeneous Poisson process(es)

Description

Get the n consecutive event times of a non-homogeneous poisson process. Events are simulated using an homogeneous process with rate, and an event at time t is admitted with probability prob.func(t). The rate parameter of an homogeneous process is often called lambda.

Usage

nhpp.sim(rate, num.events, prob.func, num.sims = 1, t0 = 0, prepend.t0 = T)

Arguments

rate the rate at which events occur in the equivalent homogeneous Poisson process, aka lambda
num.events number of event times to simulate in each process
prob.func aka intensity function, function that takes time as sole argument and returns value between 0 and 1
num.sims number of simulated paths to create
t0 the reference start time of all events
prepend.t0 T to include t0 at the start of the process

Details

This method is called 'thinning' by Lewis & Shedler (1978)

Value

a numeric vector of length num.events if num.sims=1 else, a num.events by num.sims matrix [num.events+1 is prepend.zero=T]

Author(s)

Kristian Brock - Author, Daniel Slade - Contributor

References

Lewis & Shedler, Simulation of Non-Homogeneous Poisson Processes by Thinning, 1978

See Also

nhpp.scenario, hpp.sim
nhpp.sim.slow

Examples

```r
intensity <- function(t) pmin(t/3, 1)
rate <- 10
num.events <- 100
nhpp.sim(rate, num.events, prob.func=intensity)
```

nhpp.sim.slow  
Simulate a non-homogeneous Poisson process.

Description

Get the n consecutive event times of a non-homogeneous poisson process. Events are simulated using an homogeneous process with rate, and an event at time t is admitted with probability prob.func(t).

Usage

```r
nhpp.sim.slow(rate, num.events, prob.func, num.sims = 1, t0 = 0, prepend.t0 = T)
```

Arguments

- **rate**  
  the rate at which events occur in the equivalent homogeneous Poisson process, aka lambda
- **num.events**  
  number of event times to simulate in each process
- **prob.func**  
  aka intensity function, function that takes time as sole argument and returns value between 0 and 1
- **num.sims**  
  number of simulated paths to create
- **t0**  
  the reference start time of all events
- **prepend.t0**  
  T to include t0 at the start of the process

Details

This method is called 'thinning' by Lewis & Shedler (1978)

Value

a numeric vector of length num.events if num.sims=1 else, a num.events by num.sims matrix

Note

This item is my original (slower) implementation of NHPP simulation, hence the name. It does not use recursion so the code is easier to understand.

Author(s)

Kristian Brock - Author, Daniel Slade - Contributor
References

Lewis & Shedler, Simulation of Non-Homogeneous Poisson Processes by Thinning, 1978

See Also


Examples

```r
intensity <- function(t) pmin(t/3, 1)
rate <- 10
num.events <- 100
nhpp.sim.slow(rate, num.events, prob.func=intensity)
```

Description

A simulated scenario can be visualised with a plot. Included are process paths, the mean process and quartile processes.

Usage

```r
## S4 method for signature 'PoissonProcessScenario'
plot(x, plot.mean, plot.quantiles, ...)
```

Arguments

- `x` The `PoissonProcessScenario` object to plot
- `plot.mean` TRUE to plot the mean process
- `plot.quantiles` TRUE to plot the quantile processes
- `...` Additional arguments affecting the plot

Examples

```r
scen = hpp.scenario(rate = 5, num.events = 20, num.sims = 100)
scen@x.bar
plot(scen, main='My HPP Scenario')
```
plotprocesses  

Plot simulated process paths

Description

Plot a matrix of simulated process paths

Usage

plotprocesses(x, y = NULL, xlab = "t (years)", ylab = "N", type = "l",
               lty = 2, col = "cadetblue3", xlim = c(0, 1.1 * max(x)),
               lwd = 0.5, add = F, ...)

Arguments

x  matrix of process paths
y  variable for y axis, index of x if NULL
xlab  Label for x-axis
ylab  Label for y-axis
type  Type of plot for simulated processes paths
lty  Line type for simulated processes paths
col  Colour for simulated processes paths
xlim  The range for the x-axis
lwd  Line-width for simulated processes paths
add  TRUE to add to existing plot; FALSE to start afresh
...  Additional arguments affecting the plot

Author(s)

Kristian Brock - Author, Daniel Slade - Contributor

Examples

scen = hpp.scenario(rate = 5, num.events = 20, num.sims = 100)
plotprocesses(scen@x, main='My HPP paths')
Description

This class is the result of a Poisson process simulation scenario, yielded by methods like `hpp.scenario` and `nhpp.scenario`. The object has slots for the simulated random processes, the mean process, and quantile processes. It has specific implementations of plot and show.

Objects from the Class

Objects can be created by calls of the form `new("PoissonProcessScenario", ...), although they would more commonly be fetched from calls to `hpp.scenario` and `nhpp.scenario`.

Slots

- `x`: Object of class "matrix", the simulated process paths
- `x.bar`: Object of class "numeric", the mean process
- `x.bar.index`: Object of class "numeric", the time variable of the mean process
- `x.q`: Object of class "matrix", the quantile processes.

Methods

- `plot signature(x = "PoissonProcessScenario"): ...
- `show signature(object = "PoissonProcessScenario"): ...

Author(s)

Kristian Brock - Author, Daniel Slade - Contributor

See Also

`hpp.scenario`, `nhpp.scenario`
Description
A simulated scenario can be examined with a show.

Usage
```r
## S4 method for signature 'PoissonProcessScenario'
show(object)
```

Arguments
- **object**: The `PoissonProcessScenario` object to show

Examples
```r
scen = hpp.scenario(rate = 5, num.events = 20, num.sims = 100)
show(scen)
```
Index

*Topic **HPP**
  hpp.event.times, 3
  hpp.lik, 4
  hpp.mean, 5
  hpp.mean.event.times, 6
  hpp.mle, 6
  hpp.plot, 7
  hpp.scenario, 8
  hpp.sim, 9
  PoissonProcessScenario-class, 21

*Topic **MLE**
  hpp.mle, 6
  nhpp.mle, 14

*Topic **NHPP**
  nhpp.event.times, 10
  nhpp.lik, 11
  nhpp.mean.event.times, 13
  nhpp.mle, 14
  nhpp.plot, 15
  nhpp.scenario, 16
  PoissonProcessScenario-class, 21

*Topic **classes**
  PoissonProcessScenario-class, 21

*Topic **likelihood**
  hpp.lik, 4
  nhpp.lik, 11

*Topic **maximum likelihood**
  hpp.mle, 6
  nhpp.mle, 14

*Topic **methods**
  plot-methods, 19
  show-methods, 22

*Topic **nhpp**
  nhpp.mean, 12
  nhpp.sim, 17
  nhpp.sim.slow, 18

*Topic **plot**
  plot-methods, 19

*Topic **poisson**

hpp.event.times, 3
hpp.lik, 4
hpp.mean, 5
hpp.mean.event.times, 6
hpp.mle, 6
hpp.plot, 7
hpp.scenario, 8
hpp.sim, 9
nhpp.event.times, 10
nhpp.lik, 11
nhpp.mean, 12
nhpp.mean.event.times, 13
nhpp.mle, 14
nhpp.plot, 15
nhpp.scenario, 16
nhpp.sim, 17
nhpp.sim.slow, 18
plotprocesses, 20
PoissonProcessScenario-class, 21

*Topic **show**
  show-methods, 22

*Topic **simulation**
  hpp.event.times, 3
  hpp.scenario, 8
  hpp.sim, 9
  nhpp.event.times, 10
  nhpp.scenario, 16
  nhpp.sim, 17
  nhpp.sim.slow, 18

hpp.event.times, 3, 11
hpp.lik, 4, 7, 11
hpp.mean, 5, 12
hpp.mean.event.times, 3, 6, 13
hpp.mle, 4, 6, 14
hpp.plot, 7, 15
hpp.scenario, 3, 5, 6, 8, 8, 9, 16, 21
hpp.sim, 9, 17, 19

nhpp.event.times, 3, 10, 13
nhpp.lik, 4, 11, 14
nhpp.mean, 5, 12
nhpp.mean.event.times, 6, 11, 13
nhpp.mle, 7, 11, 14
nhpp.plot, 8, 15
nhpp.scenario, 9, 11–13, 15, 16, 17, 19, 21
nhpp.sim, 9, 17
nhpp.sim.slow, 18

plot,PoissonProcessScenario-method
   (plot-methods), 19
plot-methods, 19
plotprocesses, 20
poisson (poisson-package), 2
poisson-package, 2
PoissonProcessScenario, 9, 16, 19, 22
PoissonProcessScenario-class, 21

show,PoissonProcessScenario-method
   (show-methods), 22
show-methods, 22