

Package: MG1StationaryProbability (via r-universe)

September 4, 2024

Type Package

Title Computes Stationary Distribution for M/G/1 Queuing System

URL <https://github.com/MashroomMole/MG1StationaryProbability>

Version 0.1.2

Description The idea of a computational algorithm described in the article by Andronov M. et al. (2022) https://link.springer.com/chapter/10.1007/978-3-030-92507-9_13. The purpose of this package is to automate computations for a Markov-Modulated M/G/1 queuing system with alternating Poisson flow of arrivals. It offers a set of functions to calculate various mean indices of the system, including mean flow intensity, mean service busy and idle times, and the system's stationary probability.

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Encoding UTF-8

LazyData true

RoxygenNote 7.2.3

BugReports <https://github.com/MashroomMole/MG1StationaryProbability/issues>

Imports parallel, stats, doParallel(>= 1.0.17), foreach(>= 1.5.2), memoise(>= 2.0.1),

Depends R (>= 4.0.0)

Suggests testthat (>= 3.0.0)

Config/testthat/edition 3

Repository <https://mashroommole.r-universe.dev>

RemoteUrl <https://github.com/mashroommole/mg1stationaryprobability>

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b *Service continuous density distribution*

Description

Service continuous density distribution

Usage

b(t)

Arguments

t time value

Value

density function value (double) given t

densityOfSojournTimeAtState_i

The density of the sojourn time in state i with probability that

Description

The density of the sojourn time in state i with probability that

Usage

densityOfSojournTimeAtState_i(i, j, t, dt, m = c(0.2, 0.3), mMax = 14)

Arguments

i	MC i-th state
j	MC j-th state
t	time value
dt	time increment
m	distribution parameters vector of sojourn times in alternating environment states
mMax	max number of addends in sums

Value

double

Examples

densityOfSojournTimeAtState_i(1, 0, 10, 1, m=c(1, 2), mMax=5)

EN

Expectation of number of arriving claims depending on i and j

Description

Expectation of number of arriving claims depending on i and j

Usage

EN(i, j, t, m = c(0.2, 0.3), lambda = c(1, 2))

Arguments

i	MC i-th state
j	MC j-th state
t	time value
m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector

Value

double

Examples

EN(1, 1, 2)

ENU

Expectation of number of arriving claims

Description

Expectation of number of arriving claims

Usage

ENU(i, t)

Arguments

i	MC i-th state
t	time value

Value

double

Examples

ENU(1, 3)

finalStateProbability *Probability of the final state*

Description

Probability of the final state

Usage

```
finalStateProbability(i, j, t, m = c(0.2, 0.3))
```

Arguments

i	MC i-th state
j	MC j-th state
t	time value
m	distribution parameters vector of sojourn times in alternating environment states

Value

double

Examples

```
finalStateProbability(0, 1, 10)
```

flowIntensityMean *The mean intensity of the arrived flow*

Description

The mean intensity of the arrived flow

Usage

```
flowIntensityMean(lambda = c(1, 2))
```

Arguments

lambda	Poisson flow intensity vector
--------	-------------------------------

Value

mean intensity value (double) of the arrived flow

h	<i>Density of empty time for initial state i jointly with probability of final state j</i>
---	--

Description

Density of empty time for initial state i jointly with probability of final state j

Usage

```
h(i, j, t, m = c(0.2, 0.3), lambda = c(1, 2))
```

Arguments

i	MC i-th state
j	MC j-th state
t	time value
m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector

Value

double

Examples

```
h(1, 1, 2, m = c(2.5, 0.2))
```

loadCoefficient	<i>Load coefficient</i>
-----------------	-------------------------

Description

Load coefficient

Usage

```
loadCoefficient(m, lambda)
```

Arguments

m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector

Value

load coefficient value (double) of the arriving flow

Examples

```
loadCoefficient(m = c(0.2, 0.3), lambda = c(1,2))
```

meanSojournTimeWithFSP

Mean sojourn time in the initial state i jointly with final probability of state j

Description

Mean sojourn time in the initial state i jointly with final probability of state j

Usage

```
meanSojournTimeWithFSP(i, j, t, m = c(0.2, 0.3))
```

Arguments

- i MC i-th state
- j MC j-th state
- t time value
- m distribution parameters vector of sojourn times in alternating environment states

Value

double

Examples

```
meanSojournTimeWithFSP(1, 0, 3)
```

meanSoujournTime	<i>Mean sojourn time in the initial state i (without final probability of state j)</i>
------------------	--

Description

Mean sojourn time in the initial state i (without final probability of state j)

Usage

```
meanSoujournTime(i, t)
```

Arguments

i	MC i-th state
t	time value

Value

double

Examples

```
meanSoujournTime(0, 10)
```

meanTimeEmptyFixed	<i>Mean time of empty period in fixed state i</i>
--------------------	---

Description

Mean time of empty period in fixed state i

Usage

```
meanTimeEmptyFixed(i)
```

Arguments

i	MC i-th state
---	---------------

Value

complex

meanTimeOfBusyPeriodETW
Mean time of busy period

Description

Mean time of busy period

Usage

meanTimeOfBusyPeriodETW(m = c(0.2, 0.3), lambda = c(1, 2))

Arguments

m distribution parameters vector of sojourn times in alternating environment states
lambda Poisson flow intensity vector description

Value

complex

meanTimeOfBusyPeriodEW
Mean time of busy period multiplied by load coefficient

Description

Mean time of busy period multiplied by load coefficient

Usage

meanTimeOfBusyPeriodEW(m = c(0.2, 0.3), lambda = c(1, 2))

Arguments

m distribution parameters vector of sojourn times in alternating environment states
lambda Poisson flow intensity vector

Value

complex

`meanTimeOfEmptyPeriod` *Mean time of empty period given the stationary probability*

Description

Mean time of empty period given the stationary probability

Usage

`meanTimeOfEmptyPeriod()`

Value

complex

`MET` *Mean idle time if initial state i*

Description

Mean idle time if initial state i

Usage

`MET(i, m = c(0.2, 0.3), lambda = c(1, 2), tmax = 12)`

Arguments

<code>i</code>	MC i-th state
<code>m</code>	distribution parameters vector of sojourn times in alternating environment states
<code>lambda</code>	Poisson flow intensity vector
<code>tmax</code>	upper integration limit

Value

double

Examples

`MET(1)`

MST	<i>Mean empty time sojourn time in the initial state i during the empty period</i>
-----	--

Description

Mean empty time sojourn time in the initial state i during the empty period

Usage

```
MST(i, m = c(0.2, 0.3), lambda = c(1, 2), tmax = 12)
```

Arguments

i	MC i-th state
m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector
tmax	upper integration limit

Value

double

Examples

```
MST(1)
```

not_i	<i>Helper "not i" function</i>
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Description

Helper "not i" function

Usage

```
not_i(i = 0)
```

Arguments

i	MC i-th state
---	---------------

Value

2 if i = 0 and 1 if i = 1

p0 *The stationary probabilities of the environment state 0*

Description

The stationary probabilities of the environment state 0

Usage

p0(m = c(0.2, 0.3))

Arguments

m distribution parameters vector of sojourn times in alternating environment states

Value

stationary probability of the environment state 0 (double)

Examples

p0()

p1 *The stationary probabilities of the environment state 1*

Description

The stationary probabilities of the environment state 1

Usage

p1(m = c(0.2, 0.3))

Arguments

m distribution parameters vector of sojourn times in alternating environment states

Value

stationary probability of the environment state 1 (double)

pi *Stationary probabilities for continuous time environment's state*

Description

Stationary probabilities for continuous time environment's state

Usage

```
pi(m = c(0.2, 0.3))
```

Arguments

m distribution parameters vector of sojourn times in alternating environment states

Value

double

Examples

```
pi()
```

probabilitiesMatrix *Probability matrix calculation. Rows represent arriving probabilities at state i and columns represent the same for state j*

Description

Probability matrix calculation. Rows represent arriving probabilities at state i and columns represent the same for state j

Usage

```
probabilitiesMatrix(  
  i,  
  j,  
  m = c(0.2, 0.3),  
  lambda = c(1, 2),  
  tmax = 12,  
  nmax = 5  
)
```

Arguments

i	MC i-th state
j	MC j-th state
m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector
tmax	upper integration limit
nmax	limitation for number of arriving claims

Value

matrix with nmax rows and columns

probabilityOfNArrival *Probability of n arrival during time t jointly with final state j if initial state is i*

Description

Probability of n arrival during time t jointly with final state j if initial state is i

Usage

```
probabilityOfNArrival(i, j, n, t, m = c(0.2, 0.3), lambda = c(1, 2))
```

Arguments

i	MC i-th state
j	MC j-th state
n	number of arrivals
t	upper integration limit
m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector

Value

double

Examples

```
probabilityOfNArrival(1, 0, 10, 3, m=c(0.5, 0.3), lambda=c(2, 1))
```

probabilityOfNArrivalW

Probability of n arrival during time t (without joint probability of j)

Description

Probability of n arrival during time t (without joint probability of j)

Usage

probabilityOfNArrivalW(i, n, t, m = c(0.2, 0.3), lambda = c(1, 2))

Arguments

i	MC i-th state
n	number of arrivals
t	time value
m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector

Value

double

Examples

probabilityOfNArrivalW(1, 2, 3)

PrTr	<i>Probability to have state j in the ending of the idle period, if initially we have state i</i>
------	---

Description

Probability to have state j in the ending of the idle period, if initially we have state i

Usage

PrTr(i, j, m = c(0.2, 0.3), lambda = c(1, 2), tmax = 12)

Arguments

i	MC i-th state
j	MC j-th state
m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector
tmax	upper integration limit

Value

double

Examples

```
PrTr(1, 0)
```

resultingMatrix	<i>Resulting probabilities matrix calculation</i>
-----------------	---

Description

Resulting probabilities matrix calculation

Usage

```
resultingMatrix(m = c(0.2, 0.3), lambda = c(1, 2), tmax = 12, nmax = 5)
```

Arguments

m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector
tmax	upper integration limit
nmax	limitation for number of arriving claims

Value

matrix with $2 \cdot n_{\max}$ rows and columns

serviceDistribution *Service distribution function*

Description

Service distribution function

Usage

serviceDistribution(t)

Arguments

t time value

Value

service function value (double) given t

stationaryProbabilities
 Stationary probability function

Description

Stationary probability function

Usage

stationaryProbabilities(m = c(0.2, 0.3), lambda = c(1, 2), tmax = 12, nmax = 5)

Arguments

m distribution parameters vector of sojourn times in alternating environment states
lambda Poisson flow intensity vector
tmax upper integration limit
nmax limitation for number of arriving claims

Value

MC stationary probability vector

stationaryProbabilitiesOfEmptyStates

Stationary probabilities of the empty states in continuous time model

Description

Stationary probabilities of the empty states in continuous time model

Usage

```
stationaryProbabilitiesOfEmptyStates(i, m = c(0.2, 0.3), lambda = c(1, 2))
```

Arguments

i	MC i-th state
m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector

Value

complex

stationaryProbabilities_cached

Stationary probability caching function

Description

Stationary probability caching function

Usage

```
stationaryProbabilities_cached(  
  m = c(0.2, 0.3),  
  lambda = c(1, 2),  
  tmax = 12,  
  nmax = 5  
)
```

Arguments

m	distribution parameters vector of sojourn times in alternating environment states
lambda	Poisson flow intensity vector
tmax	upper integration limit
nmax	limitation for number of arriving claims

stationaryProbabilities_cached

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Value

stationary probability vector cached

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