Package ‘queueing’

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Title Analysis of Queueing Networks and Models

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Depends R (>= 2.11.1)

Description

It provides versatile tools for analysis of birth and death based Markovian Queueing Models
and Single and Multiclass Product-Form Queueing Networks.
It implements M/M/1, M/M/c, M/M/Infinite, M/M/1/K, M/M/c/K, M/M/c/c, M/M/1/K/K, M/M/c/K/K, M/M/c/K/m, M/M/Infinite/K
Multiple Channel Open Jackson Networks, Multiple Channel Closed Jackson Networks,
Single Channel Multiple Class Open Networks, Single Channel Multiple Class Closed Networks
and Single Channel Multiple Class Mixed Networks.
Also it provides a B-Erlang, C-Erlang and Engset calculators.
This work is dedicated to the memory of D. Sixto Rios Insua.

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`queueing-package` *Analysis of Queueing Networks and Models.*

Description

It provides a versatile tool for analysis of birth and death based Markovian Queueing Models and Single and Multiclass Product-Form Queueing Networks.

It implements the following basic markovian models:

M/M/1,	M/M/c,		M/M/Infinite,
M/M/1/K,	M/M/c/K,	M/M/c/c,	
M/M/1/K/K,	M/M/c/K/K,	M/M/c/K/m,	M/M/Infinite/K/K

It also solves the following types of networks:

- Multiple Channel Open Jackson Networks.
- Multiple Channel Closed Jackson Networks.
- Single Channel Multiple Class Open Networks.
- Single Channel Multiple Class Closed Networks
- Single Channel Multiple Class Mixed Networks

Also it provides B-Erlang, C-Erlang and Engset calculators.

This work is dedicated to the memory of D. Sixto Rios Insua.

Details

All models are used in the same way:

1. Create inputs calling the appropiate *NewInput.model*. For example, `x <- NewInput.MM1(lambda=0.25, mu=1, n=10)` for a M/M/1 model. To know the exact acronymn model to use for *NewInput* function, you can search the html help or write `help.search("NewInput")` at the command line.
2. Optionally, as a help for creating the inputs, the `CheckInput(x)` function can be called
3. Solve the model calling `y <- QueueingModel(x)`. In this step, the `CheckInput(x)` will be called. That is the reason that the previous step is optional
4. Finally, you can get a performance value as `W(y)`, `Wq(y)` or a report of the principals performace values calling `summary(y)`

See the examples for more detailed information of the use.

Author(s)

Author, Maintainer and Copyright: Pedro Canadilla <pedro.canadilla@gmail.com>

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

Examples

```
## M/M/1 model
summary(QueueingModel(NewInput.MM1(lambda=1/4, mu=1/3, n=0)))

## M/M/1/K model
summary(QueueingModel(NewInput.MM1K(lambda=1/4, mu=1/3, k=3)))
```

`B_erlang` *Returns the probability that all servers are busy*

Description

Returns the probability that all servers are busy

Usage

```
B_erlang(c=1, u=0)
```

Arguments

c	numbers of servers
u	lambda/mu, that is, ratio of rate of arrivals and rate of service

Details

Returns the probability that all servers are busy

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Jagerman1974] Jagerman, D. L. (1974).
Some properties of the Erlang loss function.
Bell System Tech. J. (53), 525-551

See Also

C_erlang

Examples

```
## two servers
B_erlang(2, 0.5/0.7)
```

CheckInput *Generic S3 method to check the params of a queueing model (or network)*

Description

Generic S3 method to check the params of a queueing model (or network)

Usage

```
CheckInput(x, ...)
```

Arguments

x	a object of class i_MM1, i_MMC, i_MM1K, i_MMCK, i_MM1KK, i_MMCKK, i_MMCC, i_MMCKM, i_MMInfKK, i_MMInf, i_OJN
...	aditional arguments

Details

Generic S3 method to check the params of a queueing model (or network)

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

CheckInput.i_MM1
CheckInput.i_MMC
CheckInput.i_MM1K
CheckInput.i_MMCK
CheckInput.i_MM1KK
CheckInput.i_MMCKK
CheckInput.i_MMCC
CheckInput.i_MMCKM
CheckInput.i_MMInfKK
CheckInput.i_MMInf
CheckInput.i_OJN

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Check the inputs
CheckInput(i_mm1)
```

CheckInput.i_BnD *Checks the input params of a generic Birth and Death process model*

Description

Checks the input params of a generic Birth and Death process model

Usage

```
## S3 method for class 'i_BnD'
CheckInput(x, ...)
```

Arguments

x	a object of class i_BnD
...	aditional arguments

Details

Checks the input params of a generic Birth and Death process model. The inputs params are created calling previously the NewInput.BnD

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.BnD.

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)

## Check the inputs
CheckInput(i_BnD)
```

CheckInput.i_CJN *Check the input params of a Closed Jackson Network*

Description

Check the input params of a Closed Jackson Network

Usage

```
  ## S3 method for class 'i_CJN'
CheckInput(x, ...)
```

Arguments

x	a object of class i_CJN
...	aditional arguments

Details

Check the input params of a Closed Jackson Network. The inputs params are created calling previously the NewInput.CJN

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.CJN

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

CheckInput(cjn1)
```

CheckInput.i_MCCN *Check the input params of a MultiClass Closed Network*

Description

Check the input params of a MultiClass Closed Network

Usage

```
  ## S3 method for class 'i_MCCN'
CheckInput(x, ...)
```

Arguments

x	a object of class i_MCCN
...	aditional arguments

Details

Check the input params of a MultiClass Closed Network. The inputs params are created calling previously the NewInput.MCCN

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`NewInput.MCCN`

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

CheckInput(i_MCCN1)
```

`CheckInput.i_MCMN` *Check the input params of a MultiClass Mixed Network*

Description

Check the input params of a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'i_MCMN'
CheckInput(x, ...)
```

Arguments

`x`	a object of class i_MCMN
`...`	aditional arguments

Details

Check the input params of a MultiClass Mixed Network. The inputs params are created calling previously the NewInput.MCMN

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`NewInput.MCMN`

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

CheckInput(i_mcmn1)
```

CheckInput.i_MCON — *Check the input params of a MultiClass Open Network*

Description

Check the input params of a MultiClass Open Network

Usage

```
  ## S3 method for class 'i_MCON'
CheckInput(x, ...)
```

Arguments

x	a object of class i_MCON
...	aditional arguments

Details

Check the input params of a MultiClass Open Network. The inputs params are created calling previously the NewInput.MCON

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`NewInput.MCON`

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

CheckInput(i_mcon1)
```

`CheckInput.i_MM1` *Checks the input params of a M/M/1 queueing model*

Description

Checks the input params of a M/M/1 queueing model

Usage

```
  ## S3 method for class 'i_MM1'
CheckInput(x, ...)
```

Arguments

`x`	a object of class i_MM1
`...`	aditional arguments

Details

Checks the input params of a M/M/1 queueing model. The inputs params are created calling previously the NewInput.MM1

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MM1`.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Check the inputs
CheckInput(i_mm1)
```

`CheckInput.i_MM1K` *Checks the input params of a M/M/1/K queueing model*

Description

Checks the input params of a M/M/1/K queueing model

Usage

```
  ## S3 method for class 'i_MM1K'
CheckInput(x, ...)
```

Arguments

`x`	a object of class i_MM1K
`...`	aditional arguments

Details

Checks the input params of a M/M/1/K queueing model. The inputs params are created calling previously the NewInput.MM1K

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## check the parameters
CheckInput(i_mm1k)
```

CheckInput.i_MM1KK *Checks the input params of a M/M/1/K/K queueing model*

Description

Checks the input params of a M/M/1/K/K queueing model

Usage

```
## S3 method for class 'i_MM1KK'
CheckInput(x, ...)
```

Arguments

x	a object of class i_MM1KK
...	aditional arguments

Details

Checks the input params of a M/M/1/K/K queueing model. The inputs params are created calling previously the NewInput.MM1KK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## check the parameters
CheckInput(i_mm1kk)
```

CheckInput.i_MMC *Checks the input params of a M/M/c queueing model*

Description

Checks the input params of a M/M/c queueing model

Usage

```
  ## S3 method for class 'i_MMC'
CheckInput(x, ...)
```

Arguments

x	a object of class i_MMC
...	aditional arguments

Details

Checks the input params of a M/M/c queueing model. The inputs params are created calling previously the NewInput.MMC

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## check the parameters
CheckInput(i_mmc)
```

`CheckInput.i_MMCC` *Checks the input params of a M/M/c/c queueing model*

Description

Checks the input params of a M/M/c/c queueing model

Usage

```
  ## S3 method for class 'i_MMCC'
CheckInput(x, ...)
```

Arguments

`x`	a object of class i_MMCC
`...`	aditional arguments

Details

Checks the input params of a M/M/c/c queueing model. The inputs params are created calling previously the NewInput.MMCC

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MMCC`.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## check the parameters
CheckInput(i_mmcc)
```

`CheckInput.i_MMCK` *Checks the input params of a M/M/c/K queueing model*

Description

Checks the input params of a M/M/c/K queueing model

Usage

```
  ## S3 method for class 'i_MMCK'
CheckInput(x, ...)
```

Arguments

`x`	a object of class i_MMCK
`...`	aditional arguments

Details

Checks the input params of a M/M/c/K queueing model. The inputs params are created calling previously the NewInput.MMCK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MMCK`.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Check the inputs
CheckInput(i_mmck)
```

`CheckInput.i_MMCKK` *Checks the input params of a M/M/c/K/K queueing model*

Description

Checks the input params of a M/M/c/K/K queueing model

Usage

```
## S3 method for class 'i_MMCKK'
CheckInput(x, ...)
```

Arguments

`x`	a object of class i_MMCKK
`...`	aditional arguments

Details

Checks the input params of a M/M/c/K/K queueing model. The inputs params are created calling previously the NewInput.MMCKK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MMCKK`.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## check the parameters
CheckInput(i_mmckk)
```

CheckInput.i_MMCKM *Checks the input params of a M/M/c/K/m queueing model*

Description

Checks the input params of a M/M/c/K/m queueing model

Usage

```
## S3 method for class 'i_MMCKM'
CheckInput(x, ...)
```

Arguments

x	a object of class i_MMCKM
...	aditional arguments

Details

Checks the input params of a M/M/c/K/m queueing model. The inputs params are created calling previously the NewInput.MMCKM

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## check the parameters
CheckInput(i_mmckm)
```

`CheckInput.i_MMInf` *Checks the input params of a M/M/Infinite queueing model*

Description

Checks the input params of a M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'i_MMInf'
CheckInput(x, ...)
```

Arguments

`x`	a object of class i_MMInf
`...`	aditional arguments

Details

Checks the input params of a M/M/Infinite queueing model. The inputs params are created calling previously the NewInput.MMInf

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Check the parameters
CheckInput(i_mminf)
```

CheckInput.i_MMInfKK *Checks the input params of a M/M/Infinite/K/K queueing model*

Description

Checks the input params of a M/M/Infinite/K/K queueing model

Usage

```
  ## S3 method for class 'i_MMInfKK'
CheckInput(x, ...)
```

Arguments

x	a object of class i_MMInfKK
...	aditional arguments

Details

Checks the input params of a M/M/Infinite/K/K queueing model. The inputs params are created calling previously the NewInput.MMInfKK

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

NewInput.MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## check the parameters
CheckInput(i_MMInfKK)
```

CheckInput.i_OJN *Check the input params of an Open Jackson Network*

Description

Check the input params of an Open Jackson Network

Usage

```
  ## S3 method for class 'i_OJN'
CheckInput(x, ...)
```

Arguments

x	a object of class i_OJN
...	aditional arguments

Details

Check the input params of an Open Jackson Network. The inputs params are created calling previously the NewInput.OJN

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.OJN

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

ojn1 <- NewInput.OJN(prob, n1, n2, n3, n4)

CheckInput(ojn1)
```

CompareQueueingModels *Compare several queueing models in a tabulated format*

Description

Compare several queueing models in a tabulated format

Usage

```
CompareQueueingModels(model, ...)
CompareQueueingModels2(models)
```

Arguments

`model`	A Queueing Model obtained calling QueueingModel from classes described in the details section
`...`	a separated by comma list of queueing models obtained calling QueueingModel from classes described in the details section
`models`	A list of queueing models obtained calling QueueingModel from classes described in the details section

Details

Compare several queueing models in a tabulated format. By now, only o_MM1, o_MMC, o_MMInf, o_MM1K, o_MMCK, o_MMCC, o_MM1KK, o_MMCKK, o_MMCKM, o_MMInfKK classes can be compared

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel

Examples

```
q1 <- QueueingModel(NewInput.MM1(lambda=5, mu=7))
q2 <- QueueingModel(NewInput.MMC(lambda=5, mu=3, c=4))
q3 <- QueueingModel(NewInput.MMInf(lambda=3, mu=4))
q4 <- QueueingModel(NewInput.MMCC(lambda=5, mu=3, c=4))

CompareQueueingModels(q1, q2, q3)
CompareQueueingModels2(list(q1, q2, q3, q4))
```

C_erlang *Returns the probability to wait in queue because all servers are busy*

Description

Returns the probability to wait in queue because all servers are busy

Usage

```
C_erlang(c=1, r=0)
```

Arguments

c	numbers of servers
r	lambda/mu, that is, ratio of rate of arrivals and rate of service

Details

Returns the probability to wait in queue because all servers are busy

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

B_erlang

Examples

```
## two servers
C_erlang(2, 0.5/0.7)
```

`Engset` *Returns the probability that all servers are busy*

Description

Returns the probability that all servers are busy

Usage

```
Engset(k=1, c=0, r=0)
```

Arguments

`k`	numbers of users
`c`	numbers of servers
`r`	lambda/mu, that is, ratio of rate of arrivals and rate of service

Details

Returns the probability of blocking in a finite source model

See Also

`B_erlang`

Examples

```
## three users, two servers
Engset(3, 2, 0.5/0.7)
```

`Inputs` *Returns the input parameters of a queueing model (or network)*

Description

Returns the inputs parameters of a already built queueing model (or network)

Usage

```
Inputs(x, ...)
```

Arguments

`x`	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf, o_OJN, o_MCON, o_MCCN, o_MCMN
`...`	aditional arguments

Details

Returns the input parameters of a queueing model (or network)

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

Inputs.o_MM1
Inputs.o_MMC
Inputs.o_MM1K
Inputs.o_MMCK
Inputs.o_MM1KK
Inputs.o_MMCKK
Inputs.o_MMCC
Inputs.o_MMCKM
Inputs.o_MMInfKK
Inputs.o_MMInf
Inputs.o_OJN
Inputs.o_CJN
Inputs.o_MCON
Inputs.o_MCCN
Inputs.o_MCMN

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## It returns the Inputs
Inputs(o_mm1)
```

`Inputs.o_BnD` *Returns the input parameters of a generic Birth and Death process model*

Description

Returns the inputs parameters of a already built Birth and Death process model

Usage

```
## S3 method for class 'o_BnD'
Inputs(x, ...)
```

Arguments

x	a object of class o_BnD
...	aditional arguments

Details

Returns the input parameters of a generic Birth and Death process model. The inputs parameters are created calling previously the NewInput.BnD

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.BnD`.

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)

## Build the model
o_BnD <- QueueingModel(i_BnD)

## It returns the Inputs
Inputs(o_BnD)
```

`Inputs.o_CJN` *Returns the input params of a Closed Jackson Network*

Description

Returns the input params of a Closed Jackson Network

Usage

```
## S3 method for class 'o_CJN'
Inputs(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Returns the input params of a Closed Jackson Network. The inputs parameters are created calling previously the NewInput.CJN

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.CJN`.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

Inputs(m_cjn1)
```

`Inputs.o_MCCN` *Returns the input params of a MultiClass Closed Network*

Description

Returns the input params of a MultiClass Closed Network

Usage

```
## S3 method for class 'o_MCCN'
Inputs(x, ...)
```

Arguments

`x`	a object of class o_MCCN
`...`	aditional arguments

Details

Returns the input params of a MultiClass Closed Network. The inputs parameters are created calling previously the NewInput.MCCN

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`NewInput.MCCN`.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)
```

```
Inputs(o_MCCN1)
```

`Inputs.o_MCMN` *Returns the input params of a MultiClass Mixed Network*

Description

Returns the input params of a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Inputs(x, ...)
```

Arguments

`x`	a object of class o_MCMN
`...`	aditional arguments

Details

Returns the input params of a MultiClass Mixed Network. The inputs parameters are created calling previously the NewInput.MCMN

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`NewInput.MCMN`.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)
```

```
i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Inputs(o_mcmn1)
```

`Inputs.o_MCON` *Returns the input params of a MultiClass Open Network*

Description

Returns the input params of a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
Inputs(x, ...)
```

Arguments

`x`	a object of class o_MCON
`...`	aditional arguments

Details

Returns the input params of a MultiClass Open Network. The inputs parameters are created calling previously the NewInput.MCON

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`NewInput.MCON`.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Inputs(o_mcon1)
```

Inputs.o_MM1 *Returns the input parameters of a M/M/1 queueing model*

Description

Returns the inputs parameters of a already built M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
Inputs(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the input parameters of a M/M/1 queueing model. The inputs parameters are created calling previously the NewInput.MM1

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## It returns the Inputs
Inputs(o_mm1)
```

Inputs.o_MM1K *Returns the input parameters of a M/M/1/K queueing model*

Description

Returns the inputs parameters of a already built M/M/1/K queueing model

Usage

```
  ## S3 method for class 'o_MM1K'
Inputs(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Returns the input parameters of a M/M/1/K queueing model. The inputs parameters are created calling previously the NewInput.MM1K

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## It returns the Inputs
Inputs(o_mm1k)
```

`Inputs.o_MM1KK` *Returns the input parameters of a M/M/1/K/K queueing model*

Description

Returns the inputs parameters of a already built M/M/1/K/K queueing model

Usage

```
  ## S3 method for class 'o_MM1KK'
Inputs(x, ...)
```

Arguments

`x`	a object of class o_MM1KK
`...`	aditional arguments

Details

Returns the input parameters of a M/M/1/K/K queueing model. The inputs parameters are created calling previously the NewInput.MM1KK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MM1KK`.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## It returns the Inputs
Inputs(o_mm1kk)
```

`Inputs.o_MMC` *Returns the input parameters of a M/M/c queueing model*

Description

Returns the inputs parameters of a already built M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
Inputs(x, ...)
```

Arguments

`x`	a object of class o_MMC
`...`	aditional arguments

Details

Returns the input parameters of a M/M/c queueing model. The inputs parameters are created calling previously the NewInput.MMC

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MMC`.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## It returns the Inputs
Inputs(o_mmc)
```

Inputs.o_MMCC — *Returns the input parameters of a M/M/c/c queueing model*

Description

Returns the inputs parameters of a already built M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
Inputs(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the input parameters of a M/M/c/c queueing model. The inputs parameters are created calling previously the NewInput.MMCC

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMCC.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## It returns the Inputs
Inputs(o_mmcc)
```

Inputs.o_MMCK *Returns the input parameters of a M/M/c/K queueing model*

Description

Returns the inputs parameters of a already built M/M/c/K queueing model

Usage

```
  ## S3 method for class 'o_MMCK'
Inputs(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Returns the input parameters of a M/M/c/K queueing model. The inputs parameters are created calling previously the NewInput.MMCK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMCK.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## It returns the Inputs
Inputs(o_mmck)
```

`Inputs.o_MMCKK` *Returns the input parameters of a M/M/c/K/K queueing model*

Description

Returns the inputs parameters of a already built M/M/c/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMCKK'
Inputs(x, ...)
```

Arguments

`x`	a object of class o_MMCKK
`...`	aditional arguments

Details

Returns the input parameters of a M/M/c/K/K queueing model. The inputs parameters are created calling previously the NewInput.MMCKK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MMCKK`.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Retunns the Inputs
Inputs(o_mmckk)
```

`Inputs.o_MMCKM` *Returns the input parameters of a M/M/c/K/m queueing model*

Description

Returns the inputs parameters of a already built M/M/c/K/m queueing model

Usage

```
  ## S3 method for class 'o_MMCKM'
Inputs(x, ...)
```

Arguments

`x`	a object of class o_MMCKM
`...`	aditional arguments

Details

Returns the input parameters of a M/M/c/K/m queueing model. The inputs parameters are created calling previously the NewInput.MMCKM

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`NewInput.MMCKM`.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## It returns the Inputs
Inputs(o_mmckm)
```

Inputs.o_MMInf *Returns the input parameters of a M/M/Infinite queueing model*

Description

Returns the inputs parameters of a already built M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
Inputs(x, ...)
```

Arguments

x	a object of class o_MMInf
...	aditional arguments

Details

Returns the input parameters of a M/M/Infinite queueing model. The inputs parameters are created calling previously the NewInput.MMInf

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMInf.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## It returns the Inputs
Inputs(o_mminf)
```

Inputs.o_MMInfKK *Returns the input parameters of a M/M/Infinite/K/K queueing model*

Description

Returns the inputs parameters of a already built M/M/Infinite/K/K queueing model

Usage

```
## S3 method for class 'o_MMInfKK'
Inputs(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the input parameters of a M/M/Infinite/K/K queueing model. The inputs parameters are created calling previously the NewInput.MMInfKK

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

NewInput.MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## It returns the Inputs
Inputs(o_MMInfKK)
```

Inputs.o_OJN *Returns the input params of an Open Jackson Network*

Description

Returns the input params of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
Inputs(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Returns the input params of an Open Jackson Network. The inputs parameters are created calling previously the NewInput.OJN

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

i_ojn1 <- NewInput.OJN(prob, n1, n2, n3, n4)

# Build the model
o_ojn1 <- QueueingModel(i_ojn1)

Inputs(o_ojn1)
```

L — *Returns the mean number of customers in a queueing model (or network)*

Description

Returns the mean number of customers in a queueing model (or network)

Usage

```
L(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf, o_OJN, o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Returns the mean number of customers in a queueing model (or network)

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

L.o_MM1
L.o_MMC
L.o_MM1K
L.o_MMCK
L.o_MM1KK
L.o_MMCKK
L.o_MMCC
L.o_MMCKM
L.o_MMInfKK
L.o_MMInf
L.o_OJN
L.o_CJN
L.o_MCON
L.o_MCCN
L.o_MCMN

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the L
L(o_mm1)
```

L.o_BnD *Returns the mean number of customers in the generic Birth and Death process model*

Description

Returns the mean number of customers in the generic Birth and Death process model

Usage

```
  ## S3 method for class 'o_BnD'
L(x, ...)
```

Arguments

x	a object of class o_BnD
...	aditional arguments

Details

Returns the mean number of customers in the generic Birth and Death process model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_BnD.

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)

## Build the model
o_BnD <- QueueingModel(i_BnD)

## Returns the L
L(o_BnD)
```

`L.o_CJN` *Returns the mean number of customers of a Closed Jackson Network*

Description

Returns the mean number of customers of a Closed Jackson Network

Usage

```
## S3 method for class 'o_CJN'
L(x, ...)
```

Arguments

`x`	a object of class o_CJN
`...`	aditional arguments

Details

Returns the mean number of customers of a Closed Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_CJN.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

L(m_cjn1)
```

L.o_MCCN *Returns the mean number of customers of a MultiClass Closed Network*

Description

Returns the mean number of customers of a MultiClass Closed Network

Usage

```
## S3 method for class 'o_MCCN'
L(x, ...)
```

Arguments

`x`	a object of class o_MCCN
`...`	aditional arguments

Details

Returns the mean number of customers of a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCCN`.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

L(o_MCCN1)
```

`L.o_MCMN` *Returns the mean number of customers of a MultiClass Mixed Network*

Description

Returns the mean number of customers of a MultiClass Mixed Network

Usage

```
## S3 method for class 'o_MCMN'
L(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Returns the mean number of customers of a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

L(o_mcmn1)
```

`L.o_MCON` *Returns the mean number of customers of a MultiClass Open Network*

Description

Returns the mean number of customers of a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
L(x, ...)
```

Arguments

`x`	a object of class o_MCON
`...`	aditional arguments

Details

Returns the mean number of customers of a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCON`.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

L(o_mcon1)
```

L.o_MM1 *Returns the mean number of customers in the M/M/1 queueing model*

Description

Returns the mean number of customers in the M/M/1 queueing model

Usage

```
## S3 method for class 'o_MM1'
L(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the mean number of customers in the M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the L
L(o_mm1)
```

`L.o_MM1K` *Returns the mean number of customers in the M/M/1/K queueing model*

Description

Returns the mean number of customers in the M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
L(x, ...)
```

Arguments

`x`	a object of class o_MM1K
`...`	aditional arguments

Details

Returns the mean number of customers in the M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MM1K`.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the L
L(o_mm1k)
```

L.o_MM1KK	*Returns the mean number of customers in the M/M/1/K/K queueing model*

Description

Returns the mean number of customers in the M/M/1/K/K queueing model

Usage

```
  ## S3 method for class 'o_MM1KK'
L(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the mean number of customers in the M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the L
L(o_mm1kk)
```

L.o_MMC *Returns the mean number of customers in the M/M/c queueing model*

Description

Returns the mean number of customers in the M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
L(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Returns the mean number of customers in the M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the L
L(o_mmc)
```

`L.o_MMCC` *Returns the mean number of customers in the M/M/c/c queueing model*

Description

Returns the mean number of customers in the M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
L(x, ...)
```

Arguments

`x`	a object of class o_MMCC
`...`	aditional arguments

Details

Returns the mean number of customers in the M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCC`.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the L
L(o_mmcc)
```

L.o_MMCK *Returns the mean number of customers in the M/M/c/K queueing model*

Description

Returns the mean number of customers in the M/M/c/K queueing model

Usage

```
## S3 method for class 'o_MMCK'
L(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Returns the mean number of customers in the M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCK.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the L
L(o_mmck)
```

`L.o_MMCKK` *Returns the mean number of customers in the M/M/c/K/K queueing model*

Description

Returns the mean number of customers in the M/M/c/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMCKK'
L(x, ...)
```

Arguments

`x`	a object of class o_MMCKK
`...`	aditional arguments

Details

Returns the mean number of customers in the M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCKK`.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the L
L(o_mmckk)
```

`L.o_MMCKM` *Returns the mean number of customers in the M/M/c/K/m queueing model*

Description

Returns the mean number of customers in the M/M/c/K/m queueing model

Usage

```
  ## S3 method for class 'o_MMCKM'
L(x, ...)
```

Arguments

`x`	a object of class o_MMCKM
`...`	aditional arguments

Details

Returns the mean number of customers in the M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCKM`.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the L
L(o_mmckm)
```

`L.o_MMInf` *Returns the mean number of customers in the M/M/Infinite queueing model*

Description

Returns the mean number of customers in the M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
L(x, ...)
```

Arguments

`x`	a object of class o_MMInf
`...`	aditional arguments

Details

Returns the mean number of customers in the M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the L
L(o_mminf)
```

`L.o_MMInfKK` *Returns the mean number of customers in the M/M/Infinite/K/K queueing model*

Description

Returns the mean number of customers in the M/M/Infinite/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMInfKK'
L(x, ...)
```

Arguments

`x`	a object of class o_MMInfKK
`...`	aditional arguments

Details

Returns the mean number of customers in the M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

`QueueingModel.i_MMInfKK`.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the L
L(o_MMInfKK)
```

L.o_OJN *Returns the mean number of customers of an Open Jackson Network*

Description

Returns the mean number of customers of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
L(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Returns the mean number of customers of an Open Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

# Build the model
o_ojn <- QueueingModel(i_ojn)
```

```
L(o_ojn)
```

`Lc` *Returns the vector with the mean number of customers of each class in a multiclass queueing network*

Description

Returns the vector with the mean number of customers of each class in a multiclass queueing network

Usage

```
Lc(x, ...)
```

Arguments

`x`	a object of class o_MCON, o_MCCN, o_MCMN
`...`	aditional arguments

Details

Returns the vector with the mean number of customers of each class in a multiclass queueing network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`Lc.o_MCON`
`Lc.o_MCCN`
`Lc.o_MCMN`

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Lc(o_mcon1)
```

`Lc.o_MCCN` *Returns the vector with the mean number of customers of each class in a MultiClass Closed Network*

Description

Returns the vector with the mean number of customers of each class in a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
Lc(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Returns the vector with the mean number of customers of each class in a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Lc(o_MCCN1)
```

Lc.o_MCMN *Returns the vector with the mean number of customers of each class in a MultiClass Mixed Network*

Description

Returns the vector with the mean number of customers of each class in a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Lc(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Returns the vector with the mean number of customers of each class in a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Lc(o_mcmn1)
```

`Lc.o_MCON` *Returns the vector with the mean number of customers of each class in a MultiClass Open Network*

Description

Returns the vector with the mean number of customers of each class in a MultiClass Open Network

Usage

```
  ## S3 method for class 'o_MCON'
Lc(x, ...)
```

Arguments

`x`	a object of class o_MCON
`...`	aditional arguments

Details

Returns the vector with the mean number of customers of each class in a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Lc(o_mcon1)
```

Lck *Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Network*

Description

Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Network

Usage

```
Lck(x, ...)
```

Arguments

x	a object of class o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Lck.o_MCON
Lck.o_MCCN
Lck.o_MCMN

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Lck(o_mcon1)
```

`Lck.o_MCCN` *Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Closed Network*

Description

Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
Lck(x, ...)
```

Arguments

`x`	a object of class o_MCCN
`...`	aditional arguments

Details

Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCCN`.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)
```

```
# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Lck(o_MCCN1)
```

`Lck.o_MCMN` *Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Mixed Network*

Description

Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Lck(x, ...)
```

Arguments

`x`	a object of class o_MCMN
`...`	aditional arguments

Details

Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCMN`.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Lck(o_mcmn1)
```

`Lck.o_MCON` *Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Open Network*

Description

Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Open Network

Usage

```
  ## S3 method for class 'o_MCON'
Lck(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Reports a matrix with the mean number of customers of class i in each node (server) j in a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Lck(o_mcon1)
```

Lk — *Returns the vector with the mean number of customers in each node (server) of a queueing network*

Description

Returns the vector with the mean number of customers in each node (server) of a queueing network

Usage

```
Lk(x, ...)
```

Arguments

x	a object of class o_OJN, o_CJN, o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Returns the vector with the mean number of customers in each node (server) of a queueing network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Lk.o_OJN
Lk.o_CJN
Lk.o_MCON
Lk.o_MCCN
Lk.o_MCMN

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Lk(o_mcon1)
```

Lk.o_CJN   *Returns the vector with the mean number of customers in each node (server) of a Closed Jackson Network*

Description

Returns the vector with the mean number of customers in each node (server) of a Closed Jackson Network

Usage

```
## S3 method for class 'o_CJN'
Lk(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Returns the vector with the mean number of customers in each node (server) of a Closed Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_CJN.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

Lk(m_cjn1)
```

Lk.o_MCCN *Returns a vector with the mean number of customers in each node (server) of a MultiClass Closed Network*

Description

Returns a vector with the mean number of customers in each node (server) of a MultiClass Closed Network

Usage

```
## S3 method for class 'o_MCCN'
Lk(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Returns a vector with the mean number of customers in each node (server) of a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)
```

```
# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Lk(o_MCCN1)
```

`Lk.o_MCMN` *Returns a vector with the mean number of customers in each node (server) of a MultiClass Mixed Network*

Description

Returns a vector with the mean number of customers in each node (server) of a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Lk(x, ...)
```

Arguments

`x`	a object of class o_MCMN
`...`	aditional arguments

Details

Returns a vector with the mean number of customers in each node (server) of a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCMN`.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Lk(o_mcmn1)
```

Lk.o_MCON — *Returns a vector with the mean number of customers in each node (server) of a MultiClass Open Network*

Description

Returns a vector with the mean number of customers in each node (server) of a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
Lk(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Returns a vector with the mean number of customers in each node (server) of a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Lk(o_mcon1)
```

Lk.o_OJN *Returns the vector with the mean number of customers in each node (server) of an Open Jackson Network*

Description

Returns the vector with the mean number of customers in each node (server) of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
Lk(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Returns the vector with the mean number of customers in each node (server) of an Open Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

# Build the model
o_ojn <- QueueingModel(i_ojn)

Lk(o_ojn)
```

Lq — *Returns the mean number of customers in the queue in a queueing model*

Description

Returns the mean number of customers in the queue in a queueing model

Usage

```
Lq(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
...	aditional arguments

Details

Returns the mean number of customers in the queue in a queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

Lq.o_MM1
Lq.o_MMC
Lq.o_MM1K
Lq.o_MMCK
Lq.o_MM1KK
Lq.o_MMCKK
Lq.o_MMCC
Lq.o_MMCKM
Lq.o_MMInfKK
Lq.o_MMInf

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the Lq
Lq(o_mm1)
```

Lq.o_MM1 — *Returns the mean number of customers in the queue in the M/M/1 queueing model*

Description

Returns the mean number of customers in the queue in the M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
Lq(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the Lq
Lq(o_mm1)
```

Lq.o_MM1K — *Returns the mean number of customers in the queue in the M/M/1/K queueing model*

Description

Returns the mean number of customers in the queue in the M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
Lq(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the Lq
Lq(o_mm1k)
```

Lq.o_MM1KK — *Returns the mean number of customers in the queue in the M/M/1/K/K queueing model*

Description

Returns the mean number of customers in the queue in the M/M/1/K/K queueing model

Usage

```
  ## S3 method for class 'o_MM1KK'
Lq(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the Lq
Lq(o_mm1kk)
```

Lq.o_MMC *Returns the mean number of customers in the queue in the M/M/c queueing model*

Description

Returns the mean number of customers in the queue in the M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
Lq(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the Lq
Lq(o_mmc)
```

Lq.o_MMCC *Returns the mean number of customers in the queue in the M/M/c/c queueing model*

Description

Returns the mean number of customers in the queue in the M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
Lq(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCC.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the Lq
Lq(o_mmcc)
```

Lq.o_MMCK — *Returns the mean number of customers in the queue in the M/M/c/K queueing model*

Description

Returns the mean number of customers in the queue in the M/M/c/K queueing model

Usage

```
  ## S3 method for class 'o_MMCK'
Lq(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCK.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the Lq
Lq(o_mmck)
```

Lq.o_MMCKK — *Returns the mean number of customers in the queue in the M/M/c/K/K queueing model*

Description

Returns the mean number of customers in the queue in the M/M/c/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMCKK'
Lq(x, ...)
```

Arguments

x	a object of class o_MMCKK
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the Lq
Lq(o_mmckk)
```

Lq.o_MMCKM — *Returns the mean number of customers in the queue in the M/M/c/K/m queueing model*

Description

Returns the mean number of customers in the queue in the M/M/c/K/m queueing model

Usage

```
## S3 method for class 'o_MMCKM'
Lq(x, ...)
```

Arguments

x	a object of class o_MMCKM
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the Lq
Lq(o_mmckm)
```

Lq.o_MMInf — *Returns the mean number of customers in the queue in the M/M/Infinite queueing model*

Description

Returns the mean number of customers in the queue in the M/M/Infinite queueing model

Usage

```
## S3 method for class 'o_MMInf'
Lq(x, ...)
```

Arguments

x	a object of class o_MMInf
...	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMInf.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the Lq
Lq(o_mminf)
```

`Lq.o_MMInfKK` *Returns the mean number of customers in the queue in the M/M/Infinite/K/K queueing model*

Description

Returns the mean number of customers in the queue in the M/M/Infinite/K/K queueing model

Usage

```
## S3 method for class 'o_MMInfKK'
Lq(x, ...)
```

Arguments

`x`	a object of class o_MMInfKK
`...`	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

`QueueingModel.i_MMInfKK`.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the Lq
Lq(o_MMInfKK)
```

Lqq *Returns the mean number of customers in queue when there is queue in a queueing model*

Description

Returns the mean number of customers in queue when there is queue in a queueing model

Usage

```
Lqq(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
...	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in a queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

Lqq.o_MM1
Lqq.o_MMC
Lqq.o_MM1K
Lqq.o_MMCK
Lqq.o_MM1KK
Lqq.o_MMCKK
Lqq.o_MMCC

Lqq.o_MMCKM
Lqq.o_MMInfKK
Lqq.o_MMInf

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the Lqq
Lqq(o_mm1)
```

Lqq.o_MM1 *Returns the mean number of customers in queue when there is queue in the M/M/1 queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
Lqq(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the Lqq
Lqq(o_mm1)
```

`Lqq.o_MM1K` *Returns the mean number of customers in queue when there is queue in the M/M/1/K queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
Lqq(x, ...)
```

Arguments

`x`	a object of class o_MM1K
`...`	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MM1K`.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the Lq
Lqq(o_mm1k)
```

Lqq.o_MM1KK *Returns the mean number of customers in queue when there is queue in the M/M/1/K/K queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/1/K/K queueing model

Usage

```
## S3 method for class 'o_MM1KK'
Lqq(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the Lqq
Lqq(o_mm1kk)
```

Lqq.o_MMC *Returns the mean number of customers in queue when there is queue in the M/M/c queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/c queueing model

Usage

```
## S3 method for class 'o_MMC'
Lqq(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the Lqq
Lqq(o_mmc)
```

`Lqq.o_MMCC` *Returns the mean number of customers in queue when there is queue in the M/M/c/c queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/c/c queueing model

Usage

```
## S3 method for class 'o_MMCC'
Lqq(x, ...)
```

Arguments

`x`	a object of class o_MMCC
`...`	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCC`.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the Lqq
Lqq(o_mmcc)
```

Lqq.o_MMCK — *Returns the mean number of customers in queue when there is queue in the M/M/c/K queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/c/K queueing model

Usage

```
## S3 method for class 'o_MMCK'
Lqq(x, ...)
```

Arguments

`x`	a object of class o_MMCK
`...`	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCK`.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the Lqq
Lqq(o_mmck)
```

`Lqq.o_MMCKK` *Returns the mean number of customers in queue when there is queue in the M/M/c/K/K queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/c/K/K queueing model

Usage

```
## S3 method for class 'o_MMCKK'
Lqq(x, ...)
```

Arguments

x	a object of class o_MMCKK
...	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCKK`.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the Lqq
Lqq(o_mmckk)
```

`Lqq.o_MMCKM` *Returns the mean number of customers in queue when there is queue in the M/M/c/K/m queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/c/K/m queueing model

Usage

```
  ## S3 method for class 'o_MMCKM'
Lqq(x, ...)
```

Arguments

`x`	a object of class o_MMCKM
`...`	aditional arguments

Details

Returns the mean number of customers in the queue in the M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCKM`.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the Lqq
Lqq(o_mmckm)
```

Lqq.o_MMInf *Returns the mean number of customers in queue when there is queue in the M/M/Infinite queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
Lqq(x, ...)
```

Arguments

x	a object of class o_MMInf
...	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMInf.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the Lqq
Lqq(o_mminf)
```

Lqq.o_MMInfKK *Returns the mean number of customers in queue when there is queue in the M/M/Infinite/K/K queueing model*

Description

Returns the mean number of customers in queue when there is queue in the M/M/Infinite/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMInfKK'
Lqq(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the mean number of customers in queue when there is queue in the M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the Lqq
Lqq(o_MMInfKK)
```

NewInput.BnD *Define the inputs of a new generic Birth and Death process model*

Description

Define the inputs of a new generic Birth and Death process model

Usage

```
NewInput.BnD(lambda=NULL, mu=NULL)
```

Arguments

`lambda`	vectors of arrival rate depending of the number of users in the system. Observe that in R, the vectors starts counting at 1, so lambda[1] is the arrival rate when the system has 0 users on it
`mu`	vectors of service rate depending of the number of users in the system. Observe that in R, the vectors starts counting at 1, so mu[1] is the arrival rate when the system has 1 users on it

Details

Define the inputs of a new generic Birth and Death process model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`CheckInput.i_BnD`

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)
```

NewInput.CJN — *Define the inputs of a Closed Jackson Network*

Description

Define the inputs of a Closed Jackson Network

Usage

```
NewInput.CJN(prob=NULL, n=0, z=0, operational=FALSE, method=0, tol=0.001, ...)
NewInput2.CJN(prob=NULL, n=0, z=0, operational=FALSE, method=0, tol=0.001, nodes)
NewInput3.CJN(n, z, numNodes, vType, vVisit, vService, vChannel, method=0, tol=0.001)
```

Arguments

`prob`	It is probability transition matrix or visit ratio vector. That is, the prob[i, j] is the transition probability of node i to node j, or prob[i] is the visit ratio (a probability, that is, a value between 0 and 1) to node i. Also, the visit ratio can express the number of times that a client visits the queueing center, in a more operational point of view. See the parameter operational
`n`	number of customers in the Network
`z`	think time of the client
`operational`	If prob is a vector with the visit ratios, operational equal to FALSE gives to the visit ratio a probability meaning, that is, as the stacionary values of the imbedded markov chain. If operational is equal to TRUE, the operational point of view is used: it is the number of visits that the same client makes to a node.
`method`	If method is 0, the exact MVA algorith is used. If method is 1, the Bard-Schweitzer approximation algorithm is used.
`tol`	If the parameter method is 1, this is the tolerance parameter of the algorithm.
`...`	a separated by comma list of nodes of i_MM1, i_MMC or i_MMInf class
`nodes`	A list of nodes of i_MM1, i_MMC or i_MMInf class
`numNodes`	The number of nodes of the network
`vType`	A vector with the type of server: "Q" for a queueing node, "D" for a delay node
`vVisit`	A vector with the visit ratios. It represent visit counts to a center as if the parameter operational were TRUE
`vService`	A vector with the services time of each node
`vChannel`	A vector with the number of channels of the node. The type of the server has to be "Q" to be inspected

Details

Define the inputs of a Closed Jackson Network. For a operational use, NewInput3.CJN is recommended. For a more academic use, NewInput.CJN or NewInput2.CJN is recommended. Please, note that the different ways to create the inputs for a Closed Jackson Network are equivalent to each other, and no validation is done at this stage. The validation is done calling CheckInput function.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_CJN

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

## think time = 0
z <- 0

## operational value
operational <- FALSE

## definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

## Not run:
  cjn1 <- NewInput2.CJN(prob, n, z, operational, 0, 0.001, list(n1, n2))

## End(Not run)


## using visit ratios and service demands. See [Lazowska84] pag 117.
## E[S] cpu = 0.005, Visit cpu = 121, D cpu = E[S] cpu * Visit cpu = 0.605
cpu <- NewInput.MM1(mu=1/0.005)
```

```
## E[S] disk1 = 0.030, Visit disk1 = 70, D disk1 = E[S] disk1 * Visit disk1 = 2.1
disk1 <- NewInput.MM1(mu=1/0.030)

## E[S] disk2 = 0.027, Visit disk2 = 50, D disk2 = E[S] disk2 * Visit disk2 = 1.35
disk2 <- NewInput.MM1(mu=1/0.027)

## The visit ratios.
vVisit <- c(121, 70, 50)

operational <- TRUE

net <- NewInput.CJN(prob=vVisit, n=3, z=15, operational, 0, 0.001, cpu, disk1, disk2)

## Using the operational creation function
n <- 3
think <- 15
numNodes <- 3
vType <- c("Q", "Q", "Q")
vService <- c(0.005, 0.030, 0.027)
vChannel <- c(1, 1, 1)

net2 <- NewInput3.CJN(n, think, numNodes, vType, vVisit, vService, vChannel, method=0, tol=0.001)
```

NewInput.MCCN *Define the inputs of a MultiClass Closed Network*

Description

Define the inputs of a MultiClass Closed Network

Usage

```
NewInput.MCCN(
  classes, vNumber, vThink, nodes, vType, vVisit, vService, method=1, tol=0.01
)
```

Arguments

`classes`	The number of classes
`vNumber`	A vector with the number of customers of each class
`vThink`	A vector with the think time of each class
`nodes`	The number of nodes in the network
`vType`	A vector with the type of node: "Q" for queueing nodes or "D" for delay nodes
`vVisit`	A matrix[i, j]. The rows represents the different visit count for each class i to each node j
`vService`	A matrix[i, j]. The rows represents the different service time for each class i in each node j

`method` If method is 0, the exact MVA algorith is used. If method is 1, the Bard-Schweitzer approximation algorithm is used

`tol` If the parameter method is 1, this is the tolerance parameter of the algorithm

Details

Define the inputs of a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)
```

NewInput.MCMN *Define the inputs of a MultiClass Mixed Network*

Description

Define the inputs of a MultiClass Mixed Network

Usage

```
NewInput.MCMN(
  classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService, method=0, tol=0.01
)
```

Arguments

`classes`	The number of classes
`vLambda`	It is a vector with the rate of arrivals of each class
`vNumber`	A vector with the number of customers of each class
`vThink`	A vector with the think time of each class
`nodes`	The number of nodes in the network
`vType`	A vector with the type of node: "Q" for queueing nodes or "D" for delay nodes
`vVisit`	A matrix[i, j]. The rows represents the different visit count for each class i to each node j. Take caution about the orden: open classes are defined first and closed clasess are defined second
`vService`	A matrix[i, j]. The rows represents the different service times for each class i in each node j. Take caution about the orden: open classes are defined first and closed clasess are defined second.
`method`	If method is 0, the exact MVA algorith is used. If method is 1, the Bard-Schweitzer approximation algorithm is used
`tol`	If the parameter method is 1, this is the tolerance parameter of the algorithm

Details

Define the inputs of a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCMN`

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4 # A and B are open classes and C and D are closed classes.
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")

# When the visit ratios and vService are set,
#   be sure that the open classes are in the first positions
#   and the closed classes after the open classes.
vVisit <- matrix(data=1, nrow=4, ncol=2)
```

```
# A and B are open clasess:
#   with demand service of 1/4 and 1/2 at the node 1 and 1/2 and 1 at the node 2
# C and D are open clasess:
#   with demand service of 1/4 and 1/2 at the node 1 and 1/2 and 1 at the node 2
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)
```

`NewInput.MCON` *Define the inputs of a MultiClass Open Network*

Description

Define the inputs of a MultiClass Open Network

Usage

```
NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)
```

Arguments

`classes`	The number of classes
`vLambda`	It is a vector with the rate of arrivals of each class
`nodes`	The number of nodes in the network
`vType`	A vector with the type of node: "Q" for queueing nodes or "D" for delay nodes
`vVisit`	A matrix[i, j]. The rows represents the different visit count for each class i to each node j
`vService`	A matrix[i, j]. The rows represents the different service times for each class i in each node j

Details

Define the inputs of a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)
```

`NewInput.MM1` *Define the inputs of a new M/M/1 queueing model*

Description

Define the inputs of a new M/M/1 queueing model

Usage

```
NewInput.MM1(lambda=0, mu=0, n=0)
```

Arguments

`lambda`	arrival rate
`mu`	server service rate
`n`	number of customers in the system from which you want to obtain its probabilities. Put n=0 for a idle probability (no customer present in the system or system idle). With n=-1, no probabilities are computed

Details

Define the inputs of a new M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`CheckInput.i_MM1`

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)
```

NewInput.MM1K *Define the inputs of a new M/M/1/K queueing model*

Description

Define the inputs of a new M/M/1/K queueing model

Usage

```
NewInput.MM1K(lambda=0, mu=0, k=1)
```

Arguments

`lambda`	arrival rate
`mu`	server service rate
`k`	system capacity

Details

Define the inputs of a new M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`CheckInput.i_MM1K`

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)
```

NewInput.MM1KK *Define the inputs of a new M/M/1/K/K queueing model*

Description

Define the inputs of a new M/M/1/K/K queueing model

Usage

```
NewInput.MM1KK(lambda=0, mu=0, k=1, method=3)
```

Arguments

lambda	arrival rate
mu	server service rate
k	system capacity
method	method of computation of the probabilities of k (system capacity) customers down. With method=0, the exact results are calculated using the formal definition. With method=1, aproximate results are calculated using Stirling aproximation of factorials and logaritms. With method=2, Jain's Method [Jain2007], pag. 26 is used. With method=3, the result that K-n customers up has a truncated poisson distribution is used [Kobayashi2012] pag. 709

Details

Define the inputs of a new M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Jain2007] Joti Lal Jain, Sri Gopal Mohanty, Walter Bohm (2007).
A course on Queueing Models.
Chapman-Hall.

[Kobayashi2012] Hisashi Kobayashi, Brian L. Mark, William Turin (2012).
Probability, Random Processes, and Statistical Analysis: Applications to Communications, Signal Processing, Queueing Theory and Mathematical Finance.
Cambridge University Press.

See Also

CheckInput.i_MM1KK

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)
```

`NewInput.MMC` *Define the inputs of a new M/M/c queueing model*

Description

Define the inputs of a new M/M/c queueing model

Usage

```
NewInput.MMC(lambda=0, mu=0, c=1, n=0, method=0)
```

Arguments

`lambda`	arrival rate
`mu`	server service rate
`c`	number of servers
`n`	number of customers in the system from which you want to obtain its probabilities. Put n=0 for a idle probability (no customer present in the system or system idle). With n=-1, no probabilities are computed
`method`	method of computation of the probabilities of n number of customers in the system. With method=0, the exact results are calculated using the formal definition. With method=1, aproximate results are calculated using Stirling aproximation of factorials and logaritms.

Details

Define the inputs of a new M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`CheckInput.i_MMC`

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)
```

`NewInput.MMCC` *Define the inputs of a new M/M/c/c queueing model*

Description

Define the inputs of a new M/M/c/c queueing model

Usage

```
NewInput.MMCC(lambda=0, mu=0, c=1, method=1)
```

Arguments

`lambda`	arrival rate
`mu`	server service rate
`c`	number of servers
`method`	with method = 0, the state probabilities are calculated using the formal definition (with overflow problems with factorials; with method = 1 (default), the truncated poisson distribution is used (recomended for professional use)

Details

Define the inputs of a new M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Kobayashi2012] Hisashi Kobayashi, Brian L. Mark, William Turin (2012).
Probability, Random Processes, and Statistical Analysis: Applications to Communications, Signal Processing, Queueing Theory and Mathematical Finance.
Cambridge University Press.

See Also

`CheckInput.i_MMCC`

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)
```

NewInput.MMCK *Define the inputs of a new M/M/c/K queueing model*

Description

Define the inputs of a new M/M/c/K queueing model

Usage

```
NewInput.MMCK(lambda=0, mu=0, c=1, k=1)
```

Arguments

lambda	arrival rate
mu	server service rate
c	number of servers
k	system capacity

Details

Define the inputs of a new M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MMCK

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)
```

NewInput.MMCKK *Define the inputs of a new M/M/c/K/K queueing model*

Description

Define the inputs of a new M/M/c/K/K queueing model

Usage

```
NewInput.MMCKK(lambda=0, mu=0, c=1, k=1, method=0)
```

Arguments

lambda	arrival rate
mu	server service rate
c	number of servers
k	system capacity
method	method of computation of the probabilities of k (system capacity) customers down. With method=0, the exact results are calculated using the formal definition. With method=1, aproximate results are calculated using Stirling aproximation of factorials and logaritms. With method=2, Jain's Method [Jain2007], pag. 26 is used

Details

Define the inputs of a new M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Jain2007] Joti Lal Jain, Sri Gopal Mohanty, Walter Bohm (2007).
A course on Queueing Models.
Chapman-Hall.

See Also

CheckInput.i_MMCKK

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)
```

NewInput.MMCKM *Define the inputs of a new M/M/c/K/m queueing model*

Description

Define the inputs of a new M/M/c/K/m queueing model

Usage

```
NewInput.MMCKM(lambda=0, mu=0, c=1, k=1, m=1, method=0)
```

Arguments

lambda	arrival rate
mu	server service rate
c	number of servers
k	system capacity
m	poblation size. Please, observe that should be m >= k
method	method of computation of the probabilities of k (system capacity) customers down. With method=0, the exact results are calculated using the formal definition. With method=1, aproximate results are calculated using Stirling aproximation of factorials and logaritms.

Details

Define the inputs of a new M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MMCKM

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)
```

NewInput.MMInf — *Define the inputs of a new M/M/Infinite queueing model*

Description

Define the inputs of a new M/M/Infinite queueing model

Usage

```
NewInput.MMInf(lambda=0, mu=0, n=0)
```

Arguments

lambda	arrival rate
mu	server service rate
n	number of customers in the system from which you want to obtain its probabilities. Put n=0 for a idle probability (no customer present in the system or system idle). With n=-1, no probabilities are computed

Details

Define the inputs of a new M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MMInf

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)
```

NewInput.MMInfKK *Define the inputs of a new M/M/Infinite/K/K queueing model*

Description

Define the inputs of a new M/M/Infinite/K/K queueing model

Usage

```
NewInput.MMInfKK(lambda=0, mu=0, k=1)
```

Arguments

lambda	arrival rate
mu	server service rate
k	system capacity

Details

Define the inputs of a new M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

CheckInput.i_MMInfKK

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)
```

`NewInput.OJN` *Define the inputs of an Open Jackson Network*

Description

Define the inputs of an Open Jackson Network

Usage

```
NewInput.OJN(prob=NULL, ...)
NewInput2.OJN(prob=NULL, nodes)
NewInput3.OJN(vLambda, numNodes, vType, vVisit, vService, vChannel)
```

Arguments

`prob`	It is probability transition matrix or visit ratio vector. That is, the prob[i, j] is the transition probability of node i to node j, or prob[i] is the visit ratio to node i (the visit ratio values doesn't need to be probabilities, that is, a value greater than 1 can be used here. See the examples)
`...`	a separated by comma list of nodes of i_MM1, i_MMC or i_MMInf class
`nodes`	A list of nodes of i_MM1, i_MMC or i_MMInf class
`vLambda`	Vector with the arrivals rates to each node
`numNodes`	Number of nodes
`vType`	A vector with the type of server: "Q" for a queueing node, "D" for a delay node
`vVisit`	A vector with the visit ratios
`vService`	A vector with the services time of each node
`vChannel`	A vector with the number of channels of the node. The type of the server has to be "Q" to be inspected

Details

Define the inputs of an Open Jackson Network. For a operational use, NewInput3.OJN is recommended. For a more academic use, NewInput.OJN or NewInput2.OJN is recommended. Please, note that the different ways to create the inputs for a Open Jackson Network are equivalent to each other, and no validation is done at this stage. The validation is done calling CheckInput function.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_OJN

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

ojn1 <- NewInput.OJN(prob, n1, n2, n3, n4)

## Using function NewInput2
## Not run:
  ojn1 <- NewInput2.OJN(prob, list(n1, n2, n3, n4))

## End(Not run)


## Using visit ratios. Values taken from [Lazowska84], pag. 113.

## E[S] cpu = 0.005, Visit cpu = 121, D cpu = E[S] cpu * Visit cpu = 0.605
cpu <- NewInput.MM1(lambda=0.2, mu=1/0.005)

## E[S] disk1 = 0.030, Visit disk1 = 70, D disk1 = E[S] disk1 * Visit disk1 = 2.1
disk1 <- NewInput.MM1(lambda=0.2, mu=1/0.030)

## E[S] disk2 = 0.027, Visit disk2 = 50, D disk2 = E[S] disk2 * Visit disk2 = 1.35
disk2 <- NewInput.MM1(lambda=0.2, mu=1/0.027)

## In this example, to have the throughput per node, the visit ratios has to be given in this form.
## Please, don't use in the closed Jackson Network
visit <- c(121, 70, 50)
net <- NewInput.OJN(visit, cpu, disk1, disk2)

## Using NewInput3
vLambda <- c(0.2, 0.2, 0.2)
vService <- c(0.005, 0.030, 0.027)
numNodes <- 3
vType <- c("Q", "Q", "Q")
vChannel <- c(1, 1, 1)
net2 <- NewInput3.OJN(vLambda, numNodes, vType, visit, vService, vChannel)
```

Pn *Returns the probabilities of a queueing model (or network)*

Description

Pn returns the probabilities that a queueing model (or network) has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it

Usage

```
Pn(x, ...)
Qn(x, ...)
```

Arguments

x	For Pn, an object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf, o_OJN, o_BnD. For Qn, an object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
...	aditional arguments

Details

Pn returns the system probabilities of a queueing model (or network). Qn returns the probability that an effective arrival see n customers in the system

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

Pn.o_MM1
Qn.o_MM1
Pn.o_MMC
Qn.o_MMC
Pn.o_MM1K
Qn.o_MM1K
Pn.o_MMCK
Qn.o_MMCK
Pn.o_MM1KK
Qn.o_MM1KK
Pn.o_MMCKK
Qn.o_MMCKK

Pn.o_MMCC
Qn.o_MMCC
Pn.o_MMCKM
Qn.o_MMCKM
Pn.o_MMInfKK
Qn.o_MMInfKK
Pn.o_MMInf
Qn.o_MMInf
Pn.o_OJN
Pn.o_BnD

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the probabilities
Pn(o_mm1)
```

Pn.o_BnD *Returns the probabilities of a generic Birth and Death process model*

Description

Pn returns the probabilities that a generic Birth and Death process model has n customers.

Usage

```
  ## S3 method for class 'o_BnD'
Pn(x, ...)
```

Arguments

x	a object of class o_BnD
...	aditional arguments

Details

Pn returns the probabilities that a generic Birth and Death process model has n customers.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_BnD.

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)

## Build the model
o_BnD <- QueueingModel(i_BnD)

## Returns the probabilities
Pn(o_BnD)

## Simulating M/M/1
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

pn_bnd_mm1 <- Pn(QueueingModel(NewInput.BnD(lambda=lambda, mu=mu)))
pn_mm1 <- Pn(QueueingModel(NewInput.MM1(lambda=1/4, mu=1/3, n=200)))

## Simulating M/M/2
lambda <- rep(5, 200)
mu <- c(1*10, rep(2*10, 199))

pn_mmc <- Pn(QueueingModel(NewInput.MMC(lambda=5, mu=10, c=2, n=200, method=0)))
pn_bnd_mmc <- Pn(QueueingModel(NewInput.BnD(lambda=lambda, mu=mu)))


## Simulating M/M/1/K/K
lambda <- c(2*0.25, 0.25)
mu <- rep(4, 2)
pn_mm1kk <- Pn(QueueingModel(NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)))
pn_bnd <- Pn(QueueingModel(NewInput.BnD(lambda=lambda, mu=mu)))
```

Pn.o_MM1 *Returns the probabilities of a M/M/1 queueing model*

Description

Pn returns the probabilities that a M/M/1 queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
## S3 method for class 'o_MM1'
Pn(x, ...)
## S3 method for class 'o_MM1'
Qn(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Pn returns the probabilities that a M/M/1 queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers. By the PASTA property, both probabilities has to be the same.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the probabilities
Pn(o_mm1)
Qn(o_mm1)
```

Pn.o_MM1K *Returns the probabilities of a M/M/1/K queueing model*

Description

Pn returns the probabilities that a M/M/1/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MM1K'
Pn(x, ...)
  ## S3 method for class 'o_MM1K'
Qn(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Pn returns the probabilities that a M/M/1/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the probabilities
Pn(o_mm1k)
Qn(o_mm1k)
```

`Pn.o_MM1KK` *Returns the probabilities of a M/M/1/K/K queueing model*

Description

Pn eeturns the probabilities of a M/M/1/K/K queueing model Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MM1KK'
Pn(x, ...)
  ## S3 method for class 'o_MM1KK'
Qn(x, ...)
```

Arguments

`x`	a object of class o_MM1KK
`...`	aditional arguments

Details

Pn returns the probabilities that a M/M/1/K/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MM1KK`.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)
```

```
## Returns the probabilities
Pn(o_mm1kk)
Qn(o_mm1kk)
```

Pn.o_MMC *Returns the probabilities of a M/M/c queueing model*

Description

Pn returns the probabilities that a M/M/c queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MMC'
Pn(x, ...)
  ## S3 method for class 'o_MMC'
Qn(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Pn returns the probabilities that a M/M/c queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers. By the PASTA property, both probabilities has to be the same.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the probabilities
Pn(o_mmc)
Qn(o_mmc)
```

Pn.o_MMCC — *Returns the probabilities of a M/M/c/c queueing model*

Description

Pn returns the probabilities that a M/M/c/c queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MMCC'
Pn(x, ...)
  ## S3 method for class 'o_MMCC'
Qn(x, ...)
```

Arguments

`x`	a object of class o_MMCC
`...`	aditional arguments

Details

Pn returns the probabilities that a M/M/c/c queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCC`.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the probabilities
Pn(o_mmcc)
Qn(o_mmcc)
```

Pn.o_MMCK *Returns the probabilities of a M/M/c/K queueing model*

Description

Pn returns the probabilities that a M/M/c/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MMCK'
Pn(x, ...)
  ## S3 method for class 'o_MMCK'
Qn(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Pn returns the probabilities that a M/M/c/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCK.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the probabilities
Pn(o_mmck)
Qn(o_mmck)
```

Pn.o_MMCKK *Returns the probabilities of a M/M/c/K/K queueing model*

Description

Pn returns the probabilities that a M/M/c/K/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MMCKK'
Pn(x, ...)
  ## S3 method for class 'o_MMCKK'
Qn(x, ...)
```

Arguments

`x`	a object of class o_MMCKK
`...`	aditional arguments

Details

Pn returns the probabilities that a M/M/c/K/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCKK`.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the parameters
Pn(o_mmckk)
Qn(o_mmckk)
```

`Pn.o_MMCKM` *Returns the probabilities of a M/M/c/K/m queueing model*

Description

Pn returns the probabilities that a M/M/c/K/m queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MMCKM'
Pn(x, ...)
  ## S3 method for class 'o_MMCKM'
Qn(x, ...)
```

Arguments

`x`	a object of class o_MMCKM
`...`	aditional arguments

Details

Pn returns the probabilities that a M/M/c/K/m queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCKM`.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the probabilities
Pn(o_mmckm)
Qn(o_mmckm)
```

`Pn.o_MMInf` *Returns the probabilities of a M/M/Infinite queueing model*

Description

Pn returns the probabilities that a M/M/Infinite queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MMInf'
Pn(x, ...)
  ## S3 method for class 'o_MMInf'
Qn(x, ...)
```

Arguments

`x`	a object of class o_MMInf
`...`	aditional arguments

Details

Pn returns the probabilities that a M/M/Infinite queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers. By the PASTA property, both probabilities has to be the same.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the probabilities
Pn(o_mminf)
Qn(o_mminf)
```

Pn.o_MMInfKK   *Returns the probabilities of a M/M/Infinite/K/K queueing model*

Description

Pn returns the probabilities that a M/M/Infinite/K/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers in it.

Usage

```
  ## S3 method for class 'o_MMInfKK'
Pn(x, ...)
  ## S3 method for class 'o_MMInfKK'
Qn(x, ...)
```

Arguments

`x`	a object of class o_MMInfKK
`...`	aditional arguments

Details

Pn returns the probabilities that a M/M/Infinite/K/K queueing model has n customers.
Qn returns the probabilities that an arrival that enter the system see n customers.

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the probabilities
Pn(o_MMInfKK)
Qn(o_MMInfKK)
```

Pn.o_OJN — *Returns vector of the probabilities of each node (server) of an Open Jackson Network*

Description

Returns vector of the probabilities of each node (server) of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
Pn(x, ...)
```

Arguments

`x`	a object of class o_OJN
`...`	aditional arguments

Details

Returns vector of the probabilities of each node (server) of an Open Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

# Deinition of the new input
i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

# Build the models
o_ojn <- QueueingModel(i_ojn)

Pn(o_ojn)
```

`print.summary.o_BnD` *Summary of the results of a generic Birth and Death process model*

Description

Summary of the results of a generic Birth and Death process model.

Usage

```
  ## S3 method for class 'summary.o_BnD'
print(x, ...)
```

Arguments

`x`	a object of class summary.o_BnD
`...`	aditional arguments

Details

Summaries a generic Birth and Death process model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_BnD.

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)

## Build the model
o_BnD <- QueueingModel(i_BnD)

## Report the results
print(summary(o_BnD))
```

---

print.summary.o_CJN *Summary of the results of a Closed Jackson Network*

Description

Summary of the results of a Closed Jackson Network

Usage

```
  ## S3 method for class 'summary.o_CJN'
print(x, ...)
```

Arguments

x	a object of class summary.o_CJN
...	aditional arguments

Details

Summaries a Closed Jackson Network model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_CJN.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

print(summary(m_cjn1))
```

---

print.summary.o_MCCN *Summary of the results of a MultiClass Closed Network*

Description

Summary of the results of a MultiClass Closed Network

Usage

```
  ## S3 method for class 'summary.o_MCCN'
print(x, ...)
```

Arguments

x	a object of class summary.o_MCCN
...	aditional arguments

Details

Summaries a MultiClass Closed Network model

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

print(summary(o_MCCN1))
```

`print.summary.o_MCMN` *Summary of the results of a MultiClass Mixed Network*

Description

Summary of the results of a MultiClass Mixed Network

Usage

```
## S3 method for class 'summary.o_MCMN'
print(x, ...)
```

Arguments

x	a object of class summary.o_MCMN
...	aditional arguments

Details

Summaries a MultiClass Mixed Network model

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

print(summary(o_mcmn1))
```

`print.summary.o_MCON` *Summary of the results of a MultiClass Open Network*

Description

Summary of the results of a MultiClass Open Network

Usage

```
## S3 method for class 'summary.o_MCON'
print(x, ...)
```

Arguments

x	a object of class summary.o_MCON
...	aditional arguments

Details

Summaries a MultiClass Open Network model

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

print(summary(o_mcon1))
```

---

print.summary.o_MM1 *Summary of the results of a M/M/1 queueing model*

Description

Summary of the results of a M/M/1 queueing model.

Usage

```
  ## S3 method for class 'summary.o_MM1'
print(x, ...)
```

Arguments

x	a object of class summary.o_MM1
...	aditional arguments

Details

Summaries a M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Report the results
print(summary(o_mm1))
```

---

print.summary.o_MM1K *Summary of the results of a M/M/1/K queueing model*

Description

Summary of the results of a M/M/1/K queueing model.

Usage

```
  ## S3 method for class 'summary.o_MM1K'
print(x, ...)
```

Arguments

x	a object of class summary.o_MM1K
...	aditional arguments

Details

Summaries a M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Report the results
print(summary(o_mm1k))
```

---

print.summary.o_MM1KK *Summary of the results of a M/M/1/K/K queueing model*

Description

Summary of the results of a M/M/1/K/K queueing model.

Usage

```
  ## S3 method for class 'summary.o_MM1KK'
print(x, ...)
```

Arguments

x	a object of class summary.o_MM1KK
...	aditional arguments

Details

Summaries a M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Report the results
print(summary(o_mm1kk))
```

---

print.summary.o_MMC *Summary of the results of a M/M/c queueing model*

Description

Summary of the results of a M/M/c queueing model.

Usage

```
  ## S3 method for class 'summary.o_MMC'
print(x, ...)
```

Arguments

x	a object of class summary.o_MMC
...	aditional arguments

Details

Summaries a M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Report the results
print(summary(o_mmc))
```

---

print.summary.o_MMCC *Summary of the results of a M/M/c/c queueing model*

Description

Summary of the results of a M/M/c/c queueing model.

Usage

```
  ## S3 method for class 'summary.o_MMCC'
print(x, ...)
```

Arguments

x	a object of class summary.o_MMCC
...	aditional arguments

Details

Summaries a M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCC.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Report the results
print(summary(o_mmcc))
```

`print.summary.o_MMCK` *Summary of the results of a M/M/c/K queueing model*

Description

Summary of the results of a M/M/c/K queueing model.

Usage

```
  ## S3 method for class 'summary.o_MMCK'
print(x, ...)
```

Arguments

`x`	a object of class summary.o_MMCK
`...`	aditional arguments

Details

Summaries a M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCK`.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Report the results
print(summary(o_mmck))
```

---

print.summary.o_MMCKK *Summary of the results of a M/M/c/K/K queueing model*

Description

Summary of the results of a M/M/c/K/K queueing model.

Usage

```
## S3 method for class 'summary.o_MMCKK'
print(x, ...)
```

Arguments

x	a object of class summary.o_MMCKK
...	aditional arguments

Details

Summaries a M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Report the results
print(summary(o_mmckk))
```

`print.summary.o_MMCKM` *Summary of the results of a M/M/c/K/m queueing model*

Description

Summary of the results of a M/M/c/K/m queueing model.

Usage

```
## S3 method for class 'summary.o_MMCKM'
print(x, ...)
```

Arguments

`x`	a object of class summary.o_MMCKM
`...`	aditional arguments

Details

Summaries a M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCKM`.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Report the results
print(summary(o_mmckm))
```

`print.summary.o_MMInf` *Summary of the results of a M/M/Infinite queueing model*

Description

Summary of the results of a M/M/Infinite queueing model.

Usage

```
  ## S3 method for class 'summary.o_MMInf'
print(x, ...)
```

Arguments

`x`	a object of class summary.o_MMInf
`...`	aditional arguments

Details

Summaries a M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Report the results
print(summary(o_mminf))
```

`print.summary.o_MMInfKK`
Reports the results of a M/M/Infinite/K/K queueing model

Description

Reports the results of a M/M/Infinite/K/K queueing model.

Usage

```
## S3 method for class 'summary.o_MMInfKK'
print(x, ...)
```

Arguments

`x`	a object of class summary.o_MMInfKK
`...`	aditional arguments

Details

Summaries a M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

`QueueingModel.i_MMInfKK`.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Report the results
print(summary(o_MMInfKK))
```

`print.summary.o_OJN` *Reports the results of an Open Jackson Network*

Description

Reports the results of an Open Jackson Network

Usage

```
  ## S3 method for class 'summary.o_OJN'
print(x, ...)
```

Arguments

`x`	a object of class summary.o_OJN
`...`	aditional arguments

Details

Summaries an Open Jackson Network model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_OJN`.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

o_ojn <- QueueingModel(i_ojn)

print(summary(o_ojn))
```

`QueueingModel` *Generic S3 method to build a queueing model (or network)*

Description

Generic S3 method to build a queueing model (or network)

Usage

```
QueueingModel(x, ...)
```

Arguments

`x`	a object of class i_MM1, i_MMC, i_MM1K, i_MMCK, i_MM1KK, i_MMCKK, i_MMCC, i_MMCKM, i_MMInfKK, i_MMInf, i_OJN, i_MCON
`...`	aditional arguments

Details

Generic S3 method to build a queueing model (or network)

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1
QueueingModel.i_MMC
QueueingModel.i_MM1K
QueueingModel.i_MMCK
QueueingModel.i_MM1KK
QueueingModel.i_MMCKK
QueueingModel.i_MMCC
QueueingModel.i_MMCKM
QueueingModel.i_MMInfKK
QueueingModel.i_MMInf
QueueingModel.i_OJN
QueueingModel.i_MCON

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
QueueingModel(i_mm1)
```

`QueueingModel.i_BnD` *Builds a a generic Birth and Death process model*

Description

Builds a a generic Birth and Death process model

Usage

```
  ## S3 method for class 'i_BnD'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_BnD
...	aditional arguments

Details

Build a generic Birth and Death process model. It also checks the input params calling the CheckInput.i_BnD

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_BnD

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)

## Build the model
o_BnD <- QueueingModel(i_BnD)
```

QueueingModel.i_CJN *Builds one Closed Jackson Network*

Description

Builds one Closed Jackson Network

Usage

```
  ## S3 method for class 'i_CJN'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_CJN
...	aditional arguments

Details

Build one Closed Jackson Network. It also checks the input params calling the CheckInput.i_CJN

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_CJN

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

m_cjn1
```

QueueingModel.i_MCCN *Builds one MultiClass Closed Network*

Description

Builds one MultiClass Closed Network

Usage

```
  ## S3 method for class 'i_MCCN'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MCCN
...	aditional arguments

Details

Build one MultiClass Closed Network. It also checks the input params calling the CheckInput.i_MCCN

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

CheckInput.i_MCCN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

o_MCCN1
```

QueueingModel.i_MCMN *Builds one MultiClass Mixed Network*

Description

Builds one MultiClass Mixed Network

Usage

```
## S3 method for class 'i_MCMN'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MCMN
...	aditional arguments

Details

Build one MultiClass Mixed Network. It also checks the input params calling the CheckInput.i_MCMN

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

CheckInput.i_MCMN

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

o_mcmn1
```

QueueingModel.i_MCON *Builds one MultiClass Open Network*

Description

Builds one MultiClass Open Network

Usage

```
## S3 method for class 'i_MCON'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MCON
...	aditional arguments

Details

Build one MultiClass Open Network. It also checks the input params calling the CheckInput.i_MCON

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

CheckInput.i_MCON

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

o_mcon1
```

QueueingModel.i_MM1 *Builds a M/M/1 queueing model*

Description

Builds a M/M/1 queueing model

Usage

```
  ## S3 method for class 'i_MM1'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MM1
...	aditional arguments

Details

Build a M/M/1 queueing model. It also checks the input params calling the CheckInput.i_MM1

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MM1

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
QueueingModel(i_mm1)
```

QueueingModel.i_MM1K *Builds a M/M/1/K queueing model*

Description

Builds a M/M/1/K queueing model

Usage

```
  ## S3 method for class 'i_MM1K'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MM1K
...	aditional arguments

Details

Build a M/M/1/K queueing model. It also checks the input params calling the CheckInput.i_MM1K

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`CheckInput.i_MM1K`.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
QueueingModel(i_mm1k)
```

QueueingModel.i_MM1KK *Builds a M/M/1/K/K queueing model*

Description

Builds a M/M/1/K/K queueing model

Usage

```
## S3 method for class 'i_MM1KK'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MM1KK
...	aditional arguments

Details

Build a M/M/1/K/K queueing model. It also checks the input params calling the CheckInput.i_MM1KK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
QueueingModel(i_mm1kk)
```

QueueingModel.i_MMC *Builds a M/M/c queueing model*

Description

Builds a M/M/c queueing model

Usage

```
## S3 method for class 'i_MMC'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MMC
...	aditional arguments

Details

Build a M/M/c/ queueing model. It also checks the input params calling the CheckInput.i_MMC

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MMC

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
QueueingModel(i_mmc)
```

QueueingModel.i_MMCC *Builds a M/M/c/c queueing model*

Description

Builds a M/M/c/c queueing model

Usage

```
## S3 method for class 'i_MMCC'
QueueingModel(x, ...)
```

Arguments

`x`	a object of class i_MMCC
`...`	aditional arguments

Details

Build a M/M/c/c queueing model. It also checks the input params calling the CheckInput.i_MMCC

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`CheckInput.i_MMCC`.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
QueueingModel(i_mmcc)
```

QueueingModel.i_MMCK *Builds a M/M/c/K queueing model*

Description

Builds a M/M/c/K queueing model

Usage

```
## S3 method for class 'i_MMCK'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MMCK
...	aditional arguments

Details

Build a M/M/c/K queueing model. It also checks the input params calling the CheckInput.i_MMCK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MMCK.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
QueueingModel(i_mmck)
```

QueueingModel.i_MMCKK *Builds a M/M/c/K/K queueing model*

Description

Builds a M/M/c/K/K queueing model

Usage

```
  ## S3 method for class 'i_MMCKK'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MMCKK
...	aditional arguments

Details

Build a M/M/c/K/K queueing model. It also checks the input params calling the CheckInput.i_MMCKK

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
QueueingModel(i_mmckk)
```

QueueingModel.i_MMCKM *Builds a M/M/c/K/m queueing model*

Description

Builds a M/M/c/K/m queueing model

Usage

```
## S3 method for class 'i_MMCKM'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MMCKM
...	aditional arguments

Details

Build a M/M/c/K/m queueing model. It also checks the input params calling the CheckInput.i_MMCKM

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_MMCKM

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
QueueingModel(i_mmckm)
```

`QueueingModel.i_MMInf` *Builds a M/M/Infinite queue model*

Description

Builds a M/M/Infinite queue model

Usage

```
  ## S3 method for class 'i_MMInf'
QueueingModel(x, ...)
```

Arguments

`x`	a object of class i_MMInf
`...`	aditional arguments

Details

Build a M/M/Infinite model. It also checks the input params calling the CheckInput.i_MMInf

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`CheckInput.i_MMInf`

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
QueueingModel(i_mminf)
```

QueueingModel.i_MMInfKK
Builds a M/M/Infinite/K/K queueing model

Description

Builds a M/M/Infinite/K/K queueing model

Usage

```
  ## S3 method for class 'i_MMInfKK'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_MMInfKK
...	aditional arguments

Details

Build a M/M/Infinite/K/K queueing model. It also checks the input params calling the CheckInput.i_MMInfKK

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

CheckInput.i_MMInfKK

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
QueueingModel(i_MMInfKK)
```

QueueingModel.i_OJN *Builds one Open Jackson Network*

Description

Builds one Open Jackson Network

Usage

```
## S3 method for class 'i_OJN'
QueueingModel(x, ...)
```

Arguments

x	a object of class i_OJN
...	aditional arguments

Details

Build one Open Jackson Network. It also checks the input params calling the CheckInput.i_OJN

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

CheckInput.i_OJN

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

ojn1 <- NewInput.OJN(prob, n1, n2, n3, n4)

m_ojn1 <- QueueingModel(ojn1)
```

```
m_ojn1
```

`Report` *Reports the results of a queueing model*

Description

Reports the results of a queueing model.

Usage

```
Report(x, ...)
```

Arguments

x	i_MM1, i_MMC, i_MM1K, i_MMCK, i_MM1KK, i_MMCKK, i_MMCC, i_MMCKM, i_MMInfKK, i_MMInf, i_OJN, i_MCON
...	aditional arguments

Details

Generic S3 method to report a queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Report the results
Report(o_mm1)
```

Report.o_BnD *Reports the results of a M/M/1 queueing model*

Description

Reports the results of a M/M/1 queueing model.

Usage

```
  ## S3 method for class 'o_BnD'
Report(x, ...)
```

Arguments

x	a object of class o_BnD
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_BnD.

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)

## Build the model
o_BnD <- QueueingModel(i_BnD)

## Report the results
Report(o_BnD)
```

Report.o_CJN *Reports the results of a Closed Jackson Network*

Description

Reports the results of a Closed Jackson Network

Usage

```
## S3 method for class 'o_CJN'
Report(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Generates a report of the queueing network received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_CJN.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)
```

```
# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

Report(m_cjn1)
```

Report.o_MCCN *Reports the results of a MultiClass Closed Network*

Description

Reports the results of a MultiClass Closed Network

Usage

```
## S3 method for class 'o_MCCN'
Report(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Generates a report of the queueing network received as parameter

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
```

```
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Report(o_MCCN1)
```

Report.o_MCMN *Reports the results of a MultiClass Mixed Network*

Description

Reports the results of a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Report(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Generates a report of the queueing network received as parameter

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Report(o_mcmn1)
```

Report.o_MCON *Reports the results of a MultiClass Open Network*

Description

Reports the results of a MultiClass Open Network

Usage

```
  ## S3 method for class 'o_MCON'
Report(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Generates a report of the queueing network received as parameter

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Report(o_mcon1)
```

Report.o_MM1 *Reports the results of a M/M/1 queueing model*

Description

Reports the results of a M/M/1 queueing model.

Usage

```
## S3 method for class 'o_MM1'
Report(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Report the results
Report(o_mm1)
```

Report.o_MM1K *Reports the results of a M/M/1/K queueing model*

Description

Reports the results of a M/M/1/K queueing model.

Usage

```
## S3 method for class 'o_MM1K'
Report(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Report the results
Report(o_mm1k)
```

Report.o_MM1KK   *Reports the results of a M/M/1/K/K queueing model*

Description

Reports the results of a M/M/1/K/K queueing model.

Usage

```
  ## S3 method for class 'o_MM1KK'
Report(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Report the results
Report(o_mm1kk)
```

Report.o_MMC — *Reports the results of a M/M/c queueing model*

Description

Reports the results of a M/M/c queueing model.

Usage

```
  ## S3 method for class 'o_MMC'
Report(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Report the results
Report(o_mmc)
```

Report.o_MMCC *Reports the results of a M/M/c/c queueing model*

Description

Reports the results of a M/M/c/c queueing model.

Usage

```
  ## S3 method for class 'o_MMCC'
Report(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCC.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Report the results
Report(o_mmcc)
```

Report.o_MMCK *Reports the results of a M/M/c/K queueing model*

Description

Reports the results of a M/M/c/K queueing model.

Usage

```
  ## S3 method for class 'o_MMCK'
Report(x, ...)
```

Arguments

`x`	a object of class o_MMCK
`...`	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCK`.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Report the results
Report(o_mmck)
```

`Report.o_MMCKK` *Reports the results of a M/M/c/K/K queueing model*

Description

Reports the results of a M/M/c/K/K queueing model.

Usage

```
  ## S3 method for class 'o_MMCKK'
Report(x, ...)
```

Arguments

`x`	a object of class o_MMCKK
`...`	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCKK`.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Report the results
Report(o_mmckk)
```

Report.o_MMCKM *Reports the results of a M/M/c/K/m queueing model*

Description

Reports the results of a M/M/c/K/m queueing model.

Usage

```
  ## S3 method for class 'o_MMCKM'
Report(x, ...)
```

Arguments

x	a object of class o_MMCKM
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Report the results
Report(o_mmckm)
```

Report.o_MMInf *Reports the results of a M/M/Infinite queueing model*

Description

Reports the results of a M/M/Infinite queueing model.

Usage

```
  ## S3 method for class 'o_MMInf'
Report(x, ...)
```

Arguments

x	a object of class o_MMInf
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMInf.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Report the results
Report(o_mminf)
```

Report.o_MMInfKK *Reports the results of a M/M/Infinite/K/K queueing model*

Description

Reports the results of a M/M/Infinite/K/K queueing model.

Usage

```
## S3 method for class 'o_MMInfKK'
Report(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Generates a report of the queueing model received as parameter

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Report the results
Report(o_MMInfKK)
```

Report.o_OJN *Reports the results of an Open Jackson Network*

Description

Reports the results of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
Report(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Generates a report of the queueing network received as parameter

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

o_ojn <- QueueingModel(i_ojn)

Report(o_ojn)
```

RO *Reports the server use of a queueing model*

Description

Reports the server use of a queueing model)

Usage

```
RO(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
...	aditional arguments

Details

Reports the server use of a queueing model (or network)

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

RO.o_MM1
RO.o_MMC
RO.o_MM1K
RO.o_MMCK
RO.o_MM1KK
RO.o_MMCKK
RO.o_MMCC
RO.o_MMCKM
RO.o_MMInfKK
RO.o_MMInf

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Report the use of the server
RO(o_mm1)
```

RO.o_MM1 *Reports the server use of a M/M/1 queueing model*

Description

Reports the server use of a M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
RO(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Reports the server use of a M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Report the use of the server
RO(o_mm1)
```

RO.o_MM1K — *Reports the server use of a M/M/1/K queueing model*

Description

Reports the server use of a M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
RO(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Reports the server use of a M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Report the use of the server
RO(o_mm1k)
```

RO.o_MM1KK *Reports the server use of a M/M/1/K/K queueing model*

Description

Reports the server use of a M/M/1/K/K queueing model

Usage

```
## S3 method for class 'o_MM1KK'
RO(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Reports the server use of a M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Report the use of the server
RO(o_mm1kk)
```

`RO.o_MMC` *Reports the server use of a M/M/c queueing model*

Description

Reports the server use of a M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
RO(x, ...)
```

Arguments

`x`	a object of class o_MMC
`...`	aditional arguments

Details

Reports the server use of a M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMC`.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Report the use of the server
RO(o_mmc)
```

RO.o_MMCC *Reports the server use of a M/M/c/c queueing model*

Description

Reports the server use of a M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
RO(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Reports the server use of a M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCC.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Report the use of the server
RO(o_mmcc)
```

RO.o_MMCK *Reports the server use of a M/M/c/K queueing model*

Description

Reports the server use of a M/M/c/K queueing model

Usage

```
  ## S3 method for class 'o_MMCK'
RO(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Reports the server use of a M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCK.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Report the use of the server
RO(o_mmck)
```

RO.o_MMCKK *Reports the server use of a M/M/c/K/K queueing model*

Description

Reports the server use of a M/M/c/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMCKK'
RO(x, ...)
```

Arguments

x	a object of class o_MMCKK
...	aditional arguments

Details

Reports the server use of a M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Report the use of the server
RO(o_mmckk)
```

RO.o_MMCKM *Reports the server use of a M/M/c/K/m queueing model*

Description

Reports the server use of a M/M/c/K/m queueing model

Usage

```
  ## S3 method for class 'o_MMCKM'
RO(x, ...)
```

Arguments

x	a object of class o_MMCKM
...	aditional arguments

Details

Reports the server use of a M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Report the use of the server
RO(o_mmckm)
```

`RO.o_MMInf` *Reports the server use of a M/M/Infinite queueing model*

Description

Reports the server use of a M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
RO(x, ...)
```

Arguments

`x`	a object of class o_MMInf
`...`	aditional arguments

Details

Reports the server use of a M/M/Infinite queueing model. It should be noted that in this model, the RO parameter has a different meaning, its the traffic intensity and it coincides exactly with the average number of customers in the system (L)

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMInf`
`L.o_MMInf`

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Report the use of the server
RO(o_mminf)
```

`RO.o_MMInfKK` *Reports the server use of a M/M/Infinite/K/K queueing model*

Description

Reports the server use of a M/M/Infinite/K/K queueing model

Usage

```
## S3 method for class 'o_MMInfKK'
RO(x, ...)
```

Arguments

`x`	a object of class o_MMInfKK
`...`	aditional arguments

Details

Reports the server use of a M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

`QueueingModel.i_MMInfKK`.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Report the use of the server
RO(o_MMInfKK)
```

ROck *Reports a matrix with the use of class i in each node (server) j in a MultiClass Queueing Network*

Description

Reports a matrix with the use of class i in each node (server) j in a MultiClass Queueing Network

Usage

```
ROck(x, ...)
```

Arguments

x	a object of class o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Reports a matrix with the use of class i in each node (server) j in a MultiClass Queueing Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos CaballeROk, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial CentROk de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

ROck.o_MCON
ROck.o_MCCN
ROck.o_MCMN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

ROck(o_MCCN1)
```

ROck.o_MCCN — *Reports a matrix with the use of class i in each node (server) j in a MultiClass Closed Network*

Description

Reports a matrix with the use of class i in each node (server) j in a MultiClass Closed Network

Usage

```
## S3 method for class 'o_MCCN'
ROck(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Reports a matrix with the use of class i in each node (server) j in a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

ROck(o_MCCN1)
```

ROck.o_MCMN — *Reports a matrix with the use of class i in each node (server) j in a MultiClass Mixed Network*

Description

Reports a matrix with the use of class i in each node (server) j in a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
ROck(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Reports a matrix with the use of class i in each node (server) j in a

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

ROck(o_mcmn1)
```

ROck.o_MCON — *Reports a matrix with the use of class i in each node (server) j in a MultiClass Open Network*

Description

Reports a matrix with the use of class i in each node (server) j in a MultiClass Open Network

Usage

```
  ## S3 method for class 'o_MCON'
ROck(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Reports a matrix with the use of class i in each node (server) j in a

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

ROck(o_mcon1)
```

ROk *Reports a vector with each node (server) use of a queueing network*

Description

Reports a vector with each node (server) use of a queueing network

Usage

```
ROk(x, ...)
```

Arguments

`x`	a object of class o_OJN, o_CJN, o_MCON, o_MCCN, o_MCMN
`...`	aditional arguments

Details

Reports a vector with each node (server) use of a queueing network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos CaballeROk, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial CentROk de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

ROk.o_OJN
ROk.o_CJN
ROk.o_MCON
ROk.o_MCCN
ROk.o_MCMN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

ROk(o_MCCN1)
```

ROk.o_CJN — *Reports a vector with each node (server) use of a Closed Jackson Network*

Description

Reports a vector with each node (server) use of a Closed Jackson Network

Usage

```
  ## S3 method for class 'o_CJN'
ROk(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Reports a vector with each node (server) use of a Closed Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_CJN.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)
```

```
# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

ROk(m_cjn1)
```

ROk.o_MCCN *Reports a vector with each node (server) use of a MultiClass Closed Network*

Description

Reports a vector with each node (server) use of a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
ROk(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Reports a vector with each node (server) use of a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

ROk(o_MCCN1)
```

ROk.o_MCMN *Reports a vector with each node (server) use of a MultiClass Mixed Network*

Description

Reports a vector with each node (server) use of a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
ROk(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Reports a vector with each node (server) use of a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

ROk(o_mcmn1)
```

ROk.o_MCON *Reports a vector with each node (server) use of a MultiClass Open Network*

Description

Reports a vector with each node (server) use of a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
ROk(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Reports a vector with each node (server) use of a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

ROk(o_mcon1)
```

ROk.o_OJN *Reports a vector with each node (server) use of an Open Jackson Network*

Description

Reports a vector with each node (server) use of an Open Jackson Network

Usage

```
## S3 method for class 'o_OJN'
ROk(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Reports a vector with each node (server) use of an Open Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

# Deinition of the new input
i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

# Build the models
o_ojn <- QueueingModel(i_ojn)

ROk(o_ojn)
```

SP *Returns the saturation point of a queueing model*

Description

Returns the saturation point of a queueing model

Usage

```
SP(x, ...)
```

Arguments

`x`	a object of class o_MM1KK
`...`	aditional arguments

Details

Returns the saturation point of a queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`SP.o_MM1KK`

Examples

```
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=4, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the saturation point
SP(o_mm1kk)
```

`SP.o_MM1KK` *Returns the saturation point of a M/M/1/K/K queueing model*

Description

Returns the saturation point, or the maximum number of customers that the M/M/1/K/K queueing model can support with no interference or syncronization between themselves

Usage

```
  ## S3 method for class 'o_MM1KK'
SP(x, ...)
```

Arguments

`x`	a object of class o_MM1KK
`...`	aditional arguments

Details

The value returned is the optimal number of customers of a M/M/1/K/K queueing model. It coincides with the inverse of the serialization parameter of Amdahl's Law. That is, the value which converges the speedup func(k) = k/(1 + ser * (k-1)). It makes sense, because the saturation point is the maximun value in which no syncronization happens.

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MM1KK`

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=4, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the saturation point
SP(o_mm1kk)
```

`summary.o_BnD` *Summary of the results of a generic Birth and Death process model*

Description

Summary of the results of a generic Birth and Death process model.

Usage

```
  ## S3 method for class 'o_BnD'
summary(object, ...)
```

Arguments

`object`	a object of class o_BnD
`...`	aditional arguments

Details

Summaries a generic Birth and Death process model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_BnD.

Examples

```
## Generating a generic Birth and Death model with the same lambda and mu vectors as M/M/1 model
## create input parameters
lambda <- rep(1/4, 200)
mu <- rep(1/3, 200)

i_BnD <- NewInput.BnD(lambda=lambda, mu=mu)

## Build the model
o_BnD <- QueueingModel(i_BnD)

## Report the results
summary(o_BnD)
```

---

summary.o_CJN *Summary of the results of a Closed Jackson Network*

Description

Summary of the results of a Closed Jackson Network

Usage

```
## S3 method for class 'o_CJN'
summary(object, ...)
```

Arguments

object	a object of class o_CJN
...	aditional arguments

Details

Summaries a Closed Jackson Network model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_CJN.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

summary(m_cjn1)
```

---

summary.o_MCCN   *Summary of the results of a MultiClass Closed Network*

Description

Summary of the results of a MultiClass Closed Network

Usage

```
## S3 method for class 'o_MCCN'
summary(object, ...)
```

Arguments

`object`	a object of class o_MCCN
`...`	aditional arguments

Details

Summaries a queueing network model

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCCN`.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

summary(o_MCCN1)
```

`summary.o_MCMN` *Summary of the results of a MultiClass Mixed Network*

Description

Summary of the results of a MultiClass Mixed Network

Usage

```
## S3 method for class 'o_MCMN'
summary(object, ...)
```

Arguments

`object`	a object of class o_MCMN
`...`	aditional arguments

Details

Summaries a MultiClass Mixed Network model

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCMN`.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

summary(o_mcmn1)
```

summary.o_MCON *Summary of the results of a MultiClass Open Network*

Description

Summary of the results of a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
summary(object, ...)
```

Arguments

object	a object of class o_MCON
...	aditional arguments

Details

Summaries a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

summary(o_mcon1)
```

summary.o_MM1 *Summary of the results of a M/M/1 queueing model*

Description

Summary of the results of a M/M/1 queueing model.

Usage

```
  ## S3 method for class 'o_MM1'
summary(object, ...)
```

Arguments

`object`	a object of class o_MM1
`...`	aditional arguments

Details

Summaries a M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Report the results
summary(o_mm1)
```

`summary.o_MM1K` *Summary of the results of a M/M/1/K queueing model*

Description

Summary of the results of a M/M/1/K queueing model.

Usage

```
## S3 method for class 'o_MM1K'
summary(object, ...)
```

Arguments

`object`	a object of class o_MM1K
`...`	aditional arguments

Details

Summaries a M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Report the results
summary(o_mm1k)
```

summary.o_MM1KK — *Summary of the results of a M/M/1/K/K queueing model*

Description

Summary of the results of a M/M/1/K/K queueing model.

Usage

```
## S3 method for class 'o_MM1KK'
summary(object, ...)
```

Arguments

`object`	a object of class o_MM1KK
`...`	aditional arguments

Details

Summaries a M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Report the results
summary(o_mm1kk)
```

`summary.o_MMC` *Summary of the results of a M/M/c queueing model*

Description

Summary of the results of a M/M/c queueing model.

Usage

```
## S3 method for class 'o_MMC'
summary(object, ...)
```

Arguments

`object`	a object of class o_MMC
`...`	aditional arguments

Details

Summaries a M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMC`.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Report the results
summary(o_mmc)
```

summary.o_MMCC *Summary of the results of a M/M/c/c queueing model*

Description

Summary of the results of a M/M/c/c queueing model.

Usage

```
## S3 method for class 'o_MMCC'
summary(object, ...)
```

Arguments

`object`	a object of class o_MMCC
`...`	aditional arguments

Details

Summaries a M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCC`.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Report the results
summary(o_mmcc)
```

`summary.o_MMCK` *Summary of the results of a M/M/c/K queueing model*

Description

Summary of the results of a M/M/c/K queueing model.

Usage

```
  ## S3 method for class 'o_MMCK'
summary(object, ...)
```

Arguments

`object`	a object of class o_MMCK
`...`	aditional arguments

Details

Summaries a M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCK.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Report the results
summary(o_mmck)
```

summary.o_MMCKK *Summary of the results of a M/M/c/K/K queueing model*

Description

Summary of the results of a M/M/c/K/K queueing model.

Usage

```
## S3 method for class 'o_MMCKK'
summary(object, ...)
```

Arguments

`object`	a object of class o_MMCKK
`...`	aditional arguments

Details

Summaries a M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Report the results
summary(o_mmckk)
```

summary.o_MMCKM — *Summary of the results of a M/M/c/K/m queueing model*

Description

Summary of the results of a M/M/c/K/m queueing model.

Usage

```
## S3 method for class 'o_MMCKM'
summary(object, ...)
```

Arguments

object	a object of class o_MMCKM
...	aditional arguments

Details

Summaries a M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Report the results
summary(o_mmckm)
```

summary.o_MMInf *Summary of the results of a M/M/Infinite queueing model*

Description

Summary of the results of a M/M/Infinite queueing model.

Usage

```
## S3 method for class 'o_MMInf'
summary(object, ...)
```

Arguments

object	a object of class o_MMInf
...	aditional arguments

Details

Summaries a M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMInf.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Report the results
summary(o_mminf)
```

`summary.o_MMInfKK` *Summary of the results of a M/M/Infinite/K/K queueing model*

Description

Summary of the results of a M/M/Infinite/K/K queueing model.

Usage

```
  ## S3 method for class 'o_MMInfKK'
summary(object, ...)
```

Arguments

`object`	a object of class o_MMInfKK
`...`	aditional arguments

Details

Summaries a M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

`QueueingModel.i_MMInfKK`.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Report the results
summary(o_MMInfKK)
```

summary.o_OJN *Summary of the results of an Open Jackson Network*

Description

Summary of the results of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
summary(object, ...)
```

Arguments

object	a object of class o_OJN
...	aditional arguments

Details

Summaries an Open Jackson Network model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

o_ojn <- QueueingModel(i_ojn)
```

```
summary(o_ojn)
```

Throughput — *Throughput of a queueing model (or network)*

Description

Returns the throughput of a queueing model (or network)

Usage

```
Throughput(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf, o_OJN, o_CJN, o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Returns the throughput of a queueing model (or network)

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Throughput.o_MM1
Throughput.o_MMC
Throughput.o_MM1K
Throughput.o_MMCK
Throughput.o_MM1KK
Throughput.o_MMCKK
Throughput.o_MMCC
Throughput.o_MMCKM
Throughput.o_MMInfKK

Throughput.o_MMInf
Throughput.o_OJN
Throughput.o_CJN
Throughput.o_MCON
Throughput.o_MCCN
Throughput.o_MCMN

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Throughput
Throughput(o_mm1)
```

`Throughput.o_CJN` *Reports the network throughput of a Closed Jackson Network*

Description

Reports the network throughput of a Closed Jackson Network

Usage

```
## S3 method for class 'o_CJN'
Throughput(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Reports the network throughput of a Closed Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.OJN, CheckInput.i_CJN, QueueingModel.i_CJN

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

Throughput(m_cjn1)
```

Throughput.o_MCCN *Reports the throughput of a MultiClass Closed Network*

Description

Reports the throughput of a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
Throughput(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Reports the throughput of a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCCN, CheckInput.i_MCCN, QueueingModel.i_MCCN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Throughput(o_MCCN1)
```

Throughput.o_MCMN *Reports the throughput of a MultiClass Mixed Network*

Description

Reports the throughput of a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Throughput(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Reports the throughput of a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCMN, CheckInput.i_MCMN, QueueingModel.i_MCMN

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Throughput(o_mcmn1)
```

Throughput.o_MCON *Reports the throughput of a MultiClass Open Network*

Description

Reports the throughput of a MultiClass Open Network

Usage

```
  ## S3 method for class 'o_MCON'
Throughput(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Reports the throughput of a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCON, CheckInput.i_MCON, QueueingModel.i_MCON

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Throughput(o_mcon1)
```

Throughput.o_MM1 *Throughput of a M/M/1 queueing model*

Description

Returns the throughput of a M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
Throughput(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the throughput of a M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MM1, CheckInput.i_MM1, QueueingModel.i_MM1

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Throughput
Throughput(o_mm1)
```

Throughput.o_MM1K *Throughput of a M/M/1/K queueing model*

Description

Returns the throughput of a M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
Throughput(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Returns the throughput of a M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MM1K, CheckInput.i_MM1K, QueueingModel.i_MM1K

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mmck <- QueueingModel(i_mm1k)

## Throughput
Throughput(o_mmck)
```

Throughput.o_MM1KK *Throughput of a M/M/1/K/K queueing model*

Description

Returns the throughput of a M/M/1/K/K queueing model

Usage

```
  ## S3 method for class 'o_MM1KK'
Throughput(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the throughput of a M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MM1KK, CheckInput.i_MM1KK, QueueingModel.i_MM1KK

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_MM1KKk <- QueueingModel(i_mm1kk)

## Throughput
Throughput(o_MM1KKk)
```

Throughput.o_MMC *Throughput of a M/M/c queueing model*

Description

Returns the throughput of a M/M/c queueing model

Usage

```
## S3 method for class 'o_MMC'
Throughput(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Returns the throughput of a M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMC, CheckInput.i_MMC, QueueingModel.i_MMC

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Throughput
Throughput(o_mmc)
```

Throughput.o_MMCC *Throughput of a M/M/c/c queueing model*

Description

Returns the throughput of a M/M/c/c queueing model

Usage

```
## S3 method for class 'o_MMCC'
Throughput(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the throughput of a M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMCC, CheckInput.i_MMCC, QueueingModel.i_MMCC

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Throughput
Throughput(o_mmcc)
```

Throughput.o_MMCK *Throughput of a M/M/c/K queueing model*

Description

Returns the throughput of a M/M/c/K queueing model

Usage

```
## S3 method for class 'o_MMCK'
Throughput(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Returns the throughput of a M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMCK, CheckInput.i_MMCK, QueueingModel.i_MMCK

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Throughput
Throughput(o_mmck)
```

`Throughput.o_MMCKK` *Throughput of a M/M/c/K/K queueing model*

Description

Returns the throughput of a M/M/c/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMCKK'
Throughput(x, ...)
```

Arguments

`x`	a object of class o_MMCKK
`...`	aditional arguments

Details

Returns the throughput of a M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMCKK, CheckInput.i_MMCKK, QueueingModel.i_MMCKK

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## build the model
o_mmckk <- QueueingModel(i_mmckk)

## Throughput
Throughput(o_mmckk)
```

Throughput.o_MMCKM *Throughput of a M/M/c/K/m queueing model*

Description

Returns the throughput of a M/M/c/K/m queueing model

Usage

```
## S3 method for class 'o_MMCKM'
Throughput(x, ...)
```

Arguments

x	a object of class o_MMCKM
...	aditional arguments

Details

Returns the throughput of a M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMCKM, CheckInput.i_MMCKM, QueueingModel.i_MMCKM

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Throughput
Throughput(o_mmckm)
```

Throughput.o_MMInf *Throughput of a M/M/Infinite queueing model*

Description

Returns the throughput of a M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
Throughput(x, ...)
```

Arguments

x	a object of class o_MMInf
...	aditional arguments

Details

Returns the throughput of a M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.MMInf, CheckInput.i_MMInf, QueueingModel.i_MMInf

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Throughput
Throughput(o_mminf)
```

Throughput.o_MMInfKK *Throughput of a M/M/Infinite/K/K queueing model*

Description

Returns the throughput of a M/M/Infinite/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMInfKK'
Throughput(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the throughput of a M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

NewInput.MMInfKK, CheckInput.i_MMInfKK, QueueingModel.i_MMInfKK

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Throughput
Throughput(o_MMInfKK)
```

Throughput.o_OJN *Reports the throughput of an Open Jackson Network*

Description

Reports the throughput of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
Throughput(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Reports the throughput of an Open Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.OJN, CheckInput.i_OJN, QueueingModel.i_OJN

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

# Deinition of the new input
i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

# Build the models
o_ojn <- QueueingModel(i_ojn)

Throughput(o_ojn)
```

Throughputc — *Reports a vector with each class throughput in a multiclass queueing network*

Description

Reports a vector with each class throughput in a multiclass queueing network

Usage

```
Throughputc(x, ...)
```

Arguments

`x`	a object of class o_MCON, o_MCCN, o_MCMN
`...`	aditional arguments

Details

Reports a vector with each class throughput in a multiclass queueing network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Throughputc.o_MCON
Throughputc.o_MCCN
Throughputc.o_MCCN

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Throughputc(o_mcon1)
```

`Throughputc.o_MCCN` *Reports a vector with each class throughput in a MultiClass Closed Network*

Description

Reports a vector with each class throughput in a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
Throughputc(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Reports a vector with each class throughput in a MultiClass Closed Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCCN, CheckInput.i_MCCN, QueueingModel.i_MCCN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Throughputc(o_MCCN1)
```

Throughputc.o_MCMN *Reports a vector with each class throughput in a MultiClass Mixed Network*

Description

Reports a vector with each class throughput in a MultiClass Mixed Network

Usage

```
## S3 method for class 'o_MCMN'
Throughputc(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Reports a vector with each class throughput in a MultiClass Mixed Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCMN, CheckInput.i_MCMN, QueueingModel.i_MCMN

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Throughputc(o_mcmn1)
```

`Throughputc.o_MCON` *Reports a vector with each class throughput in a MultiClass Open Network*

Description

Reports a vector with each class throughput in a MultiClass Open Network

Usage

```
  ## S3 method for class 'o_MCON'
Throughputc(x, ...)
```

Arguments

`x`	a object of class o_MCON
`...`	aditional arguments

Details

Reports a vector with each class throughput in a MultiClass Open Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`NewInput.MCON`, `CheckInput.i_MCON`, `QueueingModel.i_MCON`

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)
```

```
i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Throughputc(o_mcon1)
```

Throughputck   *Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Network*

Description

Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Network

Usage

```
Throughputck(x, ...)
```

Arguments

x	a object of class o_MCON, o_MCCN
...	aditional arguments

Details

Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
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[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Throughputck.o_MCON
Throughputck.o_MCCN
Throughputck.o_MCMN

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Throughputck(o_mcon1)
```

`Throughputck.o_MCCN` *Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Closed Network*

Description

Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
Throughputck(x, ...)
```

Arguments

`x`	a object of class o_MCCN
`...`	aditional arguments

Details

Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Closed Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCCN, CheckInput.i_MCCN, QueueingModel.i_MCCN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Throughputck(o_MCCN1)
```

`Throughputck.o_MCMN` *Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Mixed Network*

Description

Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Throughputck(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Mixed Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCMN, CheckInput.i_MCMN, QueueingModel.i_MCMN

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Throughputck(o_mcmn1)
```

`Throughputck.o_MCON`	*Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Open Network*

Description

Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
Throughputck(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Reports a matrix with the throughput of class i in each node (server) j in a MultiClass Open Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCON, CheckInput.i_MCON, QueueingModel.i_MCON

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Throughputck(o_mcon1)
```

Throughputcn *Returns a matrix with the Throughput from each class and every population of a Multi Class Closed Network*

Description

Returns a matrix with the Throughput from each class and every population of a Multi Class Closed Network

Usage

```
Throughputcn(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Returns a matrix with the Throughput from each class and every population of a Multi Class Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Throughputcn.o_MCCN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)
```

```
# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Throughputcn(o_MCCN1)
```

Throughputcn.o_MCCN *Returns a matrix with the Throughput from each class and every population of a Multi Class Closed Network*

Description

Returns a matrix with the Throughput from each class and every population of a Multi Class Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
Throughputcn(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Returns a matrix with the Throughput from each class and every population of a Multi Class Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCCN, CheckInput.i_MCCN, QueueingModel.i_MCCN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Throughputcn(o_MCCN1)
```

`Throughputk` *Reports a vector with each node (server) throughput of a queueing network*

Description

Reports a vector with each node (server) throughput of a queueing network

Usage

```
Throughputk(x, ...)
```

Arguments

`x`	a object of class o_OJN, o_CJN, o_MCON, o_MCCN, o_MCMN
`...`	aditional arguments

Details

Reports a vector with each node (server) throughput of a queueing network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik

(1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Throughputk.o_OJN
Throughputk.o_CJN
Throughputk.o_MCON
Throughputk.o_MCCN
Throughputk.o_MCMN

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Throughputk(o_mcon1)
```

`Throughputk.o_CJN` *Reports a vector with each node (server) throughput of a Closed Jackson Network*

Description

Reports a vector with each node (server) throughput of a Closed Jackson Network

Usage

```
## S3 method for class 'o_CJN'
Throughputk(x, ...)
```

Arguments

`x`	a object of class o_CJN
`...`	aditional arguments

Details

Reports a vector with each node (server) throughput of a Closed Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.CJN, CheckInput.i_CJN, QueueingModel.i_CJN

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

Throughputk(m_cjn1)
```

Throughputk.o_MCCN *Reports a vector with each node (server) throughput of a MultiClass Closed Network*

Description

Reports a vector with each node (server) throughput of a MultiClass Closed Network

Usage

```
## S3 method for class 'o_MCCN'
Throughputk(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Reports a vector with each node (server) throughput of a MultiClass Closed Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCCN, CheckInput.i_MCCN, QueueingModel.i_MCCN

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Throughputk(o_MCCN1)
```

Throughputk.o_MCMN *Reports a vector with each node (server) throughput of a MultiClass Mixed Network*

Description

Reports a vector with each node (server) throughput of a MultiClass Mixed Network

Usage

```
## S3 method for class 'o_MCMN'
Throughputk(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Reports a vector with each node (server) throughput of a MultiClass Mixed Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

NewInput.MCMN, CheckInput.i_MCMN, QueueingModel.i_MCMN

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
```

```
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Throughputk(o_mcmn1)
```

`Throughputk.o_MCON` *Reports a vector with each node (server) throughput of a MultiClass Open Network*

Description

Reports a vector with each node (server) throughput of a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
Throughputk(x, ...)
```

Arguments

`x`	a object of class o_MCON
`...`	aditional arguments

Details

Reports a vector with each node (server) throughput of a MultiClass Open Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`NewInput.MCON`, `CheckInput.i_MCON`, `QueueingModel.i_MCON`

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Throughputk(o_mcon1)
```

Throughputk.o_OJN	*Reports a vector with each node (server) throughput of an Open Jackson Network*

Description

Reports a vector with each node (server) throughput of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
Throughputk(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Reports a vector with each node (server) throughput of an Open Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.OJN, CheckInput.i_OJN, QueueingModel.i_OJN

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

# Deinition of the new input
i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

# Build the models
o_ojn <- QueueingModel(i_ojn)

Throughputk(o_ojn)
```

`Throughputn` *Returns a vector with the each Throughput from 1 to the parameter n (population passed as input) of a Closed Network*

Description

Returns a vector with the each Throughput from 1 to the parameter n (population passed as input) of a Closed Network

Usage

```
Throughputn(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Returns a vector with the each Throughput from 1 to the parameter n (population passed as input) of a Closed Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

Throughputn.o_CJN

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

Throughputn(m_cjn1)
```

Throughputn.o_CJN — *Returns a vector with the each Throughput from 1 to the parameter n (population passed as input) of a Closed Jackson Network*

Description

Returns a vector with the each Throughput from 1 to the parameter n (population passed as input) of a Closed Jackson Network

Usage

```
  ## S3 method for class 'o_CJN'
Throughputn(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Returns a vector with the each Throughput from 1 to the parameter n (population passed as input) of a Closed Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

NewInput.CJN, CheckInput.i_CJN, QueueingModel.i_CJN

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

Throughputn(m_cjn1)
```

`VN` *Returns the variance of the number of customers in a queueing model (or network)*

Description

Returns the variance of the number of customers in a queueing model (or network)

Usage

```
VN(x, ...)
```

Arguments

`x`	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
`...`	aditional arguments

Details

Returns the variance of the number of customers in a queueing model (or network)

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

VN.o_MM1
VN.o_MMC
VN.o_MMCC
VN.o_MMInf
VN.o_MMInfKK
VN.o_MM1K
VN.o_MMCK
VN.o_MM1KK
VN.o_MMCKK
VN.o_MMCKM

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)
```

```
## Returns the variance
VN(o_mm1)
```

VN.o_MM1 *Returns the variance of the number of customers in the M/M/1 queueing model*

Description

Returns the variance of the number of customers in the M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
VN(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the variance of the number of customers in the M/M/1 queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MM1.

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the variance
VN(o_mm1)
```

VN.o_MM1K *Returns the variance of the number of customers in the M/M/1/K queueing model*

Description

Returns the variance of the number of customers in the M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
VN(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Returns the variance of the number of customers in the M/M/1/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MM1K.

Examples

```
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the variance
VN(o_mm1k)
```

VN.o_MM1KK *Returns the variance of the number of customers in the M/M/1/K/K queueing model*

Description

Returns the variance of the number of customers in the M/M/1/K/K queueing model

Usage

```
  ## S3 method for class 'o_MM1KK'
VN(x, ...)
```

Arguments

`x`	a object of class o_MM1KK
`...`	aditional arguments

Details

Returns the variance of the number of customers in the M/M/1/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MM1K.

Examples

```
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the variance
VN(o_mm1kk)
```

`VN.o_MMC` *Returns the variance of the number of customers in the M/M/c queueing model*

Description

Returns the variance of the number of customers in the M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
VN(x, ...)
```

Arguments

`x`	a object of class o_MMC
`...`	aditional arguments

Details

Returns the variance of the number of customers in the M/M/c queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MMC`.

Examples

```
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the variance
VN(o_mmc)
```

VN.o_MMCC *Returns the variance of the number of customers in the M/M/c/c queueing model*

Description

Returns the variance of the number of customers in the M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
VN(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the variance of the number of customers in the M/M/c/c queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCC.

Examples

```
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the variance
VN(o_mmcc)
```

VN.o_MMCK *Returns the variance of the number of customers in the M/M/c/K queueing model*

Description

Returns the variance of the number of customers in the M/M/c/K queueing model

Usage

```
  ## S3 method for class 'o_MMCK'
VN(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Returns the variance of the number of customers in the M/M/c/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCK.

Examples

```
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the variance
VN(o_mmck)
```

VN.o_MMCKK *Returns the variance of the number of customers in the M/M/c/K/K queueing model*

Description

Returns the variance of the number of customers in the M/M/c/K/K queueing model

Usage

```
## S3 method for class 'o_MMCKK'
VN(x, ...)
```

Arguments

x	a object of class o_MMCKK
...	aditional arguments

Details

Returns the variance of the number of customers in the M/M/c/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the variance
VN(o_mmckk)
```

`VN.o_MMCKM` *Returns the variance of the number of customers in the M/M/c/K/m queueing model*

Description

Returns the variance of the number of customers in the M/M/c/K/m queueing model

Usage

```
  ## S3 method for class 'o_MMCKM'
VN(x, ...)
```

Arguments

`x`	a object of class o_MMCKM
`...`	aditional arguments

Details

Returns the variance of the number of customers in the M/M/c/K/m queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MMCKM`.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the variance
VN(o_mmckm)
```

VN.o_MMInf — *Returns the variance of the number of customers in the M/M/Infinite queueing model*

Description

Returns the variance of the number of customers in the M/M/Infinite queueing model

Usage

```
## S3 method for class 'o_MMInf'
VN(x, ...)
```

Arguments

x	a object of class o_MMInf
...	aditional arguments

Details

Returns the variance of the number of customers in the M/M/Infinite queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMInf.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the variance
VN(o_mminf)
```

VN.o_MMInfKK *Returns the variance of the number of customers in the M/M/Infinite/K/K queueing model*

Description

Returns the variance of the number of customers in the M/M/Infinite/K/K queueing model

Usage

```
## S3 method for class 'o_MMInfKK'
VN(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the variance of the number of customers in the M/M/Infinite/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the variance
VN(o_MMInfKK)
```

VNq — *Returns the variance of the number of customers in the queue in a queueing model*

Description

Returns the variance of the number of customers in the queue in a queueing model

Usage

```
VNq(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in a queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

VNq.o_MM1
VNq.o_MM1
VNq.o_MMCC
VNq.o_MMInf
VNq.o_MMInfKK
VNq.o_MM1K
VNq.o_MMCK
VNq.o_MM1KK
VNq.o_MMCKK
VNq.o_MMCKM

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)
```

```
## Returns the variance
VNq(o_mm1)
```

VNq.o_MM1 *Returns the variance of the number of customers in the queue in the M/M/1 queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/1 queueing model

Usage

```
## S3 method for class 'o_MM1'
VNq(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/1 queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MM1.

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the variance
VNq(o_mm1)
```

VNq.o_MM1K *Returns the variance of the number of customers in the queue in the M/M/1/K queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/1/K queueing model

Usage

```
  ## S3 method for class 'o_MM1K'
VNq(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/1/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MM1K.

Examples

```
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the variance
VNq(o_mm1k)
```

`VNq.o_MM1KK` *Returns the variance of the number of customers in the queue in the M/M/1/K/K queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/1/K/K queueing model

Usage

```
## S3 method for class 'o_MM1KK'
VNq(x, ...)
```

Arguments

`x`	a object of class o_MM1KK
`...`	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/1/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MM1KK`.

Examples

```
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the variance
VNq(o_mm1kk)
```

VNq.o_MMC *Returns the variance of the number of customers in the queue in the M/M/c queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
VNq(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/c queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMC.

Examples

```
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the variance
VNq(o_mmc)
```

VNq.o_MMCC *Returns the variance of the number of customers in the queue in the M/M/c/c queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
VNq(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/c/c queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCC.

Examples

```
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the variance
VNq(o_mmcc)
```

VNq.o_MMCK *Returns the variance of the number of customers in the queue in the M/M/c/K queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/c/K queueing model

Usage

```
  ## S3 method for class 'o_MMCK'
VNq(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/c/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCK.

Examples

```
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the variance
VNq(o_mmck)
```

VNq.o_MMCKK *Returns the variance of the number of customers in the queue in the M/M/c/K/K queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/c/K/K queueing model

Usage

```
## S3 method for class 'o_MMCKK'
VNq(x, ...)
```

Arguments

x	a object of class o_MMCKK
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/c/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the variance
VNq(o_mmckk)
```

VNq.o_MMCKM *Returns the variance of the number of customers in the queue in the M/M/c/K/m queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/c/K/m queueing model

Usage

```
## S3 method for class 'o_MMCKM'
VNq(x, ...)
```

Arguments

x	a object of class o_MMCKM
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/c/K/m queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the variance
VNq(o_mmckm)
```

`VNq.o_MMInf` *Returns the variance of the number of customers in the queue in the M/M/Infinite queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
VNq(x, ...)
```

Arguments

`x`	a object of class o_MMInf
`...`	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/Infinite queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the variance
VNq(o_mminf)
```

VNq.o_MMInfKK *Returns the variance of the number of customers in the queue in the M/M/Infinite/K/K queueing model*

Description

Returns the variance of the number of customers in the queue in the M/M/Infinite/K/K queueing model

Usage

```
## S3 method for class 'o_MMInfKK'
VNq(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the variance of the number of customers in the queue in the M/M/Infinite/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the VNq
VNq(o_MMInfKK)
```

VT *Returns the variance of the time spend in a queueing model (or network)*

Description

Returns the variance of the time spend in a queueing model (or network)

Usage

```
VT(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
...	aditional arguments

Details

Returns the variance of the time spend in a queueing model (or network)

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

VT.o_MM1
VT.o_MMC
VT.o_MMCC
VT.o_MMInf
VT.o_MMInfKK
VT.o_MM1K
VT.o_MM1KK

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the variance of the time spend in the system
VT(o_mm1)
```

VT.o_MM1 *Returns the variance of the time spend in the M/M/1 queueing model*

Description

Returns the variance of the time spend in the M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
VT(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the variance of the time spend in the M/M/1 queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MM1.

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the variance of the time spend in the system
VT(o_mm1)
```

`VT.o_MM1K` *Returns the variance of the time spend in the M/M/1/K queueing model*

Description

Returns the variance of the time spend in the M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
VT(x, ...)
```

Arguments

`x`	a object of class o_MM1K
`...`	aditional arguments

Details

Returns the variance of the time spend in the M/M/1/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MM1K`.

Examples

```
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the variance
VT(o_mm1k)
```

VT.o_MM1KK *Returns the variance of the time spend in the M/M/1/K/K queueing model*

Description

Returns the variance of the time spend in the M/M/1/K/K queueing model

Usage

```
## S3 method for class 'o_MM1KK'
VT(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the variance of the time spend in the M/M/1/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MM1KK.

Examples

```
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the variance
VT(o_mm1kk)
```

VT.o_MMC *Returns the variance of the time spend in the M/M/c queueing model*

Description

Returns the variance of the time spend in the M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
VT(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Returns the variance of the time spend in the M/M/c queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMC.

Examples

```
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the variance of the time spend in the system
VT(o_mmc)
```

VT.o_MMCC *Returns the variance of the time spend in the M/M/c/c queueing model*

Description

Returns the variance of the time spend in the M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
VT(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the variance of the time spend in the M/M/c/c queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCC.

Examples

```
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the variance
VT(o_mmcc)
```

`VT.o_MMInf` *Returns the variance of the time spend in the M/M/Infinite queueing model*

Description

Returns the variance of the time spend in the M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
VT(x, ...)
```

Arguments

`x`	a object of class o_MMInf
`...`	aditional arguments

Details

Returns the the variance of the time spend in the M/M/Infinite queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the variance
VT(o_mminf)
```

VT.o_MMInfKK *Returns the variance of the time spend in the M/M/Infinite/K/K queueing model*

Description

Returns the variance of the time spend in the M/M/Infinite/K/K queueing model

Usage

```
## S3 method for class 'o_MMInfKK'
VT(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the variance of the time spend in the M/M/Infinite/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the variance
VT(o_MMInfKK)
```

`VTq` *Returns the variance of the time spend in queue in a queueing model*

Description

Returns the variance of the time spend in queue in a queueing model

Usage

```
VTq(x, ...)
```

Arguments

`x`	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
`...`	aditional arguments

Details

Returns the variance of the time spend in queue in a queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

VTq.o_MM1
VTq.o_MMC
VTq.o_MMCC
VTq.o_MMInf
VTq.o_MMInfKK
VTq.o_MM1K
VTq.o_MMCK
VTq.o_MM1KK
VTq.o_MMCKK

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the variance of the time spend in queue
VTq(o_mm1)
```

VTq.o_MM1 *Returns the variance of the time spend in queue in the M/M/1 queueing model*

Description

Returns the variance of the time spend in queue in the M/M/1 queueing model

Usage

```
## S3 method for class 'o_MM1'
VTq(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/1 queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MM1.

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the variance of the time spend in queue
VTq(o_mm1)
```

`VTq.o_MM1K` *Returns the variance of the time spend in queue in the M/M/1/K queueing model*

Description

Returns the variance of the time spend in queue in the M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
VTq(x, ...)
```

Arguments

`x`	a object of class o_MM1K
`...`	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/1/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MM1K`.

Examples

```
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the variance
VTq(o_mm1k)
```

`VTq.o_MM1KK` *Returns the variance of the time spend in queue in the M/M/1/K/K queueing model*

Description

Returns the variance of the time spend in queue in the M/M/1/K/K queueing model

Usage

```
## S3 method for class 'o_MM1KK'
VTq(x, ...)
```

Arguments

`x`	a object of class o_MM1KK
`...`	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/1/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MM1KK`.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the VTq
VTq(o_mm1kk)
```

`VTq.o_MMC` *Returns the variance of the time spend in queue in the M/M/c queueing model*

Description

Returns the variance of the time spend in queue in the M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
VTq(x, ...)
```

Arguments

`x`	a object of class o_MMC
`...`	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/c queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MMC`.

Examples

```
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the variance of the time spend in queue
VTq(o_mmc)
```

VTq.o_MMCC *Returns the variance of the time spend in queue in the M/M/c/c queueing model*

Description

Returns the variance of the time spend in queue in the M/M/c/c queueing model

Usage

```
## S3 method for class 'o_MMCC'
VTq(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/c/c queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCC.

Examples

```
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the variance
VTq(o_mmcc)
```

VTq.o_MMCK *Returns the variance of the time spend in queue in the M/M/c/K queueing model*

Description

Returns the variance of the time spend in queue in the M/M/c/K queueing model

Usage

```
  ## S3 method for class 'o_MMCK'
VTq(x, ...)
```

Arguments

x	a object of class o_MMCK
...	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/c/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCK.

Examples

```
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the variance
VTq(o_mmck)
```

VTq.o_MMCKK *Returns the variance of the time spend in queue in the M/M/c/K/K queueing model*

Description

Returns the variance of the time spend in queue in the M/M/c/K/K queueing model

Usage

```
## S3 method for class 'o_MMCKK'
VTq(x, ...)
```

Arguments

`x`	a object of class o_MMCKK
`...`	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/c/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the variance
VTq(o_mmckk)
```

`VTq.o_MMInf` *Returns the variance of the time spend in queue in the M/M/Infinite queueing model*

Description

Returns the variance of the time spend in queue in the M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
VTq(x, ...)
```

Arguments

`x`	a object of class o_MMInf
`...`	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/Infinite queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

`QueueingModel.i_MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the variance
VTq(o_mminf)
```

VTq.o_MMInfKK — *Returns the variance of the time spend in queue in the M/M/Infinite/K/K queueing model*

Description

Returns the variance of the time spend in queue in the M/M/Infinite/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMInfKK'
VTq(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the variance of the time spend in queue in the M/M/Infinite/K/K queueing model

References

[Sztrik2012] Dr. Janos Sztrik (2012).
Basic Queueing Theory.
University of Debrecen, Faculty of Informatics.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the variance
VTq(o_MMInfKK)
```

W — *Returns the mean time spend in a queueing model (or network)*

Description

Returns the mean time spend in a queueing model (or network)

Usage

```
W(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf, o_OJN, o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Returns the mean time spend in a queueing model (or network)

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

W.o_MM1
W.o_MMC
W.o_MM1K
W.o_MMCK
W.o_MM1KK
W.o_MMCKK
W.o_MMCC
W.o_MMCKM
W.o_MMInfKK
W.o_MMInf
W.o_OJN
W.o_MCON
W.o_MCCN
W.o_MCMN

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the W
W(o_mm1)
```

`W.o_CJN` *Returns the mean time spend in a Closed Jackson Network*

Description

Returns the mean time spend in a Closed Jackson Network

Usage

```
## S3 method for class 'o_CJN'
W(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Returns the mean time spend in a Closed Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_CJN.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

W(m_cjn1)
```

W.o_MCCN *Returns the mean time spend in a MultiClass Closed Network*

Description

Returns the mean time spend in a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
W(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Returns the mean time spend in a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

W(o_MCCN1)
```

W.o_MCMN *Returns the mean time spend in a MultiClass Mixed Network*

Description

Returns the mean time spend in a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
W(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Returns the mean time spend in a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

W(o_mcmn1)
```

W.o_MCON *Returns the mean time spend in a MultiClass Open Network*

Description

Returns the mean time spend in a MultiClass Open Network

Usage

```
  ## S3 method for class 'o_MCON'
W(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Returns the mean time spend in a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

W(o_mcon1)
```

W.o_MM1 — *Returns the mean time spend in the M/M/1 queueing model*

Description

Returns the mean time spend in the M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
W(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the mean time spend in the M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the W
W(o_mm1)
```

W.o_MM1K *Returns the mean time spend in the M/M/1/K queueing model*

Description

Returns the mean time spend in the M/M/1/K queueing model

Usage

```
  ## S3 method for class 'o_MM1K'
W(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Returns the mean time spend in the M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the W
W(o_mm1k)
```

W.o_MM1KK *Returns the mean time spend in the M/M/1/K/K queueing model*

Description

Returns the mean time spend in the M/M/1/K/K queueing model

Usage

```
  ## S3 method for class 'o_MM1KK'
W(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the mean time spend in the M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the W
W(o_mm1kk)
```

W.o_MMC *Returns the mean time spend in the M/M/c queueing model*

Description

Returns the mean time spend in the M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
W(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Returns the mean time spend in the M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the W
W(o_mmc)
```

W.o_MMCC *Returns the mean time spend in the M/M/c/c queueing model*

Description

Returns the mean time spend in the M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
W(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the mean time spend in the M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCC.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the W
W(o_mmcc)
```

`W.o_MMCK` *Returns the mean time spend in the M/M/c/K queueing model*

Description

Returns the mean time spend in the M/M/c/K queueing model

Usage

```
## S3 method for class 'o_MMCK'
W(x, ...)
```

Arguments

`x`	a object of class o_MMCK
`...`	aditional arguments

Details

Returns the mean time spend in the M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCK`.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the W
W(o_mmck)
```

W.o_MMCKK *Returns the mean time spend in the M/M/c/K/K queueing model*

Description

Returns the mean time spend in the M/M/c/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMCKK'
W(x, ...)
```

Arguments

x	a object of class o_MMCKK
...	aditional arguments

Details

Returns the mean time spend in the M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the W
W(o_mmckk)
```

`W.o_MMCKM` *Returns the mean time spend in the M/M/c/K/m queueing model*

Description

Returns the mean time spend in the M/M/c/K/m queueing model

Usage

```
## S3 method for class 'o_MMCKM'
W(x, ...)
```

Arguments

x	a object of class o_MMCKM
...	aditional arguments

Details

Returns the mean time spend in the M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the W
W(o_mmckm)
```

W.o_MMInf *Returns the time spend in the M/M/Infinite queueing model*

Description

Returns the mean time spend in the M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
W(x, ...)
```

Arguments

x	a object of class o_MMInf
...	aditional arguments

Details

Returns the mean time spend in the M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMInf.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the W
W(o_mminf)
```

`W.o_MMInfKK` *Returns the mean time spend in the M/M/Infinite/K/K queueing model*

Description

Returns the mean time spend in the M/M/Infinite/K/K queueing model

Usage

```
  ## S3 method for class 'o_MMInfKK'
W(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the mean time spend in the M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the W
W(o_MMInfKK)
```

W.o_OJN *Returns the mean time spend in an Open Jackson Network*

Description

Returns the mean time spend in an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
W(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Returns the mean time spend in an Open Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

# Deinition of the new input
i_ojn <- NewInput.OJN(prob, n1, n2, n3, n4)

# Build the models
o_ojn <- QueueingModel(i_ojn)

W(o_ojn)
```

Wc — *Returns the vector with each class mean time spend on a multiclass queueing network*

Description

Returns the vector with each class mean time spend on a multiclass queueing network

Usage

```
Wc(x, ...)
```

Arguments

x	a object of class o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Returns the vector with each class mean time spend on a multiclass queueing network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Wc.o_MCON
Wc.o_MCCN
Wc.o_MCMN

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Wc(o_mcon1)
```

`Wc.o_MCCN` *Returns the vector with each class mean time spend on a MultiClass Closed Network*

Description

Returns the vector with each class mean time spend on a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
Wc(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Returns the vector with each class mean time spend on a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Wc(o_MCCN1)
```

`Wc.o_MCMN` *Returns the vector with each class mean time spend on a MultiClass Mixed Network*

Description

Returns the vector with each class mean time spend on a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Wc(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Returns the vector with each class mean time spend on a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Wc(o_mcmn1)
```

Wc.o_MCON *Returns the vector with each class mean time spend on a MultiClass Open Network*

Description

Returns the vector with each class mean time spend on a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
Wc(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Returns the vector with each class mean time spend on a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Wc(o_mcon1)
```

Wck *Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Queueing Network*

Description

Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Queueing Network

Usage

```
Wck(x, ...)
```

Arguments

x	a object of class o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Queueing Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.
[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Wck.o_MCON
Wck.o_MCCN
Wck.o_MCMN

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
```

```
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Wck(o_mcon1)
```

Wck.o_MCCN *Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Closed Network*

Description

Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Closed Network

Usage

```
## S3 method for class 'o_MCCN'
Wck(x, ...)
```

Arguments

x	a object of class o_MCCN
...	aditional arguments

Details

Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCCN.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)

Wck(o_MCCN1)
```

`Wck.o_MCMN` *Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Mixed Network*

Description

Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Mixed Network

Usage

```
## S3 method for class 'o_MCMN'
Wck(x, ...)
```

Arguments

x	a object of class o_MCMN
...	aditional arguments

Details

Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models. Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCMN.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)

i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Wck(o_mcmn1)
```

Wck.o_MCON *Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Open Network*

Description

Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Open Network

Usage

```
## S3 method for class 'o_MCON'
Wck(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Reports a matrix with the mean time of class i in each node (server) j in a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Wck(o_mcon1)
```

Wk — *Generic S3 method to return the mean time spend in each node (or server) of a network*

Description

Generic S3 method to return the mean time spend in each node (or server) of a network

Usage

```
Wk(x, ...)
```

Arguments

x	a object of class o_OJN, o_CJN, o_MCON, o_MCCN, o_MCMN
...	aditional arguments

Details

Generic S3 method to return the mean time spend in each node (or server) of a network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.
[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

Wk.o_OJN
Wk.o_CJN
Wk.o_MCON
Wk.o_MCCN
Wk.o_MCMN

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Wk(o_mcon1)
```

Wk.o_CJN *Returns the vector with the mean time spend in each node (server) of a Closed Jackson Network*

Description

Returns the vector with the mean time spend in each node (server) of a Closed Jackson Network

Usage

```
  ## S3 method for class 'o_CJN'
Wk(x, ...)
```

Arguments

x	a object of class o_CJN
...	aditional arguments

Details

Returns the vector with the mean time spend in each node (server) of a Closed Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_CJN.

Examples

```
## See example 11.13 in reference [Sixto2004] for more details.
## create the nodes
n <- 2
n1 <- NewInput.MM1(lambda=0, mu=1/0.2, n=0)
n2 <- NewInput.MM1(lambda=0, mu=1/0.4, n=0)

# think time = 0
z <- 0

# operational value
operational <- FALSE

# definition of the transition probabilities
prob <- matrix(data=c(0.5, 0.5, 0.5, 0.5), nrow=2, ncol=2, byrow=TRUE)

# Define a new input
cjn1 <- NewInput.CJN(prob, n, z, operational, 0, 0.001, n1, n2)

# Check the inputs and build the model
m_cjn1 <- QueueingModel(cjn1)

Wk(m_cjn1)
```

`Wk.o_MCCN` *Returns a vector with the mean time spend in each node (server) of a MultiClass Closed Network*

Description

Returns a vector with the mean time spend in each node (server) of a MultiClass Closed Network

Usage

```
  ## S3 method for class 'o_MCCN'
Wk(x, ...)
```

Arguments

`x`	a object of class o_MCCN
`...`	aditional arguments

Details

Returns a vector with the mean time spend in each node (server) of a MultiClass Closed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCCN`.

Examples

```
## See example in pag 142 in reference [Lazowska84] for more details.

classes <- 2
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_MCCN1 <- NewInput.MCCN(classes, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_MCCN1 <- QueueingModel(i_MCCN1)
```

```
Wk(o_MCCN1)
```

`Wk.o_MCMN` *Returns a matrix with the mean time spend in each node (server) of a MultiClass Mixed Network*

Description

Returns a matrix with the mean time spend in each node (server) of a MultiClass Mixed Network

Usage

```
  ## S3 method for class 'o_MCMN'
Wk(x, ...)
```

Arguments

`x`	a object of class o_MCMN
`...`	aditional arguments

Details

Returns a matrix with the mean time spend in each node (server) of a MultiClass Mixed Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

`QueueingModel.i_MCMN`.

Examples

```
## See example in pag 147 in reference [Lazowska84] for more details.

classes <- 4
vLambda <- c(1, 1/2)
vNumber <- c(1, 1)
vThink <- c(0, 0)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=1, nrow=4, ncol=2)
vService <- matrix(data=c(1/4, 1/2, 1/2, 1, 1/6, 1, 1, 4/3), nrow=4, ncol=2)
```

```
i_mcmn1 <- NewInput.MCMN(classes, vLambda, vNumber, vThink, nodes, vType, vVisit, vService)

# Build the model
o_mcmn1 <- QueueingModel(i_mcmn1)

Wk(o_mcmn1)
```

Wk.o_MCON *Returns a matrix with the mean time spend in each node (server) of a MultiClass Open Network*

Description

Returns a matrix with the mean time spend in each node (server) of a MultiClass Open Network

Usage

```
  ## S3 method for class 'o_MCON'
Wk(x, ...)
```

Arguments

x	a object of class o_MCON
...	aditional arguments

Details

Returns a matrix with the mean time spend in each node (server) of a MultiClass Open Network

References

[Lazowska84] Edward D. Lazowska, John Zahorjan, G. Scott Graham, and Kenneth C. Sevcik (1984).
Quantitative System Performance: Computer System Analysis Using Queueing Network Models.
Prentice-Hall, Inc., Englewood Cliffs, New Jersey

See Also

QueueingModel.i_MCON.

Examples

```
## See example in pag 138 in reference [Lazowska84] for more details.

classes <- 2
vLambda <- c(3/19, 2/19)
nodes <- 2
vType <- c("Q", "Q")
vVisit <- matrix(data=c(10, 9, 5, 4), nrow=2, ncol=2, byrow=TRUE)
vService <- matrix(data=c(1/10, 1/3, 2/5, 1), nrow=2, ncol=2, byrow=TRUE)

i_mcon1 <- NewInput.MCON(classes, vLambda, nodes, vType, vVisit, vService)

# Build the model
o_mcon1 <- QueueingModel(i_mcon1)

Wk(o_mcon1)
```

Wk.o_OJN — *Returns the vector with the mean time spend in each node (server) of an Open Jackson Network*

Description

Returns the vector with the mean time spend in each node (server) of an Open Jackson Network

Usage

```
  ## S3 method for class 'o_OJN'
Wk(x, ...)
```

Arguments

x	a object of class o_OJN
...	aditional arguments

Details

Returns the vector with the mean time spend in each node (server) of an Open Jackson Network

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_OJN.

Examples

```
## See example 11.11 in reference [Sixto2004] for more details.
## create the nodes
n1 <- NewInput.MM1(lambda=8, mu=14, n=0)
n2 <- NewInput.MM1(lambda=0, mu=9, n=0)
n3 <- NewInput.MM1(lambda=6, mu=17, n=0)
n4 <- NewInput.MM1(lambda=0, mu=7, n=0)
m  <- c(0, 0.2, 0.56, 0.24, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)

# definition of the transition probabilities
prob <- matrix(data=m, nrow=4, ncol=4, byrow=TRUE)

ojn1 <- NewInput.OJN(prob, n1, n2, n3, n4)

m_ojn1 <- QueueingModel(ojn1)

Wk(m_ojn1)
```

Wq — *Returns the mean time spend in queue in a queueing model*

Description

Returns the mean time spend in queue in a queueing model

Usage

```
Wq(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
...	aditional arguments

Details

Returns the mean time spend in queue in a queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

Wq.o_MM1
Wq.o_MMC
Wq.o_MM1K
Wq.o_MMCK
Wq.o_MM1KK
Wq.o_MMCKK
Wq.o_MMCC
Wq.o_MMCKM
Wq.o_MMInfKK
Wq.o_MMInf

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the Wq
Wq(o_mm1)
```

Wq.o_MM1 *Returns the mean time spend in queue in the M/M/1 queueing model*

Description

Returns the mean time spend in queue in the M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
Wq(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the mean time spend in queue in the M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the Wq
Wq(o_mm1)
```

Wq.o_MM1K *Returns the mean time spend in queue in the M/M/1/K queueing model*

Description

Returns the mean time spend in queue in the M/M/1/K queueing model

Usage

```
  ## S3 method for class 'o_MM1K'
Wq(x, ...)
```

Arguments

x	a object of class o_MM1K
...	aditional arguments

Details

Returns the mean time spend in queue in the M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1K.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the Wq
Wq(o_mm1k)
```

Wq.o_MM1KK *Returns the mean time spend in queue in the M/M/1/K/K queueing model*

Description

Returns the mean time spend in queue in the M/M/1/K/K queueing model

Usage

```
  ## S3 method for class 'o_MM1KK'
Wq(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the mean time spend in queue in the M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the Wq
Wq(o_mm1kk)
```

Wq.o_MMC *Returns the mean time spend in queue in the M/M/c queueing model*

Description

Returns the mean time spend in queue in the M/M/c queueing model

Usage

```
  ## S3 method for class 'o_MMC'
Wq(x, ...)
```

Arguments

x	a object of class o_MMC
...	aditional arguments

Details

Returns the mean time spend in queue in the M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMC.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the Wq
Wq(o_mmc)
```

`Wq.o_MMCC` *Returns the mean time spend in queue in the M/M/c/c queueing model*

Description

Returns the mean time spend in queue in the M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
Wq(x, ...)
```

Arguments

`x`	a object of class o_MMCC
`...`	aditional arguments

Details

Returns the mean time spend in queue in the M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCC`.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the Wq
Wq(o_mmcc)
```

`Wq.o_MMCK` *Returns the mean time spend in queue in the M/M/c/K queueing model*

Description

Returns the mean time spend in queue in the M/M/c/K queueing model

Usage

```
  ## S3 method for class 'o_MMCK'
Wq(x, ...)
```

Arguments

`x`	a object of class o_MMCK
`...`	aditional arguments

Details

Returns the mean time spend in queue in the M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCK`.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the Wq
Wq(o_mmck)
```

Wq.o_MMCKK — *Returns the mean time spend in queue in the M/M/c/K/K queueing model*

Description

Returns the mean time spend in queue in the M/M/c/K/K queueing model

Usage

```
## S3 method for class 'o_MMCKK'
Wq(x, ...)
```

Arguments

x	a object of class o_MMCKK
...	aditional arguments

Details

Returns the mean time spend in queue in the M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the Wq
Wq(o_mmckk)
```

Wq.o_MMCKM *Returns the mean time spend in queue in the M/M/c/K/m queueing model*

Description

Returns the mean time spend in queue in the M/M/c/K/m queueing model

Usage

```
  ## S3 method for class 'o_MMCKM'
Wq(x, ...)
```

Arguments

x	a object of class o_MMCKM
...	aditional arguments

Details

Returns the mean time spend in queue in the M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the Wq
Wq(o_mmckm)
```

`Wq.o_MMInf` *Returns the mean time spend in queue in the M/M/Infinite queueing model*

Description

Returns the mean time spend in queue in the M/M/Infinite queueing model

Usage

```
## S3 method for class 'o_MMInf'
Wq(x, ...)
```

Arguments

`x`	a object of class o_MMInf
`...`	aditional arguments

Details

Returns the mean time spend in queue in the M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the Wq
Wq(o_mminf)
```

`Wq.o_MMInfKK` *Returns the mean time spend in queue in the M/M/Infinite/K/K queueing model*

Description

Returns the mean time spend in queue in the M/M/Infinite/K/K queueing model

Usage

```
## S3 method for class 'o_MMInfKK'
Wq(x, ...)
```

Arguments

`x`	a object of class o_MMInfKK
`...`	aditional arguments

Details

Returns the mean time spend in queue in the M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

`QueueingModel.i_MMInfKK`.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the Wq
Wq(o_MMInfKK)
```

Wqq — *Returns the mean time spend in queue when there is queue in a queueing model*

Description

Returns the mean time spend in queue when there is queue in a queueing model

Usage

```
Wqq(x, ...)
```

Arguments

x	a object of class o_MM1, o_MMC, o_MM1K, o_MMCK, o_MM1KK, o_MMCKK, o_MMCC, o_MMCKM, o_MMInfKK, o_MMInf
...	aditional arguments

Details

Returns the mean time spend in queue when there is queue in a queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

Wqq.o_MM1
Wqq.o_MMC
Wqq.o_MM1K
Wqq.o_MMCK
Wqq.o_MM1KK
Wqq.o_MMCKK
Wqq.o_MMCC

Wqq.o_MMCKM
Wqq.o_MMInfKK
Wqq.o_MMInf

Examples

```
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the Wqq
Wqq(o_mm1)
```

Wqq.o_MM1 *Returns the mean time spend in queue when there is queue in the M/M/1 queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/1 queueing model

Usage

```
  ## S3 method for class 'o_MM1'
Wqq(x, ...)
```

Arguments

x	a object of class o_MM1
...	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/1 queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1.

Examples

```
## See example 10.3 in reference [Sixto2004] for more details.
## create input parameters
i_mm1 <- NewInput.MM1(lambda=1/4, mu=1/3, n=0)

## Build the model
o_mm1 <- QueueingModel(i_mm1)

## Returns the Wqq
Wqq(o_mm1)
```

`Wqq.o_MM1K` *Returns the mean time spend in queue when there is queue in the M/M/1/K queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/1/K queueing model

Usage

```
## S3 method for class 'o_MM1K'
Wqq(x, ...)
```

Arguments

`x`	a object of class o_MM1K
`...`	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/1/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MM1K`.

Examples

```
## See example 10.7 in reference [Sixto2004] for more details.
## create input parameters
i_mm1k <- NewInput.MM1K(lambda=5, mu=5.714, k=15)

## Build the model
o_mm1k <- QueueingModel(i_mm1k)

## Returns the Wqq
Wqq(o_mm1k)
```

`Wqq.o_MM1KK` *Returns the mean time spend in queue when there is queue in the M/M/1/K/K queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/1/K/K queueing model

Usage

```
## S3 method for class 'o_MM1KK'
Wqq(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the Wqq
Wqq(o_mm1kk)
```

`Wqq.o_MMC` *Returns the mean time spend in queue when there is queue in the M/M/c queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/c queueing model

Usage

```
## S3 method for class 'o_MMC'
Wqq(x, ...)
```

Arguments

`x`	a object of class o_MMC
`...`	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMC`.

Examples

```
## See example 10.9 in reference [Sixto2004] for more details.
## create input parameters
i_mmc <- NewInput.MMC(lambda=5, mu=10, c=2, n=0, method=0)

## Build the model
o_mmc <- QueueingModel(i_mmc)

## Returns the Wqq
Wqq(o_mmc)
```

Wqq.o_MMCC *Returns the mean time spend in queue when there is queue in the M/M/c/c queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/c/c queueing model

Usage

```
  ## S3 method for class 'o_MMCC'
Wqq(x, ...)
```

Arguments

x	a object of class o_MMCC
...	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/c/c queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCC.

Examples

```
## See example 10.12 in reference [Sixto2004] for more details.
## create input parameters
i_mmcc <- NewInput.MMCC(lambda=3, mu=0.25, c=15)

## Build the model
o_mmcc <- QueueingModel(i_mmcc)

## Returns the Wqq
Wqq(o_mmcc)
```

`Wqq.o_MMCK` *Returns the mean time spend in queue when there is queue in the M/M/c/K queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/c/K queueing model

Usage

```
## S3 method for class 'o_MMCK'
Wqq(x, ...)
```

Arguments

`x`	a object of class o_MMCK
`...`	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/c/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMCK`.

Examples

```
## See example 10.11 in reference [Sixto2004] for more details.
## create input parameters
i_mmck <- NewInput.MMCK(lambda=8, mu=4, c=5, k=12)

## Build the model
o_mmck <- QueueingModel(i_mmck)

## Returns the Wqq
Wqq(o_mmck)
```

Wqq.o_MMCKK *Returns the mean time spend in queue when there is queue in the M/M/c/K/K queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/c/K/K queueing model

Usage

```
## S3 method for class 'o_MMCKK'
Wqq(x, ...)
```

Arguments

x	a object of class o_MMCKK
...	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/c/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKK.

Examples

```
## create input parameters
i_mmckk <- NewInput.MMCKK(lambda=8, mu=2, c=5, k=12, method=0)

## Build the model
o_mmckk <- QueueingModel(i_mmckk)

## Returns the Wqq
Wqq(o_mmckk)
```

Wqq.o_MMCKM *Returns the mean time spend in queue when there is queue in the M/M/c/K/m queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/c/K/m queueing model

Usage

```
## S3 method for class 'o_MMCKM'
Wqq(x, ...)
```

Arguments

x	a object of class o_MMCKM
...	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/c/K/m queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MMCKM.

Examples

```
## create input parameters
i_mmckm <- NewInput.MMCKM(lambda=0.25, mu=4, c=2, k=4, m=8, method=0)

## Build the model
o_mmckm <- QueueingModel(i_mmckm)

## Returns the Wqq
Wqq(o_mmckm)
```

`Wqq.o_MMInf` *Returns the mean time spend in queue when there is queue in the M/M/Infinite queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/Infinite queueing model

Usage

```
  ## S3 method for class 'o_MMInf'
Wqq(x, ...)
```

Arguments

`x`	a object of class o_MMInf
`...`	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/Infinite queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

`QueueingModel.i_MMInf`.

Examples

```
## create input parameters
i_mminf <- NewInput.MMInf(lambda=0.25, mu=4, n=0)

## Build the model
o_mminf <- QueueingModel(i_mminf)

## Returns the Wqq
Wqq(o_mminf)
```

Wqq.o_MMInfKK *Returns the mean time spend in queue when there is queue in the M/M/Infinite/K/K queueing model*

Description

Returns the mean time spend in queue when there is queue in the M/M/Infinite/K/K queueing model

Usage

```
## S3 method for class 'o_MMInfKK'
Wqq(x, ...)
```

Arguments

x	a object of class o_MMInfKK
...	aditional arguments

Details

Returns the mean time spend in queue when there is queue in the M/M/Infinite/K/K queueing model

References

[Kleinrock1975] Leonard Kleinrock (1975).
Queueing Systems Vol 1: Theory.
John Wiley & Sons.

See Also

QueueingModel.i_MMInfKK.

Examples

```
## create input parameters
i_MMInfKK <- NewInput.MMInfKK(lambda=0.25, mu=4, k=4)

## Build the model
o_MMInfKK <- QueueingModel(i_MMInfKK)

## Returns the Wqq
Wqq(o_MMInfKK)
```

WWs *Returns the normalized mean response time in a queueing model*

Description

Returns the normalized mean response time in a queueing model

Usage

```
WWs(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the normalized mean response time in a queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

WWs.o_MM1KK.

Examples

```
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the WWs
WWs(o_mm1kk)
```

WWs.o_MM1KK *Returns the normalized mean response time in the M/M/1/K/K queueing model*

Description

Returns the normalized mean response time in the M/M/1/K/K queueing model

Usage

```
  ## S3 method for class 'o_MM1KK'
WWs(x, ...)
```

Arguments

x	a object of class o_MM1KK
...	aditional arguments

Details

Returns the normalized mean response time in the M/M/1/K/K queueing model

References

[Sixto2004] Sixto Rios Insua, Alfonso Mateos Caballero, M Concepcion Bielza Lozoya, Antonio Jimenez Martin (2004).
Investigacion Operativa. Modelos deterministicos y estocasticos.
Editorial Centro de Estudios Ramon Areces.

See Also

QueueingModel.i_MM1KK.

Examples

```
## See example 10.13 in reference [Sixto2004] for more details.
## create input parameters
i_mm1kk <- NewInput.MM1KK(lambda=0.25, mu=4, k=2, method=3)

## Build the model
o_mm1kk <- QueueingModel(i_mm1kk)

## Returns the WWs
WWs(o_mm1kk)
```

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