Package 'mcmapper'

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Title Mapping First Moment and C-Statistic to the Parameters of Distributions for Risk

Version 0.0.12

Description Provides a series of numerical methods for extracting parameters of distributions for risks based on knowing the expected value and c-statistics (e.g., from a published report on the performance of a risk prediction model). This package implements the methodology described in Sadatsafavi et al (2024) <doi:10.48550/arXiv.2409.09178>. The core of the package is mcmap(), which takes a pair of (mean, c-statistic) and the distribution type requested. This function provides a generic interface to more customized functions (mcmap_beta(), mcmap_logitnorm(), mcmap_probitnorm()) for specific distributions.

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`logitnorm` *Functions related to logit-normal distribution.*

Description

Functions related to logit-normal distribution.

Usage

```
rlogitnorm(n, mu, sigma)

dlogitnorm(x, mu, sigma)

plogitnorm(x, mu, sigma)

qlogitnorm(x, mu, sigma)

elogitnorm(mu, sigma)
```

Arguments

`n`	Number of draws requested (for rlogitnorm)
`mu`	Mean of the logit-transformed variable
`sigma`	SD of the logit-transformed variable
`x`	For density, CDF, and quantile functions

Details

`elogitnorm()` returns the mean (expected value) of the logit-normal distribution, i.e. `E[1/(1+exp(-Z))]` for `Z ~ Normal(mu, sigma)`. The integral has no closed form; it is evaluated by an accurate series expansion (with a numerical-integration fallback in extreme cases). Vectorised over `mu` and `sigma`, which are recycled to a common length.

Value

Depends on the function

Examples

```
elogitnorm(0, 1)            # 0.5, by symmetry
elogitnorm(c(-1, 0, 1), 1)  # vectorised over mu
```

mcmap *The main mapper function*

Description

Maps a pair of mean and c-statistic value to the parameters of a specified distribution for risk

Usage

```
mcmap(target, type = c("beta", "logitnorm", "probitnorm"))
```

Arguments

target	A vector of size 2. The first element is mean and the second element is c-statistic.
type	One of "beta", "logitnorm", "probitnorm". Loose matching is enabled (so "b" will be mapped to "beta").

Value

An object of class mcmapper. The "value" component returns the parameter. Any warning or error from the integration or gradient ascent will also be returned in the "info" component.

Examples

```
mcmap(c(0.1, 0.75), "beta")
```

mcmap_beta *Mapper function for beta distribution*

Description

Maps a pair of mean and c-statistic value to the parameters of a beta distribution

Usage

```
mcmap_beta(
  target,
  method = "",
  integrate_controls = list(),
  optim_controls = list()
)
```

Arguments

target	A vector of size 2. The first element is mean and the second element is c-statistic.
method	Not implemented for this function yet; leave as empty string.
integrate_controls	(optional): parameters to be passed to integrate()
optim_controls	(optional): parameters to be passed to optim()

Value

A vector of size two that contains the distribution parameters

Examples

```
mcmap_beta(c(0.1, 0.75))
```

---

mcmap_generic *A generic mapper function*

Description

Maps a pair of mean and c-statistic value to the parameters of an unspecified distribution that is indexed by two parameters

Usage

```
mcmap_generic(
  target,
  CDF,
  integrate_controls = list(),
  optim_controls = list()
)
```

Arguments

target	A vector of size 2. The first element is mean and the second element is c-statistic.
CDF	Cumulative distribution function of an unspecified distribution. The CDF must be indexed by two parameters.
integrate_controls	(optional): parameters to be passed to integrate()
optim_controls	(optional): parameters to be passed to optim()

Value

A vector of size two that contains the distribution parameters

Examples

```
mcmap_generic(c(0.1, 0.75), pbeta)
```

mcmap_logitnorm *Mapper function for logit-normal distribution*

Description

Maps a pair of mean and c-statistic value to the parameters of a logit-normal distribution

Usage

```
mcmap_logitnorm(
  target = c(m = 0.25, c = 0.75),
  method = "",
  integrate_controls = list(),
  optim_controls = list()
)
```

Arguments

target	A vector of size 2. The first element is mean and the second element is c-statistic.
method	Either empty string, which invoked the default method; or "meansolve" which uses two 1-dimensional optimization approach.
integrate_controls	(optional): parameters to be passed to integrate()
optim_controls	(optional): parameters to be passed to optim()

Value

A vector of size two that contains the distribution parameters

Examples

```
mcmap_logitnorm(c(0.1, 0.75))
```

mcmap_probitnorm *Mapper function for probit-normal distribution*

Description

Maps a pair of mean and c-statistic value to the parameters of a probit-normal distribution

Usage

```
mcmap_probitnorm(
  target = c(m = 0.25, c = 0.75),
  method = "",
  integrate_controls = list(),
  optim_controls = list()
)
```

Arguments

target	A vector of size 2. The first element is mean and the second element is c-statistic.
method	For compatibility with other functions. Use "" for now (alternative optimization methods might be implemented in the future)
integrate_controls	(optional): parameters to be passed to integrate()
optim_controls	(optional): parameters to be passed to optim()

Value

A vector of size two that contains the distribution parameters

Examples

```
mcmap_probitnorm(c(0.1, 0.75))
```

---

probitnorm *Functions related to probit-normal distribution.*

Description

Functions related to probit-normal distribution.

Usage

```
dprobitnorm(x, mu, sigma)

pprobitnorm(x, mu, sigma)

rprobitnorm(n, mu, sigma)

qprobitnorm(x, mu, sigma)

eprobitnorm(mu, sigma)
```

Arguments

x	For density, CDF, and quantile functions
mu	Mean of the probit-transformed variable
sigma	SD of the probit-transformed variable
n	Number of draws requested (for rprobitnorm)

Details

eprobitnorm() returns the mean (expected value) of the probit-normal distribution, i.e. E[pnorm(Z)] for Z ~ Normal(mu, sigma). Unlike the logit-normal case this has the closed form pnorm(mu / sqrt(1 + sigma^2)). Vectorised over mu and sigma.

Value

Depends on the function

Examples

```
eprobitnorm(0, 1)            # 0.5, by symmetry
eprobitnorm(c(-1, 0, 1), 1)  # vectorised over mu
```

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