

Package ‘bgumbel’

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Title Bimodal Gumbel Distribution

Version 0.0.3

Description Bimodal Gumbel distribution. General functions for performing extreme value analysis.

Imports MCMCpack, MASS, quantreg, SparseM, coda, stats

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dbgumbel	<i>Bimodal Gumbel: Density Function</i>
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Description

Bimodal Gumbel: Density Function

Usage

dbgumbel(x, mu, sigma, delta)

Arguments

- x Domain.
- mu First location parameter.
- sigma Scale parameter.
- delta Second location parameter.

Value

Vector.

Examples

```
dbgumbel(x = 0, mu = -2, sigma = 1, delta = -1)
curve(dbgumbel(x, mu = -2, sigma = 1, delta = -1), xlim = c(-5, 10), ylim= c(0, .4))
integrate(dbgumbel, mu = -2, sigma = 1, delta = -1, lower = -5, upper = 0)
```

m1bgumbel

*Bimodal Gumbel: Theoretical E(X)***Description**

Bimodal Gumbel: Theoretical E(X)

Usage

m1bgumbel(mu, sigma, delta)

Arguments

mu	First location parameter.
sigma	Scale parameter.
delta	Second location parameter.

Value

Vector.

Examples

```
(EX <- m1bgumbel(mu = -2, sigma = 1, delta = -1))

# Comparison: Theoretical E(X) and empirical mean

x <- rbgumbel(100000, mu = -2, sigma = 1, delta = -1)
mean(x)
abs(EX - mean(x))/abs(EX) # relative error

# grid 1

mu <- seq(-5, 5, length.out = 100)
delta <- seq(-5, 5, length.out = 100)
z <- outer(
  X = mu,
  Y = delta,
  FUN = function(x, y) m1bgumbel(mu = x, sigma = 1, delta = y)
)

persp(x = mu, y = delta, z = z, theta = -60, ticktype = 'detailed')

# grid 2

mu <- seq(-5, 5, length.out = 100)
delta <- seq(-5, 5, length.out = 100)
sigmas <- seq(.1, 10, length.out = 20)
```

```

for (sigma in sigmas) {
  z <- outer(
    X <- mu,
    Y <- delta,
    FUN = function(x, y) m1bgumbel(mu = x, sigma = sigma, delta = y)
  )
  persp(x = mu, y = delta, z = z, theta = -60, zlab = 'E(X)')
  Sys.sleep(.5)
}

```

m2bgumbel

Bimodal Gumbel: Theoretical $E(X^2)$

Description

Bimodal Gumbel: Theoretical $E(X^2)$

Usage

```
m2bgumbel(mu, sigma, delta)
```

Arguments

mu	First location parameter.
sigma	Scale parameter.
delta	Second location parameter.

Value

Vector.

Examples

```

(EX2 <- m2bgumbel(mu = -2, sigma = 1, delta = -1))

# Comparison: Theoretical  $E(X^2)$  and empirical second moment

x <- rbgumbel(100000, mu = -2, sigma = 1, delta = -1)
mean(x^2)
abs(EX2 - mean(x))/abs(EX2) # relative error

# Variance
EX <- m1bgumbel(mu = -2, sigma = 1, delta = -1)
EX2 - EX^2
var(x)
abs(EX2 - EX^2 - var(x))/abs(EX2 - EX^2) # relative error

```

```

# grid 1

mu <- seq(-5, 5, length.out = 100)
delta <- seq(-5, 5, length.out = 100)
z <- outer(
  X <- mu,
  Y <- delta,
  FUN = function(x, y) m2bgumbel(mu = x, sigma = 1, delta = y)
)
persp(x = mu, y = delta, z = z, theta = -30, ticktype = 'detailed')

# grid 2

mu <- seq(-5, 5, length.out = 100)
delta <- seq(-5, 5, length.out = 100)
sigmas <- seq(.1, 10, length.out = 20)
for (sigma in sigmas) {
  z <- outer(
    X <- mu,
    Y <- delta,
    FUN = function(x, y) m2bgumbel(mu = x, sigma = sigma, delta = y)
  )
  persp(x = mu, y = delta, z = z, theta = -45, zlab = 'E(X^2)')
  Sys.sleep(.5)
}

```

mlebgumbel

*Bimodal Gumbel: Maximum Likelihood Estimation***Description**

Bimodal Gumbel: Maximum Likelihood Estimation

Usage

mlebgumbel(data, theta, auto = TRUE)

Arguments

data	A numeric vector.
theta	Vector. Starting parameter values for the minimization. Default: theta = c(1, 1, 1)
auto	Logical. Automatic search for theta initial condition. Default: TRUE

Value

List.

Examples

```
# Let's generate some values

set.seed(123)
x <- rbgumbel(1000, mu = -2, sigma = 1, delta = -1)

# Look for these references in the figure:

hist(x, probability = TRUE)
lines(density(x), col = 'blue')
abline(v = c(-2.5, -.5), col = 'red')
text(x = c(c(-2.5, -.5)), y = c(.05, .05), c('mu\nnear here', 'delta\nnear here'))

# Time to fit!

# If argument auto = FALSE
fit <- mlebgumbel(
  data = x,
  # try some values near the region. Format: theta = c(mu, sigma, delta)
  theta = c(-3, 2, -2),
  auto = FALSE
)
print(fit)

# If argument auto = TRUE
fit <- mlebgumbel(
  data = x,
  auto = TRUE
)
print(fit)

# Kolmogorov-Smirnov Tests

mu.sigma.delta <- fit$estimate$estimate
ks.test(
  x,
  y = 'pbgumbel',
  mu = mu.sigma.delta[[1]],
  sigma = mu.sigma.delta[[2]],
  delta = mu.sigma.delta[[3]]
)
```

pbgumbel

Bimodal Gumbel: Distribution Function

Description

Bimodal Gumbel: Distribution Function

Usage

```
pbgumbel(q, mu, sigma, delta, lower.tail = TRUE)
```

Arguments

q	Quantile.
mu	First location parameter.
sigma	Scale parameter.
delta	Second location parameter.
lower.tail	Logical; if TRUE (default), probabilities are $P(X \leq x)$ otherwise, $P(X > x)$.

Value

Vector.

Examples

```
pbgumbel(0, mu = -2, sigma = 1, delta = -1)
integrate(dbgumbel, mu = -2, sigma = 1, delta = -1, lower = -Inf, upper = 0)
pbgumbel(0, mu = -2, sigma = 1, delta = -1, lower.tail = FALSE)
curve(pbgumbel(x, mu = -2, sigma = 1, delta = -1), xlim = c(-5, 10))
```

qbgumbel

Bimodal Gumbel: Quantile Function

Description

Bimodal Gumbel: Quantile Function

Usage

```
qbgumbel(p, mu, sigma, delta, initial = -10, final = 10)
```

Arguments

p	Probability.
mu	First location parameter.
sigma	Scale parameter.
delta	Second location parameter.
initial	Starting point of range in desired quantile.
final	Starting point of range in desired quantile.

Value

Vector.

Examples

```
# It is recommended to set up a pbgumbel
# graph to see the starting and ending
# range of the desired quantile.
curve(pbgumbel(x, mu = -2, sigma = 1, delta = -1), xlim = c(-5, 5))
(value <- qbgumbel(.25, mu = -2, sigma = 1, delta = -1, initial = -4, final = -2))
pbgumbel(value, mu = -2, sigma = 1, delta = -1)
```

rbgumbel

Bimodal Gumbel: Pseudo-Random Numbers Generator

Description

Bimodal Gumbel: Pseudo-Random Numbers Generator

Usage

```
rbgumbel(n, mu, sigma, delta)
```

Arguments

n	Number of observations. If length(n) > 1, the length is taken to be the number required.
mu	First location parameter.
sigma	Scale parameter.
delta	Second location parameter.

Value

A matrix nx1.

Examples

```
x <- rbgumbel(40000, mu = -2, sigma = 1, delta = -1)
hist(x, probability = TRUE)
curve(dbgumbel(x, mu = -2, sigma = 1, delta = -1), add = TRUE, col = 'blue')
lines(density(x), col = 'red')
```

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