# Package 'shannon'

August 26, 2024
Type Package
Title Computation of Entropy Measures and Relative Loss
Version 0.2.0
Author Muhammad Imran [aut, cre], Christophe Chesneau [aut], Farrukh Jamal [aut]
Maintainer Muhammad Imran <imranshakoor84@yahoo.com></imranshakoor84@yahoo.com>
<b>Depends</b> R (>= $4.0$ )
Imports stats, VaRES, extraDistr
Suggests ggplot2
<b>Description</b> The functions allow for the numerical evaluation of some commonly used entropy measures, such as Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, at selected parametric values from several well-known and widely used probability distributions. Moreover, the functions also compute the relative loss of these entropies using the truncated distributions. Related works include: Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148. <a href="https://doi.org/10.1093/imamci/4.2.143">doi:10.1093/imamci/4.2.143</a> .
License GPL-2
Encoding UTF-8
RoxygenNote 7.2.3
NeedsCompilation no
Repository CRAN
<b>Date/Publication</b> 2024-08-26 16:00:02 UTC
Contents
shannon-package Beta distribution

2 Contents

Chi-squared distribution
Exponential distribution
Exponential extension distribution
Exponentiated exponential distribution
Exponentiated Weibull distribution
F distribution
Frechet distribution
Gamma distribution
Gompertz distribution
Gumbel distribution
Inverse-gamma distribution
Kumaraswamy distribution
Kumaraswamy exponential distribution
Kumaraswamy normal distribution
Laplace distribution
Log-normal distribution
Logistic distribution
Lomax distribution
Nakagami distribution
Normal distribution
Rayleigh distribution
Student's t distribution
Truncated beta distribution
Truncated Birnbaum-Saunders distribution
Truncated Chi-squared distribution
Truncated exponential distribution
Truncated exponential extension distribution
Truncated F distribution
Truncated gamma distribution
Truncated Gompertz distribution
Truncated Gumbel distribution
Truncated inverse-gamma distribution
Truncated Kumaraswamy distribution
Truncated Laplace distribution
Truncated Nakagami distribution
Truncated normal distribution
Truncated Rayleigh distribution
Truncated Student's t distribution
Truncated Weibull distribution
Weibull distribution
62

Index

shannon-package 3

shannon-package

Computation of Entropy Measures and Relative Loss

#### Description

The functions allow for the numerical evaluation of some commonly used entropy measures, such as Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, at selected parametric values from several well-known and widely used probability distributions. Moreover, the functions also compute the relative loss of these entropies using the truncated distributions. Let X be an absolutely continuous random variable having the probability density function f(x). Then, the Shahnon entropy is as follows:

$$H(X) = -\int_{-\infty}^{+\infty} f(x) \log f(x) dx.$$

The Rényi entropy is as follows:

$$H_{\delta}(X) = \frac{1}{1-\delta} \log \int_{-\infty}^{+\infty} f(x)^{\delta} dx; \qquad \delta > 0, \delta \neq 1.$$

The Havrda and Charvat entropy is as follows:

$$H_{\delta}(X) = \frac{1}{2^{1-\delta} - 1} \left( \int_{-\infty}^{+\infty} f(x)^{\delta} dx - 1 \right); \qquad \delta > 0, \delta \neq 1.$$

The Arimoto entropy is as follows:

$$H_{\delta}(X) = \frac{\delta}{1 - \delta} \left[ \left( \int_{-\infty}^{+\infty} f(x)^{\delta} dx \right)^{\frac{1}{\delta}} - 1 \right]; \quad \delta > 0, \delta \neq 1.$$

Let D(X) be an entropy, and  $D_p(X)$  be its truncated integral version at p, i.e., defined with the truncated version of f(x) over the interval  $(-\infty, p)$ . Then we define the corresponding relative loss entropy is defined by

$$S_D(p) = \frac{D(X) - D_p(X)}{D(X)}.$$

**Details** 

Package: shannon Type: Package Version: 0.2.0 4 Beta distribution

Date: 2024-08-21 License: GPL-2

## **Maintainers**

Muhammad Imran <imranshakoor84@yahoo.com>

#### Author(s)

Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Shannon, C. E. (1948). A mathematical theory of communication. The Bell system technical journal, 27(3), 379-423.

Rényi, A. (1961). On measures of entropy and information, Hungarian Academy of Sciences, Budapest, Hungary, 547-561.

Havrda, J., & Charvat, F. (1967). Quantification method of classification processes. Concept of structural  $\alpha$ -entropy. Kybernetika, 3(1), 30-35.

Arimoto, S. (1971). Information-theoretical considerations on estimation problems. Information and control, 19(3), 181-194.

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Beta distribution Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the beta distribution

# **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the beta distribution.

# Usage

```
Se_beta(alpha, beta)
re_beta(alpha, beta, delta)
hce_beta(alpha, beta, delta)
ae_beta(alpha, beta, delta)
```

Beta distribution 5

#### **Arguments**

alpha	The strictly positive shape parameter of the beta distribution ( $\alpha > 0$ ).
beta	The strictly positive shape parameter of the beta distribution ( $\beta>0$ ).
delta	The strictly positive parameter ( $\delta > 0$ ) and ( $\delta \neq 1$ ).

#### **Details**

The following is the probability density function of the beta distribution:

$$f(x) = \frac{\Gamma(\alpha + \beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha - 1} (1 - x)^{\beta - 1},$$

where  $0 \le x \le 1$ ,  $\alpha > 0$  and  $\beta > 0$ , and  $\Gamma(a)$  denotes the standard gamma function.

#### Value

The functions Se\_beta, re\_beta, hce\_beta, and ae\_beta provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the beta distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Gupta, A. K., & Nadarajah, S. (2004). Handbook of beta distribution and its applications. CRC Press

Johnson, N. L., Kotz, S., & Balakrishnan, N. (1994). Beta distributions. Continuous univariate distributions. 2nd ed. New York, NY: John Wiley and Sons, 221-235.

#### See Also

```
se_kum, re_kum, hce_kum, ae_kum
```

```
# Computation of the Shannon entropy
Se_beta(2, 4)
delta <- c(1.2, 3)
# Computation of the Rényi entropy
re_beta(2, 4, delta)
# Computation of the Havrda and Charvat entropy
hce_beta(2, 4, delta)
# Computation of the Arimoto entropy
ae_beta(2, 4, delta)
# A graphic presentation of the Havrda and Charvat entropy (HCE)</pre>
```

```
library(ggplot2)
delta <- c(0.2, 0.3, 0.5, 0.8, 1.2, 1.5, 2.5, 3, 3.5)
hce_beta(2, 1.2, delta)
z <- hce_beta(2, 1.2, delta)
dat <- data.frame(x = delta , HCE = z)
p_hce <- ggplot(dat, aes(x = delta, y = HCE)) + geom_line()
plot <- p_hce + ggtitle(expression(alpha == 2~~beta == 1.2))</pre>
```

Beta exponential distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the beta exponential distribution

# Description

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the beta exponential distribution.

#### Usage

```
se_bexp(lambda, alpha, beta)
re_bexp(lambda, alpha, beta, delta)
hce_bexp(lambda, alpha, beta, delta)
ae_bexp(lambda, alpha, beta, delta)
```

## **Arguments**

lambda	The strictly positive scale parameter of the exponential distribution ( $\lambda > 0$ ).
alpha	The strictly positive shape parameter of the beta distribution ( $\alpha>0$ ).
beta	The strictly positive shape parameter of the beta distribution ( $\beta > 0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

#### **Details**

The following is the probability density function of the beta exponential distribution:

$$f(x) = \frac{\lambda e^{-\beta \lambda x}}{B(\alpha, \beta)} (1 - e^{-\lambda x})^{\alpha - 1},$$

where x > 0,  $\alpha > 0$ ,  $\beta > 0$  and  $\lambda > 0$ , and B(a, b) denotes the standard beta function.

# Value

The functions se\_bexp, re\_bexp, hce\_bexp, and ae\_bexp provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the beta exponential distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Nadarajah, S., & Kotz, S. (2006). The beta exponential distribution. Reliability Engineering & System Safety, 91(6), 689-697.

#### See Also

```
re_beta, re_exp
```

## **Examples**

```
# Computation of the Shannon entropy
se_bexp(1.2, 0.2, 1.5)
delta <- c(0.2, 0.3, 0.5)
# Computation of the Rényi entropy
re_bexp(1.2, 0.2, 0.5, delta)
# Computation of the Havrda and Charvat entropy
hce_bexp(1.2, 0.2, 1.5, delta)
# Computation of the Arimoto entropy
ae_bexp(1.2, 0.2, 1.5, delta)</pre>
```

Birnbaum-Saunders distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Birnbaum-Saunders distribution

# Description

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Birnbaum-Saunders distribution.

## Usage

```
se_bs(v)
re_bs(v, delta)
hce_bs(v, delta)
ae_bs(v, delta)
```

#### **Arguments**

v The strictly positive scale parameter of the Birnbaum-Saunders distribution (v>0). delta The strictly positive parameter ( $\delta>0$ ) and ( $\delta\neq 1$ ).

## **Details**

The following is the probability density function of the Birnbaum-Saunders distribution:

$$f(x) = \frac{x^{0.5} + x^{-0.5}}{2vx} \phi\left(\frac{x^{0.5} - x^{-0.5}}{v}\right),$$

where x>0 and v>0, and  $\phi(x)$  is the probability density function of the standard normal distribution.

#### Value

The functions se\_bs, re\_bs, hce\_bs, and ae\_bs provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Birnbaum-Saunders distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Chan, S., Nadarajah, S., & Afuecheta, E. (2016). An R package for value at risk and expected shortfall. Communications in Statistics Simulation and Computation, 45(9), 3416-3434.

Arimoto, S. (1971). Information-theoretical considerations on estimation problems. Inf. Control, 19, 181–194.

## See Also

```
re_exp, re_chi
```

```
se_bs(0.2)
delta <- c(1.5, 2, 3)
re_bs(0.2, delta)
hce_bs(0.2, delta)
ae_bs(0.2, delta)</pre>
```

Burr XII distribution 9

Burr XII distribution Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Burr XII distribution

# **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Burr XII distribution.

# Usage

```
se_burr(k, c)
re_burr(k, c, delta)
hce_burr(k, c, delta)
ae_burr(k, c, delta)
```

#### **Arguments**

k The strictly positive shape parameter of the Burr XII distribution (k>0).

c The strictly positive shape parameter of the Burr XII distribution (c>0).

delta The strictly positive parameter  $(\delta>0)$  and  $(\delta\neq 1)$ .

#### **Details**

The following is the probability density function of the Burr XII distribution:

$$f(x) = kcx^{c-1} (1 + x^c)^{-k-1},$$

where x > 0, c > 0 and k > 0.

## Value

The functions se\_burr, re\_burr, hce\_burr, and ae\_burr provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Burr XII distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Rodriguez, R. N. (1977). A guide to the Burr type XII distributions. Biometrika, 64(1), 129-134. Zimmer, W. J., Keats, J. B., & Wang, F. K. (1998). The Burr XII distribution in reliability analysis. Journal of Quality Technology, 30(4), 386-394.

## See Also

```
re_gamma, re_wei
```

## **Examples**

```
se_burr(0.2, 1.4)
delta <- c(2, 3)
re_burr(1.2, 1.4, delta)
hce_burr(1.2, 1.4, delta)
ae_burr(1.2, 1.4, delta)</pre>
```

Chi-squared distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Chi-squared distribution

# Description

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the chi-squared distribution.

# Usage

```
se_chi(n)
re_chi(n, delta)
hce_chi(n, delta)
ae_chi(n, delta)
```

## **Arguments**

The degree of freedom and the positive parameter of the Chi-squared distribution (n > 0).

# **Details**

The following is the probability density function of the (non-central) Chi-squared distribution:

$$f(x) = \frac{1}{2^{\frac{n}{2}}\Gamma(\frac{n}{2})} x^{\frac{n}{2}-1} e^{-\frac{x}{2}},$$

where x>0 and n>0, and  $\Gamma(a)$  denotes the standard gamma function.

## Value

The functions se\_chi, re\_chi, hce\_chi, and ae\_chi provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Chi-squared distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Johnson, N. L., Kotz, S., & Balakrishnan, N. (1995). Continuous univariate distributions, volume 2 (Vol. 289). John Wiley & Sons.

# See Also

```
re_exp, re_gamma, re_bs
```

# **Examples**

```
se_chi(1.2)
delta <- c(0.2, 0.3)
re_chi(1.2, delta)
hce_chi(1.2, delta)
ae_chi(1.2, delta)</pre>
```

Exponential distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the exponential distribution

# Description

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the exponential distribution.

## Usage

```
Se_exp(alpha)
re_exp(alpha, delta)
hce_exp(alpha, delta)
ae_exp(alpha, delta)
```

## **Arguments**

alpha The strictly positive scale parameter of the exponential distribution ( $\alpha>0$ ). delta The strictly positive parameter ( $\delta>0$ ) and ( $\delta\neq1$ ).

## **Details**

The following is the probability density function of the exponential distribution:

$$f(x) = \alpha e^{-\alpha x},$$

where x > 0 and  $\alpha > 0$ .

## Value

The functions Se\_exp, re\_exp, hce\_exp, and ae\_exp provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the exponential distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Balakrishnan, K. (2019). Exponential distribution: theory, methods and applications. Routledge.

Singh, A. K. (1997). The exponential distribution-theory, methods and applications, Technometrics, 39(3), 341-341.

Arimoto, S. (1971). Information-theoretical considerations on estimation problems. Inf. Control, 19, 181–194.

## See Also

```
re_chi, re_gamma, re_wei
```

```
Se_exp(0.2)
delta <- c(1.5, 2, 3)
re_exp(0.2, delta)
hce_exp(0.2, delta)
ae_exp(0.2, delta)</pre>
```

Exponential extension distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the exponential extension distribution

# **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the exponential extension distribution.

## Usage

```
se_nh(alpha, beta)
re_nh(alpha, beta, delta)
hce_nh(alpha, beta, delta)
ae_nh(alpha, beta, delta)
```

# Arguments

alpha The strictly positive parameter of the exponential extension distribution ( $\alpha>0$ ). The strictly positive parameter of the exponential extension distribution ( $\beta>0$ ). delta The strictly positive parameter ( $\delta>0$ ) and ( $\delta\neq1$ ).

## **Details**

The following is the probability density function of the exponential extension distribution:

$$f(x) = \alpha \beta (1 + \alpha x)^{\beta - 1} e^{1 - (1 + \alpha x)^{\beta}},$$

where x > 0,  $\alpha > 0$  and  $\beta > 0$ .

## Value

The functions se\_nh, re\_nh, hce\_nh, and ae\_nh provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the exponential extension distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Nadarajah, S., & Haghighi, F. (2011). An extension of the exponential distribution. Statistics, 45(6), 543-558.

## See Also

```
re_exp, re_gamma, re_ee, re_wei
```

# **Examples**

```
se_nh(1.2, 0.2)
delta <- c(1.5, 2, 3)
re_nh(1.2, 0.2, delta)
hce_nh(1.2, 0.2, delta)
ae_nh(1.2, 0.2, delta)</pre>
```

Exponentiated exponential distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the exponentiated exponential distribution

# Description

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the exponentiated exponential distribution.

# Usage

```
se_ee(alpha, beta)
re_ee(alpha, beta, delta)
hce_ee(alpha, beta, delta)
ae_ee(alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive scale parameter of the exponentiated exponential distribution ( $\alpha > 0$ ).
beta	The strictly positive shape parameter of the exponentiated exponential distribution ( $\beta>0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

#### **Details**

The following is the probability density function of the exponentiated exponential distribution:

$$f(x)=\alpha\beta e^{-\alpha x}\left(1-e^{-\alpha x}\right)^{\beta-1},$$
 where  $x>0,$   $\alpha>0$  and  $\beta>0.$ 

## Value

The functions se\_ee, re\_ee, hce\_ee, and ae\_ee provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the exponentialed exponential distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Nadarajah, S. (2011). The exponentiated exponential distribution: a survey. AStA Advances in Statistical Analysis, 95, 219-251.

Gupta, R. D., & Kundu, D. (2007). Generalized exponential distribution: Existing results and some recent developments. Journal of Statistical Planning and Inference, 137(11), 3537-3547.

#### See Also

```
re_exp, re_wei, re_nh
```

# **Examples**

```
se_ee(0.2, 1.4)
delta <- c(1.5, 2, 3)
re_ee(0.2, 1.4, delta)
hce_ee(0.2, 1.4, delta)
ae_ee(0.2, 1.4, delta)</pre>
```

Exponentiated Weibull distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the exponentiated Weibull distribution

## **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the exponentiated Weibull distribution.

#### Usage

```
se_ew(a, beta, zeta)
re_ew(a, beta, zeta, delta)
hce_ew(a, beta, zeta, delta)
ae_ew(a, beta, zeta, delta)
```

#### **Arguments**

a	The strictly positive shape parameter of the exponentiated Weibull distribution $(a > 0)$ .
beta	The strictly positive scale parameter of the baseline Weibull distribution ( $\beta>0$ ).
zeta	The strictly positive shape parameter of the baseline Weibull distribution ( $\zeta>0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

#### **Details**

The following is the probability density function of the exponentiated Weibull distribution:

$$f(x) = a\zeta\beta^{-\zeta}x^{\zeta-1}e^{-\left(\frac{x}{\beta}\right)^{\zeta}}\left[1 - e^{-\left(\frac{x}{\beta}\right)^{\zeta}}\right]^{a-1},$$

where x > 0, a > 0,  $\beta > 0$  and  $\zeta > 0$ .

## Value

The functions se\_ew, re\_ew, hce\_ew, and ae\_ew provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the exponentiated Weibull distribution and  $\delta$ .

# Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Nadarajah, S., Cordeiro, G. M., & Ortega, E. M. (2013). The exponentiated Weibull distribution: a survey. Statistical Papers, 54, 839-877.

# See Also

```
re_exp, re_wei, re_ew
```

```
se_ew(0.8, 0.2, 0.8)
delta <- c(1.5, 2, 3)
re_ew(1.2, 1.2, 1.4, delta)
hce_ew(1.2, 1.2, 1.4, delta)
ae_ew(1.2, 1.2, 1.4, delta)</pre>
```

F distribution 17

E distribution	Comments the Chamman Démit Hamman and Chammat and Assessed and
F distribution	Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto en-
	tropies of the F distribution

## **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the F distribution.

## Usage

```
se_f(alpha, beta)
re_f(alpha, beta, delta)
hce_f(alpha, beta, delta)
ae_f(alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive parameter (first degree of freedom) of the F distribution ( $\alpha>0$ ).
beta	The strictly positive parameter (second degree of freedom) of the F distribution ( $\beta>0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

#### **Details**

The following is the probability density function of the F distribution:

$$f(x) = \frac{1}{B(\frac{\alpha}{2}, \frac{\beta}{2})} \left(\frac{\alpha}{\beta}\right)^{\frac{\alpha}{2}} x^{\frac{\alpha}{2} - 1} \left(1 + \frac{\alpha}{\beta}x\right)^{-\left(\frac{\alpha + \beta}{2}\right)},$$

where x > 0,  $\alpha > 0$  and  $\beta > 0$ , and B(a, b) is the standard beta function.

# Value

The functions se\_f, re\_f, hce\_f, and ae\_f provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the F distribution and  $\delta$ .

# Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Johnson, N. L., Kotz, S., & Balakrishnan, N. (1995). Continuous univariate distributions, volume 2 (Vol. 289). John Wiley & Sons.

Frechet distribution

## See Also

```
re_exp, re_gamma
```

## **Examples**

```
se_f(1.2, 1.4)
delta <- c(2.2, 2.3)
re_f(1.2, 0.4, delta)
hce_f(1.2, 1.4, delta)
ae_f(1.2, 1.4, delta)</pre>
```

Frechet distribution Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Fréchet distribution

## **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Fréchet distribu-

# Usage

```
se_fre(alpha, beta, zeta)
re_fre(alpha, beta, zeta, delta)
hce_fre(alpha, beta, zeta, delta)
ae_fre(alpha, beta, zeta, delta)
```

## **Arguments**

alpha	The parameter of the Fréchet distribution ( $\alpha > 0$ ).
beta	The parameter of the Fréchet distribution ( $\beta \in (-\infty, +\infty)$ ).
zeta	The parameter of the Fréchet distribution ( $\zeta > 0$ ).
delta	The strictly positive parameter ( $\delta > 0$ ) and ( $\delta \neq 1$ ).

## **Details**

The following is the probability density function of the Fréchet distribution:

$$f(x) = \frac{\alpha}{\zeta} \left( \frac{x - \beta}{\zeta} \right)^{-1 - \alpha} e^{-\left(\frac{x - \beta}{\zeta}\right)^{-\alpha}},$$

where  $x > \beta$ ,  $\alpha > 0$ ,  $\zeta > 0$  and  $\beta \in (-\infty, +\infty)$ . The Fréchet distribution is also known as inverse Weibull distribution and special case of the generalized extreme value distribution.

Gamma distribution 19

## Value

The functions se\_fre, re\_fre, hce\_fre, and ae\_fre provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Fréchet distribution distribution and  $\delta$ .

# Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Abbas, K., & Tang, Y. (2015). Analysis of Fréchet distribution using reference priors. Communications in Statistics-Theory and Methods, 44(14), 2945-2956.

## See Also

```
re_exp, re_gum
```

# **Examples**

```
se_fre(0.2, 1.4, 1.2)
delta <- c(2, 3)
re_fre(1.2, 0.4, 1.2, delta)
hce_fre(1.2, 0.4, 1.2, delta)
ae_fre(1.2, 0.4, 1.2, delta)</pre>
```

Gamma distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the gamma distribution

## Description

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the gamma distribution.

# Usage

```
Se_gamma(alpha, beta)
re_gamma(alpha, beta, delta)
hce_gamma(alpha, beta, delta)
ae_gamma(alpha, beta, delta)
```

20 Gamma distribution

# Arguments

alpha	The strictly positive shape parameter of the gamma distribution ( $\alpha > 0$ ).
beta	The strictly positive scale parameter of the gamma distribution ( $\beta>0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

## **Details**

The following is the probability density function of the gamma distribution:

$$f(x) = \frac{\beta^{\alpha}}{\Gamma(\alpha)} x^{\alpha - 1} e^{-\beta x},$$

where x > 0,  $\alpha > 0$  and  $\beta > 0$ , and  $\Gamma(a)$  is the standard gamma function.

#### Value

The functions Se\_gamma, re\_gamma, hce\_gamma, and ae\_gamma provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the gamma distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Burgin, T. A. (1975). The gamma distribution and inventory control. Journal of the Operational Research Society, 26(3), 507-525.

#### See Also

```
re_exp, re_wei
```

```
Se_gamma(1.2, 1.4)
delta <- c(1.5, 2, 3)
re_gamma(1.2, 1.4, delta)
hce_gamma(1.2, 1.4, delta)
ae_gamma(1.2, 1.4, delta)</pre>
```

Gompertz distribution 21

Gompertz distribution Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Gompertz distribution

#### **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Gompertz distribution.

## Usage

```
se_gomp(alpha, beta)
re_gomp(alpha, beta, delta)
hce_gomp(alpha, beta, delta)
ae_gomp(alpha, beta, delta)
```

## **Arguments**

alpha The strictly positive parameter of the Gompertz distribution  $(\alpha>0)$ . beta The strictly positive parameter of the Gompertz distribution  $(\beta>0)$ . delta The strictly positive parameter  $(\delta>0)$  and  $(\delta\neq1)$ .

#### **Details**

The following is the probability density function of the Gompertz distribution:

$$f(x) = \alpha e^{\beta x - \frac{\alpha}{\beta} \left(e^{\beta x} - 1\right)},$$

where x > 0,  $\alpha > 0$  and  $\beta > 0$ .

## Value

The functions se\_gomp, re\_gomp, hce\_gomp, and ae\_gomp provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Gompertz distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Soliman, A. A., Abd-Ellah, A. H., Abou-Elheggag, N. A., & Abd-Elmougod, G. A. (2012). Estimation of the parameters of life for Gompertz distribution using progressive first-failure censored data. Computational Statistics & Data Analysis, 56(8), 2471-2485.

22 Gumbel distribution

#### See Also

```
re_exp, re_gamma, re_ray
```

## **Examples**

```
se_gomp(2.4,0.2)
delta <- c(2, 3)
re_gomp(2.4,0.2, delta)
hce_gomp(2.4,0.2, delta)
ae_gomp(2.4,0.2, delta)</pre>
```

Gumbel distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Gumbel distribution

## **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Gumbel distribution.

# Usage

```
Se_gum(alpha, beta)
re_gum(alpha, beta, delta)
hce_gum(alpha, beta, delta)
ae_gum(alpha, beta, delta)
```

## **Arguments**

alpha The location parameter of the Gumbel distribution  $(\alpha \in (-\infty, +\infty))$ . beta The strictly positive scale parameter of the Gumbel distribution  $(\beta > 0)$ . delta The strictly positive parameter  $(\delta > 0)$  and  $(\delta \neq 1)$ .

#### **Details**

The following is the probability density function of the Gumbel distribution:

$$f(x) = \frac{1}{\beta}e^{-(z+e^{-z})},$$

where 
$$z=\frac{x-\alpha}{\beta}, x\in (-\infty,+\infty), \alpha\in (-\infty,+\infty)$$
 and  $\beta>0.$ 

## Value

The functions Se\_gum, re\_gum, hce\_gum, and ae\_gum provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Gumbel distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Gomez, Y. M., Bolfarine, H., & Gomez, H. W. (2019). Gumbel distribution with heavy tails and applications to environmental data. Mathematics and Computers in Simulation, 157, 115-129.

#### See Also

```
re_norm
```

# **Examples**

```
Se_gum(1.2, 1.4)
delta <- c(2, 3)
re_gum(1.2, 0.4, delta)
hce_gum(1.2, 0.4, delta)
ae_gum(1.2, 0.4, delta)</pre>
```

Inverse-gamma distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the inverse-gamma distribution

# **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the inverse-gamma distribution.

# Usage

```
se_ig(alpha, beta)
re_ig(alpha, beta, delta)
hce_ig(alpha, beta, delta)
ae_ig(alpha, beta, delta)
```

# Arguments

alpha	The strictly positive shape parameter of the inverse-gamma distribution ( $\alpha>0$ ).
beta	The strictly positive scale parameter of the inverse-gamma distribution ( $\beta>0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

## **Details**

The following is the probability density function of the inverse-gamma distribution:

$$f(x) = \frac{\beta^{\alpha}}{\Gamma(\alpha)} x^{-\alpha - 1} e^{-\frac{\beta}{x}},$$

where x > 0,  $\alpha > 0$  and  $\beta > 0$ , and  $\Gamma(a)$  is the standard gamma function.

#### Value

The functions se\_ig, re\_ig, hce\_ig, and ae\_ig provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the inverse-gamma distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Rivera, P. A., Calderín-Ojeda, E., Gallardo, D. I., & Gómez, H. W. (2021). A compound class of the inverse Gamma and power series distributions. Symmetry, 13(8), 1328.

Glen, A. G. (2017). On the inverse gamma as a survival distribution. Computational Probability Applications, 15-30.

# See Also

```
re_exp, re_gamma
```

# **Examples**

```
se_ig(1.2, 0.2)
delta <- c(1.5, 2, 3)
re_ig(1.2, 0.2, delta)
hce_ig(1.2, 0.2, delta)
ae_ig(1.2, 0.2, delta)</pre>
```

Kumaraswamy distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Kumaraswamy distribution

#### **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Kumaraswamy distribution.

## Usage

```
se_kum(alpha, beta)
re_kum(alpha, beta, delta)
hce_kum(alpha, beta, delta)
ae_kum(alpha, beta, delta)
```

#### **Arguments**

alpha	The strictly positive shape parameter of the Kumaraswamy distribution ( $\alpha > 0$ ).
beta	The strictly positive shape parameter of the Kumaraswamy distribution ( $\beta > 0$ ).
delta	The strictly positive scale parameter ( $\delta > 0$ ).

#### **Details**

The following is the probability density function of the Kumaraswamy distribution:

$$f(x)=\alpha\beta x^{\alpha-1}\left(1-x^{\alpha}\right)^{\beta-1},$$
 where  $0\leq x\leq 1,$   $\alpha>0$  and  $\beta>0.$ 

#### Value

The functions se\_kum, re\_kum, hce\_kum, and ae\_kum provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Kumaraswamy distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

El-Sherpieny, E. S. A., & Ahmed, M. A. (2014). On the Kumaraswamy distribution. International Journal of Basic and Applied Sciences, 3(4), 372.

Al-Babtain, A. A., Elbatal, I., Chesneau, C., & Elgarhy, M. (2021). Estimation of different types of entropies for the Kumaraswamy distribution. PLoS One, 16(3), e0249027.

#### See Also

```
re_beta
```

```
se_kum(1.2, 1.4)
delta <- c(1.5, 2, 3)
re_kum(1.2, 1.4, delta)
hce_kum(1.2, 1.4, delta)
ae_kum(1.2, 1.4, delta)</pre>
```

Kumaraswamy exponential distribution

Compute the Rényi, Havrda and Charvat, and Arimoto entropies of the Kumaraswamy exponential distribution

## **Description**

Compute the Rényi, Havrda and Charvat, and Arimoto entropies of the Kumaraswamy exponential distribution.

# Usage

```
re_kexp(lambda, a, b, delta)
hce_kexp(lambda, a, b, delta)
ae_kexp(lambda, a, b, delta)
```

## **Arguments**

а	The strictly positive shape parameter of the Kumaraswamy distribution ( $a > 0$ ).
b	The strictly positive shape parameter of the Kumaraswamy distribution ( $b > 0$ ).
lambda	The strictly positive parameter of the exponential distribution $(\lambda > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

## **Details**

The following is the probability density function of the Kumaraswamy exponential distribution:

$$f(x) = ab\lambda e^{-\lambda x} (1 - e^{-\lambda x})^{a-1} \{1 - (1 - e^{-\lambda x})^a\}^{b-1},$$

where x > 0, a > 0, b > 0 and  $\lambda > 0$ .

#### Value

The functions re\_kexp, hce\_kexp, and ae\_kexp provide the Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Kumaraswamy exponential distribution and  $\delta$ .

# Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Cordeiro, G. M., & de Castro, M. (2011). A new family of generalized distributions. Journal of Statistical Computation and Simulation, 81(7), 883-898.

## See Also

```
re_exp, re_kum
```

## **Examples**

```
delta <- c(1.5, 2, 3)
re_kexp(1.2, 1.2, 1.4, delta)
hce_kexp(1.2, 1.2, 1.4, delta)
ae_kexp(1.2, 1.2, 1.4, delta)</pre>
```

Kumaraswamy normal distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Kumaraswamy normal distribution

## **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Kumaraswamy normal distribution.

# Usage

```
se_kumnorm(mu, sigma, a, b)
re_kumnorm(mu, sigma, a, b, delta)
hce_kumnorm(mu, sigma, a, b, delta)
ae_kumnorm(mu, sigma, a, b, delta)
```

# Arguments

mu	The location parameter of the normal distribution $(\mu \in (-\infty, +\infty))$ .
sigma	The strictly positive scale parameter of the normal distribution ( $\sigma > 0$ ).
а	The strictly positive shape parameter of the Kumaraswamy distribution ( $a>0$ ).
b	The strictly positive shape parameter of the Kumaraswamy distribution ( $b>0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

# **Details**

The following is the probability density function of the Kumaraswamy normal distribution:

$$f(x) = \frac{ab}{\sigma} \phi \left( \frac{x - \mu}{\sigma} \right) \left[ \Phi \left( \frac{x - \mu}{\sigma} \right) \right]^{a - 1} \left[ 1 - \Phi \left( \frac{x - \mu}{\sigma} \right)^a \right]^{b - 1},$$

where  $x \in (-\infty, +\infty)$ ,  $\mu \in (-\infty, +\infty)$ ,  $\sigma > 0$ , a > 0 and b > 0, and the functions  $\phi(t)$  and  $\Phi(t)$ , denote the probability density function and cumulative distribution function of the standard normal distribution, respectively.

28 Laplace distribution

## Value

The functions se\_kumnorm, re\_kumnorm, hce\_kumnorm, and ae\_kumnorm provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Kumaraswamy normal distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Cordeiro, G. M., & de Castro, M. (2011). A new family of generalized distributions. Journal of Statistical Computation and Simulation, 81(7), 883-898.

#### See Also

```
re_norm, re_kum
```

## **Examples**

```
se_kumnorm(0.2, 1.5, 1, 1)
delta <- c(1.5, 2, 3)
re_kumnorm(1.2, 1, 2, 1.5, delta)
hce_kumnorm(1.2, 1, 2, 1.5, delta)
ae_kumnorm(1.2, 1, 2, 1.5, delta)</pre>
```

Laplace distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Laplace or the double exponential distribution distribution

## **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Laplace distribution.

# Usage

```
Se_lap(alpha, beta)
re_lap(alpha, beta, delta)
hce_lap(alpha, beta, delta)
ae_lap(alpha, beta, delta)
```

Laplace distribution 29

# Arguments

alpha	The location parameter of the Laplace distribution $(\alpha \in (-\infty, +\infty))$ .
beta	The strictly positive scale parameter of the Laplace distribution ( $\beta>0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

## **Details**

The following is the probability density function of the Laplace distribution:

$$f(x) = \frac{1}{2\beta} e^{\frac{-|x-\alpha|}{\beta}},$$

where 
$$x \in (-\infty, +\infty)$$
,  $\alpha \in (-\infty, +\infty)$  and  $\beta > 0$ .

## Value

The functions Se\_lap, re\_lap, hce\_lap, and ae\_lap provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Laplace distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Cordeiro, G. M., & Lemonte, A. J. (2011). The beta Laplace distribution. Statistics & Probability Letters, 81(8), 973-982.

#### See Also

```
re_gum, re_norm
```

```
Se_lap(0.2, 1.4)
delta <- c(2, 3)
re_lap(1.2, 0.4, delta)
hce_lap(1.2, 0.4, delta)
ae_lap(1.2, 0.4, delta)</pre>
```

Log-normal distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the log-normal distribution

## **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the log-normal distribution.

# Usage

```
se_lnorm(mu, sigma)
re_lnorm(mu, sigma, delta)
hce_lnorm(mu, sigma, delta)
ae_lnorm(mu, sigma, delta)
```

#### **Arguments**

mu	The location parameter $(\mu \in (-\infty, +\infty))$ .
sigma	The strictly positive scale parameter of the log-normal distribution ( $\sigma > 0$ ).
delta	The strictly positive parameter ( $\delta > 0$ ) and ( $\delta \neq 1$ ).

# **Details**

The following is the probability density function of the log-normal distribution:

$$f(x) = \frac{1}{x\sigma\sqrt{2\pi}}e^{-\frac{(\log(x)-\mu)^2}{2\sigma^2}},$$

where x > 0,  $\mu \in (-\infty, +\infty)$  and  $\sigma > 0$ .

#### Value

The functions se\_lnorm, re\_lnorm, hce\_lnorm, and ae\_lnorm provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the log-normal distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

# References

Johnson, N. L., Kotz, S., & Balakrishnan, N. (1995). Continuous univariate distributions, Volume 1, Chapter 14. Wiley, New York.

Logistic distribution 31

## See Also

```
re_wei, re_norm
```

## **Examples**

```
se_lnorm(0.2, 1.4)
delta <- c(2, 3)
re_lnorm(1.2, 0.4, delta)
hce_lnorm(1.2, 0.4, delta)
ae_lnorm(1.2, 0.4, delta)</pre>
```

Logistic distribution Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the logistic distribution

# **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the logistic distribution.

## Usage

```
se_logis(mu, sigma)
re_logis(mu, sigma, delta)
hce_logis(mu, sigma, delta)
ae_logis(mu, sigma, delta)
```

# Arguments

mu The location parameter of the logistic distribution  $(\mu \in (-\infty, +\infty))$ . sigma The strictly positive scale parameter of the logistic distribution  $(\sigma > 0)$ . delta The strictly positive parameter  $(\delta > 0)$  and  $(\delta \neq 1)$ .

## **Details**

The following is the probability density function of the logistic distribution:

$$f(x) = \frac{e^{-\frac{(x-\mu)}{\sigma}}}{\sigma \left(1 + e^{-\frac{(x-\mu)}{\sigma}}\right)^2},$$

where  $x \in (-\infty, +\infty)$ ,  $\mu \in (-\infty, +\infty)$  and  $\sigma > 0$ .

#### Value

The functions se\_logis, re\_logis, hce\_logis, and ae\_logis provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the logistic distribution and  $\delta$ .

32 Lomax distribution

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Johnson, N. L., Kotz, S., & Balakrishnan, N. (1995). Continuous univariate distributions, Volume 2 (Vol. 289). John Wiley & Sons.

#### See Also

```
re_gum, re_norm
```

# Examples

```
se_logis(0.2, 1.4)
delta <- c(2, 3)
re_logis(1.2, 0.4, delta)
hce_logis(1.2, 0.4, delta)
ae_logis(1.2, 0.4, delta)</pre>
```

Lomax distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Lomax distribution

# Description

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Lomax distribution.

# Usage

```
se_lom(alpha, beta)
re_lom(alpha, beta, delta)
hce_lom(alpha, beta, delta)
ae_lom(alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive shape parameter of the Lomax distribution ( $\alpha > 0$ ).
beta	The strictly positive scale parameter of the Lomax distribution ( $\beta > 0$ ).
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

Nakagami distribution 33

## **Details**

The following is the probability density function of the Lomax distribution:

$$f(x) = \frac{\alpha}{\beta} \left( 1 + \frac{x}{\beta} \right)^{-\alpha - 1},$$

where x > 0,  $\alpha > 0$  and  $\beta > 0$ .

## Value

The functions se\_lom, re\_lom, hce\_lom, and ae\_lom provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Lomax distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Abd-Elfattah, A. M., Alaboud, F. M., & Alharby, A. H. (2007). On sample size estimation for Lomax distribution. Australian Journal of Basic and Applied Sciences, 1(4), 373-378.

## See Also

```
re_exp, re_gamma
```

## **Examples**

```
se_lom(1.2, 0.2)
delta <- c(1.5, 2, 3)
re_lom(1.2, 0.2, delta)
hce_lom(1.2, 0.2, delta)
ae_lom(1.2, 0.2, delta)</pre>
```

Nakagami distribution Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Nakagami distribution

# **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Nakagami distribution.

## Usage

```
se_naka(alpha, beta)
re_naka(alpha, beta, delta)
hce_naka(alpha, beta, delta)
ae_naka(alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive scale parameter of the Nakagami distribution ( $\alpha > 0$ ).
beta	The strictly positive shape parameter of the Nakagami distribution ( $\beta>0$ ).
delta	The strictly positive parameter ( $\delta > 0$ ) and ( $\delta \neq 1$ ).

## **Details**

The following is the probability density function of the Nakagami distribution:

$$f(x) = \frac{2\alpha^{\alpha}}{\Gamma(\alpha)\beta^{\alpha}} x^{2\alpha - 1} e^{-\frac{\alpha x^2}{\beta}},$$

where x > 0,  $\alpha > 0$  and  $\beta > 0$ , and  $\Gamma(a)$  is the standard gamma function.

## Value

The functions se\_naka, re\_naka, hce\_naka, and ae\_naka provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Nakagami distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Schwartz, J., Godwin, R. T., & Giles, D. E. (2013). Improved maximum-likelihood estimation of the shape parameter in the Nakagami distribution. Journal of Statistical Computation and Simulation, 83(3), 434-445.

# See Also

```
re_exp, re_gamma, re_wei
```

```
se_naka(1.2, 0.2)
delta <- c(1.5, 2, 3)
re_naka(1.2, 0.2, delta)
hce_naka(1.2, 0.2, delta)
ae_naka(1.2, 0.2, delta)</pre>
```

Normal distribution 35

Normal distribution Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the normal distribution

#### **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the normal distribution.

# Usage

```
se_norm(alpha, beta)
re_norm(alpha, beta, delta)
hce_norm(alpha, beta, delta)
ae_norm(alpha, beta, delta)
```

# **Arguments**

alpha The location parameter of the normal distribution  $(\alpha \in (-\infty, +\infty))$ . beta The strictly positive scale parameter of the normal distribution  $(\beta > 0)$ . delta The strictly positive parameter  $(\delta > 0)$  and  $(\delta \neq 1)$ .

# **Details**

The following is the probability density function of the normal distribution:

$$f(x) = \frac{1}{\beta\sqrt{2\pi}}e^{-0.5\left(\frac{x-\alpha}{\beta}\right)^2},$$

where  $x \in (-\infty, +\infty)$ ,  $\alpha \in (-\infty, +\infty)$  and  $\beta > 0$ . The parameters  $\alpha$  and  $\beta$  represent the mean and standard deviation, respectively.

#### Value

The functions se\_norm, re\_norm, hce\_norm, and ae\_norm provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Normal distribution and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Patel, J. K., & Read, C. B. (1996). Handbook of the normal distribution (Vol. 150). CRC Press.

Rayleigh distribution

## See Also

```
re_gum
```

# **Examples**

```
se_norm(0.2, 1.4)
delta <- c(1.5, 2, 3)
re_norm(0.2, 1.4, delta)
hce_norm(0.2, 1.4, delta)
ae_norm(0.2, 1.4, delta)</pre>
```

Rayleigh distribution Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Rayleigh distribution

# **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Rayleigh distribution.

## Usage

```
se_ray(alpha)
re_ray(alpha, delta)
hce_ray(alpha, delta)
ae_ray(alpha, delta)
```

# **Arguments**

alpha The strictly positive parameter of the Rayleigh distribution ( $\alpha > 0$ ). delta The strictly positive parameter ( $\delta > 0$ ) and ( $\delta \neq 1$ ).

# Details

The following is the probability density function of the Rayleigh distribution:

$$f(x) = 2\alpha x e^{-\alpha x^2},$$

where x > 0 and  $\alpha > 0$ .

# Value

The functions se\_ray, re\_ray, hce\_ray, and ae\_ray provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Rayleigh distribution and  $\delta$ .

Student's t distribution 37

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Dey, S., Maiti, S. S., & Ahmad, M. (2016). Comparison of different entropy measures. Pak. J. Statist, 32(2), 97-108.

Arimoto, S. (1971). Information-theoretical considerations on estimation problems. Inf. Control, 19, 181–194.

## See Also

```
re_exp, re_gamma, re_wei
```

# **Examples**

```
se_ray(0.2)
delta <- c(1.5, 2, 3)
re_ray(0.2, delta)
hce_ray(0.2, delta)
ae_ray(0.2, delta)
# A graphic representation of the Rényi entropy (RE)
library(ggplot2)
delta <- c(1.5, 2, 3)
z \leftarrow re_ray(0.2, delta)
dat \leftarrow data.frame(x = delta, RE = z)
p_re <- ggplot(dat, aes(x = delta, y = RE)) + geom_line()</pre>
plot <- p_re + ggtitle(expression(alpha == 0.2))</pre>
# A graphic presentation of the Havrda and Charvat entropy (HCE)
delta <- c(1.5, 2, 3)
z \leftarrow hce_ray(0.2, delta)
dat \leftarrow data.frame(x = delta, HCE = z)
p_hce <- ggplot(dat, aes(x = delta, y = HCE)) + geom_line()</pre>
plot <- p_hce + ggtitle(expression(alpha == 0.2))</pre>
```

Student's t distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Student's t distribution

# **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Student's t distribution.

38 Student's t distribution

## Usage

```
se_st(v)
re_st(v, delta)
hce_st(v, delta)
ae_st(v, delta)
```

# **Arguments**

V The strictly positive parameter of the Student's t distribution (v > 0), also called a degree of freedom.

delta The strictly positive parameter  $(\delta > 0)$  and  $(\delta \neq 1)$ .

## **Details**

The following is the probability density function of the Student t distribution:

$$f(x) = \frac{\Gamma(\frac{v+1}{2})}{\sqrt{v\pi}\Gamma(\frac{v}{2})} \left(1 + \frac{x^2}{v}\right)^{-(v+1)/2},$$

where  $x \in (-\infty, +\infty)$  and v > 0, and  $\Gamma(a)$  is the standard gamma function.

#### Value

The functions se\_st, re\_st, hce\_st, and ae\_st provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Student's t distribution and  $\delta$ .

# Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Yang, Z., Fang, K. T., & Kotz, S. (2007). On the Student's t-distribution and the t-statistic. Journal of Multivariate Analysis, 98(6), 1293-1304.

Ahsanullah, M., Kibria, B. G., & Shakil, M. (2014). Normal and Student's t distributions and their applications (Vol. 4). Paris, France: Atlantis Press.

Arimoto, S. (1971). Information-theoretical considerations on estimation problems. Inf. Control, 19, 181–194.

#### See Also

```
re_exp, re_gamma
```

Truncated beta distribution 39

## **Examples**

```
se_st(4)
delta <- c(1.5, 2, 3)
re_st(4, delta)
hce_st(4, delta)
ae_st(4, delta)</pre>
```

Truncated beta distribution

Relative loss for various entropy measures using the truncated beta distribution

## **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated beta distribution.

## Usage

```
rlse_beta(p, alpha, beta)
rlre_beta(p, alpha, beta, delta)
rlhce_beta(p, alpha, beta, delta)
rlae_beta(p, alpha, beta, delta)
```

# **Arguments**

alpha	The strictly positive shape parameter of the beta distribution ( $\alpha > 0$ ).
beta	The strictly positive shape parameter of the beta distribution ( $\beta>0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

#### Value

The functions rlse\_beta, rlre\_beta, rlhce\_beta, and rlae\_beta provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated beta distribution, p and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Gupta, A. K., & Nadarajah, S. (2004). Handbook of beta distribution and its applications. CRC Press.

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

#### See Also

```
re_beta
```

#### **Examples**

```
p <- c(0.25, 0.50, 0.75)
rlse_beta(p, 0.2, 0.4)
rlre_beta(p, 0.2, 0.4, 0.5)
rlhce_beta(p, 0.2, 0.4, 0.5)
rlae_beta(p, 0.2, 0.4, 0.5)</pre>
```

Truncated Birnbaum-Saunders distribution

Relative loss for various entropy measures using the truncated Birnbaum-Saunders distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Birnbaum-Saunders distribution.

## Usage

```
rlse_bs(p, v)
rlre_bs(p, v, delta)
rlhce_bs(p, v, delta)
rlae_bs(p, v, delta)
```

#### **Arguments**

```
v The strictly positive scale parameter of the Birnbaum-Saunders distribution (v>0).  p \qquad \qquad \text{The truncation time } (p>0).   \text{delta} \qquad \qquad \text{The strictly positive parameter } (\delta>0) \text{ and } (\delta\neq 1).
```

#### Value

The functions rlse\_bs, rlre\_bs, rlhce\_bs, and rlae\_bs provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Birnbaum-Saunders distribution, p and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Chan, S., Nadarajah, S., & Afuecheta, E. (2016). An R package for value at risk and expected shortfall. Communications in Statistics Simulation and Computation, 45(9), 3416-3434.

Arimoto, S. (1971). Information-theoretical considerations on estimation problems. Inf. Control, 19, 181–194.

## See Also

```
re_bs
```

# **Examples**

```
p <- c(1, 1.7, 3)
rlse_bs(p, 0.2)
rlre_bs(p, 0.2, 0.5)
rlhce_bs(p, 0.2, 0.5)
rlae_bs(p, 0.2, 0.5)</pre>
```

Truncated Chi-squared distribution

Relative loss for various entropy measures using the truncated Chisquared distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Chi-squared distribution.

# Usage

```
rlse_chi(p, n)
rlre_chi(p, n, delta)
rlhce_chi(p, n, delta)
rlae_chi(p, n, delta)
```

## Arguments

n	The degree of freedom and positive parameter of the Chi-squared distribution
	(n > 0).
p	The truncation time $(p > 0)$ .
delta	The strictly positive parameter ( $\delta > 0$ ) and ( $\delta \neq 1$ ).

#### Value

The functions rlse\_chi, rlre\_chi, rlhce\_chi, and rlae\_chi provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Chi-squared distribution, p and  $\delta$ .

# Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Johnson, N. L., Kotz, S., & Balakrishnan, N. (1995). Continuous univariate distributions, volume 2 (Vol. 289). John Wiley & Sons.

## See Also

```
re_chi
```

## **Examples**

```
p <- c(1, 1.7, 3)
rlse_chi(p, 2)
rlre_chi(p, 2, 0.5)
rlhce_chi(p, 2, 0.5)
rlae_chi(p, 2, 0.5)</pre>
```

Truncated exponential distribution

Relative loss for various entropy measures using the truncated exponential distribution

## **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated exponential distribution.

## Usage

```
rlse_exp(p, alpha)
rlre_exp(p, alpha, delta)
rlhce_exp(p, alpha, delta)
rlae_exp(p, alpha, delta)
```

## **Arguments**

alpha The strictly positive scale parameter of the exponential distribution  $(\alpha>0)$ .  $p \qquad \qquad \text{The truncation time } (p>0).$   $\text{delta} \qquad \qquad \text{The strictly positive parameter } (\delta>0) \text{ and } (\delta\neq1).$ 

## Value

The functions rlse\_exp, rlre\_exp, rlhce\_exp, and rlae\_exp provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated exponential distribution, p and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

## See Also

```
re_exp
```

## **Examples**

```
p <- c(1, 1.7, 3)
rlse_exp(p, 2)
rlre_exp(p, 2, 0.5)
rlhce_exp(p, 2, 0.5)
rlae_exp(p, 2, 0.5)</pre>
```

Truncated exponential extension distribution

Relative loss for various entropy measures using the truncated exponential extension distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated exponential extension distribution.

## Usage

```
rlse_nh(p, alpha, beta)
rlre_nh(p, alpha, beta, delta)
rlhce_nh(p, alpha, beta, delta)
rlae_nh(p, alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive parameter of the exponential extension distribution ( $\alpha > 0$ ).
beta	The strictly positive parameter of the exponential extension distribution ( $\beta>0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

# Value

The functions rlse\_nh, rlre\_nh, rlhce\_nh, and rlae\_nh provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated exponential extension distribution, p and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Nadarajah, S., & Haghighi, F. (2011). An extension of the exponential distribution. Statistics, 45(6), 543-558.

## See Also

re\_nh

Truncated F distribution 45

## **Examples**

```
p <- c(0.25, 0.50, 0.75)
rlse_nh(p, 1.2, 0.2)
rlre_nh(p, 1.2, 0.2, 0.5)
rlhce_nh(p, 1.2, 0.2, 0.5)
rlae_nh(p, 1.2, 0.2, 0.5)</pre>
```

Truncated F distribution

Relative loss for various entropy measures using the truncated F distribution

## **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated F distribution.

## Usage

```
rlse_f(p, alpha, beta)
rlre_f(p, alpha, beta, delta)
rlhce_f(p, alpha, beta, delta)
rlae_f(p, alpha, beta, delta)
```

# **Arguments**

alpha	The strictly positive parameter (first degree of freedom) of the F distribution ( $\alpha>0$ ).
beta	The strictly positive parameter (second degree of freedom) of the F distribution ( $\beta>0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

# Value

The functions rlse\_f, rlre\_f, rlhce\_f, and rlae\_f provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated F distribution, p and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148. Johnson, N. L., Kotz, S., & Balakrishnan, N. (1995). Continuous univariate distributions, volume 2 (Vol. 289). John Wiley & Sons.

#### See Also

```
re_f
```

# **Examples**

```
p <- c(1.25, 1.50, 1.75)
rlse_f(p, 4, 6)
rlre_f(p, 4, 6, 0.5)
rlhce_f(p, 4, 6, 0.5)
rlae_f(p, 4, 6, 0.5)</pre>
```

Truncated gamma distribution

Relative loss for various entropy measures using the truncated gamma distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated gamma distribution.

#### Usage

```
rlse_gamma(p, alpha, beta)
rlre_gamma(p, alpha, beta, delta)
rlhce_gamma(p, alpha, beta, delta)
rlae_gamma(p, alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive shape parameter of the gamma distribution ( $\alpha > 0$ ).
beta	The strictly positive scale parameter of the gamma distribution ( $\beta > 0$ ).
p	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

## Value

The functions rlse\_gamma, rlre\_gamma, rlhce\_gamma, and rlae\_gamma provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated gamma distribution, p and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Burgin, T. A. (1975). The gamma distribution and inventory control. Journal of the Operational Research Society, 26(3), 507-525.

#### See Also

```
re_gamma
```

## **Examples**

```
p <- c(1, 1.50, 1.75)
rlse_gamma(p, 0.2, 1)
rlre_gamma(p, 0.2, 1, 0.5)
rlhce_gamma(p, 0.2, 1, 0.5)
rlae_gamma(p, 0.2, 1, 0.5)</pre>
```

Truncated Gompertz distribution

Relative loss for various entropy measures using the truncated Gompertz distribution

# Description

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Gompertz distribution.

#### Usage

```
rlse_gomp(p, alpha, beta)
rlre_gomp(p, alpha, beta, delta)
rlhce_gomp(p, alpha, beta, delta)
rlae_gomp(p, alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive parameter of the Gompertz distribution ( $\alpha > 0$ ).
beta	The strictly positive parameter of the Gompertz distribution ( $\beta > 0$ ).
p	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

#### Value

The functions rlse\_gomp, rlre\_gomp, rlhce\_gomp, and rlae\_gomp provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Gompertz distribution, p and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Soliman, A. A., Abd-Ellah, A. H., Abou-Elheggag, N. A., & Abd-Elmougod, G. A. (2012). Estimation of the parameters of life for Gompertz distribution using progressive first-failure censored data. Computational Statistics & Data Analysis, 56(8), 2471-2485.

#### See Also

```
re_gomp
```

#### **Examples**

```
p <- c(0.25, 0.50)
rlse_gomp(p, 2.4,0.2)
rlre_gomp(p, 2.4,0.2, 0.5)
rlhce_gomp(p, 2.4,0.2, 0.5)
rlae_gomp(p, 2.4,0.2, 0.5)</pre>
```

Truncated Gumbel distribution

Relative loss for various entropy measures using the truncated Gumbel distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Gumbel distribution.

## Usage

```
rlse_gum(p, alpha, beta)
rlre_gum(p, alpha, beta, delta)
rlhce_gum(p, alpha, beta, delta)
rlae_gum(p, alpha, beta, delta)
```

## **Arguments**

alpha	The location parameter of the Gumbel distribution $(\alpha \in (-\infty, +\infty))$ .
beta	The strictly positive scale parameter of the Gumbel distribution ( $\beta > 0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

## Value

The functions rlse\_gum, rlre\_gum, rlhce\_gum, and rlae\_gum provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Gumbel distribution, p and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Gomez, Y. M., Bolfarine, H., & Gomez, H. W. (2019). Gumbel distribution with heavy tails and applications to environmental data. Mathematics and Computers in Simulation, 157, 115-129.

## See Also

```
re_gum
```

# **Examples**

```
p <- c(1.8,2.2)
rlse_gum(p, 4, 2)
rlre_gum(p, 4, 2, 2)
rlhce_gum(p, 4, 2, 2)
rlae_gum(p, 4, 2, 2)</pre>
```

Truncated inverse-gamma distribution

Relative loss for various entropy measures using the truncated inversegamma distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated inverse-gamma distribution.

## Usage

```
rlse_ig(p, alpha, beta)
rlre_ig(p, alpha, beta, delta)
rlhce_ig(p, alpha, beta, delta)
rlae_ig(p, alpha, beta, delta)
```

# **Arguments**

alpha	The strictly positive shape parameter of the inverse-gamma distribution ( $\alpha > 0$ ).
beta	The strictly positive scale parameter of the inverse-gamma distribution ( $\beta > 0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

#### Value

The functions rlse\_ig, rlre\_ig, rlhce\_ig, and rlae\_ig provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated inverse-gamma distribution, p and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

# References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Rivera, P. A., Calderín-Ojeda, E., Gallardo, D. I., & Gómez, H. W. (2021). A compound class of the inverse Gamma and power series distributions. Symmetry, 13(8), 1328.

## See Also

```
re_ig
```

## **Examples**

```
p <- c(1.25, 1.50)
rlse_ig(p, 1.2, 0.2)
rlre_ig(p, 1.2, 0.2, 0.5)
rlhce_ig(p, 1.2, 0.2, 0.5)
rlae_ig(p, 1.2, 0.2, 0.5)</pre>
```

Truncated Kumaraswamy distribution

Relative loss for various entropy measures using the truncated Kumaraswamy distribution

## **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Kumaraswamy distribution.

# Usage

```
rlse_kum(p, alpha, beta)
rlre_kum(p, alpha, beta, delta)
rlhce_kum(p, alpha, beta, delta)
rlae_kum(p, alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive shape parameter of the Kumaraswamy distribution ( $\alpha > 0$ ).
beta	The strictly positive shape parameter of the Kumaraswamy distribution ( $\beta>0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter ( $\delta > 0$ ) and ( $\delta \neq 1$ ).

#### Value

The functions rlse\_kum, rlre\_kum, rlhce\_kum, and rlae\_kum provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Kumaraswamy distribution, p and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

El-Sherpieny, E. S. A., & Ahmed, M. A. (2014). On the Kumaraswamy distribution. International Journal of Basic and Applied Sciences, 3(4), 372.

Al-Babtain, A. A., Elbatal, I., Chesneau, C., & Elgarhy, M. (2021). Estimation of different types of entropies for the Kumaraswamy distribution. PLoS One, 16(3), e0249027.

#### See Also

```
re_kum
```

# **Examples**

```
p <- c(0.25, 0.50, 0.75)
rlse_kum(p, 0.2, 0.4)
rlre_kum(p, 0.2, 0.4, 0.5)
rlhce_kum(p, 0.2, 0.4, 0.5)
rlae_kum(p, 0.2, 0.4, 0.5)</pre>
```

Truncated Laplace distribution

Relative loss for various entropy measures using the truncated Laplace distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Laplace distribution.

# Usage

```
rlse_lap(p, alpha, beta)
rlre_lap(p, alpha, beta, delta)
rlhce_lap(p, alpha, beta, delta)
rlae_lap(p, alpha, beta, delta)
```

#### **Arguments**

```
alpha Location parameter of the Laplace distribution (\alpha \in (-\infty, +\infty)). beta The strictly positive scale parameter of the Laplace distribution (\beta > 0). p The truncation time (p > 0). delta The strictly positive parameter (\delta > 0) and (\delta \neq 1).
```

#### Value

The functions rlse\_lap, rlre\_lap, rlhce\_lap, and rlae\_lap provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Laplace distribution, p and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Cordeiro, G. M., & Lemonte, A. J. (2011). The beta Laplace distribution. Statistics & Probability Letters, 81(8), 973-982.

#### See Also

```
re_lap
```

## **Examples**

```
p <- c(0.25, 0.50, 0.75)
rlse_lap(p, 0.2, 0.4)
rlre_lap(p, 0.2, 0.4, 0.5)
rlhce_lap(p, 0.2, 0.4, 0.5)
rlae_lap(p, 0.2, 0.4, 0.5)</pre>
```

Truncated Nakagami distribution

Relative loss for various entropy measures using the truncated Nakagami distribution

# Description

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Nakagami distribution.

## Usage

```
rlse_naka(p, alpha, beta)
rlre_naka(p, alpha, beta, delta)
rlhce_naka(p, alpha, beta, delta)
rlae_naka(p, alpha, beta, delta)
```

# Arguments

alpha	The strictly positive scale parameter of the Nakagami distribution ( $\alpha > 0$ ).
beta	The strictly positive shape parameter of the Nakagami distribution ( $\beta>0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

## Value

The functions rlse\_naka, rlre\_naka, rlhce\_naka, and rlae\_naka provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Nakagami distribution, p and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Schwartz, J., Godwin, R. T., & Giles, D. E. (2013). Improved maximum-likelihood estimation of the shape parameter in the Nakagami distribution. Journal of Statistical Computation and Simulation, 83(3), 434-445.

# See Also

```
re_naka
```

# **Examples**

```
p <- c(1.25, 1.50, 1.75)
rlse_naka(p, 0.2, 1)
rlre_naka(p, 0.2, 1, 0.5)
rlhce_naka(p, 0.2, 1, 0.5)
rlae_naka(p, 0.2, 1, 0.5)</pre>
```

Truncated normal distribution

Relative loss for various entropy measures using the truncated normal distribution

## **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated normal distribution.

# Usage

```
rlse_norm(p, alpha, beta)
rlre_norm(p, alpha, beta, delta)
rlhce_norm(p, alpha, beta, delta)
rlae_norm(p, alpha, beta, delta)
```

# **Arguments**

alpha	The location parameter of the normal distribution ( $\alpha \in (-\infty, +\infty)$ ).
beta	The strictly positive scale parameter of the normal distribution ( $\beta > 0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

# Value

The functions rlse\_norm, rlre\_norm, rlhce\_norm, and rlae\_norm provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated normal distribution, p and  $\delta$ .

# Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

## References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Patel, J. K., & Read, C. B. (1996). Handbook of the normal distribution (Vol. 150). CRC Press.

# See Also

re\_norm

## **Examples**

```
p <- c(0.25, 0.50, 0.75)
rlse_norm(p, 0.2, 1)
rlre_norm(p, 0.2, 1, 0.5)
rlhce_norm(p, 0.2, 1, 0.5)
rlae_norm(p, 0.2, 1, 0.5)</pre>
```

Truncated Rayleigh distribution

Relative loss for various entropy measures using the truncated Rayleigh distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Rayleigh distribution.

# Usage

```
rlse_ray(p, alpha)
rlre_ray(p, alpha, delta)
rlhce_ray(p, alpha, delta)
rlae_ray(p, alpha, delta)
```

## Arguments

alpha The strictly positive scale parameter of the Rayleigh distribution  $(\alpha>0)$ . p The truncation time (p>0). delta The strictly positive parameter  $(\delta>0)$  and  $(\delta\neq1)$ .

# Value

The functions rlse\_ray, rlre\_ray, rlhce\_ray, and rlae\_ray provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Rayleigh distribution, p and  $\delta$ .

# Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Dey, S., Maiti, S. S., & Ahmad, M. (2016). Comparison of different entropy measures. Pak. J. Statist, 32(2), 97-108.

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

## See Also

```
re_ray
```

## **Examples**

```
p < - seq(0.25, 2, by=0.25)
rlse_ray(p, 2)
rlre_ray(p, 2, 0.5)
rlhce_ray(p, 2, 0.5)
rlae_ray(p, 2, 0.5)
# A graphic representation of relative loss (RL)
library(ggplot2)
# p is a truncation time vector
p < - seq(0.25, 2, by = 0.25)
# RL based on the Rényi entropy
z1 <- rlre_ray(p, 0.1, 0.5)
# RL based on the Havrda and Charvat entropy
z2 <- rlhce_ray(p, 0.1, 0.5)
# RL based on the Arimoto entropy
z3 <- rlae_ray(p, 0.1, 0.5)
# RL based on the Shannon entropy
z4 <- rlse_ray(p, 0.1)
df \leftarrow data.frame(x = p, RL = z1, z2, z3, z4)
head(df)
p1 \leftarrow ggplot(df, aes(x = p, y = RL, color = Entropy))
p1 + geom_line(aes(colour = "RE"), size = 1) + geom_line(aes(x,
    y = z^2, colour = "HCE"), size = 1) + geom_line(aes(x, y = z^3),
    colour = "AR"), size = 1) + geom_line(aes(x, y = z4, colour = "SE"),
    size = 1) + ggtitle(expression(delta == 0.5 ~ ~alpha == 0.1))
```

Truncated Student's t distribution

Relative loss for various entropy measures using the truncated Student's t distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Student's t distribution.

## Usage

```
rlse_st(p, v)
rlre_st(p, v, delta)
rlhce_st(p, v, delta)
rlae_st(p, v, delta)
```

## **Arguments**

V	The strictly positive parameter of the Student distribution $(v>0)$ , also called a degree of freedom.
p	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

#### Value

The functions rlse\_st, rlre\_st, rlhce\_st, and rlae\_st provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Student's t distribution, p and  $\delta$ .

## Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

# References

Yang, Z., Fang, K. T., & Kotz, S. (2007). On the Student's t-distribution and the t-statistic. Journal of Multivariate Analysis, 98(6), 1293-1304.

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

# See Also

```
re_st
```

# **Examples**

```
p <- c(1, 1.7, 3)
rlse_st(p, 4)
rlre_st(p, 4, 0.5)
rlhce_st(p, 4, 0.5)
rlae_st(p, 4, 0.5)</pre>
```

#### Truncated Weibull distribution

Relative loss for various entropy measures using the truncated Weibull distribution

# **Description**

Compute the relative information loss of the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the truncated Weibull distribution.

## Usage

```
rlse_wei(p, alpha, beta)
rlre_wei(p, alpha, beta, delta)
rlhce_wei(p, alpha, beta, delta)
rlae_wei(p, alpha, beta, delta)
```

## **Arguments**

alpha	The strictly positive scale parameter of the Weibull distribution ( $\alpha > 0$ ).
beta	The strictly positive shape parameter of the Weibull distribution ( $\beta > 0$ ).
р	The truncation time $(p > 0)$ .
delta	The strictly positive parameter $(\delta > 0)$ and $(\delta \neq 1)$ .

# Value

The functions rlse\_wei, rlre\_wei, rlhce\_wei, and rlae\_wei provide the relative information loss based on the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the truncated Weibull distribution, p and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

#### References

Awad, A. M., & Alawneh, A. J. (1987). Application of entropy to a life-time model. IMA Journal of Mathematical Control and Information, 4(2), 143-148.

Weibull, W. (1951). A statistical distribution function of wide applicability. Journal of applied mechanics, 18, 293-297.

## See Also

```
re_wei
```

60 Weibull distribution

## **Examples**

```
p <- c(1, 1.7, 3)
rlse_wei(p, 2, 1)
rlre_wei(p, 2, 1, 0.5)
rlhce_wei(p, 2, 1, 0.5)
rlae_wei(p, 2, 1, 0.5)</pre>
```

Weibull distribution

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Weibull distribution

## **Description**

Compute the Shannon, Rényi, Havrda and Charvat, and Arimoto entropies of the Weibull distribution.

# Usage

```
se_wei(alpha, beta)
re_wei(alpha, beta, delta)
hce_wei(alpha, beta, delta)
ae_wei(alpha, beta, delta)
```

## **Arguments**

alpha The strictly positive scale parameter of the Weibull distribution ( $\alpha > 0$ ). beta The strictly positive shape parameter of the Weibull distribution ( $\beta > 0$ ). delta The strictly positive parameter ( $\delta > 0$ ) and ( $\delta \neq 1$ ).

#### **Details**

The following is the probability density function of the Weibull distribution:

$$f(x) = \frac{\beta}{\alpha} \left(\frac{x}{\alpha}\right)^{\beta - 1} e^{-\left(\frac{x}{\alpha}\right)^{\beta}},$$

where x > 0,  $\alpha > 0$  and  $\beta > 0$ .

# Value

The functions se\_wei, re\_wei, hce\_wei, and ae\_wei provide the Shannon entropy, Rényi entropy, Havrda and Charvat entropy, and Arimoto entropy, respectively, depending on the selected parametric values of the Weibull distribution and  $\delta$ .

#### Author(s)

Muhammad Imran, Christophe Chesneau and Farrukh Jamal

R implementation and documentation: Muhammad Imran <imranshakoor84@yahoo.com>, Christophe Chesneau <christophe.chesneau@unicaen.fr> and Farrukh Jamal <farrukh.jamal@iub.edu.pk>.

Weibull distribution 61

# References

Weibull, W. (1951). A statistical distribution function of wide applicability. Journal of applied mechanics, 18, 293-297.

# See Also

```
re_exp, re_gamma, re_ee
```

# **Examples**

```
se_wei(1.2, 0.2)
delta <- c(1.5, 2, 3)
re_wei(1.2, 0.2, delta)
hce_wei(1.2, 0.2, delta)
ae_wei(1.2, 0.2, delta)</pre>
```

# **Index**

* Arimoto entropy	ae_kum(Kumaraswamy distribution), 24
shannon-package, 3	ae_kumnorm(Kumaraswamy normal
* Distribution theory	distribution), 27
shannon-package, 3	ae_lap(Laplace distribution), 28
* Entropy measures	<pre>ae_lnorm(Log-normal distribution), 30</pre>
shannon-package, 3	<pre>ae_logis(Logistic distribution), 31</pre>
* Havrda and Charvat entropy	<pre>ae_lom(Lomax distribution), 32</pre>
shannon-package, 3	ae_naka(Nakagami distribution), 33
* Relative loss	<pre>ae_nh (Exponential extension</pre>
shannon-package, 3	distribution), 13
* Rényi entropy	<pre>ae_norm(Normal distribution), 35</pre>
shannon-package, 3	ae_ray(Rayleigh distribution), 36
* Shannon entropy	<pre>ae_st(Student's t distribution), 37</pre>
shannon-package, 3	ae_wei(Weibull distribution), 60
* Truncated model	
shannon-package, 3	Beta distribution, 4
* Truncation time	Beta exponential distribution, 6
shannon-package, 3	Birnbaum-Saunders distribution, 7
	Burr XII distribution, 9
ae_beta(Beta distribution),4	
<pre>ae_bexp (Beta exponential</pre>	Chi-squared distribution, 10
distribution), 6	Exponential distribution, 11
<pre>ae_bs (Birnbaum-Saunders distribution),</pre>	Exponential distribution, 11
7	Exponentiated exponential
ae_burr(Burr XII distribution), 9	distribution, 14
<pre>ae_chi (Chi-squared distribution), 10</pre>	Exponentiated Weibull distribution, 15
<pre>ae_ee (Exponentiated exponential</pre>	exponentiated werbuil distribution, 13
distribution), 14	F distribution, 17
<pre>ae_ew(Exponentiated Weibull</pre>	Frechet distribution, 18
distribution), 15	
<pre>ae_exp (Exponential distribution), 11</pre>	Gamma distribution, 19
<pre>ae_f (F distribution), 17</pre>	Gompertz distribution, 21
<pre>ae_fre (Frechet distribution), 18</pre>	Gumbel distribution, 22
ae_gamma (Gamma distribution), 19	
<pre>ae_gomp (Gompertz distribution), 21</pre>	<pre>hce_beta(Beta distribution), 4</pre>
<pre>ae_gum(Gumbel distribution), 22</pre>	<pre>hce_bexp(Beta exponential</pre>
<pre>ae_ig(Inverse-gamma distribution), 23</pre>	distribution), $6$
<pre>ae_kexp(Kumaraswamy exponential</pre>	hce_bs(Birnbaum-Saunders
distribution), 26	distribution), 7
ae_kum, 5	hce_burr(Burr XII distribution),9

INDEX 63

hce_chi(Chi-squared distribution), 10	re_bs, <i>11</i> , <i>41</i>
<pre>hce_ee (Exponentiated exponential</pre>	re_bs(Birnbaum-Saunders distribution)
distribution), 14	7
hce_ew(Exponentiated Weibull	re_burr(Burr XII distribution),9
distribution), 15	re_chi, <i>8</i> , <i>12</i> , <i>42</i>
<pre>hce_exp (Exponential distribution), 11</pre>	re_chi(Chi-squared distribution), 10
hce_f (F distribution), 17	re_ee, <i>14</i> , <i>61</i>
hce_fre(Frechet distribution), 18	<pre>re_ee (Exponentiated exponential</pre>
hce_gamma (Gamma distribution), 19	distribution), 14
hce_gomp(Gompertz distribution), 21	re_ew, <i>16</i>
hce_gum (Gumbel distribution), 22	re_ew(Exponentiated Weibull
<pre>hce_ig(Inverse-gamma distribution), 23</pre>	distribution), 15
<pre>hce_kexp(Kumaraswamy exponential</pre>	re_exp, 7, 8, 11, 14–16, 18–20, 22, 24, 27, 33
distribution), 26	34, 37, 38, 43, 61
hce_kum, 5	re_exp(Exponential distribution), 11
hce_kum(Kumaraswamy distribution), 24	re_f, 46
hce_kumnorm(Kumaraswamy normal	re_f (F distribution), 17
distribution), 27	re_fre (Frechet distribution), 18
hce_lap(Laplace distribution), 28	re_gamma, 10-12, 14, 18, 22, 24, 33, 34, 37,
hce_lnorm(Log-normal distribution), 30	38, 47, 61
hce_logis(Logistic distribution), 31	re_gamma (Gamma distribution), 19
<pre>hce_lom(Lomax distribution), 32</pre>	re_gomp, 48
hce_naka(Nakagami distribution),33	re_gomp (Gompertz distribution), 21
hce_nh(Exponential extension	re_gum, 19, 29, 32, 36, 49
distribution), 13	re_gum (Gumbel distribution), 22
hce_norm(Normal distribution), 35	re_ig, 50
hce_ray(Rayleigh distribution), 36	re_ig(Inverse-gamma distribution), 23
<pre>hce_st(Student's t distribution), 37</pre>	re_kexp (Kumaraswamy exponential
hce_wei(Weibull distribution), 60	distribution), 26
Inverse-gamma distribution, 23	re_kum, 5, 27, 28, 52
Kumanaan diataibutian 24	re_kum (Kumaraswamy distribution), 24
Kumaraswamy distribution, 24	re_kumnorm (Kumaraswamy normal
Kumaraswamy exponential distribution,	distribution), 27
26	re_lap, 53
Kumaraswamy normal distribution, 27	re_lap(Laplace distribution), 28
Laplace distribution, 28	re_lnorm(Log-normal distribution), 30
Log-normal distribution, 30	re_logis (Logistic distribution), 31
Logistic distribution, 31	re_lom(Lomax distribution), 32
Lomax distribution, 32	re_naka, <i>54</i>
Lonax distribution, 32	re_naka(Nakagami distribution),33
Nakagami distribution, 33	re_nh, <i>15</i> , <i>44</i>
Normal distribution, 35	re_nh(Exponential extension
	distribution), 13
Rayleigh distribution, 36	re_norm, 23, 28, 29, 31, 32, 55
re_beta, 7, 25, 40	re_norm (Normal distribution), 35
re_beta(Beta distribution),4	re_ray, 22, 57
re_bexp(Beta exponential	re_ray(Rayleigh distribution),36
distribution), 6	re_st, 58

64 INDEX

re_st(Student's t distribution), 37	distribution), 47
re_wei, 10, 12, 14–16, 20, 31, 34, 37, 59	rlhce_gum (Truncated Gumbel
re_wei (Weibull distribution), 60	distribution), 48
rlae_beta (Truncated beta	rlhce_ig(Truncated inverse-gamma
distribution), 39	distribution), 50
rlae_bs (Truncated Birnbaum-Saunders	rlhce_kum(Truncated Kumaraswamy
distribution), 40	distribution), 51
rlae_chi (Truncated Chi-squared	rlhce_lap(Truncated Laplace
distribution), 41	distribution), 52
rlae_exp(Truncated exponential	rlhce_naka(Truncated Nakagami
distribution), 42	distribution), 53
rlae_f (Truncated F distribution), 45	rlhce_nh (Truncated exponential
rlae_gamma (Truncated gamma	extension distribution), 44
distribution), 46	rlhce_norm(Truncated normal
rlae_gomp (Truncated Gompertz	distribution), 55
distribution), 47	rlhce_ray(Truncated Rayleigh
rlae_gum (Truncated Gumbel	distribution), 56
distribution), 48	rlhce_st(Truncated Student's t
rlae_ig (Truncated inverse-gamma	distribution), 57
distribution), 50	rlhce_wei(Truncated Weibull
rlae_kum (Truncated Kumaraswamy	distribution), 59
distribution), 51	rlre_beta(Truncated beta
rlae_lap (Truncated Laplace	distribution), 39
distribution), 52	rlre_bs(Truncated Birnbaum-Saunders
rlae_naka (Truncated Nakagami	distribution), 40
distribution), 53	rlre_chi (Truncated Chi-squared
rlae_nh (Truncated exponential	distribution), 41
extension distribution), 44	rlre_exp (Truncated exponential
rlae_norm (Truncated normal	distribution), 42
distribution), 55	rlre_f (Truncated F distribution), 45
rlae_ray (Truncated Rayleigh	rlre_gamma (Truncated gamma
distribution), 56	distribution), 46
rlae_st (Truncated Student's t	rlre_gomp (Truncated Gompertz
distribution), 57	distribution), 47
rlae_wei(Truncated Weibull	rlre_gum (Truncated Gumbel
distribution), 59	distribution), 48
rlhce_beta (Truncated beta	rlre_ig (Truncated inverse-gamma
distribution), 39	distribution), 50
rlhce_bs (Truncated Birnbaum-Saunders	rlre_kum (Truncated Kumaraswamy
distribution), 40	distribution), 51
rlhce_chi (Truncated Chi-squared	rlre_lap(Truncated Laplace
distribution), 41	distribution), 52
rlhce_exp (Truncated exponential	rlre_naka(Truncated Nakagami
distribution), 42	distribution), 53
rlhce_f (Truncated F distribution), 45	rlre_nh (Truncated exponential
rlhce_gamma (Truncated gamma	extension distribution), 44
distribution), 46	rlre_norm (Truncated normal
rlhce_gomp (Truncated Gompertz	distribution), 55

INDEX 65

rlre_ray(Truncated Rayleigh	se_ew(Exponentiated Weibull
distribution), 56	distribution), 15
rlre_st(Truncated Student's t	Se_exp(Exponential distribution), 11
distribution), 57	<pre>se_f (F distribution), 17</pre>
rlre_wei (Truncated Weibull	se_fre (Frechet distribution), $18$
distribution), 59	Se_gamma(Gamma distribution), 19
rlse_beta(Truncated beta	<pre>se_gomp (Gompertz distribution), 21</pre>
distribution), 39	Se_gum (Gumbel distribution), 22
rlse_bs (Truncated Birnbaum-Saunders	se_ig (Inverse-gamma distribution), 23
distribution), $40$	se_kum, 5
rlse_chi(Truncated Chi-squared	se_kum(Kumaraswamy distribution), 24
distribution), 41	<pre>se_kumnorm(Kumaraswamy normal</pre>
rlse_exp (Truncated exponential	distribution), 27
distribution), 42	Se_lap(Laplace distribution), 28
rlse_f (Truncated F distribution), 45	<pre>se_lnorm(Log-normal distribution), 30</pre>
rlse_gamma (Truncated gamma	<pre>se_logis(Logistic distribution), 31</pre>
distribution), 46	<pre>se_lom(Lomax distribution), 32</pre>
rlse_gomp (Truncated Gompertz	se_naka(Nakagami distribution), 33
distribution), 47	<pre>se_nh (Exponential extension</pre>
rlse_gum(Truncated Gumbel	distribution), 13
distribution), 48	<pre>se_norm(Normal distribution), 35</pre>
rlse_ig(Truncated inverse-gamma	se_ray(Rayleigh distribution), 36
distribution), 50	<pre>se_st(Student's t distribution), 37</pre>
rlse_kum (Truncated Kumaraswamy	se_wei(Weibull distribution), 60
distribution), 51	shannon-package, 3
rlse_lap (Truncated Laplace	Student's t distribution, 37
distribution), 52	
rlse_naka (Truncated Nakagami	Truncated beta distribution, 39
distribution), 53	Truncated Birnbaum-Saunders
rlse_nh (Truncated exponential	distribution, 40
extension distribution), 44	Truncated Chi-squared distribution, 41
rlse_norm (Truncated normal	Truncated exponential distribution, 42
distribution), 55	Truncated exponential extension
rlse_ray (Truncated Rayleigh	distribution, 44
distribution), 56	Truncated F distribution, 45
rlse_st (Truncated Student's t	Truncated gamma distribution, 46
distribution), 57	Truncated Gompertz distribution, 47
rlse_wei(Truncated Weibull	Truncated Gumbel distribution, 48
distribution), 59	Truncated inverse-gamma distribution,
distribution, sy	50
Se_beta (Beta distribution), 4	Truncated Kumaraswamy distribution, 51
se_bexp(Beta exponential	Truncated Laplace distribution, 52
distribution), 6	Truncated Nakagami distribution, 53
se_bs (Birnbaum-Saunders distribution),	Truncated normal distribution, 55
7	Truncated Rayleigh distribution, 56
se_burr(Burr XII distribution),9	Truncated Student's t distribution, 57
se_chi (Chi-squared distribution), 10	Truncated Weibull distribution, 59
se_ee (Exponentiated exponential	and the method in the trong of
distribution), 14	Weibull distribution, 60
4100110401011/, 11	·