Package: LMoFit (via r-universe)

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Type Package

Title Advanced L-Moment Fitting of Distributions

Version 0.1.7

Description A complete framework for frequency analysis is provided by 'LMoFit'. It has functions related to the determination of sample L-moments as in Hosking, J.R.M. (1990) <doi:10.1111/j.2517-6161.1990.tb01775.x>, the fitting of various distributions as in Zaghloul et al. (2020) <doi:10.1016/j.advwatres.2020.103720> and Hosking, J.R.M. (2019) <https://CRAN.R-project.org/package=lmom>, besides plotting and manipulating L-space diagrams as in Papalexiou, S.M. & Koutsoyiannis, D. (2016) <doi:10.1016/j.advwatres.2016.05.005> for two-shape parametric distributions on the L-moment ratio diagram. Additionally, the quantile, probability density, and cumulative probability functions of various distributions are provided in a user-friendly manner.

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Depends R (>= 3.3)

Imports lmom, pracma, stats, ggplot2, sf, utils

License GPL-3

Encoding UTF-8

LazyData true

LazyDataCompression xz

RoxygenNote 7.1.0

VignetteBuilder knitr

Suggests knitr, rmarkdown

NeedsCompilation no

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Repository https://mohanad-zaghloul.r-universe.dev

RemoteUrl https://github.com/cran/LMoFit

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Contents

`com_sam_lspace` *Comparing sample L-moment ratios with L-spaces of various distributions on the L-moments ratio diagram*

Description

Comparing sample L-moment ratios with L-spaces of various distributions on the L-moments ratio diagram

Usage

```
com_sam_lspace(sample, type = "m", Dist = "BrIII", color = "red", shape = 8)
```

Arguments

sample	for a single site, sample is a vector of observations, e.x. FLOW_AMAX. For multiple sites, sample is a dataframe consisting of multiple columns where each column has the data observed at one site; this dataframe should have column names as station names, e.x. FLOW_AMAX_MULT.
type	the type of the sample. It can be "s" for single site, the default, or "m" for multiple sites.
Dist	select the distribution to plot its L-space in the background. This can be "BrIII" for Burr Typr-III distribution, "BrXII" for Burr Typr-XII distribution, or "GG" for Generalized Gamma distribution. The default Dist is "BrIII".
color	color of the L-point/s, default is "red".
shape	shape of the L-point/s, default is 8.

Value

ggplot plot comparing sample/s L-point/s with L-space of a distribution on the L-moment ratio diagram

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
com_plot_BrIII <- com_sam_lspace(LMoFit::FLOW_AMAX, type = "s", Dist = "BrIII")
com_plot_BrXII <- com_sam_lspace(LMoFit::FLOW_AMAX, type = "s", Dist = "BrXII")
com_plot_GG <- com_sam_lspace(LMoFit::FLOW_AMAX, type = "s", Dist = "GG")
com_plot_BrIII <- com_sam_lspace(LMoFit::FLOW_AMAX_MULT, type = "m", Dist = "BrIII")
com_plot_BrXII <- com_sam_lspace(LMoFit::FLOW_AMAX_MULT, type = "m", Dist = "BrXII")
com_plot_GG <- com_sam_lspace(LMoFit::FLOW_AMAX_MULT, type = "m", Dist = "GG")
```

---

con_samlmom_lspace *Condition of sample lpoints, as inside/outside of specific L-spaces on the L-moments ratio diagram, using sample lmoments.*

Description

Condition of sample lpoints, as inside/outside of specific L-spaces on the L-moments ratio diagram, using sample lmoments.

Usage

```
con_samlmom_lspace(samplelmom, Dist = "BrIII")
```

Arguments

samplelmom	L-moments as c(l1, l2, l3, l4, t2, t3, t4). Use get_sample_lmom() to obtain these lmoments.
Dist	select the distribution to plot its L-space in the background. This can be "BrIII" for Burr Typr-III distribution, "BrXII" for Burr Typr-XII distribution, or "GG" for Generalized Gamma distribution. The default Dist is "BrIII". The default is set to BrIII.

Value

The condition of the L-points in regards to the selected L-space as inside or outside.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
sample <- LMoFit::FLOW_AMAX
samplelmom <- get_sample_lmom(x = sample)
con_samlmom_lspace(samplelmom, Dist = "BrIII")
con_samlmom_lspace(samplelmom, Dist = "BrXII")
con_samlmom_lspace(samplelmom, Dist = "GG")
```

---

con_sam_lspace *Condition of sample lpoints, as inside/outside of specific L-spaces on the L-moments ratio diagram, using sample.*

Description

Condition of sample lpoints, as inside/outside of specific L-spaces on the L-moments ratio diagram, using sample.

Usage

```
con_sam_lspace(sample, type = "s", Dist = "BrIII")
```

Arguments

sample	for a single site, sample is a vector of observations, e.x. FLOW_AMAX. For multiple sites, sample is a dataframe consisting of multiple columns where each column has the data observed at one site; this dataframe should have column names as station names, e.x. FLOW_AMAX_MULT.
type	the type of the sample. It can be "s" for single site, the default, or "m" for multiple sites.
Dist	select the distribution to plot its L-space in the background. This can be "BrIII" for Burr Typr-III distribution, "BrXII" for Burr Typr-XII distribution, or "GG" for Generalized Gamma distribution. The default Dist is "BrIII".

Value

The condition of the L-points in regards to the selected L-space as inside or outside.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
con_sam_lspace(LMoFit::FLOW_AMAX, type = "s", Dist = "BrIII")
con_sam_lspace(LMoFit::FLOW_AMAX, type = "s", Dist = "BrXII")
con_sam_lspace(LMoFit::FLOW_AMAX, type = "s", Dist = "GG")
con_sam_lspace(LMoFit::FLOW_AMAX_MULT, type = "m", Dist = "BrIII")
con_sam_lspace(LMoFit::FLOW_AMAX_MULT, type = "m", Dist = "BrXII")
con_sam_lspace(LMoFit::FLOW_AMAX_MULT, type = "m", Dist = "GG")
```

---

dBrIII *Probability density function of BrIII distribution*

Description

Probability density function of BrIII distribution

Usage

```
dBrIII(x, para = c(1, 2, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(scale, shape1, shape2)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dBrIII(x = 108.4992, para = c(10, 0.25, 0.5))
```

dBrXII *Probability density function of BrXII distribution*

Description

Probability density function of BrXII distribution

Usage

```
dBrXII(x, para = c(1, 2, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(scale, shape1, shape2)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dBrXII(x = 108.4992, para = c(10, 0.25, 0.5))
```

dgam *Probability density function of Gamma distribution*

Description

Probability density function of Gamma distribution

Usage

```
dgam(x, para = c(1, 2, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(shape, scale)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dgam(x = 0.1, para = c(0.1, 0.2))
```

---

dgev *Probability density function of GEV distribution*

Description

Probability density function of GEV distribution

Usage

```
dgev(x, para)
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dgev(x = 108.4992, para = c(10, 1, 1))
```

dGG *Probability density function of Generalized Gamma (GG) distribution*

Description

Probability density function of Generalized Gamma (GG) distribution

Usage

```
dGG(x, para = c(10, 0.25, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(scale, shape1, shape2)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dGG(x = 108.4992, para = c(10, 0.25, 0.5))
```

dglo *Probability density function of Generalized Logestic Distribution*

Description

Probability density function of Generalized Logestic Distribution

Usage

```
dglo(x, para = c(1, 2, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dglo(x = 0.1, para = c(1, 2, 0.5))
```

---

dgno *Probability density function of Generalized normal Distribution*

Description

Probability density function of Generalized normal Distribution

Usage

```
dgno(x, para = c(1, 2, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dgno(x = 0.1, para = c(1, 2, 0.5))
```

dgpa *Probability density function of Generalized Pareto Distribution*

Description

Probability density function of Generalized Pareto Distribution

Usage

```
dgpa(x, para)
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dgpa(x = 0.1, para = c(1, 2, 0.5))
```

dln3 *Probability density function of Lognormal-3 Distribution*

Description

Probability density function of Lognormal-3 Distribution

Usage

```
dln3(x, para = c(0, 0, 1))
```

Arguments

x	quantile/s
para	parameters as c(zeta, mu, sigma) that is c(lower bound, mean on log scale, standard deviation on log scale).

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dln3(x = 12, para = c(0, 0, 1))
```

---

dnor *Probability density function of Normal Distribution*

Description

Probability density function of Normal Distribution

Usage

```
dnor(x, para = c(1, 2))
```

Arguments

x	quantile/s
para	parameters as c(location, scale)

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dnor(x = 1.5, para = c(1, 2))
```

dpe3 *Probability density function of Pearson type-3 Distribution*

Description

Probability density function of Pearson type-3 Distribution

Usage

```
dpe3(x, para = c(10, 1, 1.5))
```

Arguments

x	quantile/s
para	parameters as c(mu, sigma, gamma) that is c(location, scale, shape).

Value

Probability density function

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
d <- dpe3(x = 12, para = c(10, 1, 1.5))
```

fit_BrIII *Fit Burr Type-III (BrIII) Distribution*

Description

Fit Burr Type-III (BrIII) Distribution

Usage

```
fit_BrIII(sl1, st2, st3)
```

Arguments

sl1	1st l-moments
st2	2nd l-moment ratio
st3	3rd l-moment ratio

Value

A dataframe containing the scale parameter, the shape1 parameter, the shape2 parameter, the squared error of scale parameter, and the squared error of shape parameter

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
BrIII_par_valid <- fit_BrIII(sl1 = 10, st2 = 0.25, st3 = 0.1)
BrIII_par_invalid <- fit_BrIII(sl1 = 10, st2 = 0.5, st3 = 0.8)
```

---

fit_BrXII *Fit Burr Type-XII (BrXII) Distribution*

Description

Fit Burr Type-XII (BrXII) Distribution

Usage

```
fit_BrXII(sl1, st2, st3)
```

Arguments

sl1	1st l-moments
st2	2nd l-moment ratio
st3	3rd l-moment ratio

Value

A dataframe containing the scale parameter, the shape1 parameter, the shape2 parameter, the squared error of the scale parameter, and the squared error of the shape parameters.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
BrXII_par_valid <- fit_BrXII(sl1 = 10, st2 = 0.25, st3 = 0.25)
BrXII_par_invalid <- fit_BrXII(sl1 = 10, st2 = 0.5, st3 = 0.8)
```

`fit_gam` *Fit Gamma distribution using the 'lmom' package*

Description

Fit Gamma distribution using the 'lmom' package

Usage

```
fit_gam(sl1, sl2, st3, st4)
```

Arguments

`sl1`	sample 1st l-moment
`sl2`	sample 2nd l-moment
`st3`	sample 3rd l-moment ratio
`st4`	sample 4th l-moment ratio

Value

A vector of parameters as alpha (shape) and beta (scale).

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
gam_par <- fit_gam(15, 1.7, 0.04, -0.02)
```

`fit_gev` *Fit GEV distribution*

Description

Fit GEV distribution

Usage

```
fit_gev(sl1, sl2, st3)
```

Arguments

sl1	sample 1st l-moment
sl2	sample 2nd l-moment
st3	sample 3rd l-moment ratio

Value

A dataframe containing the location parameter, the scale parameter, the shape parameter, and the squared error of shape parameters.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
GEV_par <- fit_gev(sl1 = 10, sl2 = 0.5, st3 = 0.8)
```

---

fit_GG *Fit Generalized Gamma (GG) Distribution*

Description

Fit Generalized Gamma (GG) Distribution

Usage

```
fit_GG(sl1, st2, st3)
```

Arguments

sl1	1st l-moments
st2	2nd l-moment ratio
st3	3rd l-moment ratio

Value

A dataframe containing the scale parameter, the shape1 parameter, the shape2 parameter, the squared error of scale parameter, and the squared error of shape parameters.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
GG_par_valid <- fit_GG(sl1 = 10, st2 = 0.4, st3 = 0.2)
GG_par_invalid <- fit_GG(sl1 = 1, st2 = 0.25, st3 = 0.25)
```

`fit_glo` *Fit Generalized Logistic distribution using the 'lmom' package*

Description

Fit Generalized Logistic distribution using the 'lmom' package

Usage

```
fit_glo(sl1, sl2, st3, st4)
```

Arguments

`sl1`	sample 1st l-moment
`sl2`	sample 2nd l-moment
`st3`	sample 3rd l-moment ratio
`st4`	sample 4th l-moment ratio

Value

A vector of parameters as xi (location), alpha (scale), and k (shape).

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
glo_par <- fit_glo(15, 1.7, 0.04, -0.02)
```

fit_gno *Fit Generalized Normal distribution using the 'lmom' package*

Description

Fit Generalized Normal distribution using the 'lmom' package

Usage

```
fit_gno(sl1, sl2, st3, st4)
```

Arguments

sl1	sample 1st l-moment
sl2	sample 2nd l-moment
st3	sample 3rd l-moment ratio
st4	sample 4th l-moment ratio

Value

A vector of parameters as xi (location), alpha (scale), and k (shape).

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
gno_par <- fit_gno(15, 1.7, 0.04, -0.02)
```

fit_gpa *Fit Generalized Pareto distribution using the 'lmom' package*

Description

Fit Generalized Pareto distribution using the 'lmom' package

Usage

```
fit_gpa(sl1, sl2, st3, st4)
```

Arguments

sl1	sample 1st l-moment
sl2	sample 2nd l-moment
st3	sample 3rd l-moment ratio
st4	sample 4th l-moment ratio

Value

A vector of parameters as xi (location), alpha (scale), and k (shape).

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
gpa_par <- fit_gpa(15, 1.7, 0.04, -0.02)
```

---

fit_ln3 *Fit LogNormal-3 distribution using the 'lmom' package*

Description

Fit LogNormal-3 distribution using the 'lmom' package

Usage

```
fit_ln3(sl1, sl2, st3, st4)
```

Arguments

sl1	sample 1st l-moment
sl2	sample 2nd l-moment
st3	sample 3rd l-moment ratio
st4	sample 4th l-moment ratio

Value

A vector of parameters as zeta (lower bound), mu (mean on log-scale), and sigma (st.dev. on log-scale)

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
ln3_par <- fit_ln3(15, 1.7, 0.04, -0.02)
```

`fit_nor` *Fit Normal distribution using the 'lmom' package*

Description

Fit Normal distribution using the 'lmom' package

Usage

```
fit_nor(sl1, sl2, st3, st4)
```

Arguments

`sl1`	sample 1st l-moment
`sl2`	sample 2nd l-moment
`st3`	sample 3rd l-moment ratio
`st4`	sample 4th l-moment ratio

Value

A vector of parameters as mu (location) and sigma (scale).

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
nor_par <- fit_nor(15, 1.7, 0.04, -0.02)
```

`fit_pe3` *Fit Pearson Type-3 distribution using the 'lmom' package*

Description

Fit Pearson Type-3 distribution using the 'lmom' package

Usage

```
fit_pe3(sl1, sl2, st3, st4)
```

Arguments

`sl1`	sample 1st l-moment
`sl2`	sample 2nd l-moment
`st3`	sample 3rd l-moment ratio
`st4`	sample 4th l-moment ratio

Value

A vector of parameters as mu (location), sigma (scale), and gamma (shape).

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
pe3_par <- fit_pe3(15, 1.7, 0.04, -0.02)
```

`FLOW_AMAX` *Annual maximum flow data at Water Survey of Canada WSC flow gauge number 08NA002 in BC, Vancouver, Canada. Lat: 51°14'36.8¨ N, Long: 116°54'46.6¨ W.*

Description

Annual maximum flow data at Water Survey of Canada WSC flow gauge number 08NA002 in BC, Vancouver, Canada. Lat: 51°14'36.8¨ N, Long: 116°54'46.6¨ W.

Usage

```
FLOW_AMAX
```

Format

A vector of observations of length equal to 112

flow annual maximum flow observed per each year at one site

Source

coded in data-raw

FLOW_AMAX_MULT *Annual maximum flow data at 10 hypothetical flow gauge.*

Description

Annual maximum flow data at 10 hypothetical flow gauge.

Usage

```
FLOW_AMAX_MULT
```

Format

A data frame with 112 rows and 10 variables:

flow_st1 annual maximum flow observed per each year at site 1

flow_st2 annual maximum flow observed per each year at site 2

flow_st3 annual maximum flow observed per each year at site 3

flow_st4 annual maximum flow observed per each year at site 4

flow_st5 annual maximum flow observed per each year at site 5

flow_st6 annual maximum flow observed per each year at site 6

flow_st7 annual maximum flow observed per each year at site 7

flow_st8 annual maximum flow observed per each year at site 8

flow_st9 annual maximum flow observed per each year at site 9

flow_st10 annual maximum flow observed per each year at site 10

Source

coded in data-raw

get_julian *Get julian date from the begining of the year*

Description

Get julian date from the begining of the year

Usage

```
get_julian(x)
```

Arguments

x	date or a series of dates such as, as.Date("yyyy-mm-dd")

Value

A julian date between 1 and 365, note that in leap years the day 366 is considered as 365

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
get_julian(x = as.Date("1979-01-15"))
```

get_sample_lmom *Estimate sample L-moments and L-moment ratios*

Description

Estimate sample L-moments and L-moment ratios

Usage

```
get_sample_lmom(x)
```

Arguments

x	a series of quantiles

Value

A dataframe containing the 1st l-moment, the 2nd l-moment, the 3rd l-moment, the 4th l-moment, the 2nd l-moment ratio "L-variation", the 3rd l-moment ratio "L-skewness", and the 4th l-moment ratio "L-kurtosis"

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
sample_lmom <- get_sample_lmom((rnorm(n = 500, mean = 10, sd = 0.5)))
```

---

lspace_BrIII *L-space of Burr Type-III Distribution (BrIII)*

Description

This is a plot of the L-space of BrIII Distribution with L-variation on x-axis and L-skewness on y-axis. The L-space is bounded by shape1 in the range of 0.01 to 150.01, and by shape2 in the range of 0.005 to 0.999.

Usage

```
lspace_BrIII
```

Format

A ggplot

data

layers

scales

mapping

theme

coordinates

facet

plot_env

labels

Source

coded in data-raw

lspace_BrIII.xy *coordinates of the L-space of Burr Type-III Distribution (BrIII)*

Description

This is a plot of the L-space of BrIII Distribution with L-variation on x-axis and L-skewness on y-axis. The L-space is bounded by shape1 in the range of 0.01 to 150.01, and by shape2 in the range of 0.005 to 0.999.

Usage

```
lspace_BrIII.xy
```

Format

A ggplot

x l-variatoin "t2"

y l-skewness "t3"

Source

coded in data-raw

lspace_BrXII *L-space of Burr Type-XII Distribution (BrXII)*

Description

This is a plot of the L-space of BrXII Distribution with L-variation on x-axis and L-skewness on y-axis. The L-space is bounded by shape1 in the range of 0.1 to 150, and by shape2 in the range of 0.001 to 1.

Usage

```
lspace_BrXII
```

Format

A ggplot

data

layers

scales

mapping

theme

coordinates

facet

plot_env

labels

Source

coded in data-raw

`lspace_BrXII.xy` *coordinates of the L-space of Burr Type-XII Distribution (BrXII)*

Description

This is a plot of the L-space of BrXII Distribution with L-variation on x-axis and L-skewness on y-axis. The L-space is bounded by shape1 in the range of 0.1 to 150, and by shape2 in the range of 0.001 to 1.

Usage

```
lspace_BrXII.xy
```

Format

A ggplot

x l-variatoin "t2"

y l-skewness "t3"

Source

coded in data-raw

lspace_GG *L-space of Generalized Gamma Distribution (GG)*

Description

This is a plot of the L-space of GG Distribution with L-variation on x-axis and L-skewness on y-axis. The L-space is bounded by shape1 in the range of 0.1 to 5.9, and by shape2 in the range of 0.19 to 38.

Usage

```
lspace_GG
```

Format

A ggplot

data

layers

scales

mapping

theme

coordinates

facet

plot_env

labels

Source

coded in data-raw

lspace_GG.xy *coordinates of the L-space of Generalized Gamma Distribution (GG)*

Description

This is a plot of the L-space of GG Distribution with L-variation on x-axis and L-skewness on y-axis. The L-space is bounded by shape1 in the range of 0.1 to 5.9, and by shape2 in the range of 0.19 to 38.

Usage

```
lspace_GG.xy
```

Format

A ggplot

x l-variatoin "t2"

y l-skewness "t3"

Source

coded in data-raw

`pBrIII` *Cumulative distribution function of BrIII distribution*

Description

Cumulative distribution function of BrIII distribution

Usage

```
pBrIII(x, para = c(1, 2, 0.5))
```

Arguments

`x`	quantile/s
`para`	parameters as c(scale, shape1, shape2)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pBrIII(x = 108.4992, para = c(10, 0.25, 0.5))
```

pBrXII *Cumulative distribution function of BrXII distribution*

Description

Cumulative distribution function of BrXII distribution

Usage

```
pBrXII(x, para = c(1, 2, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(scale, shape1, shape2)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pBrXII(x = 108.4992, para = c(10, 0.25, 0.5))
```

pemp *Emperical cumulative distribution function*

Description

Emperical cumulative distribution function

Usage

```
pemp(data)
```

Arguments

data	quantile/s

Value

A dataframe containing two columns as the sorted observations and the corresponding empirical probability of non-exceedance

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
output <- pemp(data = runif(n = 50, min = 10, max = 100))
```

---

pgam *Cumulative distribution function of Gamma distribution*

Description

Cumulative distribution function of Gamma distribution

Usage

```
pgam(x, para = c(1.5, 1))
```

Arguments

x	quantile/s
para	parameters as c(shape, scale)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pgam(x = 0.1, para = c(0.1, 0.2))
```

pgev — *Cumulative distribution function of GEV distribution*

Description

Cumulative distribution function of GEV distribution

Usage

```
pgev(x, para)
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pgev(x = 108.4992, para = c(10, 1, 1))
```

pGG — *Cumulative distribution function of Generalized Gamma (GG) distribution*

Description

Cumulative distribution function of Generalized Gamma (GG) distribution

Usage

```
pGG(x, para = c(10, 0.25, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(scale, shape1, shape2)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pGG(x = 108.4992, para = c(10, 0.25, 0.5))
```

---

pglo *Cumulative distribution function of Generalized Logistic Distribution*

Description

Cumulative distribution function of Generalized Logistic Distribution

Usage

```
pglo(x, para = c(10, 1.5, 1))
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pglo(x = 0.1, para = c(10, 0.1, 0.2))
```

pgno *Cumulative distribution function of Generalized Normal Distribution*

Description

Cumulative distribution function of Generalized Normal Distribution

Usage

```
pgno(x, para = c(10, 1.5, 1))
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pgno(x = 10.1, para = c(10, 0.1, 0.2))
```

pgpa *Cumulative distribution function of Generalized Pareto Distribution*

Description

Cumulative distribution function of Generalized Pareto Distribution

Usage

```
pgpa(x, para = c(1, 1, 1))
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pgpa(x = 1.2, para = c(1, 2, 0.5))
```

---

pln3 *Cumulative distribution function of Lognormal-3 Distribution*

Description

Cumulative distribution function of Lognormal-3 Distribution

Usage

```
pln3(x, para = c(0, 0, 1))
```

Arguments

x	quantile/s
para	parameters as c(zeta, mu, sigma) that is c(lower bound, mean on log scale, standard deviation on log scale).

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pln3(x = 12, para = c(0, 0, 1))
```

pnor *Cumulative distribution function of Noramal Distribution*

Description

Cumulative distribution function of Noramal Distribution

Usage

```
pnor(x, para = c(10, 1.5))
```

Arguments

x	quantile/s
para	parameters as c(location, scale)

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- pnor(x = 11, para = c(10, 1.5))
```

ppe3 *Cumulative distribution function of Pearson type-3 Distribution*

Description

Cumulative distribution function of Pearson type-3 Distribution

Usage

```
ppe3(x, para = c(10, 1, 1.5))
```

Arguments

x	quantile/s
para	parameters as c(mu, sigma, gamma) that are c(location, scale, shape).

Value

Non-exceedance probability from the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
u <- ppe3(x = 12, para = c(10, 1, 1.5))
```

---

qBrIII *Quantile distribution function of BrIII distribution*

Description

Quantile distribution function of BrIII distribution

Usage

```
qBrIII(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(scale, shape1, shape2)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qBrIII(u = 0.99, para = c(1, 10, 0.8))
x <- qBrIII(RP = 100, para = c(1, 10, 0.8))
```

qBrXII *Quantile distribution function of BrXII distribution*

Description

Quantile distribution function of BrXII distribution

Usage

```
qBrXII(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(scale, shape1, shape2)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qBrXII(u = 0.99, para = c(1, 10, 0.8))
x <- qBrXII(RP = 100, para = c(1, 10, 0.8))
```

qgam *Quantile distribution function of Gamma distribution*

Description

Quantile distribution function of Gamma distribution

Usage

```
qgam(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(shape, scale)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qgam(u = 0.99, para = c(0.1, 0.2))
x <- qgam(RP = 100, para = c(0.1, 0.2))
```

---

qgev *Quantile distribution function of GEV distribution*

Description

Quantile distribution function of GEV distribution

Usage

```
qgev(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(location, scale, shape)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qgev(u = 0.99, para = c(10, 1, 1))
x <- qgev(RP = 100, para = c(10, 1, 1))
```

qGG *Quantile distribution function of the Generalized Gamma (GG) distribution*

Description

Quantile distribution function of the Generalized Gamma (GG) distribution

Usage

```
qGG(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(scale, shape1, shape2)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qGG(u = 0.99, para = c(10, 0.25, 0.5))
x <- qGG(RP = 100, para = c(10, 0.25, 0.5))
```

qglo *Quantile distribution function of Generalized Logistic Distribution*

Description

Quantile distribution function of Generalized Logistic Distribution

Usage

```
qglo(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(location, scale, shape)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qglo(u = 0.99, para = c(10, 0.1, 0.2))
x <- qglo(RP = 100, para = c(10, 0.1, 0.2))
```

---

qgno *Quantile distribution function of Generalized normal Distribution*

Description

Quantile distribution function of Generalized normal Distribution

Usage

```
qgno(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(location, scale, shape)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qgno(u = 0.99, para = c(10, 0.1, 0.2))
x <- qgno(RP = 100, para = c(10, 0.1, 0.2))
```

qgpa *Quantile distribution function of Generalized Pareto Distribution*

Description

Quantile distribution function of Generalized Pareto Distribution

Usage

```
qgpa(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(location, scale, shape)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qgpa(u = 0.99, para = c(10, 0.1, 0.2))
x <- qgpa(RP = 100, para = c(10, 0.1, 0.2))
```

qln3 *Quantile distribution function of Lognormal-3 Distribution*

Description

Quantile distribution function of Lognormal-3 Distribution

Usage

```
qln3(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(zeta, mu, sigma) that is c(lower bound, mean on log scale, standard deviation on log scale).

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qln3(u = 0.99, para = c(0, 0, 1))
x <- qln3(RP = 100, para = c(0, 0, 1))
```

---

qnor *Quantile distribution function of Normal Distribution*

Description

Quantile distribution function of Normal Distribution

Usage

```
qnor(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(location, scale)

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qnor(u = 0.99, para = c(10, 0.1))
x <- qnor(RP = 100, para = c(10, 0.1))
```

---

qpe3 *Quantile distribution function of Pearson type-3 Distribution*

Description

Quantile distribution function of Pearson type-3 Distribution

Usage

```
qpe3(u = NULL, RP = 1/(1 - u), para)
```

Arguments

u	non-exceedance probability
RP	Return Period "don't use in case u is used"
para	parameters as c(mu, sigma, gamma) that is c(location, scale, shape).

Value

Quantile value/s using the inverse of the cumulative distribution function.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
x <- qpe3(u = 0.99, para = c(1, 1, 0))
x <- qpe3(RP = 100, para = c(1, 1, 0))
```

tBrIII *Return period function of BrIII distribution*

Description

Return period function of BrIII distribution

Usage

```
tBrIII(x, para = c(1, 2, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(scale, shape1, shape2)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tBrIII(x = 108.4992, para = c(10, 0.25, 0.5))
```

tBrXII *Return period function of BrXII distribution*

Description

Return period function of BrXII distribution

Usage

```
tBrXII(x, para = c(1, 2, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(scale, shape1, shape2)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tBrXII(x = 108.4992, para = c(10, 0.25, 0.5))
```

---

tgam *Return period function of Gamma distribution*

Description

Return period function of Gamma distribution

Usage

```
tgam(x, para = c(1.5, 1))
```

Arguments

x	quantile/s
para	parameters as c(shape, scale)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tgam(x = 0.1, para = c(0.1, 0.2))
```

tgev *Return period function of GEV distribution*

Description

Return period function of GEV distribution

Usage

```
tgev(x, para)
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tgev(x = 108.4992, para = c(10, 1, 1))
```

tGG *Return period function of Generalized Gamma distribution*

Description

Return period function of Generalized Gamma distribution

Usage

```
tGG(x, para = c(10, 0.25, 0.5))
```

Arguments

x	quantile/s
para	parameters as c(scale, shape1, shape2)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tGG(x = 108.4992, para = c(10, 0.25, 0.5))
```

---

tglo *Return period function of Generalized Logistic distribution*

Description

Return period function of Generalized Logistic distribution

Usage

```
tglo(x, para = c(10, 1.5, 1))
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tglo(x = 0.1, para = c(10, 0.1, 0.2))
```

tgno *Return period function of Generalized Normal distribution*

Description

Return period function of Generalized Normal distribution

Usage

```
tgno(x, para = c(10, 1.5, 1))
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tgno(x = 10.1, para = c(10, 0.1, 0.2))
```

tgpa *Return period function of Generalized Pareto distribution*

Description

Return period function of Generalized Pareto distribution

Usage

```
tgpa(x, para = c(1, 1, 1))
```

Arguments

x	quantile/s
para	parameters as c(location, scale, shape)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tgpa(x = 1.2, para = c(1, 2, 0.5))
```

`tln3` *Return period function of Lognormal-3 distribution*

Description

Return period function of Lognormal-3 distribution

Usage

```
tln3(x, para = c(0, 0, 1))
```

Arguments

`x`	quantile/s
`para`	parameters as c(zeta, mu, sigma) that is c(lower bound, mean on log scale, standard deviation on log scale).

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tln3(x = 12, para = c(0, 0, 1))
```

tnor *Return period function of Noramal distribution*

Description

Return period function of Noramal distribution

Usage

```
tnor(x, para = c(10, 1.5))
```

Arguments

x	quantile/s
para	parameters as c(location, scale)

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tnor(x = 11, para = c(10, 1.5))
```

tpe3 *Return period function of Pearson type-3 distribution*

Description

Return period function of Pearson type-3 distribution

Usage

```
tpe3(x, para = c(10, 1, 1.5))
```

Arguments

x	quantile/s
para	parameters as c(mu, sigma, gamma) that are c(location, scale, shape).

Value

Return Period/s corresponding to quantile/s.

Author(s)

Mohanad Zaghloul [aut, cre], Simon Michael Papalexiou [aut, ths], Amin Elshorbagy [aut, ths]

Examples

```
RP <- tpe3(x = 12, para = c(10, 1, 1.5))
```

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