

# Package ‘RobExtremes’

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**Version** 1.2.0

**Date** 2019-04-08

**Title** Optimally Robust Estimation for Extreme Value Distributions

**Description** Optimally robust estimation for extreme value distributions using S4 classes and methods (based on packages 'distr', 'distrEx', 'distrMod', 'RobAStBase', and 'ROptEst').

**Depends** R(>= 3.4), methods, distrMod(>= 2.8.1), ROptEst(>= 1.2.0), robustbase, evd

**Suggests** RUnit(>= 0.4.26), ismev(>= 1.39)

**Enhances** fitdistrplus(>= 1.0-9)

**Imports** RobAStRDA, distr, distrEx(>= 2.8.0), RandVar, RobAStBase(>= 1.2.0), startupmsg, actuar

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**LazyLoad** yes

**License** LGPL-3

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RobExtremes-package     *RobExtremes – Optimally Robust Estimation for Extreme Value Distributions*

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## Description

**RobExtremes** provides infrastructure for speeded-up optimally robust estimation (i.e., MBRE, OMSE, RMXE) for extreme value distributions, extending packages **distr**, **distrEx**, **distrMod**, **robustbase**, **RobAStBase**, and **ROptEst**.

## Details

Package:	RobExtremes
Version:	1.2.0
Date:	2019-04-08
Title:	Optimally Robust Estimation for Extreme Value Distributions
Description:	Optimally robust estimation for extreme value distributions using S4 classes and methods (based on packages <code>distr</code> , <code>distrEx</code> , <code>distrMod</code> , <code>RobAStBase</code> , and <code>ROptEst</code> ).
Depends:	R(>= 3.4), <code>methods</code> , <code>distrMod</code> (>= 2.8.1), <code>ROptEst</code> (>= 1.2.0), <code>robustbase</code> , <code>evd</code>
Suggests:	<code>RUnit</code> (>= 0.4.26), <code>ismev</code> (>= 1.39)
Imports:	<code>RobAStRDA</code> , <code>distr</code> , <code>distrEx</code> (>= 2.8.0), <code>RandVar</code> , <code>RobAStBase</code> (>= 1.2.0), <code>startupmsg</code> , <code>actuar</code>
Authors:	Bernhard Spangl [contributed smoothed grid values of the Lagrange multipliers] Sascha Desmettre [contributed smoothed grid values of the Lagrange multipliers] Eugen Massini [contributed an interactive smoothing routine for smoothing the Lagrange multipliers and smoothed grid values of the Lagrange multipliers] Daria Pupashenko [contributed MDE-estimation for GEV distribution in the framework of her PhD thesis 2011–14] Gerald Kroisandt [contributed testing routines] Nataliya Horbenko ["aut", "cph"] Matthias Kohl ["aut", "cph"] Peter Ruckdeschel ["cre", "aut", "cph"],
Contact:	<code>peter.ruckdeschel@uni-oldenburg.de</code>
ByteCompile:	yes
LazyLoad:	yes
License:	LGPL-3
URL:	<a href="http://robast.r-forge.r-project.org/">http://robast.r-forge.r-project.org/</a>
Encoding:	latin1
VCS/SVNRevision:	1220

## Distributions

Importing from packages **actuar**, **evd**, it provides S4 classes and methods for the

- Gumbel distribution
- Generalized Extreme Value distribution (GEVD)
- Generalized Pareto distribution (GPD)
- Pareto distribution

## Functionals for Distributions

These distributions come together with particular methods for expectations. I.e., a functional  $E()$  as in package **distrEx**, which as first argument takes the distribution, and, optionally, can take as second argument a function which then is used as integrand. These particular methods are available for the GPD, Pareto, Gamma, Weibull, and GEV distribution and use integration on the quantile scale, i.e.,

$$E[X] = \int_0^1 q^X(s) ds$$

where  $q^X$  is the quantile function of  $X$ . In addition, where they exist, we provide closed form expressions for variances, median, IQR, skewness, kurtosis.

In addition, extending estimators  $S_n$  and  $Q_n$  from package **robustbase**, we provide functionals for  $S_n$  and  $Q_n$ . A new asymmetric version of the mad, **kMAD** gives yet another robust scale estimator (and functional).

## Models and Estimators

As to models, we provide the

- GPD model (with known threshold), together with (speeded-up) optimally robust estimators, with **LDEstimators** (in general, and with **medkMAD**, **medSn** and **medQn** as particular ones) and Pickands' estimator as starting estimators.
- GEVD model (with known or unknown threshold), together with (speeded-up) optimally robust estimators, with **LDEstimators** (see above) and Pickands' estimator as starting estimators.
- Pareto model
- Weibull model
- Gamma model

and for each of these, we provide speeded-up optimally robust estimation (i.e., **MBRE**, **OMSE**, **RMXE**).

We robust (high-breakdown) starting estimators for

- GPD (**PickandsEstimator**, **medkMAD**, **medSn**, **medQn**)
- GEV (**PickandsEstimator**)
- Pareto (**Cramér-von-Mises-Minimum-Distance-Estimator**)
- Weibull (the quantile based estimator of **Boudt/Caliskan/Croux**)
- Gamma (**Cramér-von-Mises-Minimum-Distance-Estimator**)

For all these families, of course, MLEs and Minimum-Distance-Estimators are also available through package "**distrMod**".

## Diagnostics

We bridge to the diagnostics provided by package "isnev", i.e. our return objects can be plugged into the diagnostics of this package.

We have the usual diagnostic plots from package "RobAStBase", i.e.

- Outlyingness plots `outlyingPlotIC`
- IC plots `plot`
- Information plots via `infoPlot`
- IC comparison plots via `comparePlot`
- Cniperpoint plots (from package "ROptEst") via `CniperPointPlot`

but also (adopted from package "distrMod")

- qqplots (with confidence bands) via `qqplot`
- returnlevel plots via `returnlevelplot`

## Starting Point

As a starting point you may look at the included script "`RobFitsAtRealData.R`" in the scripts folder of the package, accessible by `file.path(system.file(package="RobExtremes"),`

`"scripts/RobFits`

## Classes

[\*]: there is a generating function with the same name in RobExtremes  
 [\*\*]: generating function from `distrMod`, but with (speeded-up)  
`opt.rob-estimators` in RobExtremes

```
#####
Distribution Classes
#####
"Distribution" (from distr)
|>"UnivariateDistribution" (from distr)
|>|>"AbscontDistribution" (from distr)
|>|>"Gumbel"      [*]
|>|>"Pareto"      [*]
|>|>"GPareto"    [*]
|>|>"GEVD"       [*]
#####
Parameter Classes
#####
"OptionalParameter" (from distr)
|>"Parameter" (from distr)
|>|>"GumbelParameter"
|>|>"ParetoParameter"
|>|>"GEVDParameter"
|>|>"GParetoParameter"
#####
ProbFamily classes
#####
```

```

slots: [<name>(<class>)]
"ProbFamily"                (from distrMod)
|>"ParamFamily"            (from distrMod)
|>|>"L2ParamFamily"        (from distrMod)
|>|>|>"L2GroupParamFamily" (from distrMod)
|>|>|>|>"ParetoFamily"     [*]
|>|>|>|>"L2ScaleShapeUnion" (from distrMod)
|>|>|>|>"GammaFamily"     [**]
|>|>|>|>"GParetoFamily"    [*]
|>|>|>|>"GEVFamily"       [*]
|>|>|>|>"WeibullFamily"    [**]
|>|>|>|>"L2LocationScaleUnion" /VIRTUAL/ (from distrMod)
|>|>|>|>"L2LocationFamily" (from distrMod)
|>|>|>|>|>"GumbelLocationFamily" [*]
|>|>|>|>|>"L2LocScaleShapeUnion" /VIRTUAL/ (from distrMod)
|>|>|>|>|>"GEVFamilyMuUnknown" [*]

```

## Functions

LDEstimator	Estimators for scale-shape models based on location and dispersion
medSn	loc=median disp=Sn
medQn	loc=median disp=Qn
medkMAD	loc=median disp=kMAD
asvarMedkMAD	[asy. variance to MedkMADE]
PickandsEstimator	PickandsEstimator
asvarPickands	[asy. variance to PickandsE]
QuantileBCCEstimator	Quantile based estimator for the Weibull distribution
asvarQBCC	[asy. variance to QuantileBCCE]

## Generating Functions

Distribution Classes	
Gumbel	Generating function for Gumbel-class
GEVD	Generating function for GEVD-class
GPareto	Generating function for GPareto-class
Pareto	Generating function for Pareto-class
L2Param Families	
ParetoFamily	Generating function for ParetoFamily-class
GParetoFamily	Generating function for GParetoFamily-class
GEVFamily	Generating function for GEVFamily-class
WeibullFamily	Generating function for WeibullFamily-class

## Methods

Functionals:	
E	Generic function for the computation of (conditional) expectations
var	Generic functions for the computation of functionals

IQR	Generic functions for the computation of functionals
median	Generic functions for the computation of functionals
skewness	Generic functions for the computation of functionals
kurtosis	Generic functions for the computation of functionals
Sn	Generic function for the computation of (conditional) expectations
Qn	Generic functions for the computation of functionals

### Constants

EULERMASCHERONICCONSTANT  
 APERYCONSTANT

### Acknowledgement

This package is joint work by Peter Ruckdeschel, Matthias Kohl, and Nataliya Horbenko (whose PhD thesis went into this package to a large extent), with contributions by Dasha Pupashenko, Misha Pupashenko, Gerald Kroisandt, Eugen Massini, Sascha Desmettre, and Bernhard Spangl, in the framework of project "Robust Risk Estimation" (2011-2016) funded by Volkswagen foundation (and gratefully acknowledged). Thanks also goes to the maintainers of CRAN, in particular to Uwe Ligges who greatly helped us with finding an appropriate way to store the database of interpolating functions which allow the speed up – this is now package RobAStRDA on CRAN.

### Start-up-Banner

You may suppress the start-up banner/message completely by setting `options("StartupBanner"="off")` somewhere before loading this package by `library` or `require` in your R-code / R-session.

If option "StartupBanner" is not defined (default) or setting `options("StartupBanner"=NULL)` or `options("StartupBanner"="complete")` the complete start-up banner is displayed.

For any other value of option "StartupBanner" (i.e., not in `c(NULL, "off", "complete")`) only the version information is displayed.

The same can be achieved by wrapping the `library` or `require` call into either `suppressStartupMessages()` or `onlytypeStartupMessages(., atypes="version")`.

As for general `packageStartupMessage`'s, you may also suppress all the start-up banner by wrapping the `library` or `require` call into `suppressPackageStartupMessages()` from **startupmsg**-version 0.5 on.

### Package versions

Note: The first two numbers of package versions do not necessarily reflect package-individual development, but rather are chosen for the RobAStXXX family as a whole in order to ease updating "depends" information.

### Author(s)

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## References

M. Kohl (2005): *Numerical Contributions to the Asymptotic Theory of Robustness*. PhD Thesis. Bayreuth. Available as <http://r-kurs.de/RRlong.pdf> P. Ruckdeschel, M. Kohl, T. Stabla, F. Camphausen (2006): S4 Classes for Distributions, *R News*, 6(2), 2-6. [https://CRAN.R-project.org/doc/Rnews/Rnews\\_2006-2.pdf](https://CRAN.R-project.org/doc/Rnews/Rnews_2006-2.pdf) M. Kohl, P. Ruckdeschel, H. Rieder (2010): Infinitesimally Robust Estimation in General Smoothly Parametrized Models. *Stat. Methods Appl.*, **19**, 333–354. Ruckdeschel, P. and Horbenko, N. (2011): Optimally-Robust Estimators in Generalized Pareto Models. *Statistics*. **47**(4), 762–791. Ruckdeschel, P. and Horbenko, N. (2012): Yet another breakdown point notion: EFSBP –illustrated at scale-shape models. *Metrika*, **75**(8), 1025–1047.

A vignette for packages **distr**, **distrSim**, **distrTEst**, and **RobExtremes** is included into the mere documentation package **distrDoc** and may be called by `require("distrDoc");vignette("distr")`. A homepage to this package is available under <http://robast.r-forge.r-project.org/>.

## See Also

[distr-package](#), [distrEx-package](#), [distrMod-package](#), [RobAStBase-package](#), [ROptEst-package](#)

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.checkEstClassForParamFamily-methods

*Methods for Function .checkEstClassForParamFamily in Package 'RobExtremes'*

---

## Description

.checkEstClassForParamFamily-methods

## Arguments

PFam	a parametric family.
estimator	an estimator.

## Details

The respective methods can be used to cast an estimator to a model-specific subclass with particular methods.

## Value

The GParetoFamily, Estimate-method returns the estimator cast to S4 class GPDEstimate, the GParetoFamily, LDEstimate-method cast to S4 class GPDLEstimate, the GParetoFamily, MCEstimate-method cast to S4 class GPDMEstimate, the GParetoFamily, kStepEstimate-method cast to S4 class GPDkStepEstimate, the GParetoFamily, ORobEstimate-method cast to S4 class GPDORobEstimate, the GParetoFamily, MDEstimate-method cast to S4 class GPDMEstimate, the GParetoFamily, MLEstimate-method cast to S4 class GPDML.ALEstimate,



the GParetoFamily,CvMMDEstimate-method cast to S4 class GPDCvMMD.ALEstimate,

The GEVFamily,Estimate-method returns the estimator cast to S4 class GEVEstimate,  
 the GEVFamily,LDEstimate-method cast to S4 class GEVLDEstimate,  
 the GEVFamily,MCEstimate-method cast to S4 class GEVMCEstimate,  
 the GEVFamily,kStepEstimate-method cast to S4 class GEVkStepEstimate,  
 the GEVFamily,ORobEstimate-method cast to S4 class GEVORobEstimate,  
 the GEVFamily,MDEstimate-method cast to S4 class GEVMDEstimate,  
 the GEVFamily,MLEstimate-method cast to S4 class GEVML.ALEstimate,  
 the GEVFamily,CvMMDEstimate-method cast to S4 class GEVCvMMD.ALEstimate,

the GEVFamilyMuUnknown,Estimate-method cast to S4 class GEVEstimate,  
 the GEVFamilyMuUnknown,LDEstimate-method cast to S4 class GEVLDEstimate,  
 the GEVFamilyMuUnknown,MCEstimate-method cast to S4 class GEVMCEstimate,  
 the GEVFamilyMuUnknown,kStepEstimate-method cast to S4 class GEVkStepestimate.  
 the GEVFamilyMuUnknown,ORobEstimate-method cast to S4 class GEVORobEstimate,  
 the GEVFamilyMuUnknown,MDEstimate-method cast to S4 class GEVMDEstimate,  
 the GEVFamilyMuUnknown,MLEstimate-method cast to S4 class GEVML.ALEstimate,  
 the GEVFamilyMuUnknown,CvMMDEstimate-method cast to S4 class GEVCvMMD.ALEstimate.

### Author(s)

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

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asvarMedkMAD

*Function to compute asymptotic variance of MedkMAD estimator*

---

### Description

Function asvarMedkMAD computes the asymptotic (co)variance of a MedkMAD estimator at a Scale-Shape model.

### Usage

```
asvarMedkMAD( model, k=1)
```

### Arguments

model            an object of class "ScaleShapeUnion".  
 k                numeric (>0); additional parameter for [kMAD](#).

### Details

For the Generalized Pareto Family all terms are analytic; in case of the general scale-shape model, numerical integration is used.

**Value**

A 2x2 matrix; the covariance.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**References**

Ruckdeschel, P. and Horbenko, N. (2011): Optimally-Robust Estimators in Generalized Pareto Models. ArXiv 1005.1476. To appear at *Statistics*. DOI: 10.1080/02331888.2011.628022.

**See Also**

[LDEstimator](#)

**Examples**

```
GP <- GParetoFamily(scale=1,shape=0.7)
asvarMedkMAD(GP,k=1)

## for didactical purposes turn GP into a non-GPD
setClass("noGP",contains="L2ScaleShapeUnion")
GP2 <- GP
class(GP2) <- "noGP"
asvarMedkMAD(GP2,k=1) ### uses numerical integration
```

---

asvarPickands

*Function to compute asymptotic variance of Pickands estimator*

---

**Description**

Function asvarPickands computes the asymptotic (co)variance of a Pickands estimator at a GPD or GEVD model.

**Usage**

```
asvarPickands( model, alpha=2)
```

**Arguments**

model	an object of class "ScaleShapeUnion".
alpha	numeric > 1; determines the variant of the Pickands-Estimator based on matching the empirical $a_1 = 1 - 1/\alpha$ and $a_1 = 1 - 1/\alpha^2$ quantiles against the population counter parts. The "classical" Pickands Estimator is obtained for alpha=2 (GPD) resp. for alpha=1/log(2) (GEVD).

**Details**

All terms are analytic.

**Value**

A 2x2 matrix; the covariance.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**References**

Ruckdeschel, P. and Horbenko, N. (2011): Optimally-Robust Estimators in Generalized Pareto Models. ArXiv 1005.1476. To appear at *Statistics*. DOI: 10.1080/02331888.2011.628022.

**See Also**

[PickandsEstimator](#)

**Examples**

```
GP <- GParetoFamily(scale=1,shape=0.7)
asvarPickands(GP)
asvarPickands(GP,alpha=2.3)
```

---

asvarQBCC

---

*Function to compute asymptotic variance of QuantileBCC estimator*


---

**Description**

Function asvarQBCC computes the asymptotic (co)variance of a QuantileBCC estimator at a Weibull model.

**Usage**

```
asvarQBCC( model, p1 = 1/3, p2 = 2/3)
```

**Arguments**

model            an object of class "ScaleShapeUnion".  
p1,p2            levels of the quantiles; maximal breakdown point is achieved for  $p1 = p2 - p1 = 1 - p2 = 1/3$  which is the default.

**Details**

All terms are analytic.

**Value**

A 2x2 matrix; the covariance.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**See Also**

[QuantileBCCEstimator](#)

**Examples**

```
GP <- WeibullFamily(scale=1,shape=0.7)
asvarQBCC(GP)
asvarQBCC(GP, p1=1/4, p2= 5/8)
```

---

checkmakeIC-methods    *Methods for Functions checkIC and makeIC in Package ‘RobExtremes’*

---

**Description**

checkIC checks accuracy of the centering and Fisher consistency condition of an IC, makeIC, by centering and restandardizing warrants these conditions.

**Methods**

**checkIC** signature(IC="IC", L2Fam = "ParetoFamily"): To enhance accuracy, the method for "ParetoFamily" uses integration via the quantile transform, i.e.,  $E[h(X)]$  for a random variable  $X \sim F$  with quantil function  $q$  is computed as  $\int_0^1 h(q(s)) ds$

**checkIC** signature(IC="IC", L2Fam = "GParetoFamily"): As for "ParetoFamily", to enhance accuracy, the method for "GParetoFamily" uses integration via the quantile transform.

**checkIC** signature(IC="IC", L2Fam = "GEVFamily"): As for "ParetoFamily", to enhance accuracy, the method for "GEVFamily" uses integration via the quantile transform.

**checkIC** signature(IC="IC", L2Fam = "GEVFamilyMuUnknown"): As for "ParetoFamily", to enhance accuracy, the method for "GEVFamilyMuUnknown" uses integration via the quantile transform.

**makeIC** signature(IC="IC", L2Fam = "ParetoFamily"): As with "checkIC", to enhance accuracy, the method for "makeIC" for "ParetoFamily" uses integration via the quantile transform.

**makeIC** signature(IC="IC", L2Fam = "GParetoFamily"): As for "ParetoFamily", to enhance accuracy, the method for "GParetoFamily" uses integration via the quantile transform.

**makeIC** signature(IC="IC", L2Fam = "GEVFamily"): As for "ParetoFamily", to enhance accuracy, the method for "GEVFamily" uses integration via the quantile transform.

**makeIC** signature(IC="IC", L2Fam = "GEVFamilyMuUnknown"): As for "ParetoFamily", to enhance accuracy, the method for "GEVFamilyMuUnknown" uses integration via the quantile transform.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**See Also**

[checkIC,makeIC](#)

E

*Generic Function for the Computation of (Conditional) Expectations*

**Description**

Generic function for the computation of (conditional) expectations.

**Usage**

```
E(object, fun, cond, ...)

## S4 method for signature 'GEV,missing,missing'
E(object, low = NULL, upp = NULL, ..., diagnostic = FALSE)
## S4 method for signature
## 'DistributionsIntegratingByQuantiles,function,missing'
E(object,
    fun, low = NULL, upp = NULL,
    rel.tol= getdistrExOption("ErelativeTolerance"),
    lowerTruncQuantile = getdistrExOption("ElowerTruncQuantile"),
    upperTruncQuantile = getdistrExOption("EupperTruncQuantile"),
    IQR.fac = max(1e4,getdistrExOption("IQR.fac")), ..., diagnostic = FALSE)
## S4 method for signature 'Gumbel,missing,missing'
E(object, low = NULL, upp = NULL, ..., diagnostic = FALSE)
## S4 method for signature 'GPareto,missing,missing'
E(object, low = NULL, upp = NULL, ..., diagnostic = FALSE)
## S4 method for signature 'GPareto,function,missing'
E(object, fun, low = NULL, upp = NULL,
    rel.tol= getdistrExOption("ErelativeTolerance"),
    lowerTruncQuantile = getdistrExOption("ElowerTruncQuantile"),
    upperTruncQuantile = getdistrExOption("EupperTruncQuantile"),
    IQR.fac = max(1e4,getdistrExOption("IQR.fac")), ..., diagnostic = FALSE)
## S4 method for signature 'Pareto,missing,missing'
E(object, low = NULL, upp = NULL, ..., diagnostic = FALSE)
```

**Arguments**

object	object of class "Distribution"
fun	if missing the (conditional) expectation is computed else the (conditional) expectation of fun is computed.

<code>cond</code>	if not missing the conditional expectation given <code>cond</code> is computed.
<code>rel.tol</code>	relative tolerance for <code>distrExIntegrate</code> .
<code>low</code>	lower bound of integration range.
<code>upp</code>	upper bound of integration range.
<code>lowerTruncQuantile</code>	lower quantile for quantile based integration range.
<code>upperTruncQuantile</code>	upper quantile for quantile based integration range.
<code>IQR.fac</code>	factor for scale based integration range (i.e.; median of the distribution $\pm IQR.fac \times IQR$ ).
<code>...</code>	additional arguments to <code>fun</code>
<code>diagnostic</code>	logical; if TRUE, the return value obtains an attribute <code>"diagnostic"</code> with diagnostic information on the integration, i.e., a list with entries <code>method</code> ( <code>"integrate"</code> or <code>"GLIntegrate"</code> ), <code>call</code> , <code>result</code> (the complete return value of the method), <code>args</code> (the args with which the method was called), and <code>time</code> (the time to compute the integral).

## Details

The precision of the computations can be controlled via certain global options; cf. [distrExOptions](#). Also note that arguments `low` and `upp` should be given as named arguments in order to prevent them to be matched by arguments `fun` or `cond`. Also the result, when arguments `low` or `upp` is given, is the *unconditional value* of the expectation; no conditioning with respect to `low <= object <= upp` is done. To be able to use integration after transformation via the respective probability transformation to  $[0,1]$ , we introduce a class union `"DistributionsIntegratingByQuantiles"`, which currently comprises classes `"GPareto"`, `"Pareto"`, `"Weibull"`, `"GEV"`. In addition, the specific method for `"GPareto"`, `"function"`, `"missing"` uses integration on  $[0,1]$  via the substitution method ( $y := \log(x)$ ).

Diagnostics on the involved integrations are available if argument `diagnostic` is TRUE. Then there is attribute `diagnostic` attached to the return value, which may be inspected and accessed through [showDiagnostic](#) and [getDiagnostic](#).

## Value

The expectation is computed.

## Methods

**object = "Gumbel", fun = "missing", cond = "missing":** exact evaluation using explicit expressions.

**object = "GPareto", fun = "missing", cond = "missing":** exact evaluation using explicit expressions.

**object = "DistributionsIntegratingByQuantiles", fun = "function", cond = "missing":** use probability transform, i.e., a substitution  $y = p(object)(x)$  for numerical integration.

**object = "GPareto", fun = "function", cond = "missing":** use substitution method ( $y := \log(x)$ ) for numerical integration.

**object = "Pareto", fun = "missing", cond = "missing":** exact evaluation using explicit expressions.

**Author(s)**

Matthias Kohl <Matthias.Kohl@stamats.de> and Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**See Also**

[distrExIntegrate](#), [m1df](#), [m2df](#), [Distribution-class](#)

**Examples**

```
GP <- GPareto(shape=0.3)

E(GP)
E(GP, fun = function(x){2*x^2}) ## uses the log trafo

P <- Pareto()
E(P)
E(P, fun = function(x){1/(x^2+1)})
```

---

getCVaR

*Risk Measures for Scale-Shape Families*


---

**Description**

Functions to compute Value-at-Risk (VaR), Conditional Value-at-Risk (CVaR) and Expected Loss (EL) at data from scale-shape families.

**Usage**

```
getVaR(data, model, level, rob=TRUE)
getCVaR(data, model, level, rob=TRUE)
getEL(data, model, N0, rob=TRUE)
## S3 method for class 'riskMeasure'
print(x, level=NULL, ...)
```

**Arguments**

data	data at which to compute the risk measure.
model	an object of class "L2ScaleShapeFamily". The parametric family at which to evaluate the risk measure.
level	real: probability needed for VaR and CVaR.
N0	real: expected frequency for expected loss.
rob	logical; if TRUE (default) the RMXE-parametric estimator is used; otherwise the MLE.
x	an object of (S3-)class "riskmeasure".
...	further arguments for print.

**Value**

The risk measures `getVaR`, `getCVaR`, `getEL` return an (S3) object of class "riskMeasure", i.e., a numeric vector of length 2 with components "Risk" and "varofRisk" containing the respective risk measure and a corresponding (asymptotic) standard error for the risk measure. To the return class "riskMeasure", there is a particular print-method; if the corresponding argument `level` is NULL (default) the corresponding standard error is printed together with the risk measure; otherwise a corresponding CLT-based confidence interval for the risk measure is produced.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**References**

P. Ruckdeschel, N. Horbenko (2013): Optimally-Robust Estimators in Generalized Pareto Models. *Statistics* 47(4), 762–791. N. Horbenko, P. Ruckdeschel, T. Bae (2011): Robust Estimation of Operational Risk. *Journal of Operational Risk* 6(2), 3–30.

**See Also**

[GParetoFamily](#), [GEVFamily](#), [WeibullFamily](#), [GammaFamily](#)

**Examples**

```
# to reduce checking time
set.seed(123)
GPD <- GParetoFamily(loc=20480, scale=7e4, shape=0.3)
data <- r(GPD)(500)
getCVaR(data,GPD,0.99)
getVaR(data,GPD,0.99)
getEL(data,GPD,5)
getVaR(data,GPD,0.99, rob=FALSE)
getEL(data,GPD,5, rob=FALSE)
getCVaR(data,GPD,0.99, rob=FALSE)
```

---

getStartIC-methods      *Methods for Function getStartIC in Package 'RobExtremes'*

---

**Description**

`getStartIC` computes the optimally-robust IC to be used as argument `ICstart` in `kStepEstimator`.



**Usage**

```

getStartIC(model, risk, ...)
## S4 method for signature 'L2ScaleShapeUnion,interpolRisk'
getStartIC(model, risk, ...,
  withMakeIC = FALSE, ..debug=FALSE, modifyICwarn = NULL)
## S4 method for signature 'L2LocScaleShapeUnion,interpolRisk'
getStartIC(model, risk, ...,
  withMakeIC = FALSE, ..debug=FALSE, modifyICwarn = NULL)
## S4 method for signature 'ParetoFamily,interpolRisk'
getStartIC(model, risk, ...,
  withMakeIC = FALSE)

```

**Arguments**

model	normtype of class NormType
risk	normtype of class NormType
...	further arguments to be passed to specific methods.
withMakeIC	logical; if TRUE the IC is passed through makeIC before return.
..debug	logical; if TRUE information for debugging is issued.
modifyICwarn	logical: should a (warning) information be added if modifyIC is applied and hence some optimality information could no longer be valid? Defaults to NULL in which case this value is taken from RobASTBaseOptions.

**Details**

getStartIC is used internally in functions robest and roptest to compute the optimally robust influence function according to the arguments given to them.

**Value**

An IC of type HampIC.

**Methods**

**getStartIC** signature(model = "L2ScaleShapeUnion", risk = "interpolRisk"): computes the optimally robust influence function by interpolation on a grid (using internal helper function .getPsi).

**getStartIC** signature(model = "L2LocScaleShapeUnion", risk = "interpolRisk"): computes the optimally robust influence function by interpolation on a grid (using internal helper function .getPsi.wL).

**getStartIC** signature(model = "ParetoFamily", risk = "interpolRisk"): computes the optimally robust influence function by interpolation on a grid (using internal helper function .getPsi.P).

All of these methods recenter and restandardize the obtained ICs to warrant centeredness and Fisher consistency.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**See Also**

[robest](#), [optIC](#), [radiusMinimaxIC](#)

---

GEV

*Generating function for GEV-class*

---

**Description**

Generates an object of class "GEV".

**Usage**

```
GEV(loc = 0, scale = 1, shape = 0, location = loc)
```

**Arguments**

loc	real number: location parameter of the GEV distribution.
scale	positive real number: scale parameter of the GEV distribution
shape	non-negative real number: shape parameter of the GEV distribution.
location	real number: location of GEV distribution

**Value**

Object of class "GEV"

**Note**

The class "GEV" is based on the code provided by the package **evd** by Alec Stephenson.

**Author(s)**

Nataliya Horbenko <nhorbenko@gmail.com>

**See Also**

[GEV-class](#), [dgpd](#)

**Examples**

```
(P1 <- GEV(loc = 0, scale = 1, shape = 0))
plot(P1)

E(GEV())
E(P1)
E(P1, function(x){x^2})
var(P1)
sd(P1)
median(P1)
IQR(P1)
mad(P1)
```

---

 GEV-class

*Generalized EV distribution*


---

**Description**

[borrowed from **evd**]: The GEV distribution function with parameters  $\text{loc} = a$ ,  $\text{scale} = b$ ,  $\text{shape} = s$  is

$$G(x) = \exp[-1 + s(z - a)/b^{(1 - 1/s)}]$$

for  $1 + s(z - a)/b > 0$ , where  $b > 0$ . If  $s = 0$  the distribution is defined by continuity. If  $1 + s(z - a)/b \leq 0$ , the value  $z$  is either greater than the upper end point (if  $s < 0$ ), or less than the lower end point (if  $s > 0$ ).

**Objects from the Class**

Objects can be created by calls of the form `new("GEV", loc, scale, shape)`. More frequently they are created via the generating function `GEV`.

**Slots**

`img` Object of class "Reals".  
`param` Object of class "GEVParameter".  
`r` `rgpd`  
`d` `dgp`  
`p` `pgpd`, but vectorized and with special treatment of arguments `lower.tail` and `log.p`  
`q` `qgp`, but vectorized and with special treatment of arguments `lower.tail` and `log.p`  
`gaps` (numeric) matrix or NULL  
`.withArith` logical: used internally to issue warnings as to interpretation of arithmetics  
`.withSim` logical: used internally to issue warnings as to accuracy  
`.logExact` logical: used internally to flag the case where there are explicit formulae for the log version of density, cdf, and quantile function  
`.lowerExact` logical: used internally to flag the case where there are explicit formulae for the lower tail version of cdf and quantile function

**Extends**

Class "AbscontDistribution", directly.

Class "UnivariateDistribution", by class "AbscontDistribution".

Class "Distribution", by class "AbscontDistribution".

**Methods**

**initialize** signature(.Object = "GEV"): initialize method.

**shape** signature(object = "GEV"): wrapped access method for slot shape of slot param.

**loc** signature(object = "GEV"): wrapped access method for slot loc of slot param.

**location** signature(object = "GEV"): alias to loc, to support argument naming of package **VGAM**.

**scale** signature(x = "GEV"): wrapped access method for slot scale of slot param.

**shape<-** signature(object = "GEV"): wrapped replace method for slot shape of slot param.

**loc<-** signature(object = "GEV"): wrapped replace method for slot loc of slot param.

**location<-** signature(object = "GEV"): alias to loc<-, to support argument naming of package **VGAM**.

**scale<-** signature(x = "GEV"): wrapped replace method for slot scale of slot param.

**+** signature(e1 = "GEV", e2 = "numeric"): exact method for this transformation — stays within this class.

**\*** signature(e1 = "GEV", e2 = "numeric"): exact method for this transformation — stays within this class if  $e2 > 0$ .

**E** signature(object = "GEV", fun = "missing", cond = "missing"): exact evaluation using explicit expressions.

**var** signature(signature(x = "GEV"): exact evaluation using explicit expressions.

**median** signature(signature(x = "GEV"): exact evaluation using explicit expressions.

**IQR** signature(signature(x = "GEV"): exact evaluation using explicit expressions.

**skewness** signature(signature(x = "GEV"): exact evaluation using explicit expressions.

**kurtosis** signature(signature(x = "GEV"): exact evaluation using explicit expressions.

**liesInSupport** signature(object = "GEV", x = "numeric"): checks if x lies in the support of the respective distribution.

**Note**

This class is based on the code provided by the package **evd** by A. G. Stephenson.

**Author(s)**

Nataliya Horbenko <nhorbenko@gmail.com>

**References**

Pickands, J. (1975) *Statistical inference using extreme order statistics*. *Annals of Statistics*, \*3\*, 119-131.

**See Also**

[dgpd](#), [AbscontDistribution-class](#)

**Examples**

```
(P1 <- new("GEV", loc = 0, scale = 1, shape = 0))
plot(P1)
shape(P1)
loc(P1)
scale(P1) <- 4
loc(P1) <- 2
shape(P1) <- -1 # may be negative!
plot(P1)
```

---

GEVFamily

*Generating function for families of Generalized Extreme Value distributions*

---

**Description**

Generates an object of class "GEVFamily" which represents a Generalized EV family.

**Usage**

```
GEVFamily(loc = 0, scale = 1, shape = 0.5, of.interest = c("scale", "shape"),
  p = NULL, N = NULL, trafo = NULL, startEst = NULL, withPos = TRUE,
  secLevel = 0.7, withCentL2 = FALSE, withL2derivDistr = FALSE,
  withMDE = FALSE, ..ignoreTrafo = FALSE, ..withWarningGEV = TRUE)
```

**Arguments**

loc	real: known/fixed threshold/location parameter
scale	positive real: scale parameter
shape	positive real: shape parameter
of.interest	character: which parameters, transformations are of interest. possibilities are: "scale", "shape", "quantile", "expected loss", "expected shortfall"; a maximum number of two of these may be selected
p	real or NULL: probability needed for quantile and expected shortfall
N	real or NULL: expected frequency for expected loss
trafo	matrix or NULL: transformation of the parameter
startEst	startEstimator — if NULL <a href="#">PickandsEstimator</a> is used
withPos	logical of length 1: Is shape restricted to positive values?
secLevel	a numeric of length 1: In the ideal GEV model, for each observation $X_i$ , the expression $1 + \frac{\text{shape}(X_i - \text{loc})}{\text{scale}}$ must be positive, which in principle could be attacked by a single outlier. Hence for sample size $n$ we allow for $\varepsilon n$ violations, interpreting the violations as outliers. Here $\varepsilon = \text{secLevel} / \sqrt{n}$ .

withCentL2      logical: shall L2 derivative be centered by subtracting the E()? Defaults to FALSE, but higher accuracy can be achieved when set to TRUE.

withL2derivDistr      logical: shall the distribution of the L2 derivative be computed? Defaults to FALSE (to speed up computations).

withMDE      logical: should Minimum Distance Estimators be used to find a good starting value for the parameter search? Defaults to FALSE (to speed up computations). We have seen cases though, where the use of the then employed PickandsEstimator was drastically misleading and subsequently led to bad estimates where it is used as starting value; so where feasible it is a good idea to also try argument withMDE=TRUE for control purposes.

..ignoreTrafo      logical: only used internally in kStepEstimator; do not change this.

..withWarningGEV      logical: shall warnings be issued if shape is large?

### Details

The slots of the corresponding L2 differentiable parameteric family are filled.

### Value

Object of class "GEVFamily"

### Author(s)

Matthias Kohl <Matthias.Kohl@stamats.de>  
 Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>  
 Nataliya Horbenko <nhorbenko@gmail.com>

### References

Kohl, M. (2005) *Numerical Contributions to the Asymptotic Theory of Robustness*. Bayreuth: Dissertation.

M.-Kohl, P. Ruckdeschel, H.-Rieder (2010): Infinitesimally Robust Estimation in General Smoothly Parametrized Models. *Stat. Methods Appl.*, **19**, 333–354.

Ruckdeschel, P. and Horbenko, N. (2012): Yet another breakdown point notion: EFSBP –illustrated at scale-shape models. *Metrika*, **75**(8), 1025–1047.

### See Also

[L2ParamFamily-class](#), [GPareto](#)

### Examples

```
(G1 <- GEVFamily())
FisherInfo(G1)
checkL2deriv(G1)
```

---

GEVFamilyMuUnknown	<i>Generating function for families of Generalized Extreme Value distributions</i>
--------------------	--

---

### Description

Generates an object of class "GEVFamilyMuUnknown" which represents a Generalized EV family with unknown location parameter mu.

### Usage

```
GEVFamilyMuUnknown(loc = 0, scale = 1, shape = 0.5, of.interest = c("loc",
  "scale", "shape"), p = NULL, N = NULL, trafo = NULL,
  start0Est = NULL, withPos = TRUE, secLevel = 0.7,
  withCentL2 = FALSE, withL2derivDistr = FALSE, withMDE = FALSE,
  ..ignoreTrafo = FALSE, ..withWarningGEV = TRUE, ..name = "")
```

### Arguments

loc	real: known/fixed threshold/location parameter
scale	positive real: scale parameter
shape	positive real: shape parameter
of.interest	character: which parameters, transformations are of interest. possibilities are: "scale", "shape", "quantile", "expected loss", "expected short-fall"; a maximum number of two of these may be selected
p	real or NULL: probability needed for quantile and expected shortfall
N	real or NULL: expected frequency for expected loss
trafo	matrix or NULL: transformation of the parameter
start0Est	startEstimator — if NULL <a href="#">PickandsEstimator</a> is used
withPos	logical of length 1: Is shape restricted to positive values?
secLevel	a numeric of length 1: In the ideal GEV model, for each observation $X_i$ , the expression $1 + \frac{\text{shape}(X_i - \text{loc})}{\text{scale}}$ must be positive, which in principle could be attacked by a single outlier. Hence for sample size $n$ we allow for $\varepsilon n$ violations, interpreting the violations as outliers. Here $\varepsilon = \text{secLevel}/\sqrt{n}$ .
withCentL2	logical: shall L2 derivative be centered by subtracting the E()? Defaults to FALSE, but higher accuracy can be achieved when set to TRUE.
withL2derivDistr	logical: shall the distribution of the L2 derivative be computed? Defaults to FALSE (to speed up computations).
withMDE	logical: should Minimum Distance Estimators be used to find a good starting value for the parameter search? Defaults to FALSE (to speed up computations). We have seen cases though, where the use of the then employed <a href="#">PickandsEstimator</a> was drastically misleading and subsequently led to bad estimates where it is used as starting value; so where feasible it is a good idea to also try argument <code>withMDE=TRUE</code> for control purposes.

```

..ignoreTrafo logical: only used internally in kStepEstimator; do not change this.
..withWarningGEV
                logical: shall warnings be issued if shape is large?
..name          character: optional alternative name for the parametric family; used in generat-
                ing interpolating grids.

```

### Details

The slots of the corresponding L2 differentiable parameteric family are filled.

### Value

Object of class "GEVFamilyMuUnknown"

### Author(s)

Matthias Kohl <Matthias.Kohl@stamats.de>  
 Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>  
 Nataliya Horbenko <nhorbenko@gmail.com>

### References

Kohl, M. (2005) *Numerical Contributions to the Asymptotic Theory of Robustness*. Bayreuth: Dis-  
 sertation.

M.-Kohl, P. Ruckdeschel, H.-Rieder (2010): Infinitesimally Robust Estimation in General Smoothly  
 Parametrized Models. *Stat. Methods Appl.*, **19**, 333–354.

Ruckdeschel, P. and Horbenko, N. (2012): Yet another breakdown point notion: EFSBP –illustrated  
 at scale-shape models. *Metrika*, **75**(8), 1025–1047.

### See Also

[L2ParamFamily-class](#), [GPareto](#)

### Examples

```

(G1 <- GEVFamilyMuUnknown())
FisherInfo(G1)
checkL2deriv(G1)

```



---

GEVParameter-class      *Parameter of generalized Pareto distributions*

---

### Description

The class of the parameter of generalized Pareto distribution.

### Objects from the Class

Objects can be created by calls of the form `new("GEVParameter", ...)`.

### Slots

`loc` real number: location parameter of a GEV distribution.

`scale` real number: scale parameter of a GEV distribution.

`shape` real number: shape parameter of a GEV distribution.

`name` default name is "parameter of a GEV distribution".

### Extends

Class "Parameter", directly.

Class "OptionalParameter", by class "Parameter".

### Methods

**loc** signature(object = "GEVParameter"): access method for slot `loc`.

**location** signature(object = "GEVParameter"): alias to `loc`, to support argument naming of package **VGAM**.

**scale** signature(object = "GEVParameter"): access method for slot `scale`.

**shape** signature(object = "GEVParameter"): access method for slot `shape`.

**loc<-** signature(object = "GEVParameter"): replace method for slot `loc`.

**location<-** signature(object = "GEVParameter"): alias to `loc<-`, to support argument naming of package **VGAM**.

**shape<-** signature(object = "GEVParameter"): replace method for slot `shape`.

**shape<-** signature(object = "GEVParameter"): replace method for slot `shape`.

### Author(s)

Nataliya Horbenko <nhorbenko@gmail.com>

### See Also

[GEV-class](#), [Parameter-class](#)

**Examples**

```
P <- new("GEVParameter")
loc(P)
## same as
location(P)
scale(P)
shape(P)

scale(P) <- 2
location(P) <- 4
shape(P) <- -1 # may be negative!
P
```

---

GPareto

*Generating function for GPareto-class*

---

**Description**

Generates an object of class "GPareto".

**Usage**

```
GPareto(loc = 0, scale = 1, shape = 0, location = loc)
```

**Arguments**

loc	real number: location parameter of the GPareto distribution.
scale	positive real number: scale parameter of the GPareto distribution
shape	non-negative real number: shape parameter of the GPareto distribution.
location	alternative argument name for argument 'loc' — to support argument names of package <b>VGAM</b> .

**Value**

Object of class "GPareto"

**Note**

The class "GPareto" is based on the code provided by the package **evd** by Alec Stephenson.

**Author(s)**

Nataliya Horbenko <nhorbenko@gmail.com>

**See Also**

[GPareto-class](#), [dgpdp](#)

**Examples**

```
(P1 <- GPareto(loc = 1, scale = 1, shape = -0.5))
plot(P1)
```

```
E(GPareto())
E(P1)
E(P1, function(x){x^2})
var(P1)
sd(P1)
median(P1)
IQR(P1)
mad(P1)
```

---

 GPareto-class

*Generalized Pareto distribution*


---

**Description**

[borrowed from **evd**]:

The (Three-parameter) generalized Pareto distribution with parameter  $\text{loc} = a$ ,  $\text{scale} = b$ ,  $\text{shape} = c$  has density:

$$f(x) = \frac{1}{b}(1 + cz)^{-1/c - 1}, \quad z = \frac{x - a}{c}$$

for  $x > a$  ( $c \geq 0$ ) and  $a \leq x \leq a - b/c$  ( $c < 0$ ).

**Objects from the Class**

Objects can be created by calls of the form `new("GPareto", loc, scale, shape)`. More frequently they are created via the generating function `GPareto`.

**Slots**

`img` Object of class "Reals".

`param` Object of class "GParetoParameter".

`r` `rgpd`

`d` `dgpd`

`p` `pgpd`, but vectorized and with special treatment of arguments `lower.tail` and `log.p`

`q` `qgpd`, but vectorized and with special treatment of arguments `lower.tail` and `log.p`

`gaps` (numeric) matrix or NULL

`.withArith` logical: used internally to issue warnings as to interpretation of arithmetics

`.withSim` logical: used internally to issue warnings as to accuracy

`.logExact` logical: used internally to flag the case where there are explicit formulae for the log version of density, cdf, and quantile function

`.lowerExact` logical: used internally to flag the case where there are explicit formulae for the lower tail version of cdf and quantile function

**Extends**

Class "AbscontDistribution", directly.

Class "UnivariateDistribution", by class "AbscontDistribution".

Class "Distribution", by class "AbscontDistribution".

**Methods**

**initialize** signature(.Object = "GPareto"): initialize method.

**shape** signature(object = "GPareto"): wrapped access method for slot shape of slot param.

**loc** signature(object = "GPareto"): wrapped access method for slot loc of slot param.

**location** signature(object = "GPareto"): alias to loc, to support argument naming of package **VGAM**.

**scale** signature(x = "GPareto"): wrapped access method for slot scale of slot param.

**shape<-** signature(object = "GPareto"): wrapped replace method for slot shape of slot param.

**loc<-** signature(object = "GPareto"): wrapped replace method for slot loc of slot param.

**location<-** signature(object = "GPareto"): alias to loc<-, to support argument naming of package **VGAM**.

**scale<-** signature(x = "GPareto"): wrapped replace method for slot scale of slot param.

**+** signature(e1 = "GPareto", e2 = "numeric"): exact method for this transformation — stays within this class.

**\*** signature(e1 = "GPareto", e2 = "numeric"): exact method for this transformation — stays within this class if  $e2 > 0$ .

**E** signature(object = "GPareto", fun = "missing", cond = "missing"): exact evaluation using explicit expressions.

**var** signature(signature(x = "GPareto"): exact evaluation using explicit expressions.

**median** signature(signature(x = "GPareto"): exact evaluation using explicit expressions.

**IQR** signature(signature(x = "GPareto"): exact evaluation using explicit expressions.

**skewness** signature(signature(x = "GPareto"): exact evaluation using explicit expressions.

**kurtosis** signature(signature(x = "GPareto"): exact evaluation using explicit expressions.

**liesInSupport** signature(object = "GPareto", x = "numeric"): checks if x lies in the support of the respective distribution.

**Note**

This class is based on the code provided by the package **evd** by A. G. Stephenson.

**Author(s)**

Nataliya Horbenko <nhorbenko@gmail.com>

**References**

Pickands, J. (1975) *Statistical inference using extreme order statistics*. *Annals of Statistics*, \*3\*, 119-131.

**See Also**

[dgpdp](#), [AbscontDistribution-class](#)

**Examples**

```
(P1 <- new("GPareto", loc = 0, scale = 1, shape = 0))
plot(P1)
shape(P1)
loc(P1)
scale(P1) <- 4
location(P1) <- 2 ## same as loc(P1) <- 2
shape(P1) <- -2 # may be negative
plot(P1)
```

---

GParetoFamily

*Generating function for Generalized Pareto families*


---

**Description**

Generates an object of class "GParetoFamily" which represents a Generalized Pareto family.

**Usage**

```
GParetoFamily(loc = 0, scale = 1, shape = 0.5, of.interest = c("scale", "shape"),
  p = NULL, N = NULL, trafo = NULL, startEst = NULL, withPos = TRUE,
  secLevel = 0.7, withCentL2 = FALSE, withL2derivDistr = FALSE,
  withMDE = FALSE, ..ignoreTrafo = FALSE)
```

**Arguments**

loc	real: known/fixed threshold/location parameter
scale	positive real: scale parameter
shape	positive real: shape parameter
of.interest	character: which parameters, transformations are of interest. possibilities are: "scale", "shape", "quantile", "expected loss", "expected short-fall"; a maximum number of two of these may be selected
p	real or NULL: probability needed for quantile and expected shortfall
N	real or NULL: expected frequency for expected loss
trafo	matrix or NULL: transformation of the parameter
startEst	startEstimator — if NULL <a href="#">medkMADhybr</a> is used
withPos	logical of length 1: Is shape restricted to positive values?
secLevel	a numeric of length 1: In the ideal GEV model, for each observation $X_i$ , the expression $1 + \frac{\text{shape}(X_i - \text{loc})}{\text{scale}}$ must be positive, which in principle could be attacked by a single outlier. Hence for sample size $n$ we allow for $\varepsilon n$ violations, interpreting the violations as outliers. Here $\varepsilon = \text{secLevel} / \sqrt{n}$ .

withCentL2      logical: shall L2 derivative be centered by subtracting the E()? Defaults to FALSE, but higher accuracy can be achieved when set to TRUE.

withL2derivDistr      logical: shall the distribution of the L2 derivative be computed? Defaults to FALSE (to speed up computations).

withMDE      logical: should Minimum Distance Estimators be used to find a good starting value for the parameter search? Defaults to FALSE (to speed up computations).

..ignoreTrafo      logical: only used internally in kStepEstimator; do not change this.

### Details

The slots of the corresponding L2 differentiable parameteric family are filled.

### Value

Object of class "GParetoFamily"

### Author(s)

Matthias Kohl <Matthias.Kohl@stamats.de>  
 Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>  
 Nataliya Horbenko <nhorbenko@gmail.com>

### References

Kohl, M. (2005) *Numerical Contributions to the Asymptotic Theory of Robustness*. Bayreuth: Dissertation.

M.-Kohl, P. Ruckdeschel, H.-Rieder (2010): Infinitesimally Robust Estimation in General Smoothly Parametrized Models. *Stat. Methods Appl.*, **19**, 333–354.

Ruckdeschel, P. and Horbenko, N. (2011): Optimally-Robust Estimators in Generalized Pareto Models. ArXiv 1005.1476. To appear at *Statistics*. DOI: 10.1080/02331888.2011.628022.

Ruckdeschel, P. and Horbenko, N. (2012): Yet another breakdown point notion: EFSBP –illustrated at scale-shape models. *Metrika*, **75**(8), 1025–1047.

### See Also

[L2ParamFamily-class](#), [GPareto](#)

### Examples

```
(G1 <- GParetoFamily())
FisherInfo(G1)
checkL2deriv(G1)
```

---

GParetoParameter-class

*Parameter of generalized Pareto distributions*

---

### Description

The class of the parameter of generalized Pareto distribution.

### Objects from the Class

Objects can be created by calls of the form `new("GParetoParameter", ...)`.

### Slots

`loc` real number: location parameter of a generalized Pareto distribution.  
`scale` real number: scale parameter of a generalized Pareto distribution.  
`shape` real number: shape parameter of a generalized Pareto distribution.  
`name` default name is "parameter of a GPareto distribution".

### Extends

Class "Parameter", directly.  
Class "OptionalParameter", by class "Parameter".

### Methods

**loc** signature(object = "GParetoParameter"): access method for slot loc.  
**location** signature(object = "GParetoParameter"): alias to loc, to support argument naming of package **VGAM**.  
**scale** signature(object = "GParetoParameter"): access method for slot scale.  
**shape** signature(object = "GParetoParameter"): access method for slot shape.  
**loc<-** signature(object = "GParetoParameter"): replace method for slot loc.  
**location<-** signature(object = "GParetoParameter"): alias to loc<-, to support argument naming of package **VGAM**.  
**shape<-** signature(object = "GParetoParameter"): replace method for slot shape.  
**shape<-** signature(object = "GParetoParameter"): replace method for slot shape.

### Author(s)

Nataliya Horbenko <nhorbenko@gmail.com>

### See Also

[GPareto-class](#), [Parameter-class](#)

**Examples**

```
P <- new("GParetoParameter")
loc(P)
## same as
location(P)
scale(P)
shape(P)

scale(P) <- 2
loc(P) <- -5
shape(P) <- -1 # may be negative
P
```

---

Gumbel

*Generating function for Gumbel-class*

---

**Description**

Generates an object of class "Gumbel".

**Usage**

```
Gumbel(loc = 0, scale = 1)
```

**Arguments**

loc	real number: location parameter of the Gumbel distribution.
scale	positive real number: scale parameter of the Gumbel distribution

**Value**

Object of class "Gumbel"

**Note**

The class "Gumbel" is based on the code provided by the package **evd**.

**Author(s)**

Matthias Kohl <Matthias.Kohl@stamats.de>

**See Also**

[Gumbel-class](#), [rgumbel](#)



**Examples**

```
(G1 <- Gumbel(loc = 1, scale = 2))
plot(G1)
loc(G1)
scale(G1)
loc(G1) <- -1
scale(G1) <- 2
plot(G1)

E(Gumbel()) # Euler's constant
E(G1, function(x){x^2})

## The function is currently defined as
function(loc = 0, scale = 1){
  new("Gumbel", loc = loc, scale = scale)
}
```

---

Gumbel-class

*Gumbel distribution*


---

**Description**

The Gumbel cumulative distribution function with location parameter  $\text{loc} = \mu$  and scale parameter  $\text{scale} = \sigma$  is

$$F(x) = \exp(-\exp[-(x - \mu)/\sigma])$$

for all real  $x$ , where  $\sigma > 0$ ; c.f. `rgumbel`. This distribution is also known as extreme value distribution of type I; confer Chapter~22 of Johnson et al. (1995).

**Objects from the Class**

Objects can be created by calls of the form `new("Gumbel", loc, scale)`. More frequently they are created via the generating function `Gumbel`.

**Slots**

```
img Object of class "Reals".
param Object of class "GumbelParameter".
r rgumbel
d dgumbel
p pgumbel
q qgumbel
gaps (numeric) matrix or NULL
.withArith logical: used internally to issue warnings as to interpretation of arithmetics
.withSim logical: used internally to issue warnings as to accuracy
```

`.logExact` logical: used internally to flag the case where there are explicit formulae for the log version of density, cdf, and quantile function

`.lowerExact` logical: used internally to flag the case where there are explicit formulae for the lower tail version of cdf and quantile function

`Symmetry` object of class "DistributionSymmetry"; used internally to avoid unnecessary calculations.

### Extends

Class "AbscontDistribution", directly.  
 Class "UnivariateDistribution", by class "AbscontDistribution".  
 Class "Distribution", by class "AbscontDistribution".

### Methods

**initialize** signature(.Object = "Gumbel"): initialize method.

**loc** signature(object = "Gumbel"): wrapped access method for slot loc of slot param.

**scale** signature(x = "Gumbel"): wrapped access method for slot scale of slot param.

**loc<-** signature(object = "Gumbel"): wrapped replace method for slot loc of slot param.

**scale<-** signature(x = "Gumbel"): wrapped replace method for slot scale of slot param.

**+** signature(e1 = "Gumbel", e2 = "numeric"): result again of class "Gumbel"; exact.

**\*** signature(e1 = "Gumbel", e2 = "numeric"): result again of class "Gumbel"; exact.

**E** signature(object = "Gumbel", fun = "missing", cond = "missing"): exact evaluation of expectation using explicit expressions.

**var** signature(x = "Gumbel"): exact evaluation of expectation using explicit expressions.

**skewness** signature(x = "Gumbel"): exact evaluation of expectation using explicit expressions.

**kurtosis** signature(x = "Gumbel"): exact evaluation of expectation using explicit expressions.

**median** signature(x = "Gumbel"): exact evaluation of expectation using explicit expressions.

**IQR** signature(x = "Gumbel"): exact evaluation of expectation using explicit expressions.

**liesInSupport** signature(object = "Gumbel", x = "numeric"): checks if x lies in the support of the respective distribution.

### Note

This class is based on the code provided by the package **evd**.

### Author(s)

Matthias Kohl <Matthias.Kohl@stamats.de>

### References

Johnson et al. (1995) *Continuous Univariate Distributions. Vol. 2. 2nd ed.* New York: Wiley.

**See Also**

[rgumbel](#), [AbscontDistribution-class](#)

**Examples**

```
(G1 <- new("Gumbel", loc = 1, scale = 2))
plot(G1)
loc(G1)
scale(G1)
loc(G1) <- -1
scale(G1) <- 2
plot(G1)
```

---

GumbelLocationFamily *Generating function for Gumbel location families*

---

**Description**

Generates an object of class "L2LocationFamily" which represents a Gumbel location family.

**Usage**

```
GumbelLocationFamily(loc = 0, scale = 1, trafo)
```

**Arguments**

loc	location parameter
scale	scale parameter
trafo	function in param or matrix: transformation of the parameter

**Details**

The slots of the corresponding L2 differentiable parameteric family are filled.

**Value**

Object of class "L2LocationFamily"

**Author(s)**

Matthias Kohl <Matthias.Kohl@stamats.de>

**References**

Kohl, M. (2005) *Numerical Contributions to the Asymptotic Theory of Robustness*. Bayreuth: Dissertation.

**See Also**

[L2ParamFamily-class](#), [Gumbel-class](#)

**Examples**

```
##current implementation is:
theta <- 0
names(theta) <- "loc"
GL <- ParamFamily(name = "Gumbel location family",
  param = ParamFamParameter(name = "location parameter", main = theta),
  startPar = function(x,...) c(min(x),max(x)),
  distribution = Gumbel(loc = 0, scale = 1), ## scale known!
  modifyParam = function(theta){ Gumbel(loc = theta, scale = 1) },
  props = paste(c("The Gumbel location family is invariant under",
    "the group of transformations 'g(x) = x + loc'",
    "with location parameter 'loc'"), collapse = " "))

GL

(G1 <- GumbelLocationFamily())
plot(G1)
Map(L2deriv(G1)[[1]])
checkL2deriv(G1)
```

---

GumbelParameter-class *Parameter of Gumbel distributions*

---

**Description**

The class of the parameter of Gumbel distributions.

**Objects from the Class**

Objects can be created by calls of the form `new("GumbelParameter", ...)`.

**Slots**

`loc` real number: location parameter of a Gumbel distribution.  
`scale` positive real number: scale parameter of a Gumbel distribution.  
`name` default name is "parameter of a Gumbel distribution".

**Extends**

Class "Parameter", directly.  
 Class "OptionalParameter", by class "Parameter".

**Methods**

**loc** signature(object = "GumbelParameter"): access method for slot loc.

**scale** signature(x = "GumbelParameter"): access method for slot scale.

**loc<-** signature(object = "GumbelParameter"): replace method for slot loc.

**scale<-** signature(x = "GumbelParameter"): replace method for slot scale.

**Author(s)**

Matthias Kohl <Matthias.Kohl@stamats.de>

**See Also**

[Gumbel-class](#), [Parameter-class](#)

**Examples**

```
new("GumbelParameter")
```

---

InternalEstimatorReturnClasses

*Internal Estimator Return Classes in 'RobExtremes'*

---

**Description**

S4 classes for return values of estimators in package **RobExtremes** defined for internal purposes.

**Described classes**

The S4 classes described here are GPDEstimate, GEVEstimate, GPMCEstimate, GEVMCEstimate, GPDMEstimate, GEVMDEstimate, GPDLEstimate, GEVLDEstimate, GPDkStepEstimate, GEVkStepEstimate, GPDORobEstimate, GEVORobEstimate, GPDML.ALEstimate, GEVML.ALEstimate, GPDCvMMD.ALEstimate, GEVCvMMD.ALEstimate.

**Objects from the Class**

These classes are used internally to provide specific S4 methods for different estimators later on; thus, there are no generating functions.

**Slots**

All slots are inherited from parent classes.

**Extends**

Classes GPDEstimate, GEVEstimate extend class Estimate, directly.  
 Class GPDMEstimate extends classes GPDEstimate, MCEstimate, directly.  
 Class GEVMCEstimate extends classes GEVEstimate, MCEstimate, directly.  
 Class GPDMEstimate extends classes GPDEstimate, MDEstimate, directly.  
 Class GEVMDEstimate extends classes GEVEstimate, MDEstimate, directly.  
 Class GPDMLCAEstimate extends classes GPDEstimate, MCAEstimate, directly.  
 Class GEVMCAEstimate extends classes GEVEstimate, MCAEstimate, directly.  
 Class GPDLEstimate extends classes GPDEstimate, LDEstimate, directly.  
 Class GEVLEstimate extends classes GEVEstimate, LDEstimate, directly.  
 Class GPDkStepEstimate extends classes GPDEstimate, kStepEstimate, directly.  
 Class GEVkStepEstimate extends classes GEVEstimate, kStepEstimate, directly.  
 Class GPDORobEstimate extends classes GPDkStepEstimate, ORobEstimate, directly.  
 Class GEVORobEstimate extends classes GEVkStepEstimate, ORobEstimate, directly.  
 Class GPDML.ALEstimate extends classes GPDEstimate, ML.ALEstimate, directly.  
 Class GEVML.ALEstimate extends classes GEVEstimate, ML.ALEstimate, directly.  
 Class GPDCvMMD.ALEstimate extends classes GPDEstimate, CvMMD.ALEstimate, directly.  
 Class GEVCvMMD.ALEstimate extends classes GEVEstimate, CvMMD.ALEstimate, directly.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**See Also**

[Estimate-class](#), [MCEstimate-class](#), [kStepEstimate-class](#), [LDEstimate-class](#)

---

interpolateSn

*Function to compute LD (location-dispersion) estimates*

---

**Description**

Function LDEstimator provides a general way to compute estimates for a given parametric family of probability measures (with a scale and shape parameter) which can be obtained by matching location and dispersion functionals against empirical counterparts.

**Usage**

```
getShapeGrid(gridsize=1000, centralvalue=0.7,
             withPos=TRUE, cutoff.at.0=1e-4, fac = 2)

getSnGrid(xiGrid = getShapeGrid(), PFam=GParetoFamily(), low=0,
          upp=1.01, accuracy = 10000, GridFileName="SnGrid.Rdata",
          withPrint = FALSE)
```

**Arguments**

gridsize	integer; the size of the grid to be created.
centralvalue	numeric of length 1: the central value of the grid (for details see below).
withPos	logical of length 1; are negative values for the shape forbidden?
cutoff.at.0	numeric of length 1: How close may we come to 0?
fac	a scaling factor used for the respective grid values (see below).
xiGrid	numeric; grid of shape values.
PFam	an object of class "ParamFamily". The parametric family at which to evaluate the LDEstimator; the respective (main) parameter must contain "scale" and "shape".
low	numeric; argument for Sn.
upp	numeric; argument for Sn.
accuracy	numeric; argument for Sn.
GridFileName	character; if GridFileName!="", the pure y-grid values are saved under this filename.
withPrint	logical of length 1: shall current shape value be printed out?

**Details**

getShapeGrid is a helper function to produce an unequally spaced grid of shape values  $x_i$ , with the rationale that we need values close to some typical values more often than values at the border. The code starts with an equally spaced grid of size `gridsize` from 0.5 to  $1 - 0.25/\text{gridsize}$ . This is reflected at 0.5, and a grid of respective quantiles of  $\text{Norm}(\text{mean}=\text{centralvalue}, \text{sd}=\text{fac})$  is produced—with the heuristic rationale that most estimators will be asymptotically normal around a typical value. If `withPos` is TRUE, negative values are cut off and replaced by respective higher quantiles of the corresponding normal; similarly, values too close to 0 are replaced by values between the cutoff value and the next admissible value and again by respective higher normal quantiles.

getSnGrid is a helper function to produce a grid of Sn values for a given grid of shape values and scale equal to 1 in a given shape-scale family. This result of this function can then be used to speed up calls to Sn (or to medSn) by providing particular methods for Sn. For an example of such a particular method see the body of `getMethod("Sn", "GPareto")` where object `sng[["Generalized Pareto Family"]]` is just the result of a call `getSnGrid(xiGrid = getShapeGrid(), PFam=GPareto)` which has been stored in the namespace of package `distrMod`.

**Value**

getShapeGrid	a numeric grid of xi-values.
getSnGrid	a grid, i.e.; a matrix with columns xi and Sn—the respective interpolation grid).

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**Examples**

```
## (empirical) Data
getShapeGrid(50)
head(getShapeGrid(withPos=FALSE))

## Not run:
### code used for the grid stored in the namespace of distrMod:
getSnGrid()

## End(Not run)
```

---

 ismevgpdgevdia-diag-methods

*Methods for Diagnostic Functions in Package 'RobExtremes'*

---

**Description**

We provide wrapper to the diagnostic plots `gpd.diag` and `gev.diag` of package **isme**, as well as to profilers `gpd.prof`, `gpd.profxi` and `gev.prof`, `gev.profxi`.

**Usage**

```
gpd.diag(z,...)
## S4 method for signature 'gpd.fit'
gpd.diag(z)
## S4 method for signature 'GPDEstimate'
gpd.diag(z, npy = 365)
gev.diag(z)
## S4 method for signature 'gev.fit'
gev.diag(z)
## S4 method for signature 'GEVEstimate'
gev.diag(z)
gpd.prof(z,...)
## S4 method for signature 'gpd.fit'
gpd.prof(z, m, xlow, xup, npy = 365, conf = 0.95, nint = 100)
## S4 method for signature 'GPDEstimate'
gpd.prof(z, m, xlow, xup, npy = 365, conf = 0.95, nint = 100)
gev.prof(z,...)
## S4 method for signature 'gev.fit'
gev.prof(z, m, xlow, xup, conf = 0.95, nint = 100)
## S4 method for signature 'GEVEstimate'
gev.prof(z, m, xlow, xup, conf = 0.95, nint = 100)
gpd.profxi(z,...)
## S4 method for signature 'gpd.fit'
gpd.profxi(z, xlow, xup, conf = 0.95, nint = 100)
## S4 method for signature 'GPDEstimate'
gpd.profxi(z, xlow, xup, npy = 365, conf = 0.95, nint = 100)
```



```

gev.profxi(z,...)
## S4 method for signature 'gev.fit'
gev.profxi(z, xlow, xup, conf = 0.95, nint = 100)
## S4 method for signature 'GEVEstimate'
gev.profxi(z, xlow, xup, conf = 0.95, nint = 100)

```

### Arguments

<code>z</code>	an argument of class <code>gpd.fit</code> , <code>gev.fit</code> (recovering the original calling convention from package <b>isnev</b> or of class <code>GEVFamily</code> or <code>GParetoFamily</code> ).
<code>m</code>	The return level (i.e. the profile likelihood is for the value that is exceeded with probability $1/m$ ).
<code>...</code>	further parameters to be passed on the specific methods.
<code>xlow</code> , <code>xup</code>	The least and greatest value at which to evaluate the profile likelihood.
<code>npv</code>	The number of observations per year.
<code>conf</code>	The confidence coefficient of the plotted profile confidence interval.
<code>nint</code>	The number of points at which the profile likelihood is evaluated.

### Details

We provide a coercing of our fits of S4-classes "GPDEstimate" and "GEVEstimate" to the (S3-)classes `gpd.fit` and `gev.fit` of package **isnev** (the latter being cast to an S4 class, internally, in our package).

### Value

For `gpd.fit`, `gev.fit` (quoted from package **isnev**: For stationary models four plots are produced; a probability plot, a quantile plot, a return level plot and a histogram of data with fitted density.

For non-stationary models two plots are produced; a residual probability plot and a residual quantile plot.

For `gpd.prof`, `gev.prof` (quoted from package **isnev**:

A plot of the profile likelihood is produced, with a horizontal line representing a profile confidence interval with confidence coefficient `conf`.

### Author(s)

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

### References

isnev: An Introduction to Statistical Modeling of Extreme Values. R package version 1.39. <https://CRAN.R-project.org/package=isnev>; original S functions written by Janet E. Heffernan with R port and R documentation provided by Alec G. Stephenson. (2012).

Coles, S. (2001). *An introduction to statistical modeling of extreme values*. London: Springer.

**Examples**

```

if(require(ismev)){
  ## from ismev
  data(portpirie)
  data(rain)

  detach(package:ismev)
  ppfit <- ismev::gev.fit(portpirie[,2])
  gev.diag(ppfit)
  ##
  (m1E <- MLEstimator(portpirie[,2], GEVFamilyMuUnknown(withPos=FALSE)))
  gev.diag(m1E)

  ## not tested on CRAN because it takes some time...
  gev.prof(m1E, m = 10, 4.1, 5)
  gev.profxi(m1E, -0.3, 0.3)

  rnfit <- ismev::gpd.fit(rain,10)
  gpd.diag(rnfit)
  ##
  m1E2 <- MLEstimator(rain[rain>10], GParetoFamily(loc=10))
  gpd.diag(m1E2)

  gpd.prof(m1E2, m = 10, 55, 77)
  gpd.profxi(m1E2, -0.02, 0.02)

}

```

---

kMAD

*Asymmetric Median of Absolute Deviations for Skewed Distributions*


---

**Description**

Function for the computation of asymmetric median absolute deviation (kMAD) It coincides with ordinary median absolute deviation (MAD) for  $k = 1$ .

**Usage**

```

kMAD(x,k,...)
## S4 method for signature 'numeric,numeric'
kMAD(x, k = 1, na.rm = TRUE,
      eps = .Machine$double.eps, ... )
## S4 method for signature 'UnivariateDistribution,numeric'
kMAD(x, k = 1, up = NULL, ... )

```

**Arguments**

x	a numeric vector or a distribution.
k	numeric; tuning parameter for asymmetrical MAD; has to be of length 1 and larger than 1.
na.rm	logical; if TRUE then NA values are stripped from x before computation takes place.
eps	numeric; accuracy up to which to state equality of two numeric values
up	numeric; upper bound for search interval; important in distributions without left/right endpoint.
...	additional arguments for other functions; not used so far;

**Details**

For kMAD (asymmetrical MAD) is a root of the equation:

$$\text{kMAD}(F, k) = \inf\{t > 0 \mid F(m + kt) - F(m - t) \geq 1/2\}$$

, where F is the cumulative distribution function, m is the median of F.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>, Nataliya Horbenko <nhorbenko@gmail.com>

**References**

Ruckdeschel, P., Horbenko, N. (2010): Robustness Properties for Generalized Pareto Distributions. ITWM Report 182.

**See Also**

[mad](#)

**Examples**

```
x <- rnorm(100)
kMAD(x, k=10)
kMAD(Norm(), k=10)
```

---

LDEstimate-class      *LDEstimate-class.*

---

### Description

Class of Location Dispersion estimates.

### Objects from the Class

Objects can be created by calls of the form `new("LDEstimate", ...)`. More frequently they are created via the generating function `LDEstimator`.

### Slots

`name` Object of class "character": name of the estimator.  
`estimate` Object of class "ANY": estimate.  
`estimate.call` Object of class "call": call by which estimate was produced.  
`dispersion` Object of class "numeric": the value of the fitted dispersion.  
`location` Object of class "numeric": the value of the fitted location.  
`Infos` object of class "matrix" with two columns named `method` and `message`: additional informations.  
`asvar` object of class "OptionalMatrix" which may contain the asymptotic (co)variance of the estimator.  
`samplesize` object of class "numeric" — the samplesize at which the estimate was evaluated.  
`nuis.idx` object of class "OptionalNumeric": indices of estimate belonging to the nuisance part  
`fixed` object of class "OptionalNumeric": the fixed and known part of the parameter.  
`trafo` object of class "list": a list with components `fct` and `mat` (see below).  
`untransformed.estimate` Object of class "ANY": untransformed estimate.  
`untransformed.asvar` object of class "OptionalNumericOrMatrix" which may contain the asymptotic (co)variance of the untransformed estimator.  
`completecases` object of class "logical" — complete cases at which the estimate was evaluated.

### Extends

Class "Estimate", directly.

### Methods

**dispersion** signature(object = "LDEstimate"): accessor function for slot dispersion.  
**location** signature(object = "LDEstimate"): accessor function for slot location.  
**show** signature(object = "LDEstimate")

**Author(s)**

Matthias Kohl <Matthias.Kohl@stamats.de>  
 Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**See Also**

[Estimate-class](#), [LDEstimator](#), [MCEstimator](#)

**Examples**

```
## (empirical) Data
x <- rgamma(50, scale = 0.5, shape = 3)

## parametric family of probability measures
G <- GammaFamily(scale = 1, shape = 2)

(S <- medQn(x, G))
dispersion(S)
location(S)
```

---

LDEstimator

---

*Function to compute LD (location-dispersion) estimates*


---

**Description**

Function `LDEstimator` provides a general way to compute estimates for a given parametric family of probability measures (with a scale and shape parameter) which can be obtained by matching location and dispersion functionals against empirical counterparts.

**Usage**

```
LDEstimator(x, loc.est, disp.est, loc.fctal, disp.fctal, ParamFamily,
            loc.est.ctrl = NULL, loc.fctal.ctrl=NULL,
            disp.est.ctrl = NULL, disp.fctal.ctrl=NULL,
            q.lo =1e-3, q.up=15, log.q =TRUE,
            name, Infos, asvar = NULL, nuis.idx = NULL,
            trafo = NULL, fixed = NULL, asvar.fct = NULL, na.rm = TRUE,
            ..., .withEvalAsVar = FALSE, vdbg = FALSE)
medkMAD(x, ParamFamily, k=1, q.lo =1e-3, q.up=15, nuis.idx = NULL,
        trafo = NULL, fixed = NULL, asvar.fct = NULL, na.rm = TRUE,
        ..., .withEvalAsVar = FALSE, vdbg = FALSE)
medkMADhybr(x, ParamFamily, k=1, q.lo =1e-3, q.up=15, KK = 20, nuis.idx = NULL,
            trafo = NULL, fixed = NULL, asvar.fct = NULL, na.rm = TRUE,
            ..., .withEvalAsVar = FALSE)
medSn(x, ParamFamily, q.lo =1e-3, q.up=10, nuis.idx = NULL,
       trafo = NULL, fixed = NULL, asvar.fct = NULL, na.rm = TRUE,
       accuracy = 100, ..., .withEvalAsVar = FALSE)
medQn(x, ParamFamily, q.lo =1e-3, q.up=15, nuis.idx = NULL,
```

```
trafo = NULL, fixed = NULL, asvar.fct = NULL, na.rm = TRUE,
..., .withEvalAsVar = FALSE)
```

### Arguments

x	(empirical) data
ParamFamily	an object of class "ParamFamily". The parametric family at which to evaluate the LDEstimator; the respective (main) parameter must contain "scale" and "shape".
loc.est	a function expecting x (a numeric vector) as first argument; location estimator.
disp.est	a function expecting x (a numeric vector) as first argument; dispersion estimator; may only take non-negative values.
loc.fctal	a function expecting a distribution object as first argument; location functional.
disp.fctal	a function expecting a distribution object as first argument; dispersion functional; may only take non-negative values.
loc.est.ctrl	a list (or NULL); optional additional arguments for the location estimator.
disp.est.ctrl	a list (or NULL); optional additional arguments for the dispersion estimator.
loc.fctal.ctrl	a list (or NULL); optional additional arguments for the location functional.
disp.fctal.ctrl	a list (or NULL); optional additional arguments for the dispersion functional.
k	numeric; additional parameter for <code>kMAD</code> ; must be positive and of length 1.
KK	numeric; Maximal number of trials with different k in <code>medkMADhybr</code> .
q.lo	numeric; lower bound for search intervall in shape parameter.
q.up	numeric; upper bound for search intervall in shape parameter.
log.q	logical; shall the zero search be done on log-scale?
name	optional name for estimator.
Infos	character: optional informations about estimator
asvar	optionally the asymptotic (co)variance of the estimator
nuis.idx	optionally the indices of the estimate belonging to nuisance parameter
fixed	optionally (numeric) the fixed part of the parameter
trafo	an object of class <code>MatrixorFunction</code> – a transformation for the main parameter
asvar.fct	optionally: a function to determine the corresponding asymptotic variance; if given, <code>asvar.fct</code> takes arguments <code>L2Fam</code> (the parametric model as object of class <code>L2ParamFamily</code> ) and <code>param</code> (the parameter value as object of class <code>ParamFamParameter</code> ); arguments are called by name; <code>asvar.fct</code> may also process further arguments passed through the <code>...</code> argument
na.rm	logical: if TRUE, the estimator is evaluated at <code>complete.cases(x)</code> .
accuracy	numeric: argument to be passed on to <code>Sn</code> .
...	further arguments to be passed to location estimator and functional and dispersion estimator and functional.
vdbg	logical; if TRUE, debugging information is shown.
.withEvalAsVar	logical: shall slot <code>asVar</code> be evaluated (if <code>asvar.fct</code> is given) or just the call be returned?

**Details**

The arguments `loc.est`, `disp.est` (location and dispersion estimators) have to be functions with first argument `x` (a numeric vector with the empirical data) and additional, optional individual arguments to be passed on in the respective calls as lists `loc.est.ctrl`, `disp.est.ctrl`, and global additional arguments through the `...` argument. Similarly, arguments `loc.fctal`, `disp.fctal` (location and dispersion functionals) have to be functions with first argument an object of class `UnivariateDistribution`, and additional, optional individual arguments to be passed on in the respective calls as lists `loc.fctal.ctrl`, `disp.fctal.ctrl`, and global additional arguments again through the `...` argument. Uses `.LDMatch` internally.

**Value**

An object of S4-class "Estimate".

**Note**

The values for `q.lo` and `q.up` are a bit delicate and have to be found, model by model, by try and error. As a rule, `medSn` is rather slow, as the evaluation of the `Sn` functional is quite expensive. So if `medSn` is the estimator of choice, it pays off, for a given shape-scale family, to evaluate `medSn` on a grid of shape-values (with scale 1) and then to use an interpolation techniques in a particular method to replace the default one for this shape-scale family. As an example, we have done so for the GPD family.

**Author(s)**

Nataliya Horbenko <nhorbenko@gmail.com>,  
Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**References**

P. Ruckdeschel, N. Horbenko (2011): Yet another breakdown point notion: EFSBP –illustrated at scale-shape models. ArXiv 1005.1480. To appear at *Metrika*. DOI: 10.1007/s00184-011-0366-4.  
A. Marazzi and C. Ruffieux (1999): The truncated mean of asymmetric distribution. *Computational Statistics and Data Analysis* 32: 79-100 .

**See Also**

[ParamFamily-class](#), [ParamFamily](#), [Estimate-class](#)

**Examples**

```
## (empirical) Data
set.seed(123)
x <- rgamma(50, scale = 0.5, shape = 3)

## parametric family of probability measures
G <- GammaFamily(scale = 1, shape = 2)

medQn(x = x, ParamFamily = G)
medSn(x = x, ParamFamily = G, q.lo = 0.5, q.up = 4)
```

```

## not tested on CRAN because it takes time...
## without speedup for Sn:
LDEstimator(x, loc.est = median, disp.est = Sn, loc.fctal = median,
            disp.fctal = getMethod("Sn", "UnivariateDistribution"),
            ParamFamily = G, disp.est.ctrl = list(constant=1))

medkMAD(x = x, ParamFamily = G)
medkMADhybr(x = x, ParamFamily = G)

medkMAD(x = x, k=10, ParamFamily = G)

##not at all robust:
LDEstimator(x, loc.est = mean, disp.est = sd,
            loc.fctal = E, disp.fctal = sd,
            ParamFamily = G)

```

---

movToRef-methods	<i>Methods for Functions moving from and to reference parameter in Package 'RobExtremes'</i>
------------------	--

---

## Description

In optIC a gain in accuracy can be obtained when computing the optimally-robust ICs at a reference parameter of the model (instead of an arbitrary one). To this end, `moveL2Fam2RefParam` moved the model to the reference parameter and `moveICBackFromRefParam` moves the obtained optimal IC back to the original parameter.

## Usage

```

moveL2Fam2RefParam(L2Fam, ...)
moveICBackFromRefParam(IC, L2Fam, ...)

```

## Arguments

L2Fam	object of class L2ParamFamily
IC	IC of class HampIC
...	further arguments to be passed to particular methods

## Details

`moveL2Fam2RefParam` and `moveICBackFromRefParam` are used internally in functions `robtest` and `roptest` to compute the optimally robust influence function according to the arguments given to them.



**Value**

`moveL2Fam2RefParam`  
the L2 Family transformed to reference parameter.

`moveICBackFromRefParam`  
the backtransformed IC.

**Methods**

**`moveL2Fam2RefParam`** signature(L2Fam = "L2ScaleShapeUnion"): moves L2Fam to scale 1 (and, if existing location to 0).

**`moveICBackFromRefParam`** signature(IC = "IC", L2Fam = "L2ScaleShapeUnion"): moves IC in IC back to original location and scale in L2Fam (and in addition changes Lagrange multipliers accordingly), rescaling risk where necessary.

**`moveICBackFromRefParam`** signature(IC = "IC", L2Fam = "L2LocScaleShapeUnion"): moves IC in IC back to original location and scale in L2Fam (and in addition changes Lagrange multipliers accordingly), rescaling risk where necessary.

**Author(s)**

Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**See Also**

[robust](#), [optIC](#), [radiusMinimaxIC](#)

---

Pareto

*Generating function for Pareto-class*


---

**Description**

Generates an object of class "Pareto".

**Usage**

`Pareto(shape = 1, Min = 1)`

**Arguments**

`shape` positive real number: shape parameter of the Pareto distribution.

`Min` positive real number: Min parameter of the Pareto distribution

**Value**

Object of class "Pareto"

**Note**

The class "Pareto" is based on the code provided by the package **actuar** by Vincent Goulet and Mathieu Pigeon.

**Author(s)**

Nataliya Horbenko <nhorbenko@gmail.com>

**See Also**

[Pareto-class](#), [dpareto1](#)

**Examples**

```
(P1 <- Pareto(shape = 1, Min = 1))  
plot(P1)
```

```
E(Pareto())  
E(P1)  
E(P1, function(x){x^2})  
var(P1)  
sd(P1)  
median(P1)  
IQR(P1)  
mad(P1)
```

---

Pareto-class

*Pareto distribution*

---

**Description**

[borrowed from **actuar**]:

The (Single-parameter) Pareto distribution with parameter  $\text{shape} = \alpha$  has density:

$$f(x) = \frac{\alpha\theta^\alpha}{x^{\alpha+1}}$$

for  $x > \theta$ ,  $\alpha > 0$  and  $\theta > 0$ .

Although there appears to be two parameters, only shape is a true parameter. The value of  $\text{min} = \theta$  must be set in advance.

**Objects from the Class**

Objects can be created by calls of the form `new("Pareto", shape, Min)`. More frequently they are created via the generating function `Pareto`.

**Slots**

img Object of class "Reals".  
 param Object of class "ParetoParameter".  
 r rpareto1  
 d dpareto1  
 p ppareto1  
 q qpareto1  
 gaps (numeric) matrix or NULL  
 .withArith logical: used internally to issue warnings as to interpretation of arithmetics  
 .withSim logical: used internally to issue warnings as to accuracy  
 .logExact logical: used internally to flag the case where there are explicit formulae for the log version of density, cdf, and quantile function  
 .lowerExact logical: used internally to flag the case where there are explicit formulae for the lower tail version of cdf and quantile function

**Extends**

Class "AbscontDistribution", directly.  
 Class "UnivariateDistribution", by class "AbscontDistribution".  
 Class "Distribution", by class "AbscontDistribution".

**Methods**

**initialize** signature(.Object = "Pareto"): initialize method.  
**shape** signature(object = "Pareto"): wrapped access method for slot shape of slot param.  
**Min** signature(x = "Pareto"): wrapped access method for slot Min of slot param.  
**scale** signature(x = "Pareto"): wrapped access method for slot Min of slot param.  
**shape<-** signature(object = "Pareto"): wrapped replace method for slot shape of slot param.  
**Min<-** signature(x = "Pareto"): wrapped replace method for slot Min of slot param.  
**E** signature(object = "Pareto", fun = "missing", cond = "missing"): exact evaluation using explicit expressions.  
**var** signature(signature(x = "Pareto")): exact evaluation using explicit expressions.  
**median** signature(signature(x = "Pareto")): exact evaluation using explicit expressions.  
**IQR** signature(signature(x = "Pareto")): exact evaluation using explicit expressions.  
**skewness** signature(signature(x = "Pareto")): exact evaluation using explicit expressions.  
**kurtosis** signature(signature(x = "Pareto")): exact evaluation using explicit expressions.  
 \* signature(e1 = "Pareto", e2 = "numeric"): exact method for this transformation — stays within this class if  $e2 > 0$ .  
**liesInSupport** signature(object = "Pareto", x = "numeric"): checks if x lies in the support of the respective distribution.

**Note**

This class is based on the code provided by the package **actuar** by Vincent Goulet and Mathieu Pigeon.

**Author(s)**

Nataliya Horbenko <nhorbenko@gmail.com>

**References**

Johnson et al. (1995) *Continuous Univariate Distributions. Vol. 2. 2nd ed.* New York: Wiley.  
 Klugman, S. A., Panjer, H. H. and Willmot, G. E. (2004), *Loss Models, From Data to Decisions, Second Edition*, Wiley.

**See Also**

[dpareto1](#), [AbscontDistribution-class](#)

**Examples**

```
(P1 <- new("Pareto", shape = 1, Min = 2))
plot(P1)
shape(P1)
Min(P1)
shape(P1) <- 4
Min(P1) <- 2
plot(P1)
```

---

 ParetoFamily

*Generating function for Generalized Pareto families*


---

**Description**

Generates an object of class "ParetoFamily" which represents a Pareto family.

**Usage**

```
ParetoFamily(Min = 1, shape = 0.5, trafo = NULL, startEst = NULL,
             withCentL2 = FALSE)
```

**Arguments**

Min	real: known/fixed threshold/location parameter
shape	positive real: shape parameter
trafo	matrix or NULL: transformation of the parameter
startEst	startEstimator — if NULL $\log(2)/\log(\text{median}/\text{Min})$ is used
withCentL2	logical: shall L2 derivative be centered by subtracting the E()? Defaults to FALSE, but higher accuracy can be achieved when set to TRUE.

**Details**

The slots of the corresponding L2 differentiable parameteric family are filled.

**Value**

Object of class "ParetoFamily"

**Author(s)**

Matthias Kohl <Matthias.Kohl@stamats.de>  
Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>  
Nataliya Horbenko <nhorbenko@gmail.com>

**References**

- Kohl, M. (2005) *Numerical Contributions to the Asymptotic Theory of Robustness*. Bayreuth: Dissertation.
- M.-Kohl, P. Ruckdeschel, H.-Rieder (2010): Infinitesimally Robust Estimation in General Smoothly Parametrized Models. *Stat. Methods Appl.*, **19**, 333–354.
- Ruckdeschel, P. and Horbenko, N. (2011): Optimally-Robust Estimators in Generalized Pareto Models. ArXiv 1005.1476. To appear at *Statistics*. DOI: 10.1080/02331888.2011.628022.
- Ruckdeschel, P. and Horbenko, N. (2012): Yet another breakdown point notion: EFSBP –illustrated at scale-shape models. *Metrika*, **75**(8), 1025–1047.

**See Also**

[L2ParamFamily-class](#), [Pareto](#)

**Examples**

```
(P1 <- ParetoFamily())  
FisherInfo(P1)  
checkL2deriv(P1)
```

---

ParetoParameter-class *Parameter of Pareto distributions*

---

**Description**

The class of the parameter of Pareto distributions.

**Objects from the Class**

Objects can be created by calls of the form `new("ParetoParameter", ...)`.

**Slots**

**shape** real number: shape parameter of a Pareto distribution.  
**Min** positive real number: Min parameter of a Pareto distribution.  
**name** default name is “parameter of a Pareto distribution”.

**Extends**

Class "Parameter", directly.  
Class "OptionalParameter", by class "Parameter".

**Methods**

**shape** signature(object = "ParetoParameter"): access method for slot shape.  
**Min** signature(x = "ParetoParameter"): access method for slot Min.  
**scale** signature(x = "ParetoParameter"): access method for slot Min.  
**shape<-** signature(object = "ParetoParameter"): replace method for slot shape.  
**Min<-** signature(x = "ParetoParameter"): replace method for slot Min.

**Author(s)**

Nataliya Horbenko <nhorbenko@gmail.com>

**See Also**

[Pareto-class](#), [Parameter-class](#)

**Examples**

```
(P1 <- new("ParetoParameter"))
Min(P1)
shape(P1)

Min(P1) <- 3
shape(P1) <- 4
P1
```

---

PickandsEstimator

*Function to compute Pickands estimates for the GPD and GEVD*

---

**Description**

Function `PickandsEstimator` computes Pickands estimator (for the GPD and GEVD) at real data and returns an object of class `Estimate`.

**Usage**

```
PickandsEstimator(x, ParamFamily=GParetoFamily(), alpha=2,
                  name, Infos, nuis.idx = NULL,
                  trafo = NULL, fixed = NULL, na.rm = TRUE,
                  ...)
.PickandsEstimator(x, alpha=2, GPD.1 = TRUE)
```

**Arguments**

x	(empirical) data
alpha	numeric > 1; determines the variant of the Pickands-Estimator based on matching the empirical quantiles to levels $a_1 = 1 - 1/\alpha$ and $a_2 = 1 - 1/\alpha^2$ (in the GPD case) resp. $a_1 = \exp(-1/\alpha)$ and $a_1 = \exp(-1/\alpha^2)$ (in the GEVD case) against the population counter parts. The "classical" Pickands Estimator building up on the median is obtained for alpha=2 for the GPD and for alpha = 1/log(2) for the GEVD. If alpha is missing we set it to the optimal value (see note below).
ParamFamily	an object of class "GParetoFamily" or "GEVFamily".
name	optional name for estimator.
Infos	character: optional informations about estimator
nuis.idx	optionally the indices of the estimate belonging to nuisance parameter
fixed	optionally (numeric) the fixed part of the parameter
trafo	an object of class MatrixorFunction – a transformation for the main parameter
na.rm	logical: if TRUE, the estimator is evaluated at complete.cases(x).
...	not yet used.
GPD.1	logical: if TRUE the variant for GPD is used, else for GEVD.

**Details**

The actual work is done in .PickandsEstimator. The wrapper PickandsEstimator pre-treats the data, and constructs a respective Estimate object.

**Value**

.PickandsEstimator  
A numeric vector of length 2 with components named scale and shape.

PickandsEstimator  
An object of S4-class "Estimate".

**Note**

The scale estimate we use, i.e., with scale =  $\beta$  and shape =  $\xi$ , we estimate scale by  $\beta = \xi a_1 / (\alpha^\xi - 1)$ , differs from the one given in the original reference, where it was  $\beta = \xi a_1^2 / (a_2 - 2a_1)$ . The one chosen here avoids taking differences  $a_2 - 2a_1$  hence does not require  $a_2 > 2a_1$ ; this leads to (functional) breakdown point (bdp)

$$\min(a_1, 1 - a_2, a_2 - a_1)$$

which is independent  $\xi$ , whereas the original setting leads to a bdp which is depending on  $\xi$

$$\min(a_1, 1 - a_2, a_2 - 1 + (2\alpha^\xi - 1)^{-1/\xi}) \quad \text{for GPD}$$

$$\min(a_1, 1 - a_2, a_2 - \exp(-(2\alpha^\xi - 1)^{-1/\xi})) \quad \text{for GEVD}$$

. As a consequence our setting, the bdp-optimal choice of  $\alpha$  for GPD is 2 leading to bdp 1/4, and 2.248 for GEVD leading to bdp 0.180. For comparison, with the original setting, at  $\xi = 0.7$ , this gives optimal bdp's 0.070 and 0.060 for GPD and GEVD, respectively. The standard choice of  $\alpha$  such that  $a_1$  gives the median ( $\alpha = 2$  in the GPD and  $\alpha = 1/\log(2)$  in the GEVD) in our setting gives bdp's of 1/4 and 0.119 for GPD and GEVD, respectively, and in the original setting, at  $\xi = 0.7$ , gives bdp's 0.064 and 0.023.

### Author(s)

Nataliya Horbenko <nhorbenko@gmail.com>,  
Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

### References

P. Ruckdeschel, N. Horbenko (2012): Yet another breakdown point notion: EFSBP –illustrated at scale-shape models. *Metrika*, **75**(8), 1025–1047.

J. Pickands (1975): Statistical inference using extreme order statistics. *Ann. Stat.* **3**(1), 119–131.

### See Also

[ParamFamily-class](#), [ParamFamily](#), [Estimate-class](#)

### Examples

```
## (empirical) Data
set.seed(123)
x <- rgpd(50, scale = 0.5, shape = 3)
y <- rgev(50, scale = 0.5, shape = 3)
## parametric family of probability measures
P <- GParetoFamily(scale = 1, shape = 2)
G <- GEVFamily(scale = 1, shape = 2)
##
PickandsEstimator(x = x, ParamFamily = P)
PickandsEstimator(x = y, ParamFamily = G)
```



---

QuantileBCCEstimator    *Function to compute QuantileBCC estimates for the Weibull Family*

---

### Description

Function `QuantileBCCEstimator` computes QuantileBCC estimator (for the Weibull) at real data and returns an object of class `Estimate`.

### Usage

```
QuantileBCCEstimator(x, p1 = 1/3, p2 = 2/3,
                     name, Infos, nuis.idx = NULL,
                     trafo = NULL, fixed = NULL, na.rm = TRUE,
                     ...)
.QBCC(x, p1 = 1/3, p2 = 2/3)
```

### Arguments

<code>x</code>	(empirical) data
<code>p1, p2</code>	levels of the quantiles; maximal breakdown point is achieved for $p1 = p2 - p1 = 1 - p2 = 1/3$ which is the default.
<code>name</code>	optional name for estimator.
<code>Infos</code>	character: optional informations about estimator
<code>nuis.idx</code>	optionally the indices of the estimate belonging to nuisance parameter
<code>fixed</code>	optionally (numeric) the fixed part of the parameter
<code>trafo</code>	an object of class <code>MatrixorFunction</code> – a transformation for the main parameter
<code>na.rm</code>	logical: if TRUE, the estimator is evaluated at <code>complete.cases(x)</code> .
<code>...</code>	not yet used.

### Details

The actual work is done in `.QBCC`. The wrapper `QuantileBCCEstimator` pre-treats the data, and constructs a respective `Estimate` object.

### Value

```
.QuantileBCCEstimator
    A numeric vector of length 2 with components named scale and shape.

QuantileBCCEstimator
    An object of S4-class "Estimate".
```

### Author(s)

Nataliya Horbenko <nhorbenko@gmail.com>,  
 Peter Ruckdeschel <peter.ruckdeschel@uni-oldenburg.de>

**References**

Boudt, K., Caliskan, D., Croux, C. (2011): Robust explicit estimators of Weibull parameters. *Metrika*, **73** (2), 187-209.

**See Also**

[ParamFamily-class](#), [ParamFamily](#), [Estimate-class](#)

**Examples**

```
## (empirical) Data
set.seed(123)
distributions("withgaps"=FALSE)
x <- rweibull(50, scale = 0.5, shape = 3)
##
QuantileBCCEstimator(x = x)
```

---

RobExtremesConstants *Built-in Constants in package RobExtremes*

---

**Description**

Constants built into **RobExtremes**.

**Usage**

```
EULERMASCHERONICONSTANT
APERYCONSTANT
```

**Details**

**RobExtremes** has a small number of built-in constants.

The following constants are available:

- EULERMASCHERONICONSTANT: the Euler Mascheroni constant

$$\gamma = -\Gamma'(1)$$

given in <http://mathworld.wolfram.com/Euler-MascheroniConstant.html> (48);

- APERYCONSTANT: the Apéry constant

$$\zeta(3) = \frac{5}{2} \left( \sum_{k \geq 1} \frac{(-1)^{k-1}}{k^3 \binom{2k}{k}} \right)$$

as given in <http://mathworld.wolfram.com/AperysConstant.html>, equation (8);

These are implemented as variables in the **RobExtremes** name space taking appropriate values.

**Examples**

```
EULERMASCHERONICONSTANT
APERYCONSTANT
```

---

 validParameter-methods

*Methods for function validParameter in Package 'RobExtremes'*


---

## Description

Methods for function `validParameter` in package **RobExtremes** to check whether a new parameter (e.g. "proposed" by an optimization) is valid.

## Usage

```
validParameter(object, ...)
## S4 method for signature 'GParetoFamily'
validParameter(object, param, tol=.Machine$double.eps)
## S4 method for signature 'WeibullFamily'
validParameter(object, param, tol=.Machine$double.eps)
## S4 method for signature 'GEVFamily'
validParameter(object, param, tol=.Machine$double.eps)
## S4 method for signature 'ParetoFamily'
validParameter(object, param, tol=.Machine$double.eps)
## S4 method for signature 'GEVFamilyMuUnknown'
validParameter(object, param,
               tol=.Machine$double.eps)
```

## Arguments

<code>object</code>	an object of class <code>ParamFamily</code>
<code>param</code>	either a numeric vector or an object of class <code>ParamFamParameter</code>
<code>tol</code>	accuracy upto which the conditions have to be fulfilled
<code>...</code>	additional argument(s) for methods.

## Details

method for signature

`GParetoFamily` checks if both parameters are finite by `is.finite`, if their length is 1 or 2 (e.g. if one features as nuisance parameter), and if both are strictly larger than 0 (upto argument `tol`)

`WeibullFamily` checks if both parameters are finite by `is.finite`, if their length is 1 or 2 (e.g. if one features as nuisance parameter), and if both are strictly larger than 0 (upto argument `tol`)

`GEVFamily` checks if both parameters are finite by `is.finite`, if their length is 1 or 2 (e.g. if one features as nuisance parameter), and if both are strictly larger than 0 (upto argument `tol`)

`GParetoFamily` checks if both parameters are finite by `is.finite`, if their length is 1 or 2 (e.g. if one features as nuisance parameter), and if both are strictly larger than 0 (upto argument `tol`)

`GEVFamilyMuUnknown` checks if all parameters are finite by `is.finite`, if their length is in 1,2,3 (e.g. if one features as nuisance parameter), and scale and shape both are strictly larger than 0 (upto argument `tol`)

**Value**

logical of length 1 — valid or not

**Examples**

```
G <- GParetoFamily()
validParameter(G, c(scale=0.1, shape=2))
validParameter(G, c(scale=-0.1, shape=-2))
```

---

var

*Generic Functions for the Computation of Functionals*


---

**Description**

Generic functions for the computation of functionals on distributions.

**Usage**

```
IQR(x, ...)

## S4 method for signature 'Gumbel'
IQR(x)
## S4 method for signature 'GEV'
IQR(x)
## S4 method for signature 'GPareto'
IQR(x)
## S4 method for signature 'Pareto'
IQR(x)

median(x, ...)

## S4 method for signature 'Gumbel'
median(x)
## S4 method for signature 'GEV'
median(x)
## S4 method for signature 'GPareto'
median(x)
## S4 method for signature 'Pareto'
median(x)

var(x, ...)

## S4 method for signature 'Gumbel'
var(x, ...)
## S4 method for signature 'GEV'
var(x, ...)
## S4 method for signature 'GPareto'
```

```
var(x, ...)
## S4 method for signature 'Pareto'
var(x, ...)

skewness(x, ...)
## S4 method for signature 'Gumbel'
skewness(x, ...)
## S4 method for signature 'GEV'
skewness(x, ...)
## S4 method for signature 'GPareto'
skewness(x, ...)
## S4 method for signature 'Pareto'
skewness(x, ...)

kurtosis(x, ...)
## S4 method for signature 'Gumbel'
kurtosis(x, ...)
## S4 method for signature 'GEV'
kurtosis(x, ...)
## S4 method for signature 'GPareto'
kurtosis(x, ...)
## S4 method for signature 'Pareto'
kurtosis(x, ...)

Sn(x, ...)
## S4 method for signature 'ANY'
Sn(x, ...)
## S4 method for signature 'UnivariateDistribution'
Sn(x, low = 0, upp = 1.01, accuracy = 1000, ...)
## S4 method for signature 'DiscreteDistribution'
Sn(x, ...)
## S4 method for signature 'AffLinDistribution'
Sn(x, ...)
## S4 method for signature 'Norm'
Sn(x, ...)
## S4 method for signature 'GPareto'
Sn(x, ...)
## S4 method for signature 'Pareto'
Sn(x, ...)
## S4 method for signature 'GEV'
Sn(x, ...)
## S4 method for signature 'Gammad'
Sn(x, ...)
## S4 method for signature 'Weibull'
Sn(x, ...)

Qn(x, ...)
## S4 method for signature 'ANY'
```

```

Qn(x, ...)
## S4 method for signature 'UnivariateDistribution'
Qn(x, q00 = NULL, ...)
## S4 method for signature 'AffLinDistribution'
Qn(x, ...)
## S4 method for signature 'DiscreteDistribution'
Qn(x, ...)
## S4 method for signature 'Norm'
Qn(x, ...)

```

### Arguments

x	object of class "UnivariateDistribution"
...	additional arguments to fun or E
q00	numeric or NULL: determines search interval (from -q00 to q00) for Qn; if NULL (default) q00 is set to 10*q(x)(3/4) internally.
low	numeric; lower bound for search interval for median(abs(x-Y)) where Y (a real constant) runs over the range of x; defaults to 0.
upp	numeric; upper bound for search interval for median(abs(x-Y)) where Y (a real constant) runs over the range of x; defaults to 1.01. Is used internally as upp*(mad(x)+abs(median(x)-Y)).
accuracy	numeric; number of grid points for Sn; defaults to 1000.

### Value

The value of the corresponding functional at the distribution in the argument is computed.

### Methods

Qn, signature(x = "Any"): interface to the **robustbase**-function Qn — see [Qn](#).

Qn, signature(x = "UnivariateDistribution"): Qn of univariate distributions.

Qn, signature(x = "DiscreteDistribution"): Qn of discrete distributions.

Qn, signature(x = "AffLinDistribution"):  $\text{abs}(x@a) * Qn(x@X0)$

Sn, signature(x = "Any"): interface to the **robustbase**-function Sn — see [Sn](#).

Sn, signature(x = "UnivariateDistribution"): Sn of univariate distributions using pseudo-random variables (Thx to N. Horbenko).

Sn, signature(x = "DiscreteDistribution"): Sn of discrete distributions.

Sn, signature(x = "AffLinDistribution"):  $\text{abs}(x@a) * Sn(x@X0)$

var, signature(x = "Gumbel"): exact evaluation using explicit expressions.

var, signature(x = "GPareto"): exact evaluation using explicit expressions.

var, signature(x = "GEV"): exact evaluation using explicit expressions.

var, signature(x = "Pareto"): exact evaluation using explicit expressions.

IQR, signature(x = "Gumbel"): exact evaluation using explicit expressions.

IQR, signature(x = "GPareto"): exact evaluation using explicit expressions.

IQR, signature(x = "GEV"): exact evaluation using explicit expressions.  
 IQR, signature(x = "Pareto"): exact evaluation using explicit expressions.  
 median, signature(x = "Gumbel"): exact evaluation using explicit expressions.  
 median, signature(x = "GEV"): exact evaluation using explicit expressions.  
 median, signature(x = "GPareto"): exact evaluation using explicit expressions.  
 median, signature(x = "Pareto"): exact evaluation using explicit expressions.  
 skewness, signature(x = "Gumbel"): exact evaluation using explicit expressions.  
 skewness, signature(x = "GEV"): exact evaluation using explicit expressions.  
 skewness, signature(x = "GPareto"): exact evaluation using explicit expressions.  
 skewness, signature(x = "Pareto"): exact evaluation using explicit expressions.  
 kurtosis, signature(x = "Gumbel"): exact evaluation using explicit expressions.  
 kurtosis, signature(x = "GEV"): exact evaluation using explicit expressions.  
 kurtosis, signature(x = "GPareto"): exact evaluation using explicit expressions.  
 kurtosis, signature(x = "Pareto"): exact evaluation using explicit expressions.  
 Sn, signature(x = "Norm"): exact evaluation using explicit expressions.  
 Sn, signature(x = "GPareto"): speeded up using interpolation grid.  
 Sn, signature(x = "GEV"): speeded up using interpolation grid.  
 Sn, signature(x = "Gammad"): speeded up using interpolation grid.  
 Sn, signature(x = "Weibull"): speeded up using interpolation grid.  
 Sn, signature(x = "Pareto"): speeded up using interpolation grid.  
 Qn, signature(x = "Norm"): exact evaluation using explicit expressions.

### Caveat

If any of the packages **e1071**, **moments**, **fBasics** is to be used together with **distrEx** (or **RobExtremes**) the latter must be attached *after* any of the first mentioned. Otherwise `kurtosis()` and `skewness()` defined as *methods* in **distrEx** (or **RobExtremes**) may get masked. To re-mask, you may use `kurtosis <- distrEx::kurtosis`; `skewness <- distrEx::skewness`. See also `distrExMASK()`.

### Author(s)

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### See Also

[Var](#),  
[sd](#), [var](#), [IQR](#),  
[median](#), [mad](#), [sd](#),  
[Sn](#), [Qn](#)

**Examples**

```
# Variance of Exp(1) distribution
G <- GPareto()
var(G)

#median(Exp())
IQR(G)

## note the timing
system.time(print(Sn(GPareto(shape=0.5,scale=2))))

system.time(print(Sn(as(GPareto(shape=0.5,scale=2),"AbscontDistribution"))))
```

---

WeibullFamily

*Generating function for Weibull family*


---

**Description**

Generates an object of class "WeibullFamily" which represents a Generalized Pareto family.

**Usage**

```
WeibullFamily(scale = 1, shape = 0.5, of.interest = c("scale", "shape"),
  p = NULL, N = NULL, trafo = NULL, start0Est = NULL, withPos = TRUE,
  withCentL2 = FALSE, withL2derivDistr = FALSE, ..ignoreTrafo = FALSE)
```

**Arguments**

scale	positive real: scale parameter
shape	positive real: shape parameter
of.interest	character: which parameters, transformations are of interest. possibilities are: "scale", "shape", "quantile", "expected loss", "expected short-fall"; a maximum number of two of these may be selected
p	real or NULL: probability needed for quantile and expected shortfall
N	real or NULL: expected frequency for expected loss
trafo	matrix or NULL: transformation of the parameter
start0Est	startEstimator — if NULL <a href="#">medkMADhybr</a> is used
withPos	logical of length 1: Is shape restricted to positive values?
withCentL2	logical: shall L2 derivative be centered by subtracting the E()? Defaults to FALSE, but higher accuracy can be achieved when set to TRUE.
withL2derivDistr	logical: shall the distribution of the L2 derivative be computed? Defaults to FALSE (to speed up computations).
..ignoreTrafo	logical: only used internally in <a href="#">kStepEstimator</a> ; do not change this.



**Details**

The slots of the corresponding L2 differentiable parameteric family are filled.

**Value**

Object of class "WeibullFamily"

**Author(s)**

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Ruckdeschel, P. and Horbenko, N. (2011): Optimally-Robust Estimators in Generalized Pareto Models. ArXiv 1005.1476. To appear at *Statistics*. DOI: 10.1080/02331888.2011.628022.

Ruckdeschel, P. and Horbenko, N. (2012): Yet another breakdown point notion: EFSBP –illustrated at scale-shape models. *Metrika*, **75**(8), 1025–1047.

**See Also**

[L2ParamFamily-class](#), [Weibull-class](#)

**Examples**

```
(G1 <- WeibullFamily())  
FisherInfo(G1)  
checkL2deriv(G1)
```

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