Special Values in Extreme-Value Distributions

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Contents

Probability functions of Extreme-Value distributions

Many R packages define the probability functions (density, distribution and quantile) of the Generalised Pareto (GP) and the Generalised Extreme Value distribution (GEV). While some packages use these functions internally, most of them also export them as well. As a result, the R user interested by using such a probability function has to choose between the different implementations. The present vignette inquires about quite subtle details in the way the functions work. In most cases, these details can not be anticipated by reading the package documentation.

Vectorisation

While in most (if not all) of the packages the first argument of the probability function is vectorised, this is generally not the case for the other arguments representing the parameters (location, scale, shape). This constrasts with the classical probability functions implemented in the **stats** package, in which the parameter arguments are vectorised.

```
dnorm(1:4, mean = 1:4)
```

```
## [1] 0.3989423 0.3989423 0.3989423 0.3989423
```

```
dnorm(1:4, sd = 1:4)
```

```
## [1] 0.24197072 0.12098536 0.08065691 0.06049268
```

```
try(evd::dgev(x = c(1.4, 1.5), shape = c(-0.1, -0.1)))
```

```
## Error in evd::dgev(x = c(1.4, 1.5), shape = c(-0.1, -0.1)) :
##   invalid shape
```

```
try(SpatialExtremes::dgev(x = c(1.4, 1.5), shape = c(-0.1, -0.1)))
```

```
## Error in SpatialExtremes::dgev(x = c(1.4, 1.5), shape = c(-0.1, -0.1)) :
##   'shape' should be a scalar
```

```
try(mev::dgev(x = c(1.2, 1.3), shape = c(0.2, -0.1)))
```

```
## Error in mev::dgev(x = c(1.2, 1.3), shape = c(0.2, -0.1)) :
##   length(shape) == 1L n'est pas TRUE
```

A vectorisation w.r.t. the parameter arguments is a plus at least in the Bayesian framework when the probability functions have to be evaluated using vectors of MCMC iterates for the parameters. Using loops coded in R language may then lead to slowly executing code.

Non-finite values

By non-finite values we mean the four special values for a `double` `-Inf`, `Inf`, `NA` and `NaN`. Note that `NA` is used to show a missing value whatever be its type, but there are different classes of missing values. By default `NA` refers to the logical missing value while we will here be concerned by numeric missing values.

```
x <- NA_real_
class(x)
```

```
## [1] "numeric"
```

```
y <- NA
class(y)
```

```
## [1] "logical"
```

```
class(Inf)
```

```
## [1] "numeric"
```

```
class(-Inf)
```

```
## [1] "numeric"
```

```
class(NaN)
```

```
## [1] "numeric"
```

Non-finite values in the first argument

Most probability functions from EV packages accept non-finite values in their first arguments, with a few exceptions

```
try(POT::dgpd(x = c(0, Inf, NA), scale = 1))
```

```
## Registered S3 methods overwritten by 'POT':
##   method      from
##   print.bvpot evd
##   plot.bvpot  evd
```

```
## Error in d[index] <- log(1/scale[index]) - d[index] :
##   NAs interdits dans les affectations indicées
```

Non-finite values in the parameter arguments

As for non-finite values for the parameter arguments, only a few packages allow this possibility in a consistent way. Beside **nieve**, the **texmex** package seems to be the sole package both for the density and the distribution functions.

For some uses, this feature can be important because the density and the distributions functions are often used to define a log-likelihood function that has to be maximised numerically. By experience we know that the optimisation may have to evaluate the objective at a vector of parameters embeding non-finite values, without compromising an eventual convergence. Moreover, it is a desirable feature of an optimisation routine to allow the evaluation of the objective or constraint at such vector. The `stats::optim` routine allows this when used with `method = "BFGS"`, ant this is a very popular choice. Optimisation routines from the **nloptr** package allow the parameter to take non-finite values both in the objective and in the constraint function, if any. Of course the log-likelihood could catch non-finite values before calling the probability function(s), but this is an extra pain and may slow down the estimation

"Classical" behaviour for non-finite values

Remind of how the probability function of the classical distribution in the **stats** package work.

- The first argument of the density, distribution of quantile function is a vector in which some elements can be non-finite without casting any error or warning. In the corresponding returned vector, an input value `NA` (resp. `NaN`) will produce an output value `NA` (resp. `NaN`). An infinite value `-Inf` (resp. `Inf`) correspond to: an output value `0` (resp. `0`) for the density function, an output value `0` (resp. `1`) for the distribution function and `NaN` (resp. `NaN`) for the quantile function.
- When the first argument `p` of the quantile function contains a value `< 0.` or `> 1.` a warning is cast and the corresponding output value is `NaN`. When `p` is `0.` (resp. `1.`), the corresponding output value is the lower (resp. upper) end-point of the distribution be it finite or not.
- The parameter arguments can be vectors and some elements in these be non-finite without resulting in an error. An input value `NA` (resp. `NaN`) will produce an output value `NA` (resp. `NaN`). When an input value is `-Inf` or `Inf` the corresponding value will usually be `NaN`. Yet it can be a finite value in some cases as in `dnorm(1.3, mean = Inf)` which returns 0.
- When incorrect values are given in a parameter argument such as a negative value for a scale argument, the corresponding output value is `NaN`.

Extreme-Value packages

For a number of Extreme-Values packages we evaluate the results given by the density function for their two-parameter GP and for their three-parameter GEV distributions if any. Note that each row in a table corresponds to a call using vectorised w.r.t. thte first argument (`x` for a density, `q` for a distribution and `p` for a quantile). So an error must be considered as holding for a full row.

Findings

Our findings are as follows.

- For all packages the quantile function `q` casts an error when the vector given as probability argument contains non-finite values. This behaviour differs from that of the quantile function for classical probability functions.
- In the packages **evd**, `POT` and **SpatialExtremes**, the GPD density unduly casts an error when the shape is `0.0` and `x` is a vector containing non-finite values. This may be considered as a bug.

- Most packages do not cope with non-finite values for the parameters as the classical distribution functions do. For some packages the behaviour is not consistent between the two distributions or between the density and the distribution functions for a same distribution.

Results for package evd

Package version used: 2.3.6.1

o Equivalent of 'dGPD2': 'evd::dgpd'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	NaN
shape = 0.0	ERROR	*****	*****	*****	*****
shape = 0.5	0.2035416	0.0000000	0.0000000	NA	NaN
shape = -Inf	0	0	0	NA	NaN
shape = Inf	0	0	0	NA	NaN
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'pGPD2': 'evd::pgpd'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	1.0000000	NA	NaN
shape = -Inf	0	0	0	0	0
shape = Inf	0	0	0	0	0
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'qGPD2': 'evd::qgpd'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

o Equivalent of 'dGEV': 'evd::dgev'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.2566889	NaN	0.0000000	NA	NaN
shape = 0.0	0.1927046	NaN	0.0000000	NA	NaN
shape = 0.5	0.1440053	0.0000000	0.0000000	NA	NaN

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -Inf	0	0	0	NA	NaN
shape = Inf	0	0	0	NA	NaN
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'pGEV': 'evd::pgev'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.9037587	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.8000107	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.7214223	0.0000000	1.0000000	NA	NaN
shape = -Inf	0.3678794	0.3678794	0.3678794	0.3678794	0.3678794
shape = Inf	0.3678794	0.3678794	0.3678794	0.3678794	0.3678794
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'qGEV': 'evd::qgev'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

Results for package extRemes

Package version used: 2.1.3

o Equivalent of 'dGPD2': 'extRemes::devd'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	NaN
shape = 0.0	ERROR	*****	*****	*****	*****
shape = 0.5	0.2035416	0.0000000	0.0000000	NA	NaN
shape = -Inf	0	0	0	NA	NaN
shape = Inf	0	0	0	NA	NaN
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'pGPD2': 'extRemes::pevd'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	1.0000000	NA	NaN
shape = -Inf	0	0	0	0	0
shape = Inf	0	0	0	0	0
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'qGPD2': 'extRemes::qevd'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

o Equivalent of 'dGEV': 'extRemes::devd'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.2566889	NaN	0.0000000	NA	NaN
shape = 0.0	0.1927046	NaN	0.0000000	NA	NaN
shape = 0.5	0.1440053	0.0000000	0.0000000	NA	NaN
shape = -Inf	0	0	0	NA	NaN
shape = Inf	0	0	0	NA	NaN
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'pGEV': 'extRemes::pevd'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.9037587	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.8000107	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.7214223	0.0000000	1.0000000	NA	NaN
shape = -Inf	0.3678794	0.3678794	0.3678794	0.3678794	0.3678794
shape = Inf	0.3678794	0.3678794	0.3678794	0.3678794	0.3678794
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'qGEV': 'extRemes::qevd'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

Results for package mev

Package version used: 1.15

o Equivalent of 'dGPD2': 'mev::dgp'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	NaN
shape = 0.0	0.246597	0.000000	0.000000	NA	NaN
shape = 0.5	0.2035416	0.0000000	0.0000000	NA	NaN
shape = -Inf	ERROR	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'pGPD2': 'mev::pgp'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	1.0000000	NA	NaN
shape = -Inf	ERROR	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'qGPD2': 'mev::qgp'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

o Equivalent of 'dGEV': 'mev::dgev'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.2566889	0.0000000	0.0000000	NA	NaN
shape = 0.0	0.1927046	NaN	0.0000000	NA	NaN
shape = 0.5	0.1440053	0.0000000	0.0000000	NA	NaN
shape = -Inf	ERROR	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'pGEV': 'mev::pgev'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.9037587	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.8000107	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.7214223	0.0000000	1.0000000	NA	NaN
shape = -Inf	ERROR	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'qGEV': 'mev::qgev'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

Results for package nieve

Package version used: 0.1.4

o Equivalent of 'dGPD2': 'nieve::dGPD2'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	NaN
shape = 0.0	0.246597	0.000000	0.000000	NA	NaN
shape = 0.5	0.2035416	0.0000000	0.0000000	NA	NaN
shape = -Inf	NaN	0	0	NA	NaN
shape = Inf	NaN	0	0	NA	NaN
shape = NA	NaN	0	0	NA	NaN
shape = NaN	NaN	0	0	NA	NaN

o Equivalent of ‘pGPD2’: ‘nieve::pGPD2’

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	1.0000000	NA	NaN
shape = -Inf	NaN	0	1	NA	NaN
shape = Inf	NaN	0	1	NA	NaN
shape = NA	NaN	0	1	NA	NaN
shape = NaN	NaN	0	1	NA	NaN

o Equivalent of ‘qGPD2’: ‘nieve::qGPD2’

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

o Equivalent of ‘dGEV’: ‘nieve::dGEV’

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.2566889	0.0000000	0.0000000	NA	NaN
shape = 0.0	0.1927046	0.0000000	0.0000000	NA	NaN
shape = 0.5	0.1440053	0.0000000	0.0000000	NA	NaN
shape = -Inf	NaN	0	0	NA	NaN
shape = Inf	NaN	0	0	NA	NaN
shape = NA	NaN	0	0	NA	NaN
shape = NaN	NaN	0	0	NA	NaN

o Equivalent of ‘pGEV’: ‘nieve::pGEV’

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.9037587	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.8000107	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.7214223	0.0000000	1.0000000	NA	NaN
shape = -Inf	NaN	0	1	NA	NaN
shape = Inf	NaN	0	1	NA	NaN
shape = NA	NaN	0	1	NA	NaN
shape = NaN	NaN	0	1	NA	NaN

o Equivalent of ‘qGEV’: ‘nieve::qGEV’

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

Results for package POT

Package version used: 1.1.10

o Equivalent of 'dGPD2': 'POT::dgpd'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	NaN
shape = 0.0	ERROR	*****	*****	*****	*****
shape = 0.5	0.2035416	0.0000000	0.0000000	NA	NaN
shape = -Inf	0	0	0	NA	NaN
shape = Inf	0	0	0	NA	NaN
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'pGPD2': 'POT::pgpd'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	1.0000000	NA	NaN
shape = -Inf	0	0	0	0	0
shape = Inf	0	0	0	0	0
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'qGPD2': 'POT::qgpd'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

Results for package revdbayes

Package version used: 1.5.1

o Equivalent of 'dGPD2': 'revdbayes::dgp'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	NA
shape = 0.0	0.246597	0.000000	0.000000	NA	NA
shape = 0.5	0.2035416	0.0000000	0.0000000	NA	NA
shape = -Inf	0	0	0	NA	NA
shape = Inf	0	0	0	NA	NA
shape = NA	NA	0	0	NA	NA
shape = NaN	NA	0	0	NA	NA

o Equivalent of 'pGPD2': 'revdbayes::pgp'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	1.0000000	NA	NaN
shape = -Inf	0	0	0	0	0
shape = Inf	0	0	0	0	0
shape = NA	NA	NA	NA	NA	NA
shape = NaN	NA	NA	NA	NA	NA

o Equivalent of 'qGPD2': 'revdbayes::qgp'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

o Equivalent of 'dGEV': 'revdbayes::dgev'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.2566889	0.0000000	0.0000000	NA	NA
shape = 0.0	0.1927046	0.0000000	0.0000000	NA	NA
shape = 0.5	0.1440053	0.0000000	0.0000000	NA	NA
shape = -Inf	0	0	0	NA	NA
shape = Inf	0	0	0	NA	NA
shape = NA	NA	0	0	NA	NA
shape = NaN	NA	0	0	NA	NA

o Equivalent of 'pGEV': 'revdbayes::pgev'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.9037587	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.8000107	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.7214223	0.0000000	1.0000000	NA	NaN
shape = -Inf	0.3678794	0.3678794	0.3678794	0.3678794	0.3678794
shape = Inf	0.3678794	0.3678794	0.3678794	0.3678794	0.3678794
shape = NA	NA	NA	NA	NA	NA
shape = NaN	NA	NA	NA	NA	NA

o Equivalent of 'qGEV': 'revdbayes::qgev'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

Results for package SpatialExtremes

Package version used: 2.1.0

o Equivalent of 'dGPD2': 'SpatialExtremes::dgpd'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	NaN
shape = 0.0	ERROR	*****	*****	*****	*****
shape = 0.5	0.2035416	0.0000000	0.0000000	NA	NaN
shape = -Inf	0	0	0	NA	NaN
shape = Inf	0	0	0	NA	NaN
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of 'pGPD2': 'SpatialExtremes::pgpd'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	1.0000000	NA	NaN
shape = -Inf	0	0	0	0	0
shape = Inf	0	0	0	0	0
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of ‘qGPD2’: ‘SpatialExtremes::qgpd’

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

o Equivalent of ‘dGEV’: ‘SpatialExtremes::dgev’

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.2566889	NaN	0.0000000	NA	NaN
shape = 0.0	0.1927046	NaN	0.0000000	NA	NaN
shape = 0.5	0.1440053	0.0000000	0.0000000	NA	NaN
shape = -Inf	0	0	0	NA	NaN
shape = Inf	0	0	0	NA	NaN
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of ‘pGEV’: ‘SpatialExtremes::pgev’

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.9037587	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.8000107	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.7214223	0.0000000	1.0000000	NA	NaN
shape = -Inf	0.3678794	0.3678794	0.3678794	0.3678794	0.3678794
shape = Inf	0.3678794	0.3678794	0.3678794	0.3678794	0.3678794
shape = NA	ERROR	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****

o Equivalent of ‘qGEV’: ‘SpatialExtremes::qgev’

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

Results for package tea

Package version used: 1.1

o Equivalent of 'dGPD2': 'tea::dgpd'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	0.000000
shape = 0.0	0.246597	0.000000	0.000000	NA	0.000000
shape = 0.5	0.2035416	0.0000000	0.0000000	NA	0.0000000
shape = -Inf	0	0	0	NA	0
shape = Inf	0	0	0	NA	0
shape = NA	NA	0	NA	NA	NA
shape = NaN	NA	0	NA	NA	NA

o Equivalent of 'pGPD2': 'tea::pgpd'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	1.0000000	NA	NaN
shape = -Inf	NaN	NaN	NaN	NA	NaN
shape = Inf	NaN	NaN	NaN	NA	NaN
shape = NA	NA	NA	NA	NA	NA
shape = NaN	NA	NA	NA	NA	NA

o Equivalent of 'qGPD2': 'tea::qgpd'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

Results for package texmex

Package version used: 2.4.8

```
## Warning in log(sigma): Production de NaN
```

```
## Warning in log(sigma): Production de NaN
```

o Equivalent of 'dGPD2': 'texmex::dgpd'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.291863	0.000000	0.000000	NA	NaN

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = 0.0	0.246597	0.000000	0.000000	NA	NaN
shape = 0.5	0.2035416	0.0000000	NaN	NA	NaN
shape = -Inf	0	0	0	NA	NaN
shape = Inf	0	0	NaN	NA	NaN
shape = NA	NA	0	NA	NA	NA
shape = NaN	NaN	0	NaN	NaN	NaN

o Equivalent of 'pGPD2': 'texmex::pgpd'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.8988071	0.0000000	1.0000000	NA	NaN
shape = 0.0	0.7768698	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.6734694	0.0000000	NaN	NA	NaN
shape = -Inf	1	NaN	1	NA	NaN
shape = Inf	0	NaN	NaN	NA	NaN
shape = NA	NA	NA	NA	NA	NaN
shape = NaN	NaN	NaN	NaN	NA	NaN

o Equivalent of 'qGPD2': 'texmex::qgpd'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****

o Equivalent of 'dGEV': 'texmex::dgev'

	x = 1.4	x = -Inf	x = Inf	x = NA	x = NaN
shape = -0.4	0.2566889	NaN	NaN	NA	NaN
shape = 0.0	0.1927046	0.0000000	0.0000000	NA	NaN
shape = 0.5	0.1440053	0.0000000	NaN	NA	NaN
shape = -Inf	NaN	NaN	NaN	NA	NaN
shape = Inf	0	0	NaN	NA	NaN
shape = NA	NA	NA	NA	NA	NA
shape = NaN	NaN	NaN	NaN	NaN	NaN

o Equivalent of 'pGEV': 'texmex::pgev'

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = -0.4	0.9037587	NaN	1.0000000	NA	NaN

	q = 1.5	q = -Inf	q = Inf	q = NA	q = NaN
shape = 0.0	0.8000107	0.0000000	1.0000000	NA	NaN
shape = 0.5	0.7214223	0.0000000	NaN	NA	NaN
shape = -Inf	1	NaN	1	NA	NaN
shape = Inf	0.3678794	0.0000000	NaN	NA	NaN
shape = NA	NA	NA	NA	NA	NaN
shape = NaN	NaN	NaN	NaN	NA	NaN

o Equivalent of 'qGEV': 'texmex::qgev'

	p = -0.1	p = 0.0	p = 0.5	p = 1.0	p = 1.1	p = -Inf	p = Inf	p = NA	p = NaN
shape = -0.4	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.0	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = 0.5	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = -Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = Inf	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NA	ERROR	*****	*****	*****	*****	*****	*****	*****	*****
shape = NaN	ERROR	*****	*****	*****	*****	*****	*****	*****	*****