

Package ‘evdbayes’

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Title Bayesian Analysis in Extreme Value Theory

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Description Provides functions for the bayesian analysis of extreme value models, using MCMC methods.

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R topics documented:

Accept Rate	2
dinfo	3
Jumps Definition	4
lh	5
mc.quant	6
mposterior	7
posterior	8
posterior	9
prior	10
rainfall	11
rl.pred	12
rl.pst	13
Index	14

Accept Rate

*Compute Suited Proposal Standard Deviations***Description**

Compute suited proposal standard deviations for the MCMC algorithm.

Usage

```
ar.choice(init, prior, lh = c("none", "gev", "gpd", "pp", "os"), ..., psd,
ar = rep(.4, npar), n = 1000, tol = rep(.05, npar))
```

Arguments

<code>init</code>	a numeric vector for the starting value of the MCMC algorithm.
<code>prior</code>	A prior model. See function <code>prior.prob</code> , <code>prior.quant</code> , <code>prior.norm</code> and <code>prior.loglognorm</code> .
<code>lh</code>	The likelihood function. Should be one of “none”, “gev”, “gpd”, “pp” and “os”.
<code>...</code>	Optional arguments to be passed to the <code>posterior</code> function.
<code>psd</code>	The initials proposal standard deviations.
<code>ar</code>	Optional. The objective accept rates - default is <code>rep(.4, npar)</code> .
<code>n</code>	Optional. The length of the simulated Markov Chains.
<code>tol</code>	Optional. The tolerance for the convergence test.

Details

The suited proposal standard deviations (`psd`) are computed through trial and error processes. Proposal standard deviations are fundamental to ensure good mixing properties for the Markov Chains. For this purpose, there exists a thumb rule: *“In small dimensions, aim at an average acceptance rate of 50. In large dimensions, at an average acceptance rate of 25. (Gelman et al., 1995)”*.

For numerical conveniences, the trial and error process is more accurate with small initial starting `psd`.

Value

Return a list with two arguments. “`psd`”: the suited proposal standard deviations and “`ar`”: the accept rates related to these proposal standard deviations.

Author(s)

Mathieu Ribatet

References

Gelman, A. and Roberts, G. and Gilks, W. (1995) *Efficient Metropolis Jumping Rules*. Oxford University Press.

Examples

```

data(rainfall)
prrain <- prior.quant(shape = c(38.9, 7.1, 47), scale = c(1.5, 6.3,
  2.6))
n <- 10000; t0 <- c(43.2, 7.64, 0.32);
s <- ar.choice(init = t0, prior = prrain, lh = "pp", data = rainfall,
  thresh = 40, noy = 54, psd = rep(0.01, 3))
##Alec Stephenson choose suited psd = c(2, .2, .07) which is really
##close to values computed by ``ar.choice``

```

dinfo

Information for Beta and Gamma Distributions

Description

Show means, variances and modes for beta and gamma distributions.

Usage

```

ibeta(mean, var, shapel, shape2)
igamma(mean, var, shape, scale)

```

Arguments

mean, var Numeric vectors giving means and variances.
shapel, shape2
 Numeric vectors. See [dbeta](#).
shape, scale Numeric vectors. See [dgamma](#).

Details

For `ibeta`, either both of `mean` and `var` or both of `shapel` and `shape2` must be specified. For `igamma`, either both of `mean` and `var` or both of `shape` and `scale` must be specified. The pair of vectors that are passed to each function define a set of beta/gamma distributions. If one vector is shorter than the other, the shorter vector is replicated.

Value

A matrix with five columns and n rows, where n is the length of the longest argument. If $n = 1$ the dimension is dropped (i.e. a vector of length five is returned). The columns contain the means, variances, modes, and the shape/scale parameters of the specified distributions. If a mode is NA, it does not exist, or it is not unique, or it does not occur in the interior of the support. If an entire row is NA, the corresponding arguments do not lead to a valid distribution.

See Also

[dbeta](#), [dgamma](#)

Examples

```

ibeta(shape1 = 5, shape2 = 4)
ibeta(mean = seq(0.1,0.9,0.2), var = 0.03)
igamma(shape=c(38.9,7.1,47), scale=c(1.5,6.3,2.6))

```

Jumps Definition *Functions to define reversible jumps*

Description

These are function usefull to define reversible jumps for the algorithm. There is currently three functions: `jacFun` which evaluates the jacobian, `movTyp1` which returns a special proposal of type 1 and `movTyp2` which returns a special proposal of type 2.

Usage

```

jacFun(xi, pMass, cv)
movTyp1(prow, pMass, cv)
movTyp2(prow, propShape, cv)

```

Arguments

<code>xi</code>	The shape parameter at which the jacobian must be evaluated.
<code>pMass</code>	The point Mass i.e. the fixed value for the shape parameter. See reference guide.
<code>cv</code>	A numeric value for jumping rule. See reference guide.
<code>prow</code>	The current state of the Markov Chain.
<code>propShape</code>	The proposal shape candidate.

Details

These are special fucntions but can be overwritten to define new jumping rules.
See user's guide.

Value

`movTyp1` and `movTyp2` returns a vector of lenght two. It corresponds to location and scale proposals.
`jacFun` return the value of the Jacobian at value `xi`.

Author(s)

Mathieu Ribatet

References

Green, P. (1995) Reversible jump Markov chain Monte Carlo computation and Bayesian model determination. *Biometrika* **82**:711–732.

Description

Calculate log-likelihoods for the gev, order statistics or point process models.

Usage

```
pplik(par, data, thresh, noy, trend, exact = FALSE)
gevlik(par, data, trend)
gpdlik(par, data, trend)
oslik(par, data, trend)
```

Arguments

<code>par</code>	If <code>trend</code> is missing, should be a numeric vector of length three, containing the location, scale and shape parameters. If <code>trend</code> is not missing, should be a numeric vector of length four, containing the location intercept, scale, shape and location trend parameters, in that order.
<code>data</code>	For <code>pplik</code> , <code>gevlik</code> and <code>gpdlik</code> ; a non-empty numeric vector containing the data at which the likelihood is evaluated, possibly containing missing values. For <code>oslik</code> ; a numeric matrix (see the user's guide).
<code>thresh</code>	Threshold. Typically a single number or a vector of the same length as <code>data</code> .
<code>noy</code>	Number of years/periods of observations, excluding any missing values.
<code>trend</code>	Trend vector (optional). If given, should be the same length as <code>data</code> for <code>pplik</code> and <code>gevlik</code> . For <code>oslik</code> , should contain one value for each row of <code>data</code> .
<code>exact</code>	In general, the point process likelihood includes an approximation to an integral. If <code>exact</code> is <code>TRUE</code> , every value in <code>trend</code> and <code>thresh</code> is used for the approximation.

Details

See the user's guide.

Note

These functions are essentially internal, and need not be called by the user. They are documented only because their arguments (excluding `par`) can be passed to [posterior](#).

See Also

[posterior](#), [prior.prob](#)

`mc.quant`*Compute GEV Quantiles from Markov Chains*

Description

Compute gev quantiles from samples stored within a Markov chain, corresponding to specified probabilities in the upper tail.

Usage

```
mc.quant(post, p, lh = c("gev", "gpd"))
```

Arguments

<code>post</code>	A Markov chain generated using <code>posterior</code> , containing samples of gev parameters.
<code>p</code>	A numeric vector of upper tail probabilities.
<code>lh</code>	Specify “gev” or “gpd” likelihood.

Details

See the user’s guide.

Value

A matrix with n rows and m columns, where n is the number of samples stored within the chain, and m is the length of the vector p . If $m = 1$ the dimension is dropped (i.e. a vector of length n is returned). The (i, j) th entry contains the gev quantile corresponding to the upper tail probability $p[j]$, evaluated at the parameters within sample i .

If a linear trend on the location has been implemented, the quantiles correspond to the distribution obtained when the trend parameter is zero.

See Also

[posterior](#)

Description

Maximizing prior and posterior distributions for the location (with optional trend), scale and shape parameters under the gev, order statistics or point process models.

Usage

```
mposterior(init, prior, lh = c("none", "gev", "gpd", "pp", "os"),
            method = c("Nelder-Mead", "BFGS", "CG", "L-BFGS-B", "SANN"),
            lower = -Inf, upper = Inf, control = list(), hessian = FALSE, ...)
```

Arguments

<code>init</code>	Numeric vector of length three/four, giving the initial values for the optimization.
<code>prior</code>	An object of class "evprior", constructed using <code>prior.prob</code> , <code>prior.quant</code> or <code>prior.norm</code> .
<code>lh</code>	A character string specifying the likelihood; either "gev" for gev, "gpd" for gpd, "os" for order statistics, "pp" for Poisson process or "none" for none (the default). The latter can be used to maximize the prior distribution.
<code>method</code>	The method to be used. See optim .
<code>lower</code> , <code>upper</code>	Bounds on the variables for the "L-BFGS-B" method. See optim .
<code>control</code>	A list of control parameters. See optim .
<code>hessian</code>	Logical. See optim .
<code>...</code>	Arguments to the likelihood. Should include <code>data</code> unless <code>lh</code> is "none". Should also include <code>thresh</code> and <code>noy</code> if <code>lh</code> is "pp". Should include the vector <code>trend</code> if a linear trend on the location is implemented. See pplik for details.

Value

A list. See [optim](#).

See Also

[pplik](#), [posterior](#), [prior.prob](#)

Description

Constructing MCMC samples of prior and posterior distributions for the location (with optional trend), scale and shape parameters under the gev, order statistics or point process models. Note this function is only effective for a mixture defined in the prior distribution.

Usage

```
posterior.mix(n, init, prior, lh = c("none", "gev", "pp", "os"), ..., psd,
             pMassProb, normPi0, xitilde, pMass = 0, cv, burn = 0, thin = 1)
```

Arguments

<code>n</code>	The run-length; the number of sampled vectors (excluding <code>init</code>).
<code>init</code>	Numeric vector of length three/four, giving the initial values for the chain, taken to be iteration zero.
<code>prior</code>	An object of class "evprior", constructed using <code>prior.prob</code> , <code>prior.quant</code> or <code>prior.norm</code> .
<code>lh</code>	A character string specifying the likelihood; either "gev" for gev, "os" for order statistics, "pp" for Poisson process or "none" for none (the default). The latter can be used to sample from the prior distribution.
<code>...</code>	Arguments to the likelihood. Should include <code>data</code> unless <code>lh</code> is "none". Should also include <code>thresh</code> and <code>noy</code> if <code>lh</code> is "pp". Should include the vector <code>trend</code> if a linear trend on the location is implemented. See pplik for details.
<code>psd</code>	A vector of length three/four containing standard deviations for proposal distributions.
<code>pMassProb</code>	The probability for the point Mass.
<code>normPi0</code>	The constant such as the point mass prior distribution is a distribution.
<code>xitilde</code>	The mode of the marginal posterior distribution for the shape parameter - from a conventional Bayesian analysis i.e. without a point Mass.
<code>pMass</code>	The point mass for the shape parameter.
<code>cv</code>	A vector of length two containing probabilities for quantiles matching.
<code>burn</code>	The burn-in period (an integer); the first <code>burn</code> iterations (including <code>init</code>) are excluded from the chain.
<code>thin</code>	The thinning interval (an integer); iteration k is stored only if $k \bmod \text{thin}$ is zero (and if k greater than or equal to <code>burn</code>).

Details

See the user's guide.

Value

A matrix with $1 + \text{floor}(n/\text{thin}) - \text{burn}$ rows. Row labels give the iteration numbers. Column labels give parameter names.

An attribute `ar` is also returned. This is a matrix containing acceptance rates in the first row (the number of proposals accepted divided by the number of iterations) and “external rates” in the second (the number of proposals that resulted in a zero likelihood, divided by the number of iterations).

See Also

`pplik`, `prior.prob`

posterior

MCMC Sampling of Posterior Distributions

Description

Constructing MCMC samples of prior and posterior distributions for the location (with optional trend), scale and shape parameters under the `gev`, order statistics or point process models.

Usage

```
posterior(n, init, prior, lh = c("none", "gev", "gpd", "pp", "os"), ..., psd,
          burn = 0, thin = 1)
```

Arguments

<code>n</code>	The run-length; the number of sampled vectors (excluding <code>init</code>).
<code>init</code>	Numeric vector of length three/four, giving the initial values for the chain, taken to be iteration zero.
<code>prior</code>	An object of class "evprior", constructed using <code>prior.prob</code> , <code>prior.quant</code> or <code>prior.norm</code> .
<code>lh</code>	A character string specifying the likelihood; either "gev" for <code>gev</code> , "gpd" for <code>gpd</code> , "os" for order statistics, "pp" for Poisson process or "none" for none (the default). The latter can be used to sample from the prior distribution.
<code>...</code>	Arguments to the likelihood. Should include <code>data</code> unless <code>lh</code> is "none". Should also include <code>thresh</code> and <code>noy</code> if <code>lh</code> is "pp". Should include the vector <code>trend</code> if a linear trend on the location is implemented. See <code>pplik</code> for details.
<code>psd</code>	A vector of length three/four containing standard deviations for proposal distributions.
<code>burn</code>	The burn-in period (an integer); the first <code>burn</code> iterations (including <code>init</code>) are excluded from the chain.
<code>thin</code>	The thinning interval (an integer); iteration k is stored only if $k \bmod \text{thin}$ is zero (and if k greater than or equal to <code>burn</code>).

Details

See the user's guide.

Value

A matrix with $1 + \text{floor}(n/\text{thin}) - \text{burn}$ rows. Row labels give the iteration numbers. Column labels give parameter names.

An attribute `ar` is also returned. This is a matrix containing acceptance rates in the first row (the number of proposals accepted divided by the number of iterations) and "external rates" in the second (the number of proposals that resulted in a zero likelihood, divided by the number of iterations).

See Also

`pplik`, `prior.prob`

Examples

```
mat <- diag(c(10000, 10000, 100))
pn <- prior.norm(mean = c(0,0,0), cov = mat)
## Not run: data(portpirie)
## Not run:
posterior(1000, init = c(5,1,0.1), prior = pn, lh = "gev",
  data = portpirie, psd = c(.02, .1, .1))
## End(Not run)
```

prior

Construction of Prior Distributions

Description

Constructing prior distributions for the location, scale and shape parameters using normal, beta or gamma distributions. A linear trend for the location can also be specified, using a prior normal distribution centered at zero for the trend parameter.

Usage

```
prior.prob(quant, alpha, trendsd = 0)
prior.quant(prob = 10^(1:3), shape, scale, trendsd = 0)
prior.norm(mean, cov, trendsd = 0)
prior.loglognorm(mean, cov, trendsd = 0)
```

Arguments

`quant`, `alpha` Numeric vectors of length three and four respectively. Beta prior distributions are placed on probability ratios corresponding to the quantiles given in `quant`.

<code>prob, shape, scale</code>	Numeric vectors of length three. Gamma prior distributions, with parameters <code>shape</code> and <code>scale</code> , are placed on quantile differences corresponding to the probabilities given in <code>prob</code> .
<code>mean, cov</code>	The prior distribution for the location, $\log(\text{scale})$ and <code>shape</code> is taken to be trivariate normal, with mean <code>mean</code> (a numeric vector of length three) and covariance matrix <code>cov</code> (a symmetric positive definite three by three matrix).
<code>trendsd</code>	The standard deviation for the marginal normal prior distribution (with mean zero) placed on the linear trend parameter for the location. If this is zero (the default) a linear trend is not implemented.

Details

See the user's guide.

Value

Returns an object of class "evprior", which is essentially just a list of the arguments passed.

See Also

[posterior](#), [pplik](#)

Examples

```
mat <- diag(c(10000, 10000, 100))
prior.norm(mean = c(0,0,0), cov = mat, trendsd = 10)
prior.quant(shape = c(38.9,7.1,47), scale = c(1.5,6.3,2.6))
prior.prob(quant = c(85,88,95), alpha = c(4,2.5,2.25,0.25))
```

`rainfall`

Daily Aggregate Rainfall

Description

A numeric vector of length 20820 containing daily aggregate rainfall observations, in millimetres, recorded at a rain gauge in England over a 57 year period, beginning on a leap year. Three of these years contain only missing values.

Usage

```
data(rainfall)
```

Format

A vector containing 20820 observations.

Source

Unknown.

`rl.pred`*Return Level Plots for GEV Predictive Distributions*

Description

Produce return level plots depicting prior and posterior predictive gev distributions.

Usage

```
rl.pred(post, qlim, npy, lh = c("gev", "gpd"), period = 1, lty = 1, col = 1,
        xlab = "return period", ylab = "return level", ...)
```

Arguments

<code>post</code>	A Markov chain generated using <code>posterior</code> , containing samples from the corresponding prior/posterior distribution.
<code>qlim</code>	A vector of length two, giving the limits for the quantiles at which the predictive probabilities are calculated.
<code>npy</code>	The Number of observation Per Year (in average). If “gev” likelihood, “npy” is supposed to be equal to 1 i.e. annual maxima.
<code>lh</code>	The likelihood.
<code>period</code>	A vector of integers. One curve is plotted for each element of <code>period</code> . The i th curve depicts the probabilities that that quantiles will be exceeded over the next <code>period[i]</code> periods.
<code>lty</code>	Passed to <code>matplot</code> .
<code>col</code>	Passed to <code>matplot</code> .
<code>xlab, ylab</code>	Labels for the x and y axes.
<code>...</code>	Other arguments passed to <code>matplot</code> .

Details

See the user’s guide.

Value

The first two arguments to `matplot` are returned invisibly as a list.

If a linear trend on the location has been implemented, the plot corresponds to the distribution obtained when the trend parameter is zero.

See Also

[matplot](#), [posterior](#)

 rl.pst

Return Level Plots Depicting Distributions of GEV Quantiles

Description

Produce return level plots depicting prior and posterior distributions of gev quantiles.

Usage

```
rl.pst(post, npy, lh = c("gev", "gpd"), ci = 0.9, lty = c(2,1), col = c(2,1),
       xlab = "return period", ylab = "return level", ...)
```

Arguments

post	A Markov chain generated using <code>posterior</code> , containing samples from the corresponding prior/posterior distribution.
npv	The Number of observation Per Year (in average). If “gev” likelihood, “npv” is supposed to be equal to 1 i.e. annual maxima.
lh	The likelihood.
ci	The confidence coefficient for the plotted prior/posterior probability interval.
lty	Passed to <code>matplot</code> . The first and second values specify the line type of the probability interval and the median line respectively.
col	Passed to <code>matplot</code> . The first and second values specify the colour of the probability interval and the median line respectively.
xlab, ylab	Labels for the x and y axes.
...	Other arguments passed to <code>matplot</code> .

Details

See the user’s guide.

Value

The first two arguments to `matplot` are returned invisibly as a list.

If a linear trend on the location has been implemented, the plot corresponds to the distribution obtained when the trend parameter is zero.

See Also

[matplot](#), [posterior](#)

Index

- *Topic **datasets**
 - rainfall, 11
- *Topic **distribution**
 - dinfo, 3
- *Topic **hplot**
 - rl.pred, 12
 - rl.pst, 13
- *Topic **htest**
 - Accept Rate, 1
 - Jumps Definition, 4
- *Topic **manip**
 - mc.quant, 6
- *Topic **models**
 - lh, 5
 - posterior, 8, 9
 - prior, 10
- *Topic **optimize**
 - mposterior, 7

Accept Rate, 1

ar.choice (*Accept Rate*), 1

dbeta, 3

dgamma, 3

dinfo, 3

gevlik (*lh*), 5

gpdlik (*lh*), 5

ibeta (*dinfo*), 3

igamma (*dinfo*), 3

jacFun (*Jumps Definition*), 4

Jumps Definition, 4

lh, 5

matplot, 12, 13

mc.quant, 6

movTyp1 (*Jumps Definition*), 4

movTyp2 (*Jumps Definition*), 4

mposterior, 7

optim, 7

oslik (*lh*), 5

posterior, 2, 5–7, 8, 9, 11–13

pplik, 7–11

pplik (*lh*), 5

prior, 10

prior.loglognorm, 2

prior.norm, 2

prior.prob, 2, 5, 7, 9, 10

prior.quant, 2

rainfall, 11

rl.pred, 12

rl.pst, 13