A User's Guide to the POT Package (Version 1.1)

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1.6 Legalese

$z \leq$

5. Two random variables (with unit Fréchet margins) are perfectly dependent if $A(w) = \max(w, 1-w)$, w.

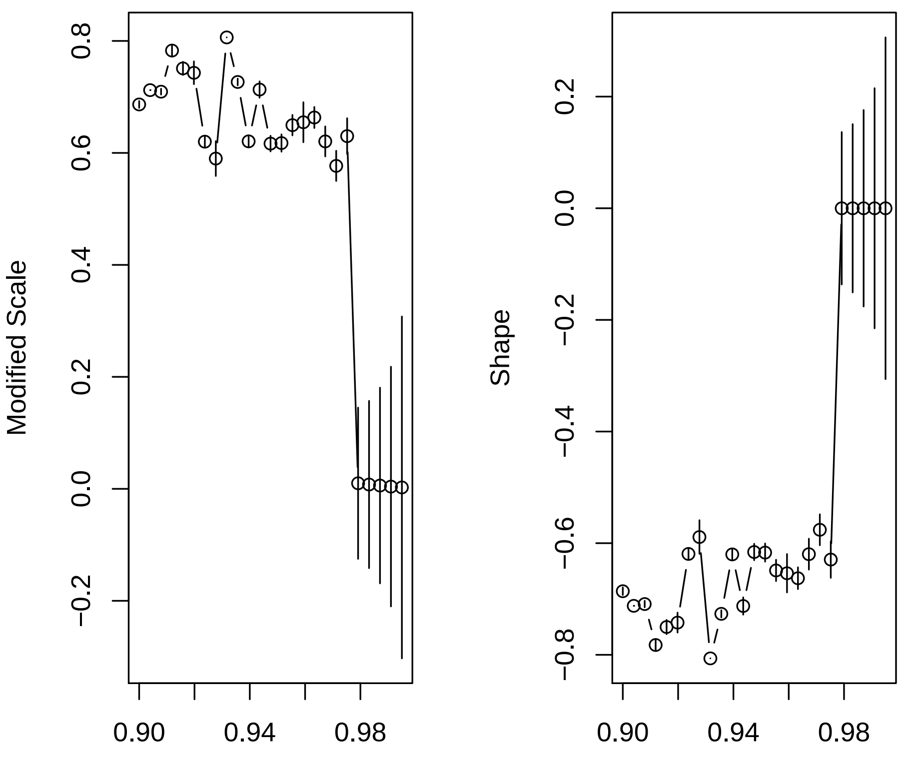
We define the multivariate extreme value distributigns which are identical to the block maxima approach in higher dimensigns. We now establish the multivariate theory for peaks over threshold.

According to Resnick (1987, Prop. 5.15), multivariate peaks over thresholds u_j has the same representatign than for block maxima. Only the margins F_j must be replaced by GPD instead of GEV. Thus,

$$F(y_1, \ldots, y_d) = \exp\left(-V\left(-\frac{1}{}\right)\right)$$

3.2 Threshold Selection

The location for the GPD or equivalently the threshold is a particular parameter as must often it is not


Modified Scale
Threshold
Shape
Threshold
0.90
0.94
0.98
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8

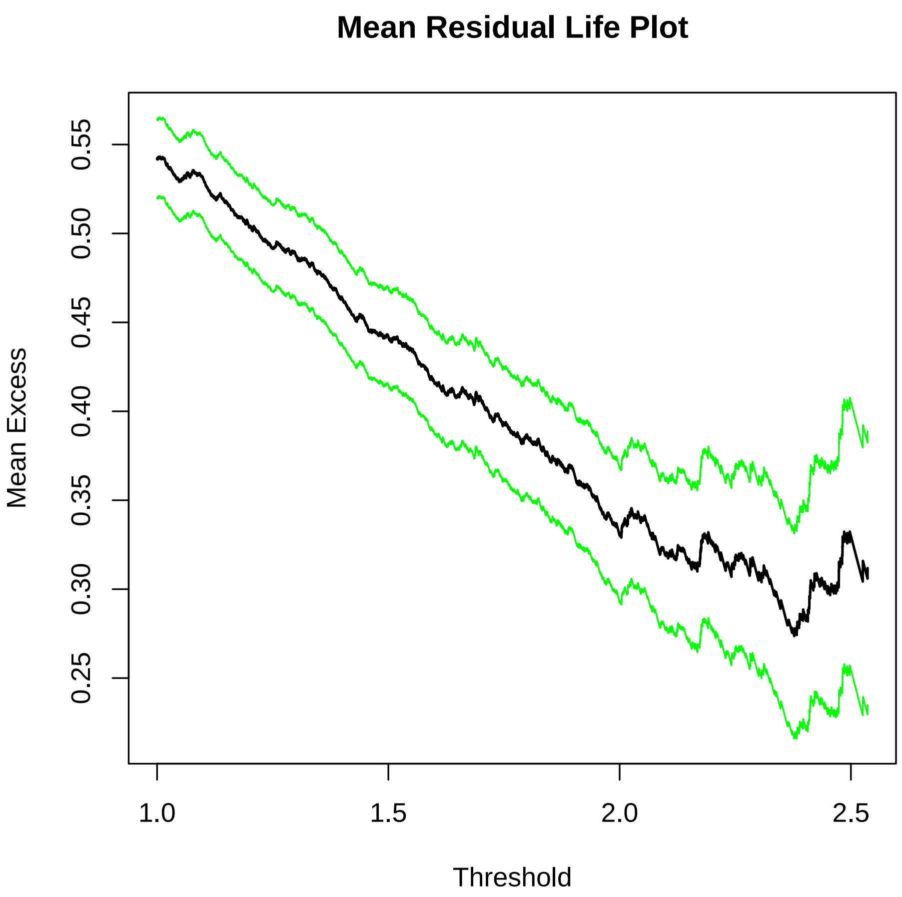


Figure 2: The threshold selection using the mrlplot function

The quantity

3.2.3 L-Moments plot: *lmomplot*

L-moments are summary statistics for probability distributions and data samples. They are analogous to
or-295iarymotexpts(r)1()27(v5)1(j)1dresusealsca(t)1(i)1dions1,rionsandbout1Thrda(ps)-6(ec(t)1(s)]TJ0-11.955Td[(fy)3068(t)
(or)3tyylplw(i)2onr(t)1(i)1(on)3lpd.

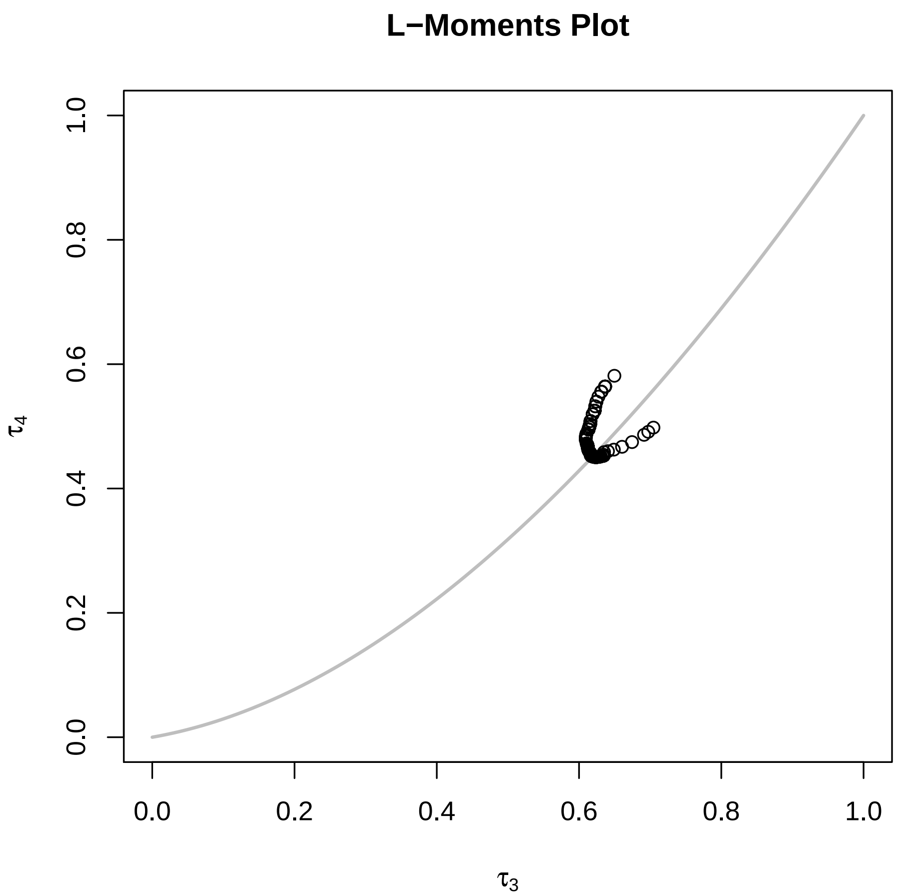


Figure 3: fig: The threshold selection using the lmomplot function

3.3 Fitting the GPD

3.3.1 The univariate case

The main function to fit the GPD is called **fitgpd**. This is a generic function which can fit the GPD according several estimators. There are currently 7 estimators available: method of moments `moments`, maximum likelihood `mle`

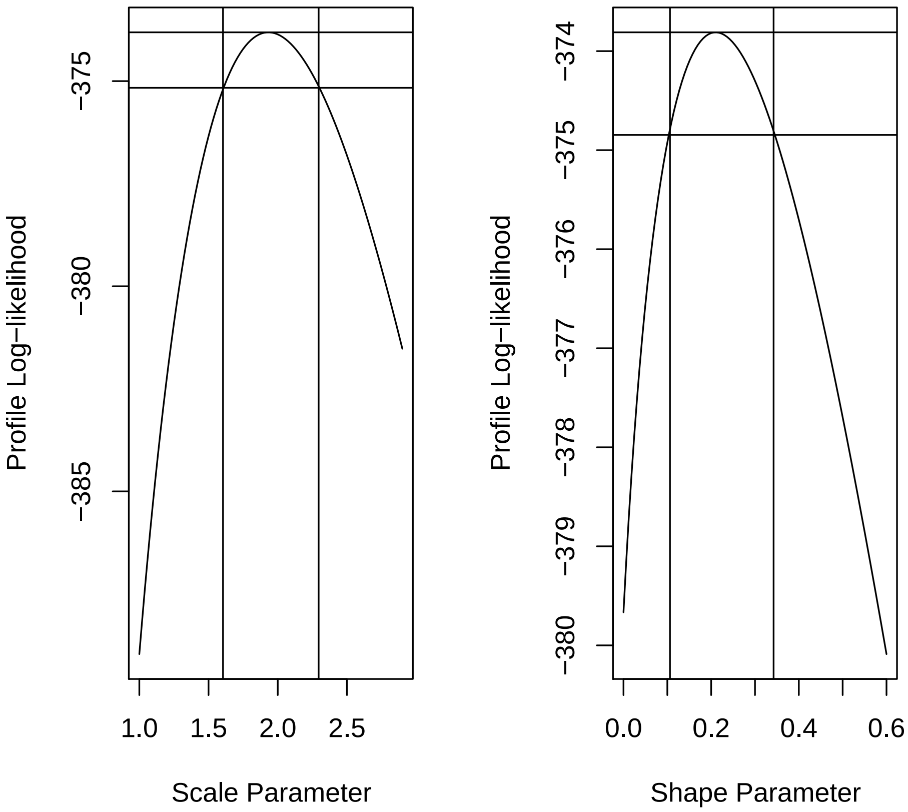
```
        Standard Error Type: Observed

        Standard Errors
         scdae
        0.1937

        Asymptoticd-523(V)1(a)1(r)1(i)1(a)1(n)1(c)1(e)-523(C)1(o)1(v)1(a)1(r)1(i)1(a)1(n)2(c)1(e)]TJ36.543-1
scdae  0.03753

Optimizdaion Informdaion
  Convergence: successful
  Function Evalu(a)1tions: 7
  Gradient Eva[illegible]lu(a)1tions: 1

> fitgpd(x, th[illegible]da21le = 2, method = "mde")

Estimator: MLE
Deviance: 332.3379
     AIC: 334.3379

Varying Threshold: FALSE

Threshold Call: 1
Number Above: 100
Proportion Above: 1

Estimates
 shape
0.0055

Standard Error Type: Observed

Standard Errors
  shape
0.06805

J-10.441-11.95[illegible])1(8)1(0)1(5)]TJ0-23.91Td[(J-10.441-11.955Td[(0)1(.)1(0)1(6)1(8)1(0)1(5)]TJ

Optimizdaion I[illegible]ion
         Conv[illegible]gence: successful
         Function Evalu(a)1tion: 100
         Gradient Evalu(a)1tions1
```

Estimator: MLE
Deviae3.55 Td[(1c)1(e)16.3379

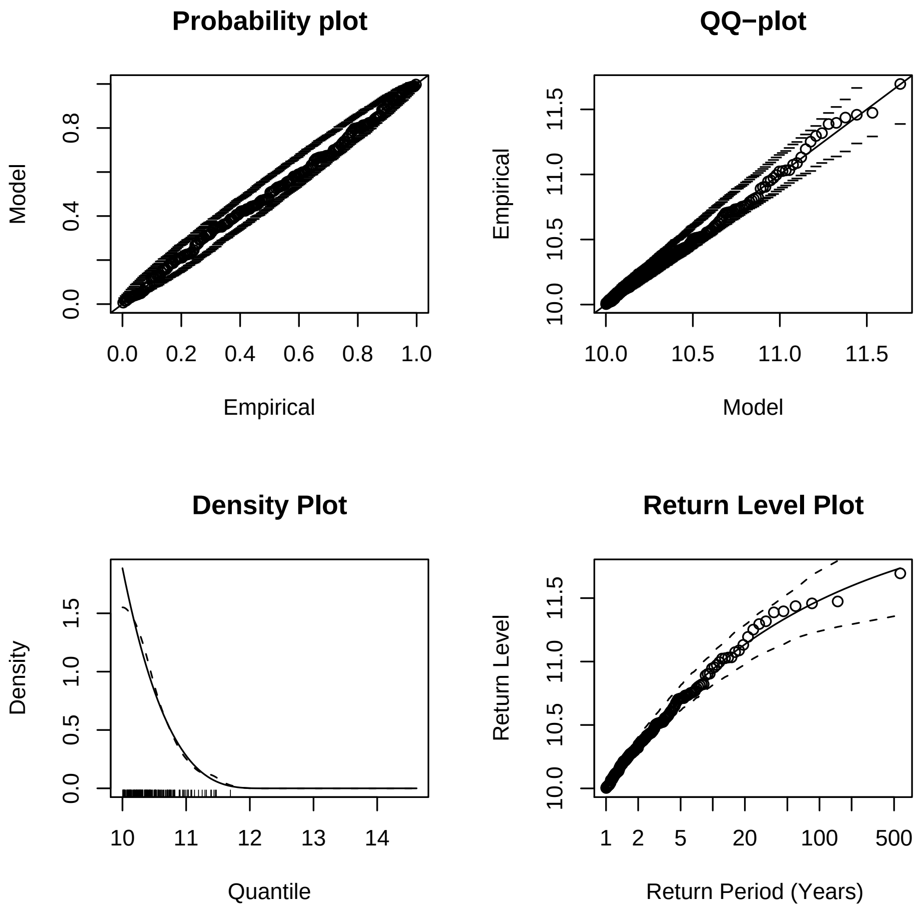
```
> x <- rgpd(200, 1, 2, 0.25)
```

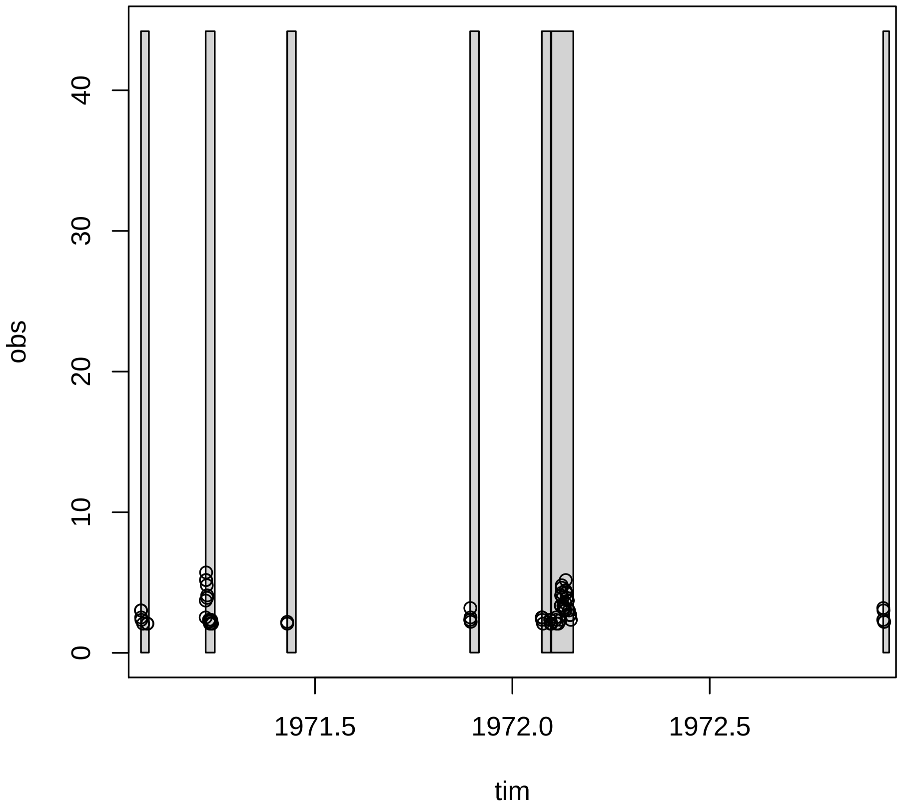
```
If there is some troubles try to put vert.lines = FALSE or change
 the range...
conf.inf conf.sup
1.604545 2.295455
```

```
If there is some troubles try to put vert.lines = FALSE or change
 the range...
 conf.inf  conf.sup
0.1060606 0.3424242
```



```
conf.inf  conf.sup
7.608018 10.631937
```


Probability plot
Model
Empirical
0.0
0.4
0.8
0.0 0.2 0.4 0.6 0.8 1.0
QQ−plot
Empirical
Model
10.0
10.5
11.0
11.5
10.0 10.5 11.0 11.5
Density Plot
Density
Quantile
0.0
0.5
1.0
1.5
10 11 12 13 14
Return Level Plot
Return Level
Return Period (Years)
10.0
10.5
11.0
11.5
1 2 5 20 100 500



0
10
20
30
40
obs
1971.5
1972.0
1972.5
tim

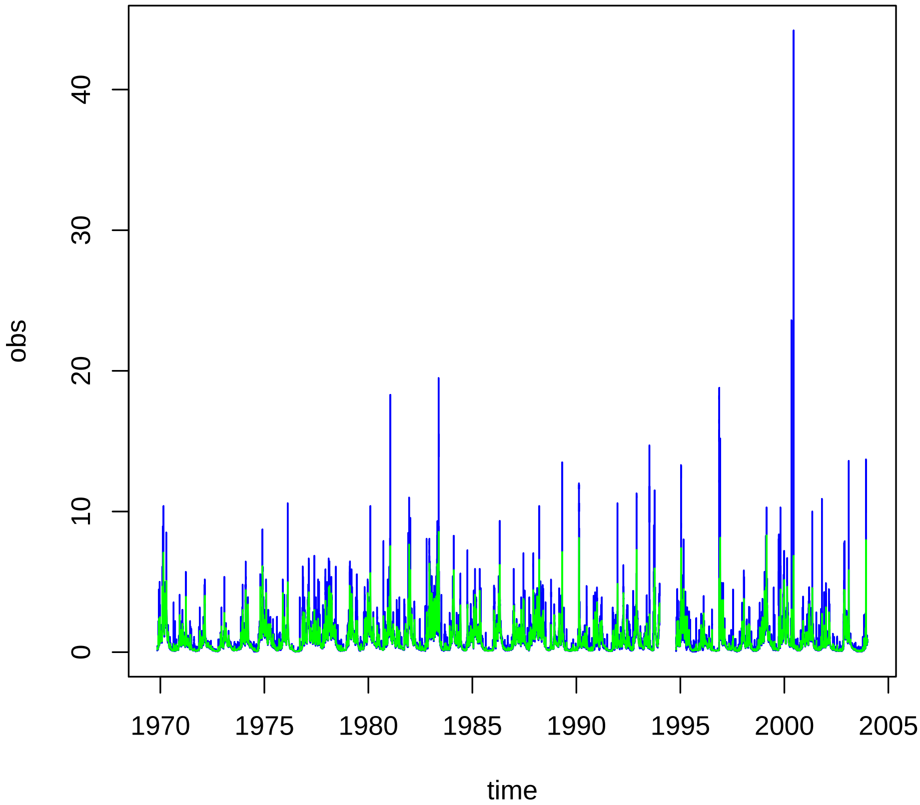


Figure 10: Instantaneous floo784.2d(F)1(i)sctre an784.2ar784.2d(F)1(i)sct784.2o784.2d(F)(gu)1(r)ati784.23(e)-33d(F)ai

4 A Concrete Statistical Analysis of Peaks Over a Threshold

In this section, we provide a full and detailed analysis of peaks over a threshold for the river Ardières at Beaujeu. Figure 10 depicts instantaneous flood discharges - blue line.

The result of function **fitgpd** gives the name of the estimator, if a varying threshold was used, the threshold value, the number and the proportion of observations above the threshold, parameter estimates, standard error estimates and type, the asymptotic variance-covariance matrix and convergence diagnostic.

Figure 12 shows graphic diagnostics for the fitted model. It can be seen that the fitted model "mle" seems to be appropriate. Suppose we want to know the return level associated to the 100-year return period.

```
> rp2prob(retper = 100, npy = npy)

       npy retper      prob
1 1.707897    100 0.9941448

> prob <- rp2prob(retper = 100, npy = npy)[, "prob"]
> qgpd(prob, loc = 6, scale = mle$param["scale"], shape = mle$param["shape"])

   scale
36.44331
```

To take into account uncertainties, Figure 13 depicts the profile confidence interval for the quantile

A Dependence Models for Bivariate Extreme Value Distributions

A.1 The Logisitic model

A.5 The Mixed model