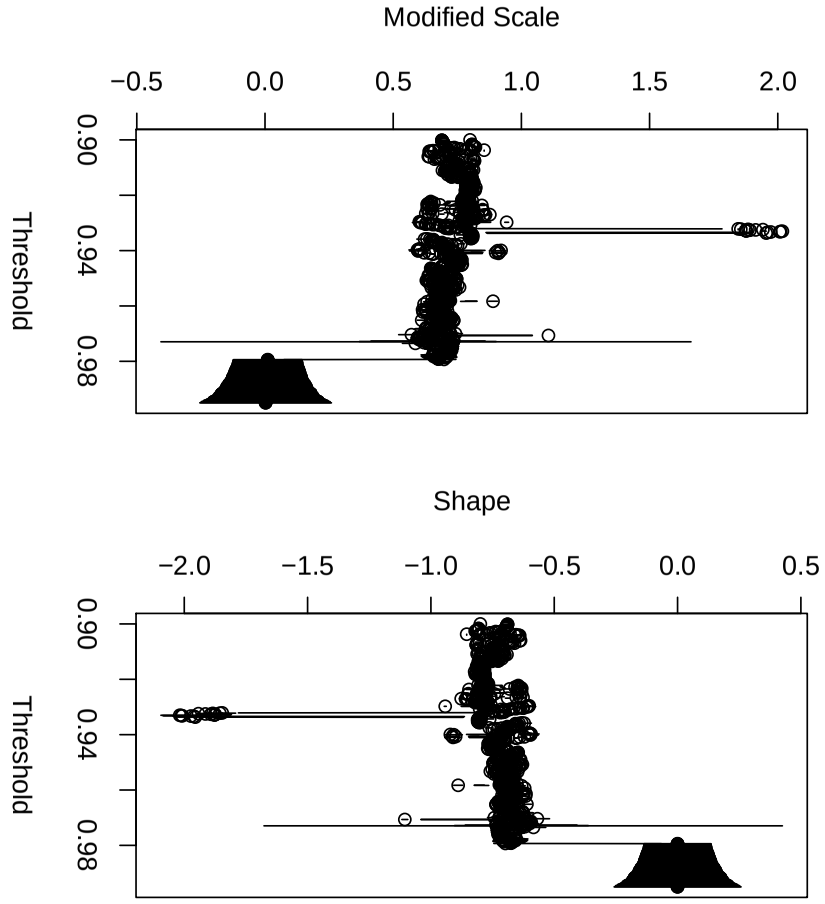
1.6 Legalese

This program is free software; you can redistribute it and/or modify it under the terms of the GNU

$z \leq$

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
−0.5
0.0
0.5
1.0
1.5
2.0
Threshold
0.90
0.94
0.98
Shape
−2.0
−1.5
−1.0
−0.5
0.0
0.5
Threshold
0.90
0.94
0.98

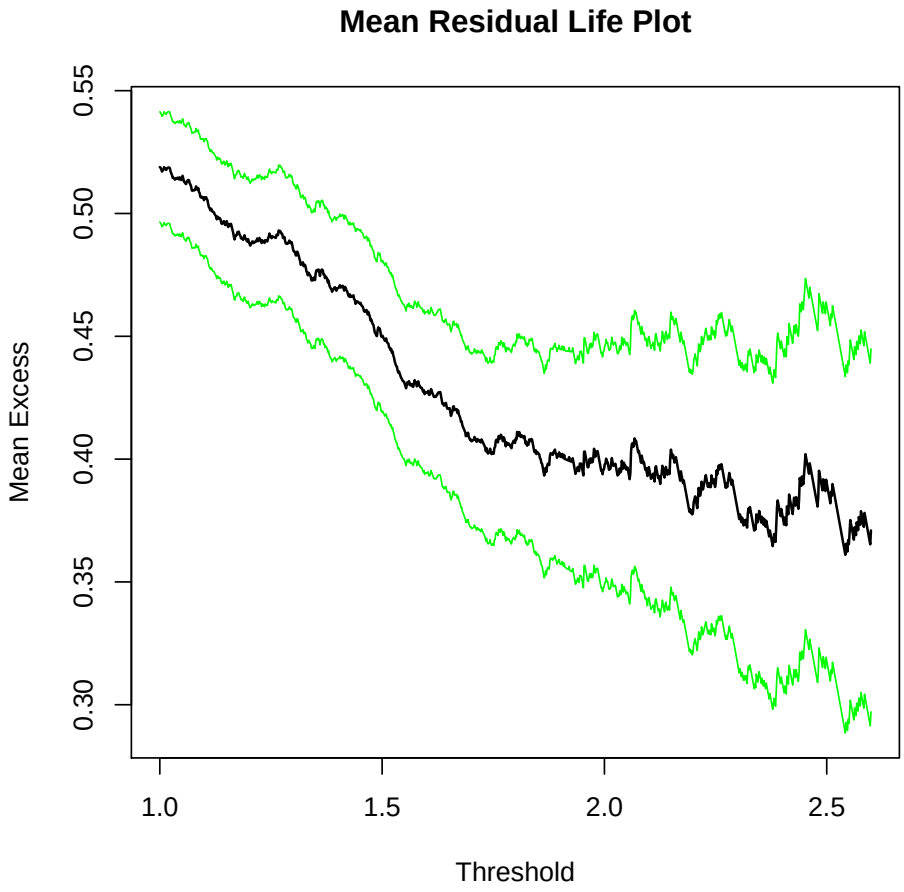


Figure 2: The threshold selection using the mrlplot function

The quantity

3.2.3 L-Moments plot: *lmomplot*

L-moments are summary statistics for probability distributions and data samples. They are analogous to ordinary moments – they provide measures of location, (i)1(on)eeersion, skewness, kurtosis, and other aeeects of the shaee of probability distributions or data samples – but are computed from linear combinations of the ordered data values (hence the prefix L).

For the GPD, the following relation holds:

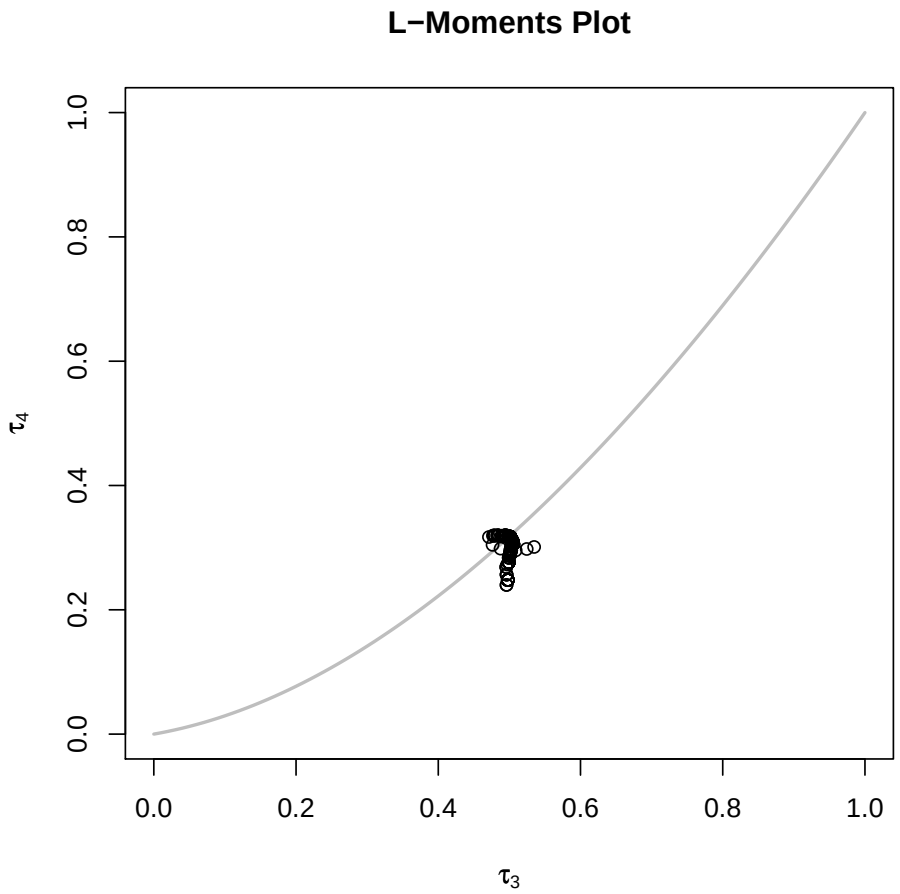


Figure 3: fig: The threshold selection using the lmomplot function

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
 scale
0.2178

Asymptotic Variance Covariance
       scale
scale  0.04744

Optimization Information
  Convergence: successful
  Function Evaluations: 6
```

```
Threshold Call: c(1, 2)
Number Above: 500
Proportion Above: 1

Estimates
    scale      shape
 0.330151  -0.009522

Standard Error Type: observed

Standard Errors
  scale    shape
0.02172  0.04827

Asymptotic Variance Covariance
        scale       shape
scale   0.0004719  -0.0007754
shape  -0.0007754   0.0023297

Optimization Information
  Convergence: successful
  Function Evaluations: 52
  Gradient Evaluations: 12
```

```
scale1   shape1   scale2   shape2    alpha
```

structure using a Markov Chains while the joint distribution is obviously a multivariate extreme value

```
> x <- rgpd(200, 1, 2, 0.25)
> mle <- fitgpd(x, 1, method = "mle")
> mom <- fitgpd(x, 1, method = "moments")
```

```
If there is some troubles try to put vert.lines = FALSE or change
 the range...
conf.inf conf.sup
1.719697 2.468182

If there is some troubles try to put vert.lines = FALSE or change
 the range...
 conf.inf  conf.sup
0.1424242 0.3909091
```

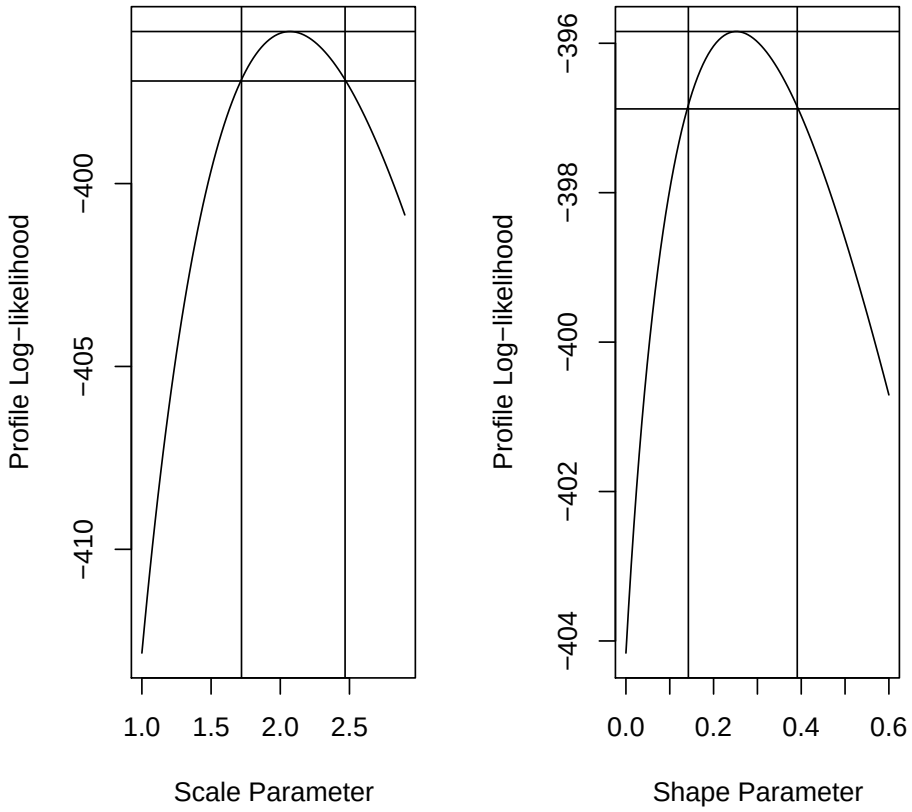
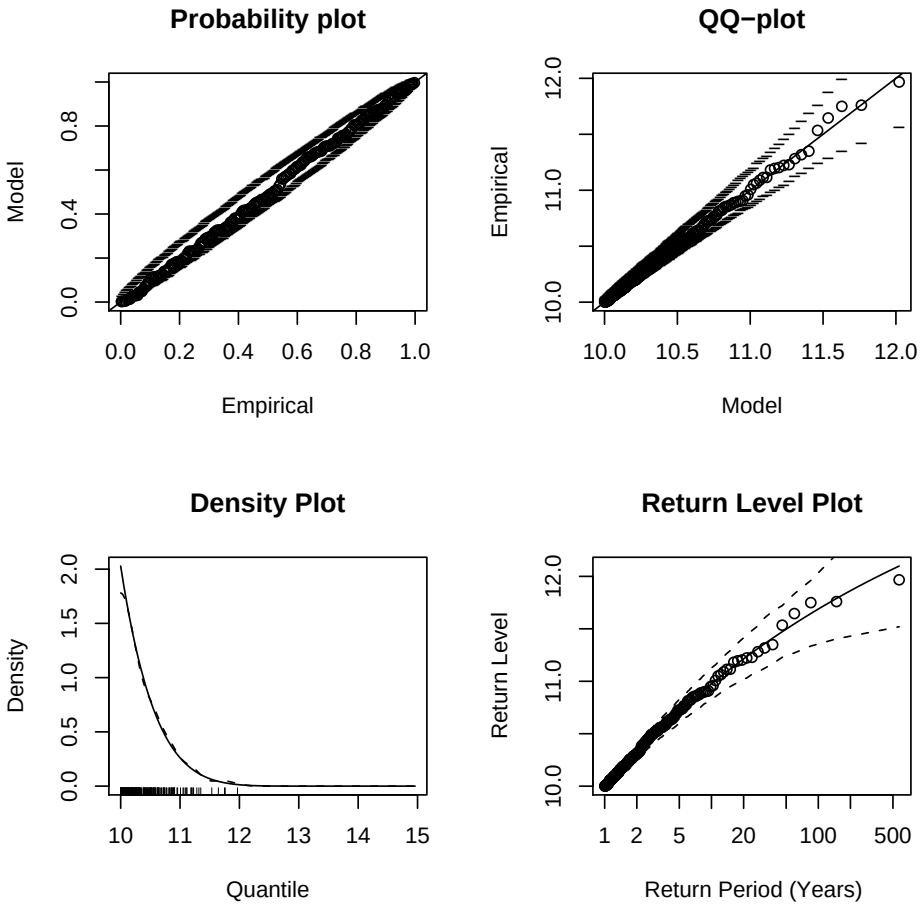
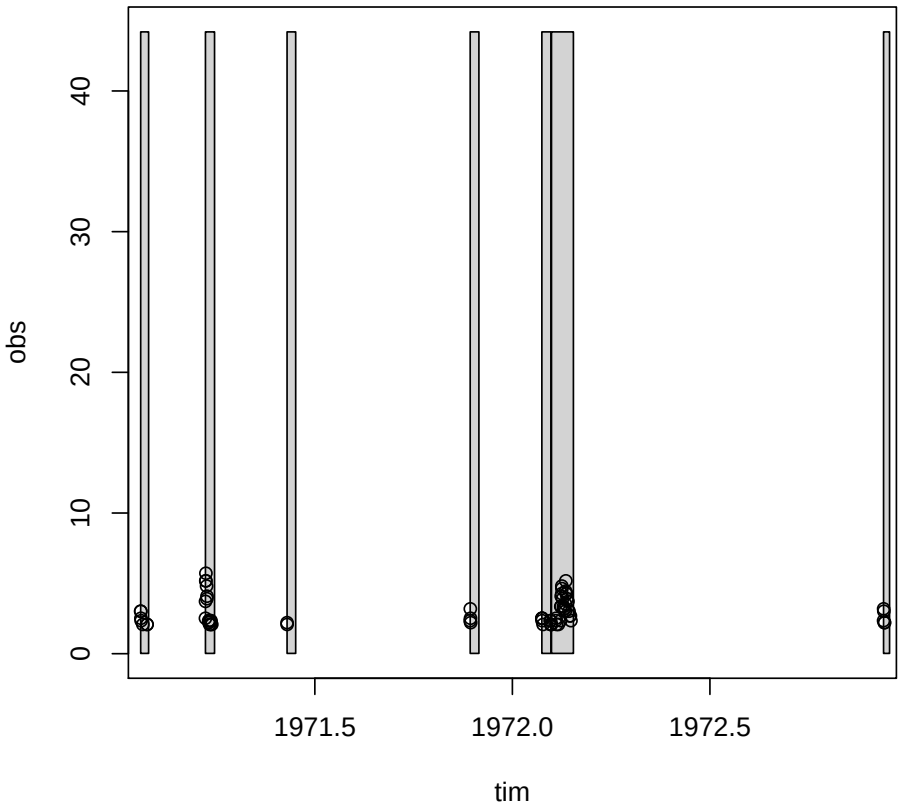


Figure 6: The profile log-likelihood confidence intervals18

```
 conf.inf  conf.sup
 9.368588 11.270484


thene...
conf.inf  conf.sup
```


Probability plot
Model
Empirical
0.0
0.2
0.4
0.6
0.8
1.0
QQ−plot
Empirical
Model
10.0
10.5
11.0
11.5
12.0
Density Plot
Density
Quantile
0.0
0.5
1.0
1.5
2.0
10
11
12
13
14
15
Return Level Plot
Return Level
Return Period (Years)
1
2
5
20
100
500


obs
0
10
20
30
40
1971.5
1972.0
1972.5
tim

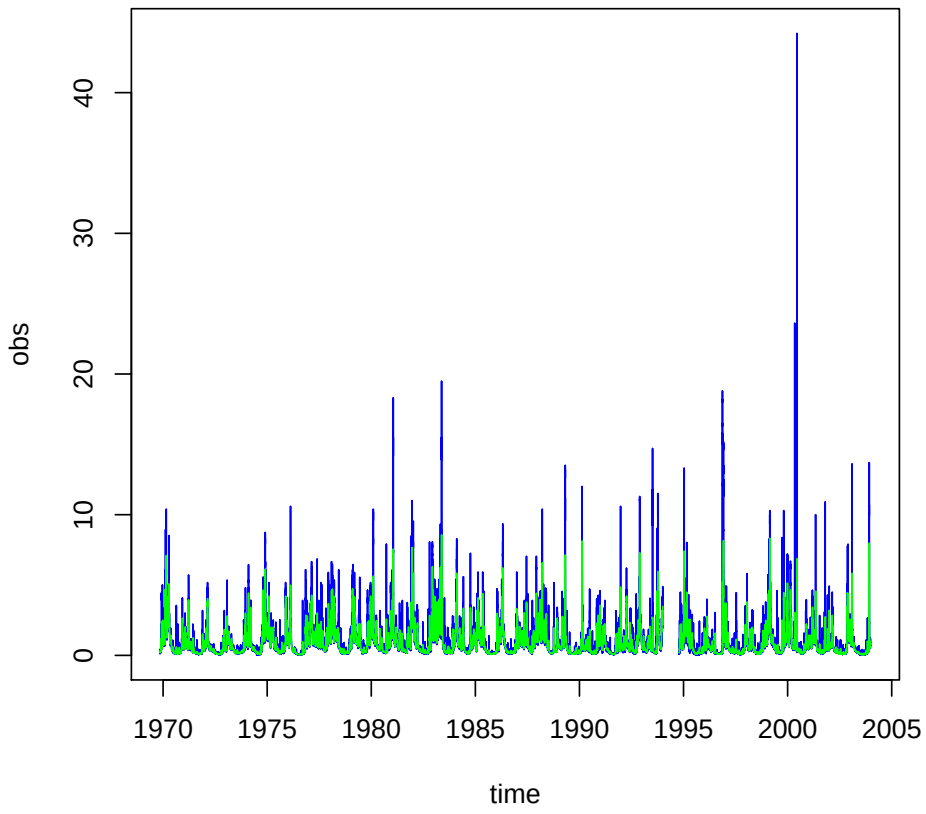


Figure 10: Instantaneous flood discharges and averaged dischaged over duration 3 days. Data ardieres

3.7.2 Unbiased Sample L-Moments: *samlmu*

The function samlmu computes the unbiased sample L-Moments.

```
> x <- runif(50)
> samlmu(x, nmom = 5)
```

```
     time           obs        
Min.   :1970   Min.   : 0.022  
1st Qu.:1981   1st Qu.: 0.236  
```

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 associated to the 100-year return period.

```
> gpd.pfrl(mle, prob, range = c(25, 100), nrang = 200)

If there is some troubles try to put vert.lines = FALSE or change
 the range...
conf.inf conf.sup
25.56533 90.76633
```

Sometimes it is necessary to know the estimated return period of a specified events. Lets do it with the larger events in "events1".