Extremes in R Laboratory

Mari Tye [1]

24 July, 2015

[1]Thanks to Eric Gilleland for examples

Exercises

- Find the maxima (blocks and peaks over threshold)
- Fit GEV and GP distributions
- Add a covariate term as a linear model
- Add a seasonal cycle using a linear model
- For more examples look at the extRemes help pages.

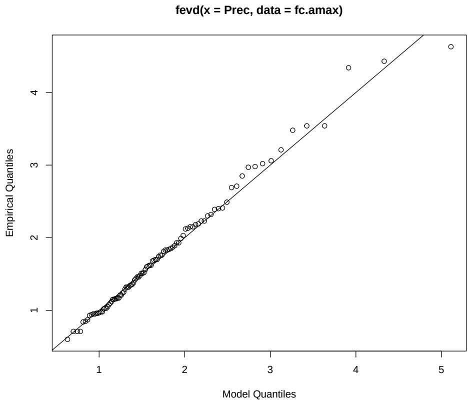
Loading packages

```r
# some setup
library( lubridate, quietly=TRUE, warn.conflicts=FALSE, verbose=FALSE)
library( extRemes, quietly=TRUE, warn.conflicts=FALSE)
setwd("~/ThursdayPM/")
# reset plotting pane
par(mfrow=c(1,1))
```

Fort Collins Annual Maxima

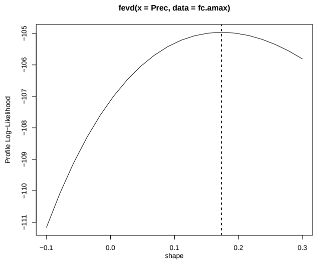
Load the Fort Collins, CO observation data

```r
data(Fort)
fc.amax <- blockmaxxer(Fort, blocks=Fort$year, which ="Prec")
fit.fc0 <- fevd(Prec, data=fc.amax)
plot(fit.fc0, "qq")
```



Fort Collins Annual Maxima

```
ci(fit.fc0, type="parameter")

## fevd(x = Prec, data = fc.amax)
##
## [1] "Normal Approx."
##
##           95% lower CI  Estimate 95% upper CI
## location  1.225753534 1.3466597    1.4675658
## scale     0.437181061 0.5328046    0.6284282
## shape    -0.006601292 0.1736264    0.3538540

profliker(fit.fc0, type="parameter", which.par=3, xrange=c(-0.1,0.3))
```



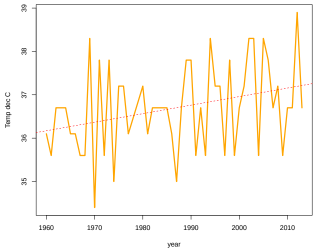
Boulder Annual Maxima

Read in the data again

```
obs <- read.table("smalldata.txt", header=T)
obs$year <- year(obs$date)
```

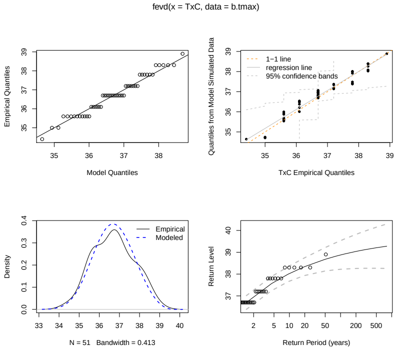
Then edit the data and plot it

```
b.tmax <- na.omit(blockmaxxer(obs, blocks=obs$year, which="TxC"))
plot(TxC~year, data=b.tmax, t="l", col="orange", lwd=3, ylab="Temp dec C")
trend <- lm(TxC~year, data=b.tmax)
abline(trend, col="red", lty=2)
```



Boulder Max Temperature

```r
fit.bgev <- fevd(TxC, data=b.tmax)
plot(fit.bgev)
```



Does the trend have an influence on the fit?

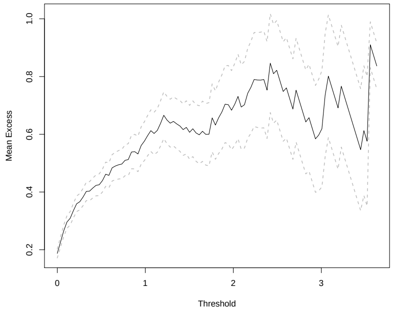
Fort Collins POT

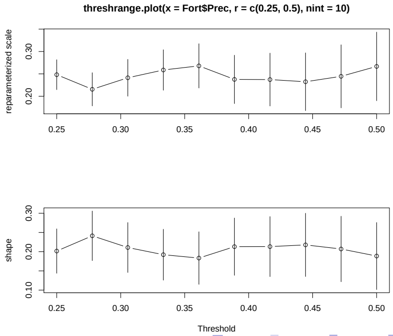
What is a reasonable threshold?

```
quantile(Fort$Prec, seq(0.9,0.99,0.01))

##  90%  91%  92%  93%  94%  95%  96%  97%  98%  99%
## 0.09 0.11 0.13 0.16 0.19 0.23 0.29 0.38 0.52 0.79
```

Pick a range somewhere >95% and <99%

```
mrlplot(Fort$Prec)
threshrange.plot(Fort$Prec, c(0.25,0.5), nint=10)
```

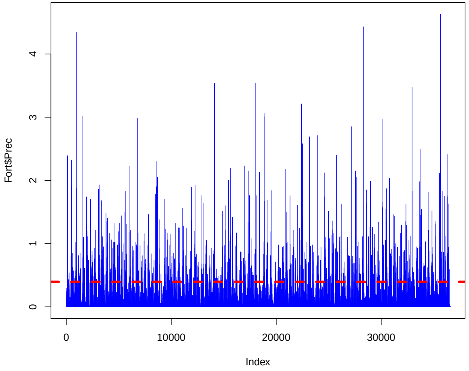




Fort Collins Clustering

The data are quite clustered above u=0.395

```
plot(Fort$Prec, type="h", col="blue")
abline(h=0.395, col="red", lty=2, lwd=4)
```



Fort Collins Clustering

```
gp.fit0 <- fevd(Prec, data=Fort, type="GP", threshold=0.395)
```

Compare the two model fits side by side. Does one look better?

```
par(mfrow=c(1,2))
plot(gp.fit0, "qq2", main="GP Fit")
plot(fit.fc0, "qq2", main="GEV Fit")
```

Fort Collins declustering

```
tmp <- extremalindex(Fort$Prec, 0.395, method="runs",
                        run.length=9, blocks=Fort$year)
ci(tmp)

## extremalindex(x = Fort$Prec, threshold = 0.395, method = "runs",
##     run.length = 9, blocks = Fort$year)
##
## [1] "Ferro-Segers Bootstrap"
##
##                     95% lower CI    Estimate 95% upper CI
## extremal.index         0.5828111   0.6135721    0.6429472
## number.of.clusters   651.0000000 651.0000000  651.0000000

Fort.dc <- decluster(Fort$Prec, 0.395)
```

```
plot(Fort.dc)
abline(h=0.395, col="red")
```

Fort Collins declustered

```
gp.fit1 <- fevd(Fort.dc, type="GP", threshold=0.395)
```

Check the fit using the plotting functions

```
findpars(gp.fit1)$shape[1]

## [1] 0.198835

findpars(gp.fit0)$shape[1]

## [1] 0.2119121

findpars(fit.fc0)$shape[1]

## [1] 0.1736264
```

Estimating the Poisson parameter

```
fpois(Fort$Prec>0.395)

##
##  Test for Equality of (Poisson) Mean and Variance
##
## data:  Fort$Prec > 0.395
## Chi-square(n - 1) = 35463, mean = 0.029, variance =
## 0.028, degrees of freedom = 36523.000, p-value = 1
## alternative hypothesis: greater
```

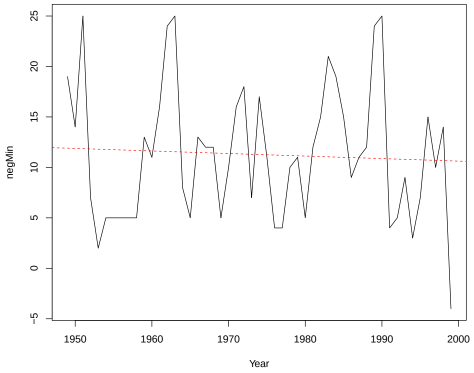
```
length(Fort$Prec[Fort$Prec>0.395])/length(Fort.dc)
mean(Fort$Prec>0.395)
```

```
pp.fit1 <- fevd(Fort.dc, type="PP", threshold=0.395)
pars <- summary(pp.fit1, silent=TRUE)$par
mu <- pars[1]
sigma <- pars[2]
xi <- pars[3]

lambda.hat <- (1 + (xi/sigma)*(0.395-mu))^(-1/xi)
1/lambda.hat

##     shape
## 0.1122304
```

Denver Minimum Temperature

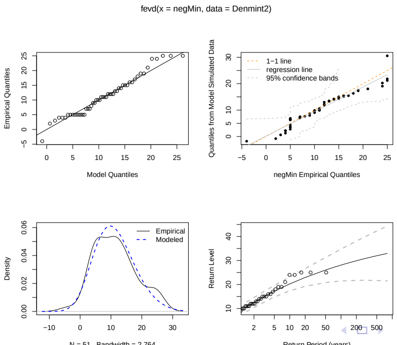
Treat the negative of the minima as a maxima series

```
data(Denmint)
Denmint$negMin <- -(Denmint$Min)
Denmint2 <- blockmaxxer(Denmint, blocks=Denmint$Year, which="negMin")
plot(negMin~Year, data=Denmint2, t="l")
lmfit <- lm(negMin~Year, data=Denmint2)
abline(lmfit, lty=2, col=2)
```



Denver Minimum Temperature

```
dm.fit0 <- fevd(negMin, data=Denmint2)
plot(dm.fit0)
ci(dm.fit0, type="parameter", which.par=3)

## fevd(x = negMin, data = Denmint2)
##
## [1] "Normal Approx."
##
## [1] "shape: -1.5"
##
## [1] "95% Confidence Interval: (-2.0562, -0.377)"
```



Denver Minimum Temperature

```
dm.fit1 <- fevd(negMin, data=Denmint2, location.fun= ~Time)
lr.test(dm.fit0, dm.fit1)

##
##  Likelihood-ratio Test
##
## data:  negMinnegMin
## Likelihood-ratio = 0.3241, chi-square critical value
## = 3.841, alpha = 0.050, Degrees of Freedom = 1.000,
## p-value = 0.5691
## alternative hypothesis: greater

dm.fit2 <- fevd(negMin, data=Denmint2, location.fun = ~Time,
                                        scale.fun= ~Time, use.phi=TRUE)

## Warning in log(z):  NaNs produced
## Warning in log(z):  NaNs produced
```

Denver Minimum Temperature

```
look1 <- summary(dm.fit0, silent=TRUE)
look2 <- summary(dm.fit1, silent=TRUE)
look3 <- summary(dm.fit2, silent=TRUE)
c(look1$AIC, look2$AIC, look3$AIC)

## [1] 342.2060 343.8818 345.6296

c(look1$BIC, look2$BIC, look3$BIC)

## [1] 348.0014 351.6091 355.2888
```

Fort Collins Cycles

```
Fort$PrecGTu <- Fort$Prec > 0.395
fit.P <- glm(PrecGTu ~ sin(2 * pi * tobs / 365.25) +
                cos(2 * pi * tobs / 365.25), data = Fort, family = poisson)
```

Compare this against a "null" model i.e. no seaonal cycle

```
null <- glm(PrecGTu~tobs, data=Fort, family = poisson)
```

Fort Collins Cycles

```r
pp.fit2 <- fevd(Prec, data=Fort,
  location.fun= ~ sin(2*pi*tobs/365.25) +
  cos(2*pi*tobs/365.25), type="PP", threshold=0.395)

lr.test(pp.fit1, pp.fit2)

pp.fit3 <- fevd(Prec, Fort, threshold=0.395,
        scale.fun=~sin(2*pi*tobs/365.25) +
          cos(2*pi*tobs/365.25), type="PP", use.phi=TRUE, verbose=TRUE)
```