HYD298 Homework #5

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February 3, 2016

Q1: Gumbel

```
foo=read.csv("..\\HW1\\sebou.csv")

xx=sort(foo$maxQ,decreasing=FALSE)
plot(density(xx),xlab="Discharge, cfs",ylab="Probability density",main="Empirical and modeled (Gumbel)\n
#MM
alpha=sqrt(6*var(xx)/pi^2)
xii=mean(xx)-0.5772*alpha
gum_pdf=(1/alpha)*exp(-((xx-xii)/alpha)-exp(-(xx-xii)/alpha))
lines(xx,gum_pdf,col="BLUE",lty=2,lwd=2)
gum_qua=xii-alpha*log(-log(c(0.01,0.99)))
#PARAMETERS
xii
```

```
## [1] 585.5702
```

```
alpha
```

```
## [1] 725.7755
```

```
#QUANTILES
gum_qua
```

```
## [1] -522.8195 3924.2460
```

```
#L-Moments
pwm_gum = function(x,r) {
  #calculates probability weightetd moments of order r
  # used for calculating betas and associated L-moments
  cs=0
  n=length(x)
  for(i in seq(1,n-r)) {
    cs=cs+(choose(n-i,r)*x[i])/choose(n-1,r)
  }
  return(cs/n)
}

lambda1=mean(xx)
beta1=pwm_gum(sort(xx,decreasing=TRUE),1)
lambda2=2*beta1-lambda1
alpha=lambda2/log(2)
xii=mean(xx)-0.5772*alpha
gum_pdf=(1/alpha)*exp(-((xx-xii)/alpha)-exp(-(xx-xii)/alpha))
```

```
gum_qua=xii-alpha*log(-log(c(0.01,0.99)))
lines(xx,gum_pdf,col="RED",lty=2,lwd=2)
#PARAMETERS
xii
```

```
## [1] 656.7242
```

```
alpha
```

```
## [1] 602.5011
```

```
#QUANTILES
gum_qua
```

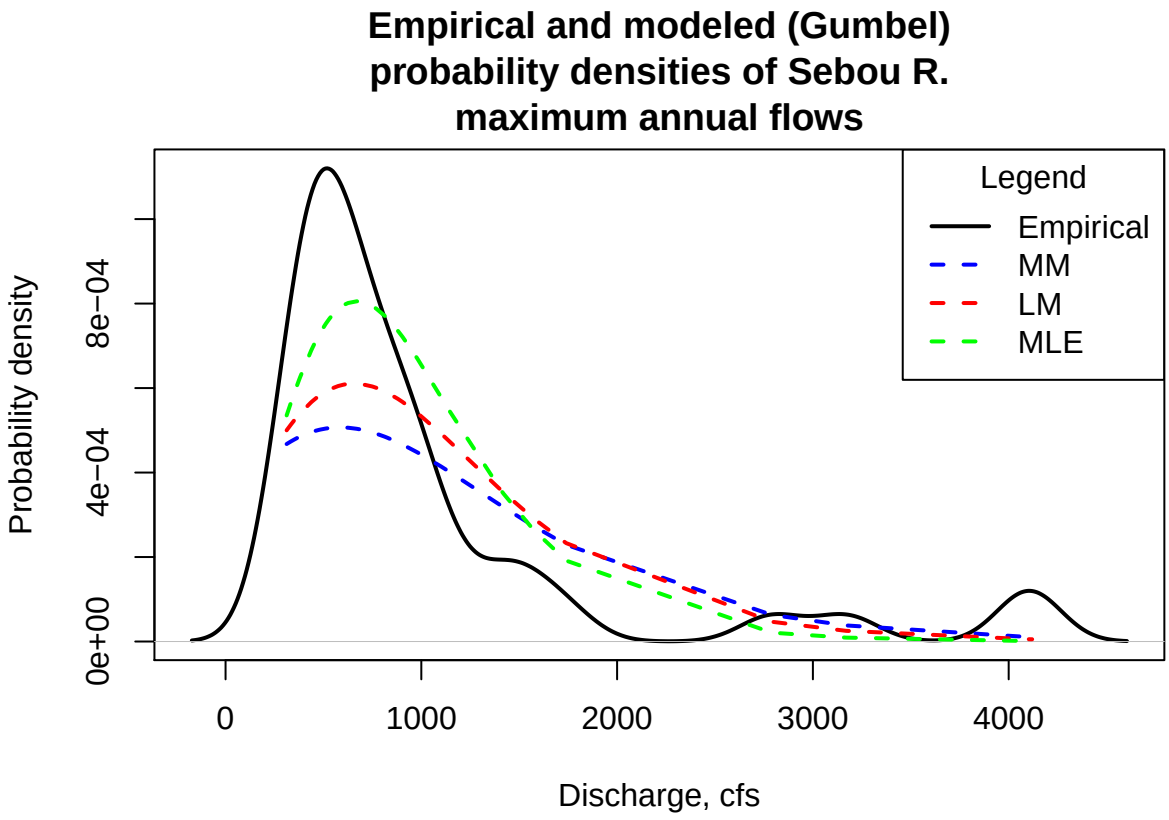
```
## [1] -263.4033 3428.3192
```

```
#MLE
library(fitdistrplus)
```

```
## Warning: package 'fitdistrplus' was built under R version 3.2.3
```

```
## Loading required package: MASS
```

```
dgumbel <- function(x, ps, al) {  exp((ps - x)/al - exp((ps - x)/al))/al }
pgumbel <- function(q, ps, al) {  exp(-exp(-((q - ps)/al))) }
qgumbel <- function(p, ps, al) {  ps-al*log(-log(p)) }
gumbel.fit <- fitdist(xx, "gumbel", start=list(ps=mean(xx), al=sd(xx)), method="mle")
xii=gumbel.fit$estimate['ps'][[1]]
alpha=gumbel.fit$estimate['al'][[1]]
gum_pdf=(1/alpha)*exp(-((xx-xii)/alpha)-exp(-(xx-xii)/alpha))
lines(xx,gum_pdf,col="GREEN",lty=2,lwd=2)
legend("topright", c("Empirical","MM","LM","MLE"), col=c('BLACK',"BLUE","RED","GREEN"), lty=c(1,2,2,2),
```




```
#PARAMETERS:
xii
```

```
## [1] 671.0222
```

```
alpha
```

```
## [1] 456.7768
```

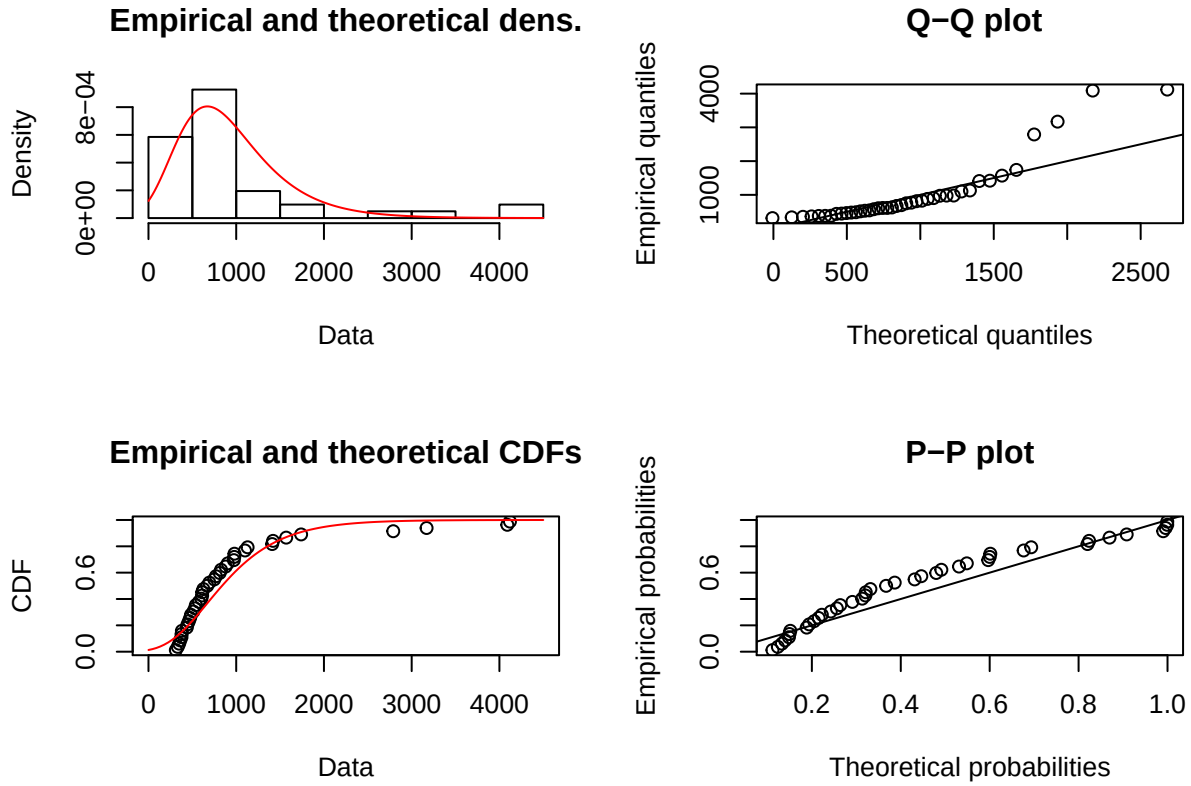
```
#QUANTILES:
gum_qua
```

```
## [1] -263.4033 3428.3192
```

```
quantile(gumbel.fit,probs=c(0.01,0.99))
```

```
## Estimated quantiles for each specified probability (non-censored data)
##              p=0.01   p=0.99
## estimate -26.55802 2772.264
```

```r
plot(gumbel.fit)
```



Q2: GEV

```r
plot(density(xx),xlab="Discharge, cfs",ylab="Probability density",main="Empirical and modeled (GEV)\npr
#LM
lambda1=mean(xx)
beta1=pwm_gum(xx,1)
beta2=pwm_gum(xx,2)
lambda2=2*beta1-lambda1
lambda3=6*beta2-6*beta1+lambda1
#calculate kappa first
cc=2*lambda2/(lambda3+3*lambda2)-(log(2)/log(3))
kappa=7.8590*cc+2.9554*(cc^2)
alpha=kappa*lambda2/(gamma(1+kappa)*(1-2^-kappa))
xii=lambda1+(alpha/kappa)*(gamma(1+kappa)-1)
gev_cdf=exp(-(1-(kappa*(xx-xii)/alpha))^(1/kappa))
gev_qua=xii+(alpha/kappa)*(1-(-log(c(0.01,0.99)))^kappa)
#plot(ecdf(xx),main="Empirical and modeled (GEV) cumulative distribution function")
#lines(ecdf(pgev(xx,xi=kappa,mu=xii,sigma=alpha)*max(xx)),lwd=2,lty=2,col='BLUE')
 #Lower bound
xii+(alpha/kappa)
```

```
## [1] 344.102
```

```
#PARAMETERS
xii
```

```
## [1] 860.5153
```

```
alpha
```

```
## [1] -745.5745
```

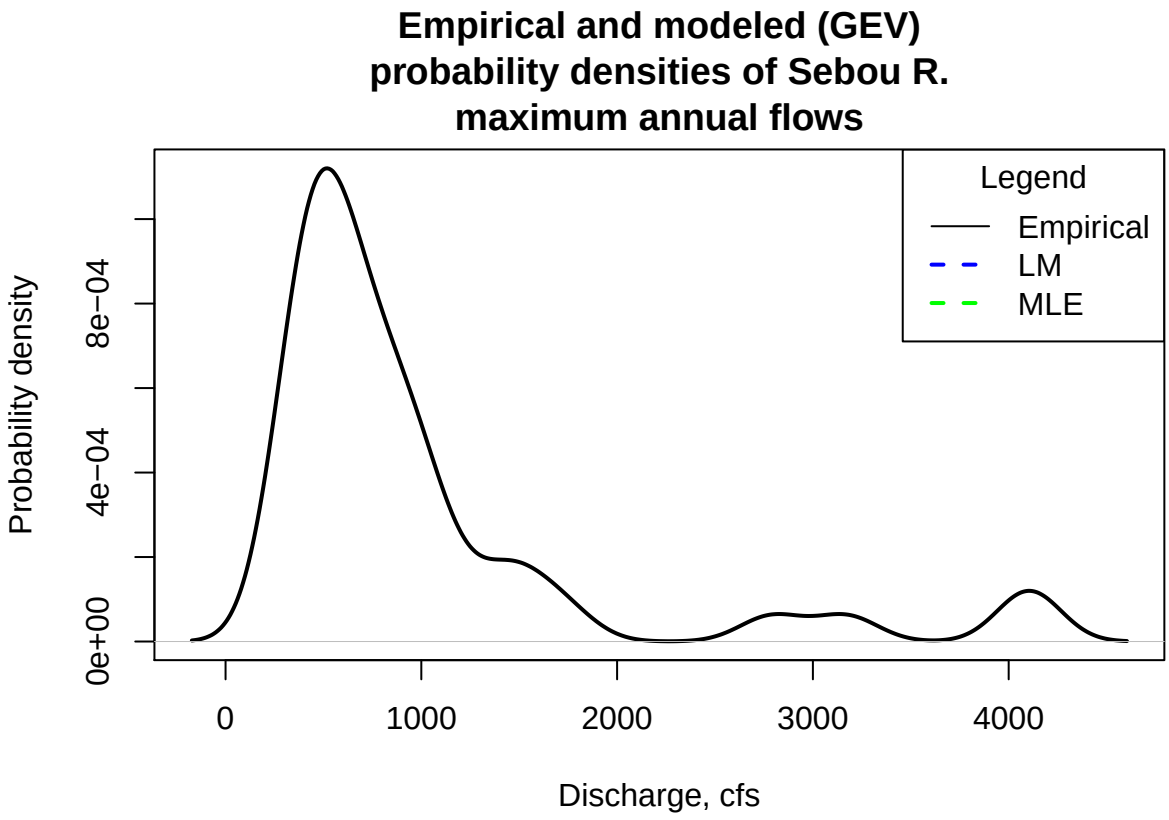
```
kappa
```

```
## [1] 1.443755
```

```
#QUANTILES
gev_qua
```

```
## [1] 5027.510  344.776
```

```
#MLE
library(fitdistrplus)
#library(evir)
dgev=function (x, xi = 1, mu = 0, sigma = 1) {
  tmp <- (1 + (xi * (x - mu))/sigma)
  (as.numeric(tmp > 0) * (tmp^(-1/xi - 1) * exp(-tmp^(-1/xi))))/sigma
}
pgev=function (q, xi = 1, mu = 0, sigma = 1) {   exp(-(1 + (xi * (q - mu))/sigma)^(-1/xi)) }
qgev=function (p, xi = 1, mu = 0, sigma = 1) {  mu + (sigma/xi) * ((-logb(p))^(-xi) - 1) }
gev.fit <- fitdist(xx, "gev", start=list(mu=0, sigma=1, xi=1), method="mle")
xii=gev.fit$estimate['mu'][[1]]
alpha=gev.fit$estimate['sigma'][[1]]
kappa=gev.fit$estimate['xi'][[1]]
legend("topright", c("Empirical","LM","MLE"), col=c('BLACK',"BLUE","GREEN"), lty=c(1,2,2), lwd=c(1,2,2)
```




```
#PARAMETERS:
xii
```

```
## [1] 543.7068
```

```
alpha
```

```
## [1] 258.0146
```

```
kappa
```

```
## [1] 0.7100908
```

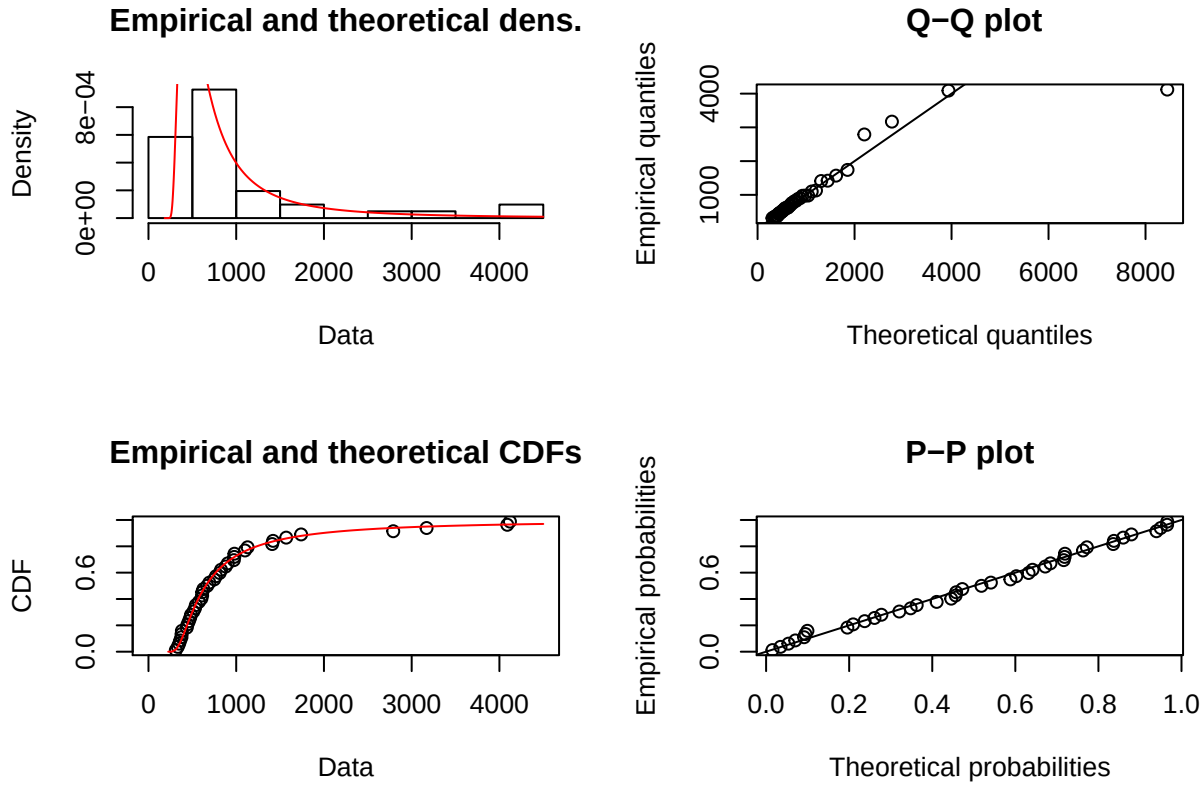
```
#QUANTILES:
gum_qua
```

```
## [1] -263.4033 3428.3192
```

```
quantile(gev.fit,probs=c(0.01,0.99))
```

```
## Estimated quantiles for each specified probability (non-censored data)
##            p=0.01   p=0.99
## estimate 303.1998 9707.516
```

```
plot(gev.fit)
```


Empirical and theoretical dens.
Density
0e+00
8e−04
0
1000
2000
3000
4000
Data
Q−Q plot
Empirical quantiles
1000
4000
0
2000
4000
6000
8000
Theoretical quantiles
Empirical and theoretical CDFs
CDF
0.0
0.6
0
1000
2000
3000
4000
Data
P−P plot
Empirical probabilities
0.0
0.6
0.0
0.2
0.4
0.6
0.8
1.0
Theoretical probabilities

‘‘‘