# Script per R utilizzati per l'analisi pluviometrica

## Analisi completa degli scrosci

```
list.files()
read.table("Esameidro.txt ",header= TRUE)  ->  data
data
summary(data)
hist(data[[2]],breaks=20,xlab="Precipitazioni [mm]",ylab="Frequenza Eventi",main="Precipitazioni  Massime  di  15 minuti")
hist(data[[3]],breaks=20,xlab="Precipitazioni [mm]",ylab="Frequenza Eventi",main="Precipitazioni  Massime  di  30 minuti")
hist(data[[4]],breaks=20,xlab="Precipitazioni [mm]",ylab="Frequenza Eventi",main="Precipitazioni  Massime  di  45 minuti")

data$anno  <-  NULL
boxplot(data,main="Precipitazioni  massime  a Tione",xlab="durata [minuti]",ylab="Precipitazioni  [mm]")

#  15  minuti

data[,2]->data15min
is.na(data15min)
data15min[!is.na(data15min)]->new.data15min
new.data15min

#  1 - Metodo  dei  momenti

eulerogamma  =0.57721566490153286060
m15min<-mean(new.data15min)
v15min<-var(new.data15min)
b115.gumbel<-sqrt(6*v15min)/pi
a115.gumbel<-m15min-b115.gumbel*eulerogamma
library(evd)
z<-sort(new.data15min)

#  2 - Metodo  dei  minimi  quadrati

ec<-ecdf(new.data15min)
Fi<-ec(sort(new.data15min))
y<--log(-log(Fi))
y<-y[-which(Fi==1)]
x<-sort(new.data15min)[-which(Fi==1)]
fts<-lsfit(x,y)
b215.gumbel<-fts$coefficients[[2]]^-1
a215.gumbel<--b215.gumbel*fts$coefficients[[1]]
```

```
# 3 - Metodo della maxverosimiglianza

library(MASS)
mlik<- fitdistr(new.data15min,densfun=dgumbel,start=list(loc=a115.gumbel,scale=b115.gumbel))
b315.gumbel<-mlik$estimate[[2]]
a315.gumbel<-mlik$estimate[[1]]
plot(z,pgumbel(z,loc=a115.gumbel,scale=b115.gumbel),type="l",col="green",xlab="Precipitazioni[mm]",ylab="P[H<h]",mai
n="Ecdf e curve di Gumbel per 15 minuti")
lines(z,pgumbel(z,loc=a215.gumbel,scale=b215.gumbel),type="l",col="blue")
lines(z,pgumbel(z,loc=a315.gumbel,scale=b315.gumbel),type="l",col="red")
lines(ecdf(new.data15min))

# Test di Pearson

# Per il metodo dei momenti

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a115.gumbel,scale=b115.gumbel)->qi
c(0,ec(qi)*length(new.data15min))->no1
c(ec(qi)*length(new.data15min),length(new.data15min))->no2
no2-no1->no
0.2*length(new.data15min)->deltapi
X1=sum((no-deltapi)^2/deltapi)

# Per il metodo dei minimi quadrati

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a215.gumbel,scale=b215.gumbel)->qi
c(0,ec(qi)*length(new.data15min))->no1
c(ec(qi)*length(new.data15min),length(new.data15min))->no2
no2-no1->no
0.2*length(new.data15min)->deltapi
X2=sum((no-deltapi)^2/deltapi)

# Per il metodo della maxverosimiglianza

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a315.gumbel,scale=b315.gumbel)->qi
c(0,ec(qi)*length(new.data15min))->no1
c(ec(qi)*length(new.data15min),length(new.data15min))->no2
no2-no1->no
0.2*length(new.data15min)->deltapi
X3=sum((no-deltapi)^2/deltapi)
```

```
#  Valori  ottenuti

m15min
v15min

a115.gumbel
b115.gumbel
X1

a215.gumbel
b215.gumbel
X2

a315.gumbel
b315.gumbel
X3

#  30  minuti

data[,3]->data30min
is.na(data30min)
data30min[!is.na(data30min)]->new.data30min
new.data30min

#  1 - Metodo dei momenti

eulerogamma  =0.57721566490153286060
m30min<-mean(new.data30min)
v30min<-var(new.data30min)
b130.gumbel<-sqrt(6*v30min)/pi
a130.gumbel<-m30min-b130.gumbel*eulerogamma
library(evd)
z<-sort(new.data30min)

#  2 - Metodo dei minimi quadrati

ec<-ecdf(new.data30min)
Fi<-ec(sort(new.data30min))
y<--log(-log(Fi))
y<-y[-which(Fi==1)]
x<-sort(new.data30min)[-which(Fi==1)]
fts<-lsfit(x,y)
b230.gumbel<-fts$coefficients[[2]]^-1
a230.gumbel<--b230.gumbel*fts$coefficients[[1]]
```

```
#  3 - Metodo della maxverosimiglianza

library(MASS)
mlik<-fitdistr(new.data30min,densfun=dgumbel,start=list(loc=a130.gumbel,scale=b130.gumbel))
b330.gumbel<-mlik$estimate[[2]]
a330.gumbel<-mlik$estimate[[1]]
plot(z,pgumbel(z,loc=a130.gumbel,scale=b130.gumbel),type="l",col="green",xlab="Precipitazioni[mm]",ylab="P[H<h]",mai
n="Ecdf e curve di Gumbelper 30 minuti")
lines(z,pgumbel(z,loc=a230.gumbel,scale=b230.gumbel),type="l",col="blue")
lines(z,pgumbel(z,loc=a330.gumbel,scale=b330.gu mbel),type="l",col="red")
lines(ecdf(new.data30min))

# Test di Pearson

# Per il metodo dei momenti

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a130.gumbel,scale=b130.gumbel)->qi
c(0,ec(qi)*length(new.data30min))->no1
c(ec(qi)*length(new.data30min),length(new.data30min))->no2
no2-no1->no
0.2*length(new.data30min)->deltapi
X1=sum((no-deltapi)^2/deltapi)

# Per il metodo dei minimi quadrati

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a230.gumbel,scale=b230.gumbel)->qi
c(0,ec(qi)*length(new.data30min))->no1
c(ec(qi)*length(new.data30min),length(new.data30min))->no2
no2-no1->no
0.2*length(new.data30min)->deltapi
X2=sum((no-deltapi)^2/deltapi)

# Per il metodo della maxverosimiglianza

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a330.gumbel,scale=b330.gumbel)->qi
c(0,ec(qi)*length(new.data30min))->no1
c(ec(qi)*length(new.data30min),length(new.data30min))->no2
no2-no1->no
0.2*length(new.data30min)->deltapi
X3=sum((no-deltapi)^2/deltapi)
```

```
#  Valori  ottenuti

m30min
v30min

a130.gumbel
b130.gumbel
X1

a230.gumbel
b230.gumbel
X2

a330.gumbel
b330.gumbel
X3

#  45  minuti

data[,4]->data45min
is.na(data45min)
data45min[!is.na(data45min)]->new.data45min
new.data45min

#  1 - Metodo dei momenti

eulerogamma  =0.57721566490153286060
m45min<-mean(new.data45min)
v45min<-var(new.data45min)
b145.gumbel<-sqrt(6*v45min)/pi
a145.gumbel<-m45min-b145.gumbel*eulerogamma
library(evd)
z<-sort(new.data45min)

#  2 - Metodo dei minimi quadrati

ec<-ecdf(new.data45min)
Fi<-ec(sort(new.data45min))
y<--log(-log(Fi))
y<-y[-which(Fi==1)]
x<-sort(new.data45min)[-which(Fi==1)]
fts<-lsfit(x,y)
b245.gumbel<-fts$coefficients[[2]]^-1
a245.gumbel<--b245.gumbel*fts$coefficients[[1]]
```

```
#  3 - Metodo della maxverosimiglianza

library(MASS)
mlik<-fitdistr(new.data45min,densfun=dgumbel,start=list(loc=a145.gumbel,scale=b145.gumbel))
b345.gumbel<-mlik$estimate[[2]]
a345.gumbel<-mlik$estimate[[1]]
plot(z,pgumbel(z,loc=a145.gumbel,scale=b145.gumbel),type="l",col="green",xlab="Precipitazioni[mm]",ylab="P[H<h]",mai
n="Ecdf e curve di Gumbelper 45 minuti")
lines(z,pgumbel(z,loc=a245.gumbel,scale=b245.gumbel),type="l",col="blue")
lines(z,pgumbel(z,loc=a345.gumbel,scale=b345.gumbel),type="l",col="red")
lines(ecdf(new.data45min))

# Test di Pearson

# Per il metodo dei momenti

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a145.gumbel,scale=b145.gumbel)->qi
c(0,ec(qi)*length(new.data45min))->no1
c(ec(qi)*length(new.data45min),length(new.data45min))->no2
no2-no1->no
0.2*length(new.data45min)->deltapi
X1=sum((no-deltapi)^2/deltapi)

# Per il metodo dei minimi quadrati

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a245.gumbel,scale=b245.gumbel)->qi
c(0,ec(qi)*length(new.data45min))->no1
c(ec(qi)*length(new.data45min),length(new.data45min))->no2
no2-no1->no
0.2*length(new.data45min)->deltapi
X2=sum((no-deltapi)^2/deltapi)

# Per il metodo della maxverosimiglianza

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a345.gumbel,scale=b345.gumbel)->qi
c(0,ec(qi)*length(new.data45min))->no1
c(ec(qi)*length(new.data45min),length(new.data45min))->no2
no2-no1->no
0.2*length(new.data45min)->deltapi
X3=sum((no-deltapi)^2/deltapi)
```

```
# Valori ottenuti

m45min
v45min

a145.gumbel
b145.gumbel
X1

a245.gumbel
b245.gumbel
X2

a345.gumbel
b345.gumbel
X3

# Grafico di non superamento

seq(from=1,to=60,by=0.1)->x
plot(x,pgumbel(x,loc=a215.gumbel,scale=b215.gumbel),type="l",col="red",xlab="Precipitazione[mm]",ylab="P[h]")

lines(x,pgumbel(x,loc=a130.gumbel,scale=b130.gumbel),col="blue")
lines(x,pgumbel(x,loc=a145.gumbel,scale=b145.gumbel),col="orange")

text(10,0.8,"15 minuti",cex=0.8,col="red")
text(10,0.7,"30 minuti",cex=0.8,col="blue")
text(10,0.6,"45 minuti",cex=0.8,col="orange")

# Distribuzione di Gumbel densità

seq(from=1,to=60,by=0.1)->x
plot(x,dgumbel(x,loc=a215.gumbel,scale=b215.gumbel),type="l",col="red",xlab="Precipitazione[mm]",ylab="P[h]")

lines(x,dgumbel(x,loc=a130.gumbel,scale=b130.gumbel),col="blue")
lines(x,dgumbel(x,loc=a145.gumbel,scale=b145.gumbel),col="orange")

text(50,0.06,"15 minuti",cex=0.8,col="red")
text(50,0.055,"30 minuti",cex=0.8,col="blue")
text(50,0.05,"45 minuti",cex=0.8,col="orange")
```

# Lspp

```
dd<-0:60
d=c(15,30,45)

c(qgumbel(0.8,loc=a215.gumbel,scale=b215.gumbel),qgumbel(0.8,loc=a130.gumbel,scale=b130.gumbel),qgumbel(0.8,loc=a145.gumbel,scale=b145.gumbel))->h05
lsfit(log(d),log(h05))->ft05
ft05$coefficients
exp(ft05$coefficients[[1]])

c(qgumbel(0.9,loc=a215.gumbel,scale=b215.gumbel),qgumbel(0.9,loc=a130.gumbel,scale=b130.gumbel),qgumbel(0.9,loc=a145.gumbel,scale=b145.gumbel))->h10
lsfit(log(d),log(h10))->ft10
ft10$coefficients
exp(ft10$coefficients[[1]])

c(qgumbel(0.95,loc=a215.gumbel,scale=b215.gumbel),qgumbel(0.95,loc=a130.gumbel,scale=b130.gumbel),qgumbel(0.95,loc=a145.gumbel,scale=b145.gumbel))->h20
lsfit(log(d),log(h20))->ft20
ft20$coefficients
exp(ft20$coefficients[[1]])

c(qgumbel(0.98,loc=a215.gumbel,scale=b215.gumbel),qgumbel(0.98,loc=a130.gumbel,scale=b130.gumbel),qgumbel(0.98,loc=a145.gumbel,scale=b145.gumbel))->h50
lsfit(log(d),log(h50))->ft50
ft50$coefficients
exp(ft50$coefficients[[1]])

c(qgumbel(0.99,loc=a215.gumbel,scale=b215.gumbel),qgumbel(0.99,loc=a130.gumbel,scale=b130.gumbel),qgumbel(0.99,loc=a145.gumbel,scale=b145.gumbel))->h100
lsfit(log(d),log(h100))->ft100
ft100$coefficients
exp(ft100$coefficients[[1]])
```

```
# Plot linee segnalatrici di possibilità pluviometrica

plot(dd,exp(ft20$coefficients[[1]])*dd^ft20$coefficients[[2]],type="l",xlab="t [min]",ylab="h[mm]",main="Linee
Segnalatrici di Possibilità Pluviometrica",xlim=c(0,60),ylim=c(0,80))

lines(dd,exp(ft05$coefficients[[1]])*dd^ft05$coefficients[[2]],type="l",col="blue")
lines(dd,exp(ft10$coefficients[[1]])*dd^ft10$coefficients[[2]],type="l",col="red")
lines(dd,exp(ft50$coefficients[[1]])*dd^ft50$coefficients[[2]],type="l",col="green")
lines(dd,exp(ft100$coefficients[[1]])*dd^ft100$coefficients[[2]],type="l",col="brown")

points(d,h05,pch=2,col="blue")
points(d,h10,pch=0,col="red")
points(d,h20,pch=1)
points(d,h50,pch=0,col="green")
points(d,h100,pch=0,col="brown")

text(10,50,"Tr=5 anni",cex=0.8,col="blue")
text(10,55,"Tr=10 anni",cex=0.8,col="red")
text(10,60,"Tr=20 anni",cex=0.8)
text(10,65,"Tr=50 anni",cex=0.8,col="green")
text(10,70,"Tr=100 anni",cex=0.8,col="brown")

# Plot linee segnalatrici di possibilità pluviometrica in scala logaritmica

plot(dd,exp(ft05$coefficients[[1]])*dd^ft05$coefficients[[2]],type="l",xlab="t [min]",ylab="h[mm]",main="Linee
Segnalatrici di Possibilita' Pluviometrica",col="blue",log="xy",xlim=c(10,60),ylim=c(10,100))

lines(dd,exp(ft10$coefficients[[1]])*dd^ft10$coefficients[[2]],type="l",xlab="t [min]",ylab="h [mm]",main="Linee
Segnalatrici di Possibilita' Pluviometrica",log="xy",col="red")
lines(dd,exp(ft20$coefficients[[1]])*dd^ft20$coefficients[[2]],type="l",xlab="t [min]",ylab="h [mm]",main="Linee
Segnalatrici di Possibilita' Pluviometrica",log="xy")
lines(dd,exp(ft50$coefficients[[1]])*dd^ft50$coefficients[[2]],type="l",xlab="t [min]",ylab="h [mm]",main="Linee
Segnalatrici di Possibilita' Pluviometrica",log="xy",col="green")
lines(dd,exp(ft100$coefficients[[1]])*dd^ft100$coefficients[[2]],type="l",xlab="t [min]",ylab="h [mm]",main="Linee
Segnalatrici di Possibilita' Pluviometrica",log="xy",col="brown")

points(d,h05,pch=2,col="blue")
points(d,h10,pch=0,col="red")
points(d,h20,pch=1)
points(d,h50,pch=0,col="green")
points(d,h100,pch=0,col="brown")

text(55,10,"Tr=5 anni",cex=0.8,col="blue")
text(55,11.5,"Tr=10 anni",cex=0.8,col="red")
text(55,13.2,"Tr=20 anni",cex=0.8)
text(55,15.3,"Tr=50 anni",cex=0.8,col="green")
text(55,17.5,"Tr=100 anni",cex=0.8,col="brown")
```

# Analisi completa precipitazioni

```
list.files()
read.table("Esameidro.txt",header= TRUE)  ->  data
data
summary(data)
hist(data[[5]],breaks=20,xlab="Precipitazioni [mm]",  ylab="Frequenza Eventi",main="Precipitazioni  Massime  di  1  ora")
hist(data[[6]],breaks=20,xlab="Precipitazioni [mm]",  ylab="Frequenza Eventi",main="Precipitazioni  Massime  di  3  ore")
hist(data[[7]],breaks=20,xlab="Precipitazioni [mm]",  ylab="Frequenza Eventi",main="Precipitazioni  Massime  di  6  ore")
hist(data[[8]],breaks=20,xlab="Precipitazioni [mm]",  ylab="Frequenza Eventi",main="Precipitazioni  Massime  di  12 ore")
hist(data[[9]],breaks=20,xlab="Precipitazioni [mm]",  ylab="Frequenza Eventi",main="Precipitazioni  Massime  di  24 ore")

data$anno  <-  NULL
boxplot(data,main="Precipitazioni  massime  a Tione",xlab="durata  [ore]",ylab="Precipitazioni [mm]")

#  1  ora

data[,5]->data1h
is.na(data1h)
data1h[!is.na(data1h)]->new.data1h
new.data1h

#  1 - Metodo dei momenti

eulerogamma  =0.57721566490153286060
m1h<-mean(new.data1h)
v1h<-var(new.data1h)
b11.gumbel<-sqrt(6*v1h)/pi
a11.gumbel<-m1h-b11.gumbel*eulerogamma
library(evd)
z<-sort(new.data1h)

#  2 - Metodo dei minimi quadrati

ec<-ecdf(new.data1h)
Fi<-ec(sort(new.data1h))
y<--log(-log(Fi))
y<-y[-which(Fi==1)]
x<-sort(new.data1h)[-which(Fi==1)]
fts<-lsfit(x,y)
b21.gumbel<-fts$coefficients[[2]]^-1
a21.gumbel<--b21.gumbel*fts$coefficients[[1]]
```

```
#  3 - Metodo della maxverosimiglianza

library(MASS)
mlik<-fitdistr(new.data1h,densfun=dgumbel,start=list(loc=a11.gumbel,scale=b11.gumbel))
b31.gumbel<-mlik$estimate[[2]]
a31.gumbel<-mlik$estimate[[1]]
plot(z,pgumbel(z,loc=a11.gumbel,scale=b11.gumbel),type="l",col="green",xlab="Precipitazioni[mm]",ylab="P[H<h]",main=
"Ecdf e curve di Gumbelper 1 ora")

lines(z,pgumbel(z,loc=a21.gumbel,scale=b21.gumbel),type="l",col="blue")
lines(z,pgumbel(z,loc=a31.gumbel,scale=b31.gumbel),type="l",col="red")
lines(ecdf(new.data1h))

# Test di Pearson

# Per il metodo dei momenti

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a11.gumbel,scale=b11.gumbel)->qi
c(0,ec(qi)*length(new.data1h))->no1
c(ec(qi)*length(new.data1h),length(new.data1h))->no2
no2-no1->no
0.2*length(new.data1h)->deltapi
X1=sum((no-deltapi)^2/deltapi)

# Per il metodo dei minimi quadrati

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a21.gumbel,scale=b21.gumbel)->qi
c(0,ec(qi)*length(new.data1h))->no1
c(ec(qi)*length(new.data1h),length(new.data1h))->no2
no2-no1->no
0.2*length(new.data1h)->deltapi
X2=sum((no-deltapi)^2/deltapi)

# Per il metodo della maxverosimiglianza

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a31.gumbel,scale=b31.gumbel)->qi
c(0,ec(qi)*length(new.data1h))->no1
c(ec(qi)*length(new.data1h),length(new.data1h))->no2
no2-no1->no
0.2*length(new.data1h)->deltapi
X3=sum((no-deltapi)^2/deltapi)
```

```
#  Valori  ottenuti

m1h
v1h

a11.gumbel
b11.gumbel
X1

a21.gumbel
b21.gumbel
X2

a31.gumbel
b31.gumbel
X3

#  3  ore

data[,6]->data3h
is.na(data3h)
data3h[!is.na(data3h)]->new.data3h
new.data3h

#  1 - Metodo dei momenti

eulerogamma  =0.57721566490153286060
m3h<-mean(new.data3h)
v3h<-var(new.data3h)
b13.gumbel<-sqrt(6*v3h)/pi
a13.gumbel<-m3h-b13.gumbel*eulerogamma
library(evd)
z<-sort(new.data3h)

#  2 - Metodo dei minimi quadrati

ec<-ecdf(new.data3h)
Fi<-ec(sort(new.data3h))
y<--log(-log(Fi))
y<-y[-which(Fi==1)]
x<-sort(new.data3h)[-which(Fi==1)]
fts<-lsfit(x,y)
b23.gumbel<-fts$coefficients[[2]]^-1
a23.gumbel<--b23.gumbel*fts$coefficients[[1]]
```

```
#  3 - Metodo della maxverosimiglianza

library(MASS)
mlik<-fitdistr(new.data3h,densfun=dgumbel,start=list(loc=a13.gumbel,scale=b13.gumbel))
b33.gumbel<-mlik$estimate[[2]]
a33.gumbel<-mlik$estimate[[1]]
plot(z,pgumbel(z,loc=a13.gumbel,scale=b13.gumbel),type="l",col="green",xlab="Precipitazioni[mm]",ylab="P[H<h]",main=
"Ecdf e curve di Gumbelper 3 ore")
lines(z,pgumbel(z,loc=a23.gumbel,scale=b23.gumbel),type="l",col="blue")
lines(z,pgumbel(z,loc=a33.gumbel,scale=b33.gumbel),type="l",col="red")
lines(ecdf(new.data3h))

# Test di Pearson

# Per il metodo dei momenti

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a13.gumbel,scale=b13.gumbel)->qi
c(0,ec(qi)*length(new.data3h))->no1
c(ec(qi)*length(new.data3h),length(new.data3h))->no2
no2-no1->no
0.2*length(new.data3h)->deltapi
X1=sum((no-deltapi)^2/deltapi)

# Per il metodo dei minimi quadrati

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a23.gumbel,scale=b23.gumbel)->qi
c(0,ec(qi)*length(new.data3h))->no1
c(ec(qi)*length(new.data3h),length(new.data3h))->no2
no2-no1->no
0.2*length(new.data3h)->deltapi
X2=sum((no-deltapi)^2/deltapi)

# Per il metodo della maxverosimiglianza

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a33.gumbel,scale=b33.gumbel)->qi
c(0,ec(qi)*length(new.data3h))->no1
c(ec(qi)*length(new.data3h),length(new.data3h))->no2
no2-no1->no
0.2*length(new.data3h)->deltapi
X3=sum((no-deltapi)^2/deltapi)
```

```
#  Valori  ottenuti

m3h
v3h

a13.gumbel
b13.gumbel
X1

a23.gumbel
b23.gumbel
X2

a33.gumbel
b33.gumbel
X3

#  6  ore

data[,7]->data6h
is.na(data6h)
data6h[!is.na(data6h)]->new.data6h
new.data6h

#  1 - Metodo dei momenti

eulerogamma  =0.57721566490153286060
m6h<-mean(new.data6h)
v6h<-var(new.data6h)
b16.gumbel<-sqrt(6*v6h)/pi
a16.gumbel<-m6h-b16.gumbel*eulerogamma
library(evd)
z<-sort(new.data6h)

#  2 - Metodo dei minimi quadrati

ec<-ecdf(new.data6h)
Fi<-ec(sort(new.data6h))
y<--log(-log(Fi))
y<-y[-which(Fi==1)]
x<-sort(new.data6h)[-which(Fi==1)]
fts<-lsfit(x,y)
b26.gumbel<-fts$coefficients[[2]]^-1
a26.gumbel<--b26.gumbel*fts$coefficients[[1]]
```

```
#  3 - Metodo della maxverosimiglianza

library(MASS)
mlik<-fitdistr(new.data6h,densfun=dgumbel,start=list(loc=a16.gumbel,scale=b16.gumbel))
b36.gumbel<-mlik$estimate[[2]]
a36.gumbel<-mlik$estimate[[1]]
plot(z,pgumbel(z,loc=a16.gumbel,scale=b16.gumbel),type="l",col="green",xlab="Precipitazioni[mm]",ylab="P[H<h]",main=
"Ecdf e curve di Gumbelper 6 ore")
lines(z,pgumbel(z,loc=a26.gumbel,scale=b26.gumbel),type="l",col="blue")
lines(z,pgumbel(z,loc=a36.gumbel,scale=b36.gumbel),type="l",col="red")
lines(ecdf(new.data6h))

# Test di Pearson

# Per il metodo dei momenti

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a16.gumbel,scale=b16.gumbel)->qi
c(0,ec(qi)*length(new.data6h))->no1
c(ec(qi)*length(new.data6h),length(new.data6h))->no2
no2-no1->no
0.2*length(new.data6h)->deltapi
X1=sum((no-deltapi)^2/deltapi)

# Per il metodo dei minimi quadrati

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a26.gumbel,scale=b26.gumbel)->qi
c(0,ec(qi)*length(new.data6h))->no1
c(ec(qi)*length(new.data6h),length(new.data6h))->no2
no2-no1->no
0.2*length(new.data6h)->deltapi
X2=sum((no-deltapi)^2/deltapi)

# Per il metodo della maxverosimiglianza

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a36.gumbel,scale=b36.gumbel)->qi
c(0,ec(qi)*length(new.data6h))->no1
c(ec(qi)*length(new.data6h),length(new.data6h))->no2
no2-no1->no
0.2*length(new.data6h)->deltapi
X3=sum((no-deltapi)^2/deltapi)
```

```
#  Valori  ottenuti

m6h
v6h

a16.gumbel
b16.gumbel
X1

a26.gumbel
b26.gumbel
X2

a36.gumbel
b36.gumbel
X3

#  12  ore

data[,8]->data12h
is.na(data12h)
data12h[!is.na(data12h)]->new.data12h
new.data12h

#  1 - Metodo dei momenti

eulerogamma  =0.57721566490153286060
m12h<-mean(new.data12h)
v12h<-var(new.data12h)
b112.gumbel<-sqrt(6*v12h)/pi
a112.gumbel<-m12h-b112.gumbel*eulerogamma
library(evd)
z<-sort(new.data12h)

#  2 - Metodo dei minimi quadrati

ec<-ecdf(new.data12h)
Fi<-ec(sort(new.data12h))
y<--log(-log(Fi))
y<-y[-which(Fi==1)]
x<-sort(new.data12h)[-which(Fi==1)]
fts<-lsfit(x,y)
b212.gumbel<-fts$coefficients[[2]]^-1
a212.gumbel<--b212.gumbel*fts$coefficients[[1]]
```

```
#  3 - Metodo della maxverosimiglianza

library(MASS)
mlik<-fitdistr(new.data12h,densfun=dgumbel,start=list(loc=a112.gumbel,scale=b112.gumbel))
b312.gumbel<-mlik$estimate[[2]]
a312.gumbel<-mlik$estimate[[1]]
plot(z,pgumbel(z,loc=a112.gumbel,scale=b112.gumbel),type="l",col="green",xlab="Precipitazioni[mm]",ylab="P[H<h]",mai
n="Ecdf e curve di Gumbelper 12 ore")
lines(z,pgumbel(z,loc=a212.gumbel,scale=b212.gumbel),type="l",col="blue")
lines(z,pgumbel(z,loc=a312.gumbel,scale=b312.gumbel),type="l",col="red")
lines(ecdf(new.data12h))

# Test di Pearson

# Per il metodo dei momenti

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a112.gumbel,scale=b112.gumbel)->qi
c(0,ec(qi)*length(new.data12h))->no1
c(ec(qi)*length(new.data12h),length(new.data12h))->no2
no2-no1->no
0.2*length(new.data12h)->deltapi
X1=sum((no-deltapi)^2/deltapi)

# Per il metodo dei minimi quadrati

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a212.gumbel,scale=b212.gumbel)->qi
c(0,ec(qi)*length(new.data12h))->no1
c(ec(qi)*length(new.data12h),length(new.data12h))->no2
no2-no1->no
0.2*length(new.data12h)->deltapi
X2=sum((no-deltapi)^2/deltapi)

# Per il metodo della maxverosimiglianza

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a312.gumbel,scale=b312.gumbel)->qi
c(0,ec(qi)*length(new.data12h))->no1
c(ec(qi)*length(new.data12h),length(new.data12h))->no2
no2-no1->no
0.2*length(new.data12h)->deltapi
X3=sum((no-deltapi)^2/deltapi)
```

```
#  Valori  ottenuti

m12h
v12h

a112.gumbel
b112.gumbel
X1

a212.gumbel
b212.gumbel
X2

a312.gumbel
b312.gumbel
X3

#  24  ore

data[,9]->data24h
is.na(data24h)
data24h[!is.na(data24h)]->new.data24h
new.data24h

#  1 - Metodo dei momenti

eulerogamma  =0.57721566490153286060
m24h<-mean(new.data24h)
v24h<-var(new.data24h)
b124.gumbel<-sqrt(6*v24h)/pi
a124.gumbel<-m24h-b124.gumbel*eulerogamma
library(evd)
z<-sort(new.data24h)

#  2 - Metodo dei minimi quadrati

ec<-ecdf(new.data24h)
Fi<-ec(sort(new.data24h))
y<--log(-log(Fi))
y<-y[-which(Fi==1)]
x<-sort(new.data24h)[-which(Fi==1)]
fts<-lsfit(x,y)
b224.gumbel<-fts$coefficients[[2]]^-1
a224.gumbel<--b224.gumbel*fts$coefficients[[1]]
```

```
#  3 - Metodo della maxverosimiglianza

library(MASS)
mlik<-fitdistr(new.data24h,densfun=dgumbel,start=list(loc=a124.gumbel,scale=b124.gumbel))
b324.gumbel<-mlik$estimate[[2]]
a324.gumbel<-mlik$estimate[[1]]
plot(z,pgumbel(z,loc=a124.gumbel,scale=b124.gumbel),type="l",col="green",xlab="Precipitazioni[mm]",ylab="P[H<h]",mai
n="Ecdf e curve di Gumbelper 24 ore")
lines(z,pgumbel(z,loc=a224.gumbel,scale=b224.gumbel),type="l",col="blue")
lines(z,pgumbel(z,loc=a324.gumbel,scale=b324.gumbel),type="l",col="red")
lines(ecdf(new.data24h))

# Test di Pearson

# Per il metodo dei momenti

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a124.gumbel,scale=b124.gumbel)->qi
c(0,ec(qi)*length(new.data24h))->no1
c(ec(qi)*length(new.data24h),length(new.data24h))->no2
no2-no1->no
0.2*length(new.data24h)->deltapi
X1=sum((no-deltapi)^2/deltapi)

# Per il metodo dei minimi quadrati

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a224.gumbel,scale=b224.gumbel)->qi
c(0,ec(qi)*length(new.data24h))->no1
c(ec(qi)*length(new.data24h),length(new.data24h))->no2
no2-no1->no
0.2*length(new.data24h)->deltapi
X2=sum((no-deltapi)^2/deltapi)

# Per il metodo della maxverosimiglianza

q=c(0.2,0.4,0.6,0.8)
qgumbel(q,loc=a324.gumbel,scale=b324.gumbel)->qi
c(0,ec(qi)*length(new.data24h))->no1
c(ec(qi)*length(new.data24h),length(new.data24h))->no2
no2-no1->no
0.2*length(new.data24h)->deltapi
X3=sum((no-deltapi)^2/deltapi)
```

```
# Valori ottenuti

m24h
v24h

a124.gumbel
b124.gumbel
X1

a224.gumbel
b224.gumbel
X2

a324.gumbel
b324.gumbel
X3

# Grafico di non superamento

seq(from=1,to=150,by=0.1)->x
plot(x,pgumbel(x,loc=a11.gumbel,scale=b11.gumbel),type="l",col="red",xlab="Precipitazione[mm]",ylab="P[h]")

lines(x,pgumbel(x,loc=a23.gumbel,scale=b23.gumbel),col="blue")
lines(x,pgumbel(x,loc=a26.gumbel,scale=b26.gumbel),col="dark green")
lines(x,pgumbel(x,loc=a112.gumbel,scale=b112.gumbel),col="orange")
lines(x,pgumbel(x,loc=a224.gumbel,scale=b224.gumbel),col="pink")

text(120,0.8,"1 ora",cex=0.8,col="red")
text(120,0.7,"3 ore",cex=0.8,col="blue")
text(120,0.6,"6 ore",cex=0.8,col="dark green")
text(120,0.5,"12 ore",cex=0.8,col="orange")
text(120,0.4,"24 ore",cex=0.8,col="pink")

# Distribuzione di Gumbel densità

seq(from=1,to=150,by=0.1)->x
plot(x,dgumbel(x,loc=a11.gumbel,scale=b11.gumbel),type="l",col="red",xlab="Precipitazione[mm]",ylab="P[h]")

lines(x,dgumbel(x,loc=a23.gumbel,scale=b23.gumbel),col="blue")
lines(x,dgumbel(x,loc=a26.gumbel,scale=b26.gumbel),col="dark green")
lines(x,dgumbel(x,loc=a112.gumbel,scale=b112.gumbel),col="orange")
lines(x,dgumbel(x,loc=a224.gumbel,scale=b224.gumbel),col="pink")

text(120,0.05,"1 ora",cex=0.8,col="red")
text(120,0.045,"3 ore",cex=0.8,col="blue")
text(120,0.04,"6 ore",cex=0.8,col="dark green")
text(120,0.035,"12 ore",cex=0.8,col="orange")
text(120,0.03,"24 ore",cex=0.8,col="pink")
```

# Lssp

```
dd<-0:60
d = c(1,3,6,12,24)
c(qgumbel(0.8,loc=a11.gumbel,scale=b11.gumbel),qgumbel(0.8,loc=a23.gumbel,scale=b23.gumbel),qgumbel(0.8,loc=a26.gumbel,scale=b26.gumbel),qgumbel(0.8,loc=a112.gumbel,scale=b112.gumbel),qgumbel(0.8,loc=a224.gumbel,scale=b224.gumbel))->h05
lsfit(log(d),log(h05))->ft05
ft05$coefficients
exp(ft05$coefficients[[1]])

c(qgumbel(0.9,loc=a11.gumbel,scale=b11.gumbel),qgumbel(0.9,loc=a23.gumbel,scale=b23.gumbel),qgumbel(0.9,loc=a26.gumbel,scale=b26.gumbel),qgumbel(0.9,loc=a112.gumbel,scale=b112.gumbel),qgumbel(0.9,loc=a224.gumbel,scale=b224.gumbel))->h10
lsfit(log(d),log(h10))->ft10
ft10$coefficients
exp(ft10$coefficients[[1]])

c(qgumbel(0.95,loc=a11.gumbel,scale=b11.gumbel),qgumbel(0.95,loc=a23.gumbel,scale=b23.gumbel),qgumbel(0.95,loc=a26.gumbel,scale=b26.gumbel),qgumbel(0.95,loc=a112.gumbel,scale=b112.gumbel),qgumbel(0.95,loc=a224.gumbel,scale=b224.gumbel))->h20
lsfit(log(d),log(h20))->ft20
ft20$coefficients
exp(ft20$coefficients[[1]])

c(qgumbel(0.98,loc=a11.gumbel,scale=b11.gumbel),qgumbel(0.98,loc=a23.gumbel,scale=b23.gumbel),qgumbel(0.98,loc=a26.gumbel,scale=b26.gumbel),qgumbel(0.98,loc=a112.gumbel,scale=b112.gumbel),qgumbel(0.98,loc=a224.gumbel,scale=b224.gumbel))->h50
lsfit(log(d),log(h50))->ft50
ft50$coefficients
exp(ft50$coefficients[[1]])

c(qgumbel(0.99,loc=a11.gumbel,scale=b11.gumbel),qgumbel(0.99,loc=a23.gumbel,scale=b23.gumbel),qgumbel(0.99,loc=a26.gumbel,scale=b26.gumbel),qgumbel(0.99,loc=a112.gumbel,scale=b112.gumbel),qgumbel(0.99,loc=a224.gumbel,scale=b224.gumbel))->h100
lsfit(log(d),log(h100))->ft100
ft100$coefficients
exp(ft100$coefficients[[1]])
```

```
# Plot linee segnalatrici di possibilità pluviometrica

plot(dd,exp(ft20$coefficients[[1]])*dd^ft20$coefficients[[2]],type="l",xlab="t [ore]",ylab="h[mm]",main="Linee
Segnalatrici di Possibilita' Pluviometrica",xlim=c(0,60),ylim=c(0,300))

lines(dd,exp(ft05$coefficients[[1]])*dd^ft05$coefficients[[2]],type="l",col="blue")
lines(dd,exp(ft10$coefficients[[1]])*dd^ft10$coefficients[[2]],type="l",col="red")
lines(dd,exp(ft50$coefficients[[1]])*dd^ft50$coefficients[[2]],type="l",col="green")
lines(dd,exp(ft100$coefficients[[1]])*dd^ft100$coefficients[[2]],type="l",col="brown")

points(d,h05,pch=2,col="blue")
points(d,h10,pch=0,col="red")
points(d,h20,pch=1)
points(d,h50,pch=0,col="green")
points(d,h100,pch=0,col="brown")

text(50,10,"Tr=5 anni",cex=0.8,col="blue")
text(50,25,"Tr=10 anni",cex=0.8,col="red")
text(50,40,"Tr=20 anni",cex=0.8)
text(50,55,"Tr=50 anni",cex=0.8,col="green")
text(50,70,"Tr=100 anni",cex=0.8,col="brown")

# Plot linee segnalatrici di possibilità pluviometrica in scala logaritmica

plot(dd,exp(ft05$coefficients[[1]])*dd^ft05$coefficients[[2]],type="l",xlab="t [ore]",ylab="h[mm]",main="Linee
Segnalatrici di Possibilita'Pluviometrica",col="blue",log="xy",xlim=c(10,60),ylim=c(40,300))

lines(dd,exp(ft10$coefficients[[1]])*dd^ft10$coefficients[[2]],type="l",xlab="t [ore]",ylab="h[mm]",main="Linee
Segnalatrici di Possibilita'Pluviometrica",log="xy",col="red")
lines(dd,exp(ft20$coefficients[[1]])*dd^ft20$coefficients[[2]],type="l",xlab="t [ore]",ylab="h[mm]",main="Linee
Segnalatrici di Possibilita'Pluviometrica",log="xy")
lines(dd,exp(ft50$coefficients[[1]])*dd^ft50$coefficients[[2]],type="l",xlab="t [ore]",ylab="h[mm]",main="Linee
Segnalatrici di Possibilita'Pluviometrica",log="xy",col="green")
lines(dd,exp(ft100$coefficients[[1]])*dd^ft100$coefficients[[2]],type="l",xlab="t[ore]",ylab="h [mm]",main="Linee
Segnalatrici di Possibilita'Pluviometrica",log="xy",col="brown")

points(d,h10,pch=0,col="red")
points(d,h20,pch=1)
points(d,h50,pch=0,col="green")
points(d,h100,pch=0,col="brown")

text(55,45,"Tr=5 anni",cex=0.8,col="blue")
text(55,50,"Tr=10 anni",cex=0.8,col="red")
text(55,55,"Tr=20 anni",cex=0.8)
text(55,61,"Tr=50 anni",cex=0.8,col="green")
text(55,68,"Tr=100 anni",cex=0.8,col="brown")
```