test

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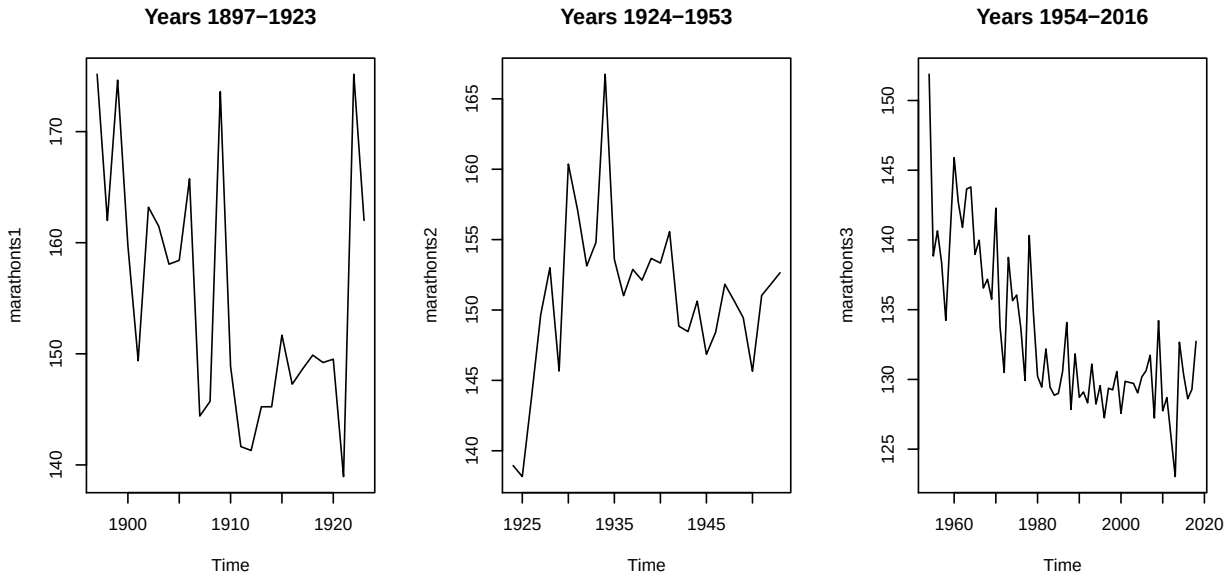
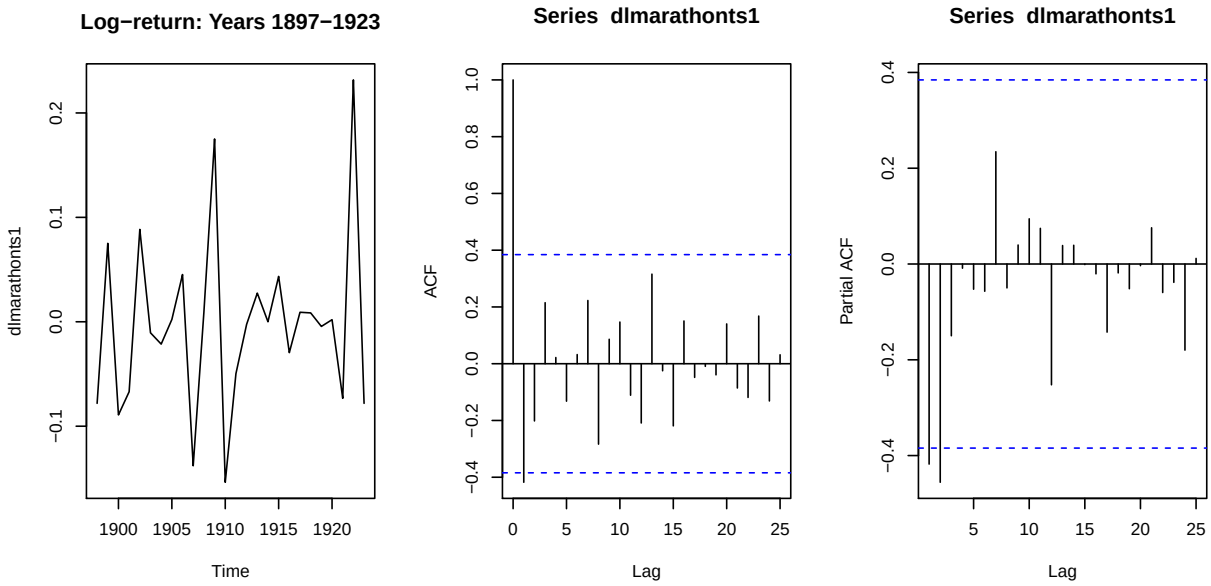
```
library(fpp2)
library(tsoutliers)
library()
marathon <- marathon
par(mfrow=c(1,3))
marathonts1<-ts(marathon[1:25],start=c(1897),end=c(1923),freq=1)
marathonts2<-ts(marathon[25:56],start=c(1924),end=c(1953),freq=1)
marathonts3<-ts(marathon[56:120],start=c(1954),freq=1)
plot(marathonts1,main="Years 1897-1923")
plot(marathonts2,main="Years 1924-1953")
plot(marathonts3,main="Years 1954-2016")
```




```
par(mfrow=c(1,3))
lmarathonts1 <- log(marathonts1)
dlmarathonts1 <- diff(lmarathonts1)
lmarathonts2 <- log(marathonts2)
dlmarathonts2 <- diff(lmarathonts2)
lmarathonts3 <- log(marathonts3)
dlmarathonts3 <- diff(lmarathonts3)
plot(dlmarathonts1)+title(" Log-return: Years 1897-1923 ")
```

```
## integer(0)
```

```r
acf(dlmarathonts1, lag=150)
pacf(dlmarathonts1, lag=150)
```




```r
auto.arima(lmarathonts1, ic="aic")
```

```
## Series: lmarathonts1
## ARIMA(0,1,1)
##
## Coefficients:
##           ma1
##       -0.7001
## s.e.   0.1435
##
## sigma^2 estimated as 0.004712:  log likelihood=32.93
## AIC=-61.86   AICc=-61.34   BIC=-59.35
```

```r
tso(lmarathonts1, types = c("AO", "LS", "TC"))
```

```
## Warning in locate.outliers.iloop(resid = resid, pars = pars, cval = cval, :
## stopped when 'maxit.iloop' was reached
```

```
## Series: lmarathonts1
## Regression with ARIMA(0,0,0) errors
##
## Coefficients:
##       intercept     TC11   TC13     LS14    TC26
##          5.0938  -0.1341  0.099  -0.1142  0.1754
## s.e.     0.0106   0.0306  0.031   0.0145  0.0308
##
## sigma^2 estimated as 0.001439:  log likelihood=52.8
## AIC=-93.6   AICc=-89.4   BIC=-85.82
##
## Outliers:
##   type ind time  coefhat  tstat
## 1   TC  11 1907 -0.13406 -4.388
```

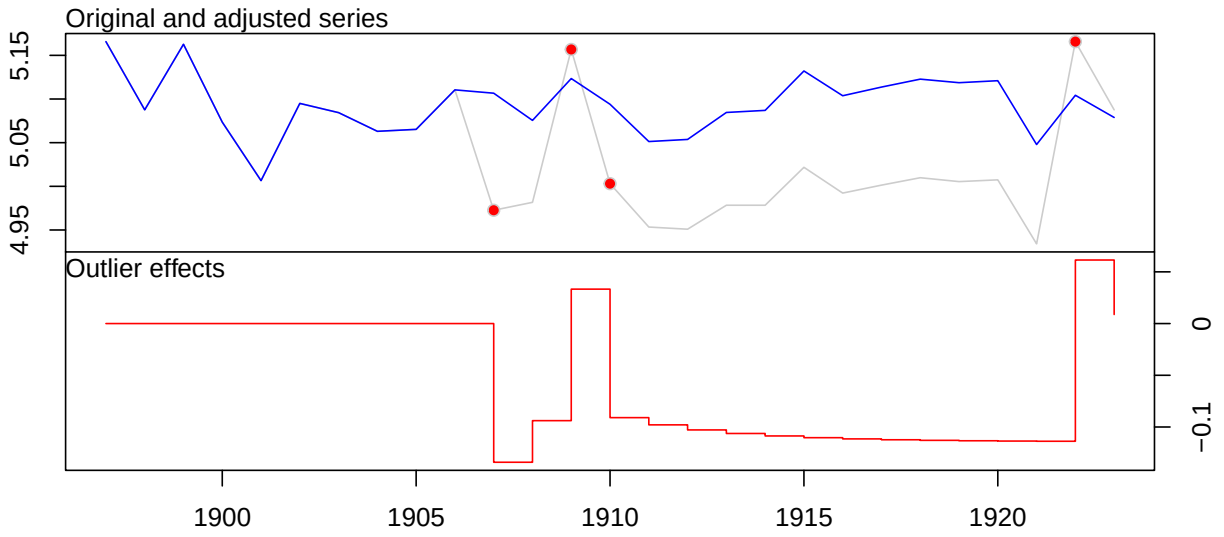
```
## 2   TC  13 1909  0.09899  3.194
## 3   LS  14 1910 -0.11424 -7.856
## 4   TC  26 1922  0.17535  5.693
```

```
a=tso(lmarathonts1, types = c("AO", "LS", "TC"))
```

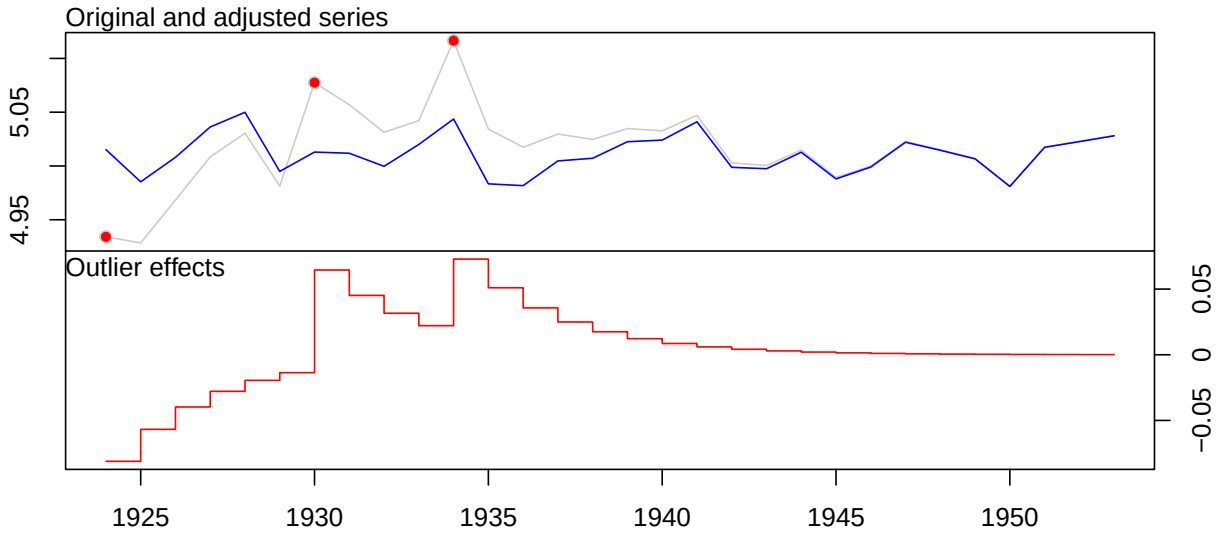
```
## Warning in locate.outliers.iloop(resid = resid, pars = pars, cval = cval, :
## stopped when 'maxit.iloop' was reached
```

```
b=tso(lmarathonts2, types = c("AO", "LS", "TC"))
c=tso(lmarathonts3, types = c("AO", "LS", "TC"))
```

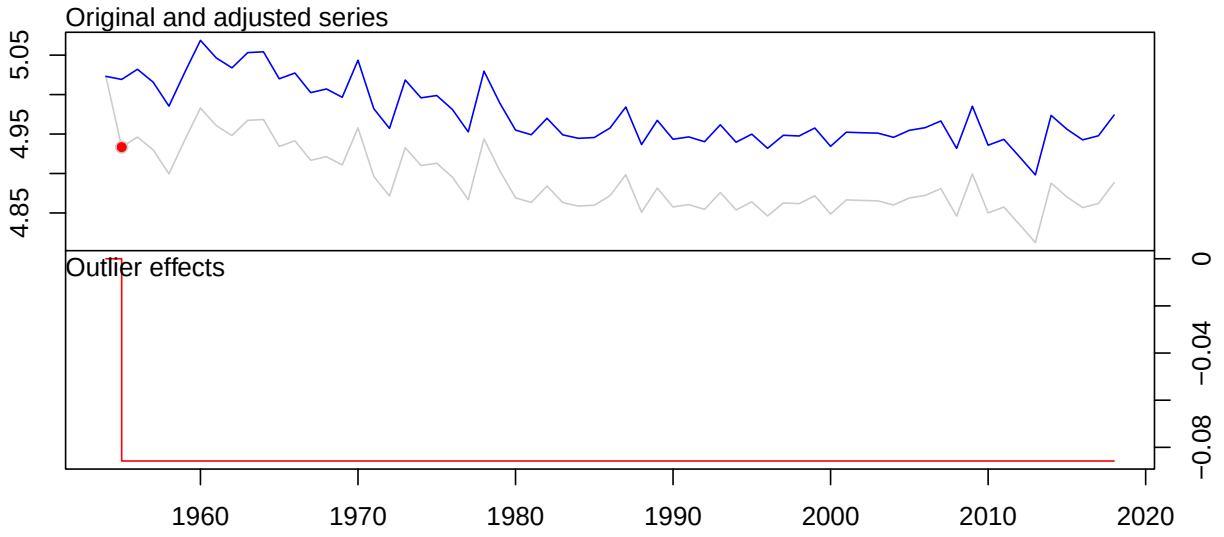
```
par(mfrow=c(1,3))
plot(a)
```




```
plot(b)
```




```
plot(c)
```

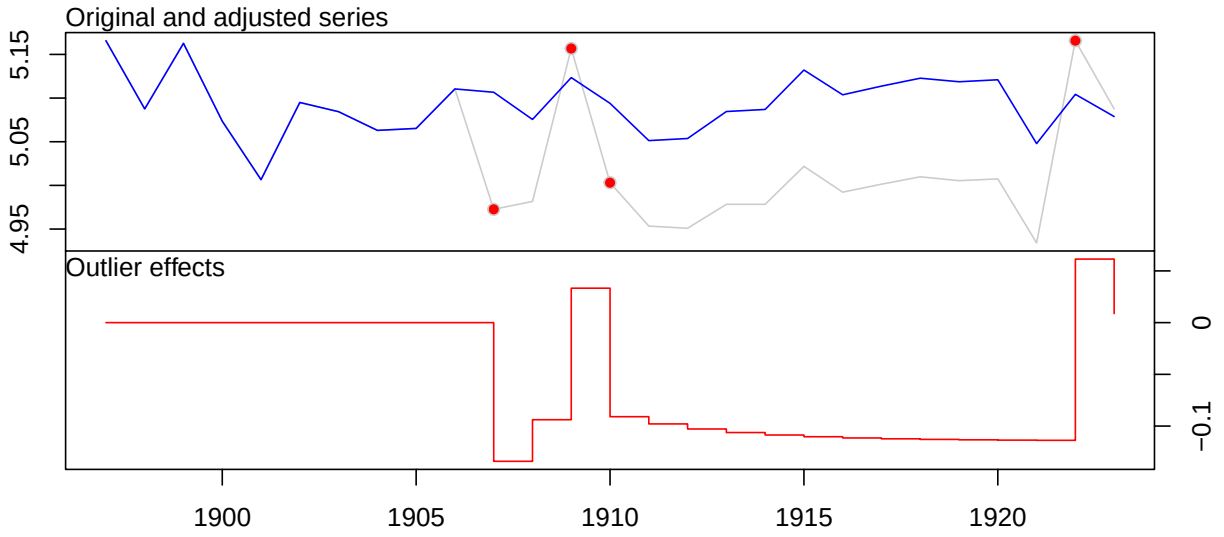



```
outmarathonts1=tso(lmarathonts1, types = c("AO", "LS", "TC"))
```

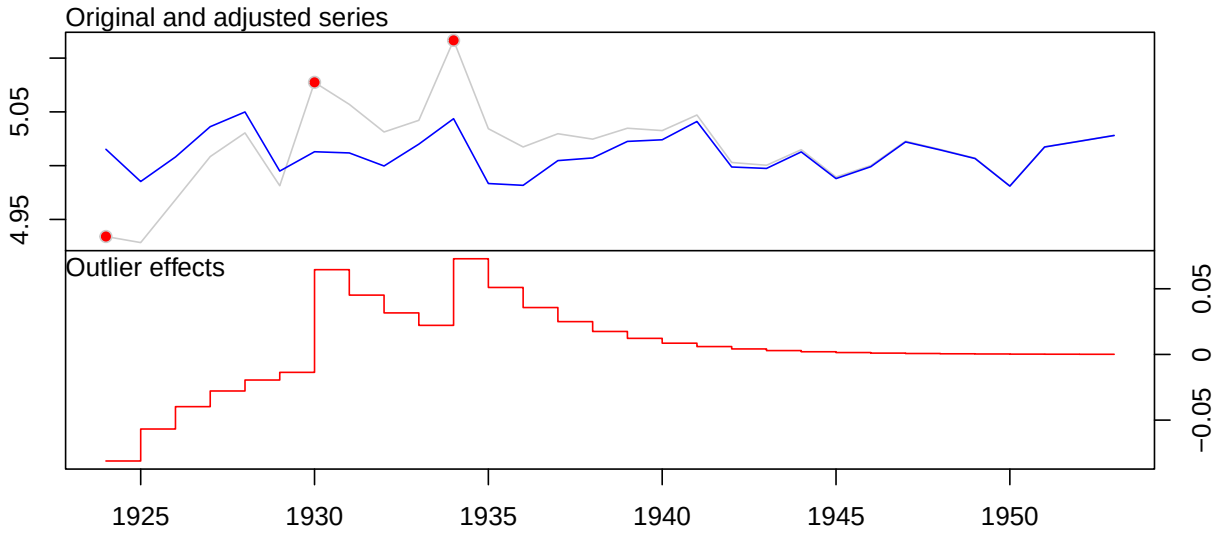
```
## Warning in locate.outliers.iloop(resid = resid, pars = pars, cval = cval, :
## stopped when 'maxit.iloop' was reached
```

```
outmarathonts2=tso(lmarathonts2, types = c("AO", "LS", "TC"))
outmarathonts3=tso(lmarathonts3, types = c("AO", "LS", "TC"))
```

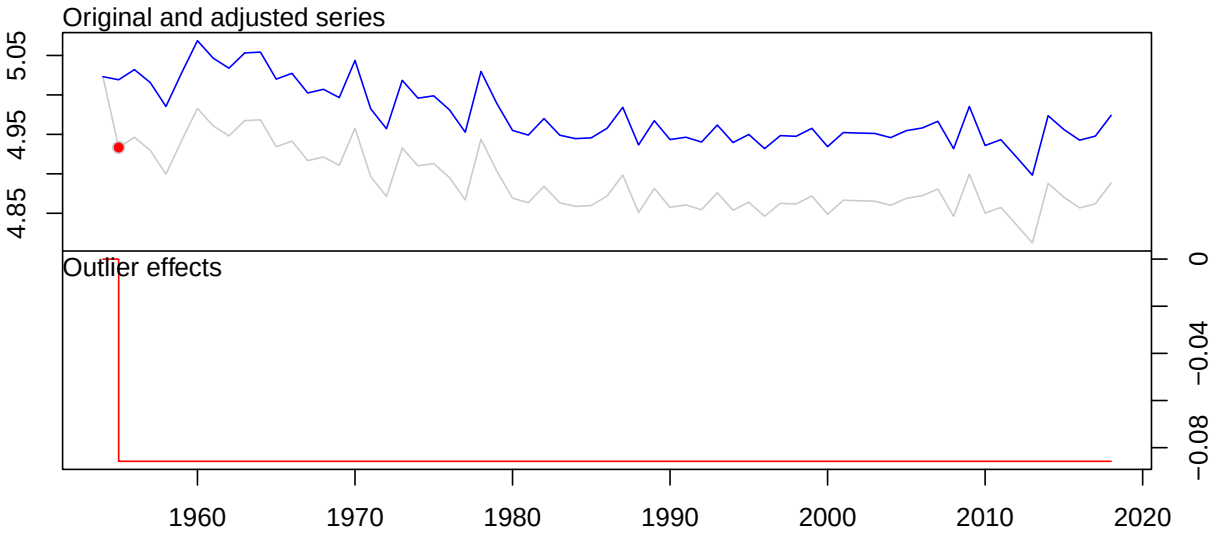
```
par(mfrow=c(1,3))
plot(outmarathonts1)
```

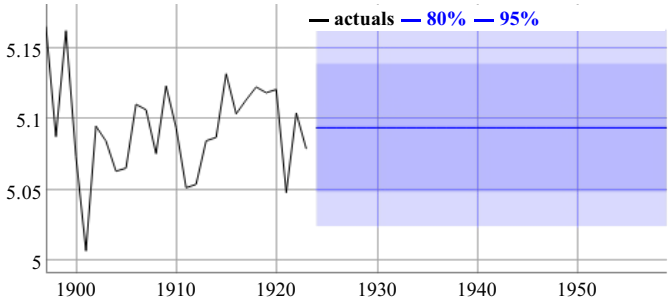


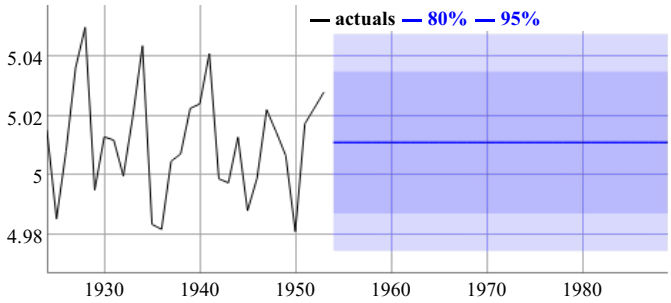

```
plot(outmarathonts2)
```

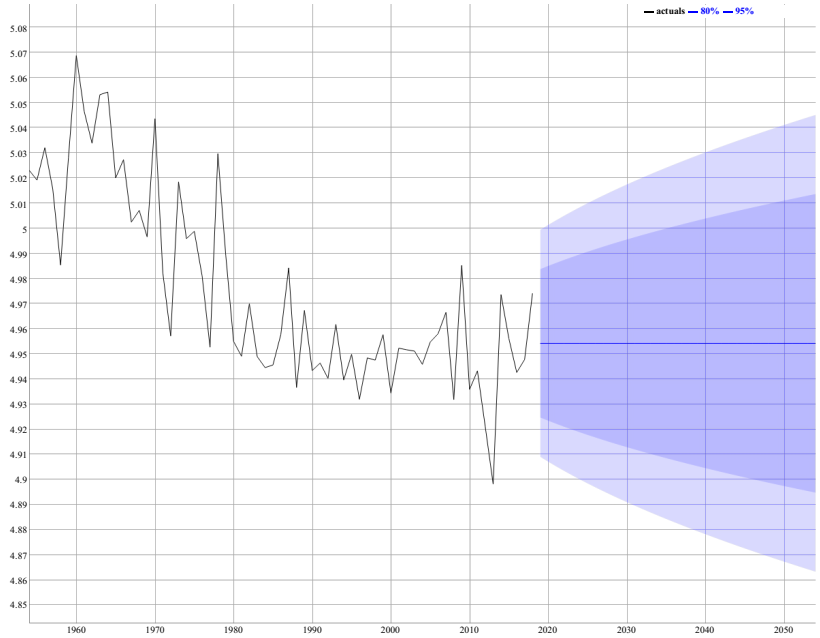



```
plot(outmarathonts3)
```


Original and adjusted series
5.05
4.95
4.85
Outlier effects
0
−0.04
−0.08
1960
1970
1980
1990
2000
2010
2020


actuals
80%
95%
5.15
5.1
5.05
5
1900
1910
1920
1930
1940
1950


actuals
80%
95%
5.04
5.02
5
4.98
1930
1940
1950
1960
1970
1980


actuals
80%
95%
5.08
5.07
5.06
5.05
5.04
5.03
5.02
5.01
5
4.99
4.98
4.97
4.96
4.95
4.94
4.93
4.92
4.91
4.9
4.89
4.88
4.87
4.86
4.85
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050