hw4 Time series

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3.10(a)

```
library(astsa)
(regr<-ar.ols(cmort, order=2,demean=F, intercept=T))
```

```
##
## Call:
## ar.ols(x = cmort, order.max = 2, demean = F, intercept = T)
##
## Coefficients:
##      1       2
## 0.4286  0.4418
##
## Intercept: 11.45 (2.394)
##
## Order selected 2  sigma^2 estimated as  32.32
```

```
regr$asy.se.coef
```

```
## $x.mean
## [1] 2.393673
##
## $ar
## [1] 0.03979433 0.03976163
```

> Our estimates are Phi0=11.45 se(2.394), Phi1=0.43 (se=.04), Phi2=0.44 (se=.04), and sigma^2=32.32.
> Est. model --> Xt = 11.45 + 0.43*X(t-1) + 0.44*X(t-2)

3.10(b)

```
# Find 4 week forcasts and 95% PI's for model (a)
cmort.pred <-predict(regr,n.ahead=4)
# list the 95% PI for each increase
upper <-c(cmort.pred$pred+2*cmort.pred$se)
lower <-c(cmort.pred$pred-2*cmort.pred$se)
list(m1=c(lower[1],upper[1]),m2=c(lower[2],upper[2]),
     m3=c(lower[3],upper[3]),m4=c(lower[4],upper[4]))
```

```
## $m1
## [1] 76.23017 98.96956
##
## $m2
## [1] 74.39354 99.13344
##
## $m3
## [1]  73.06868 101.60559
##
## $m4
## [1]  72.02679 102.40021
```

3.10(c)

```r
bound<-function(mean,sd,lambda){
  c(mean-3*sd*sqrt(lambda/(2-lambda)),mean+3*sd*sqrt(lambda/(2-lambda)))
}
library(zoo)
```

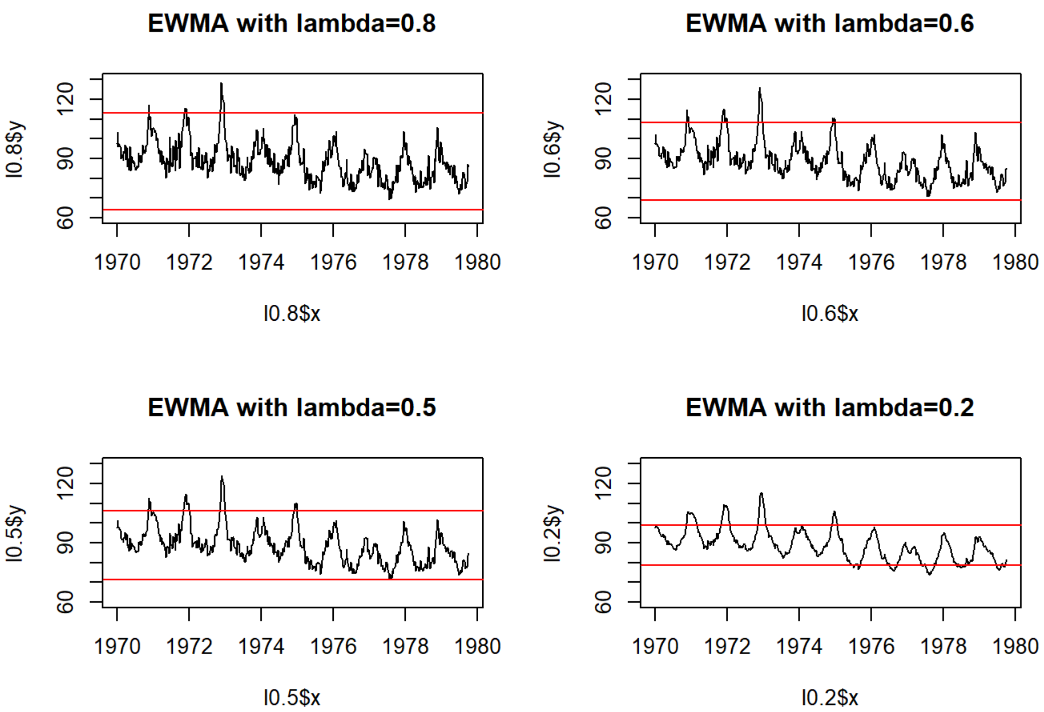
```
## Warning: package 'zoo' was built under R version 4.0.5
```

```r
t<-index(cmort)
library(qcc)
```

```
## Warning: package 'qcc' was built under R version 4.0.5
```

```r
l0.8<-ewmaSmooth(t,cmort,lambda=0.8)
l0.6<-ewmaSmooth(t,cmort,lambda=0.6)
l0.5<-ewmaSmooth(t,cmort,lambda=0.5)
l0.2<-ewmaSmooth(t,cmort,lambda=0.2)

par(mfrow=c(2,2))
{plot(l0.8,type="l", main="EWMA with lambda=0.8", ylim=c(60,130))
abline(h=bound(mean(cmort),sd(cmort),0.8)[1], col="red")
abline(h=bound(mean(cmort),sd(cmort),0.8)[2], col="red")
abline(v=150,col="blue",lty="dotted")}
{plot(l0.6,type="l", main="EWMA with lambda=0.6", ylim=c(60,130))
abline(h=bound(mean(cmort),sd(cmort),0.6)[1], col="red")
abline(h=bound(mean(cmort),sd(cmort),0.6)[2], col="red")
abline(v=150,col="blue",lty="dotted")}
{plot(l0.5,type="l",main="EWMA with lambda=0.5", ylim=c(60,130))
abline(h=bound(mean(cmort),sd(cmort),0.5)[1], col="red")
abline(h=bound(mean(cmort),sd(cmort),0.5)[2], col="red")
abline(v=150,col="blue",lty="dotted")}
{plot(l0.2,type="l", main="EWMA with lambda=0.2", ylim=c(60,130))
abline(h=bound(mean(cmort),sd(cmort),0.2)[1], col="red")
abline(h=bound(mean(cmort),sd(cmort),0.2)[2], col="red")
abline(v=150,col="blue",lty="dotted")}
```



```
sse<-c(sum((l0.8$y-cmort)^2),
       sum((l0.6$y-cmort)^2),
       sum((l0.5$y-cmort)^2),
       sum((l0.2$y-cmort)^2))
sse<-as.data.frame(sse)
rownames(sse)<-c('lambda=0.8','lambda=0.6', 'lambda=0.5', 'lambda=0.2')
sse
```

```
##                    sse
## lambda=0.8   780.4592
## lambda=0.6  2844.5530
## lambda=0.5  4394.5428
## lambda=0.2 14549.1013
```

> Choose lambda=0.8, as the process is in control because most of the values are in the upper and lower bound, which are defined by control limits for EWMA. Also, by setting lambda=0.8 we can get the minimum sse.

3.10(d)

```
arpred<-predict(regr,n.ahead=2)
arpred$pred
```

```
## Time Series:
## Start = c(1979, 41)
## End = c(1979, 42)
## Frequency = 52
## [1] 87.59986 86.76349
```

```
m2<-c(lower[2],upper[2])
m2
```

```
## [1] 74.39354 99.13344
```

```
l0.8$y[490] #start:1979.404
```

```
## [1] 81.34431
```

```
l0.8$y[491] #end:1979.423
```

```
## [1] 79.21286
```

> We can see the result of 1-step-ahead prediction of ewma model when lambda=0.8 are both in the 95% prediction interval in the AR(2) model.