732A62 Lab 2

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Assignment 1

a)

```
library(astsa)
library(kernlab)

set.seed(12345)
AR3 <- arima.sim(1000, model = list(order = c(3,0,0),
                                    ar = c(0.8, -0.2, 0.1)))

## The theoretical
AR3.pacf <- pacf(AR3, plot=F)
AR3.data <- ts.intersect(xt = AR3, x1 = lag(AR3, 1), x2 =lag(AR3, 2), x3= lag(AR3, 3))

AR.lm <- resid(lm(xt ~ x1 + x2, data = AR3.data))
AR.lm.lag3 <- resid(lm(x3 ~ x1 + x2 , data = AR3.data))

AR3.pacf[3]
```

```
##
## Partial autocorrelations of series 'AR3', by lag
##
##     3
## 0.117
```

```
cor(AR.lm, AR.lm.lag3)
```

```
## [1] 0.1146076
```

b)

```
set.seed(12345)
AR2 <- arima.sim(100, model = list(order = c(2,0,0),
                                   ar = c(0.8, 0.1)))

ar2.yw <- ar(AR2, order.max = 2, method = "yw", aic = FALSE)
ar2.ols <- ar(AR2, order.max = 2, method = "ols", aic = FALSE)
ar2.mle <- arima(AR2, order = c(2,0,0), method = "ML")

ar2.yw
```

```
##
## Call:
```

```
## ar(x = AR2, aic = FALSE, order.max = 2, method = "yw")
##
## Coefficients:
##      1       2
## 0.8029  0.1037
##
## Order selected 2  sigma^2 estimated as  1.267
```

```
ar2.ols
```

```
##
## Call:
## ar(x = AR2, aic = FALSE, order.max = 2, method = "ols")
##
## Coefficients:
##      1       2
## 0.8067  0.1205
##
## Intercept: -0.04401 (0.1074)
##
## Order selected 2  sigma^2 estimated as  1.129
```

```
ar2.mle
```

```
##
## Call:
## arima(x = AR2, order = c(2, 0, 0), method = "ML")
##
## Coefficients:
##          ar1     ar2  intercept
##       0.7967  0.1189     0.8290
## s.e.  0.0992  0.1000     1.1385
##
## sigma^2 estimated as 1.126:  log likelihood = -148.71,  aic = 305.41
```

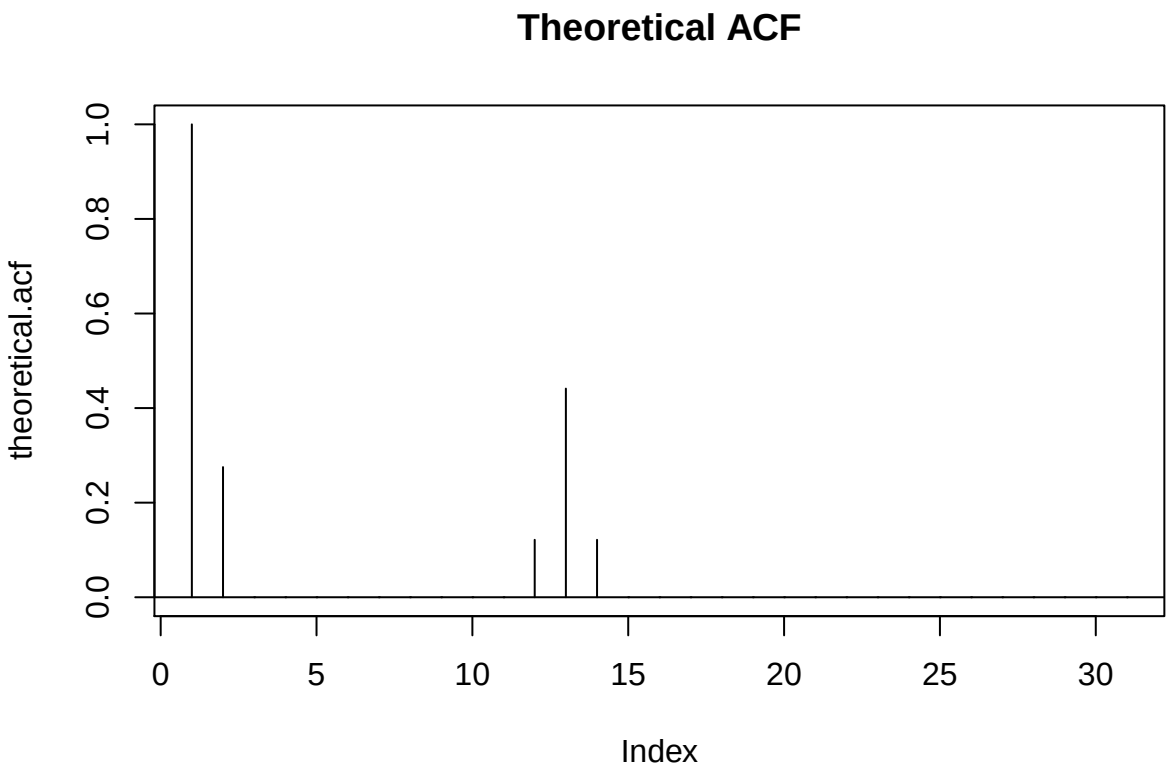
Yes, the theoretical value for

$$\phi_2$$

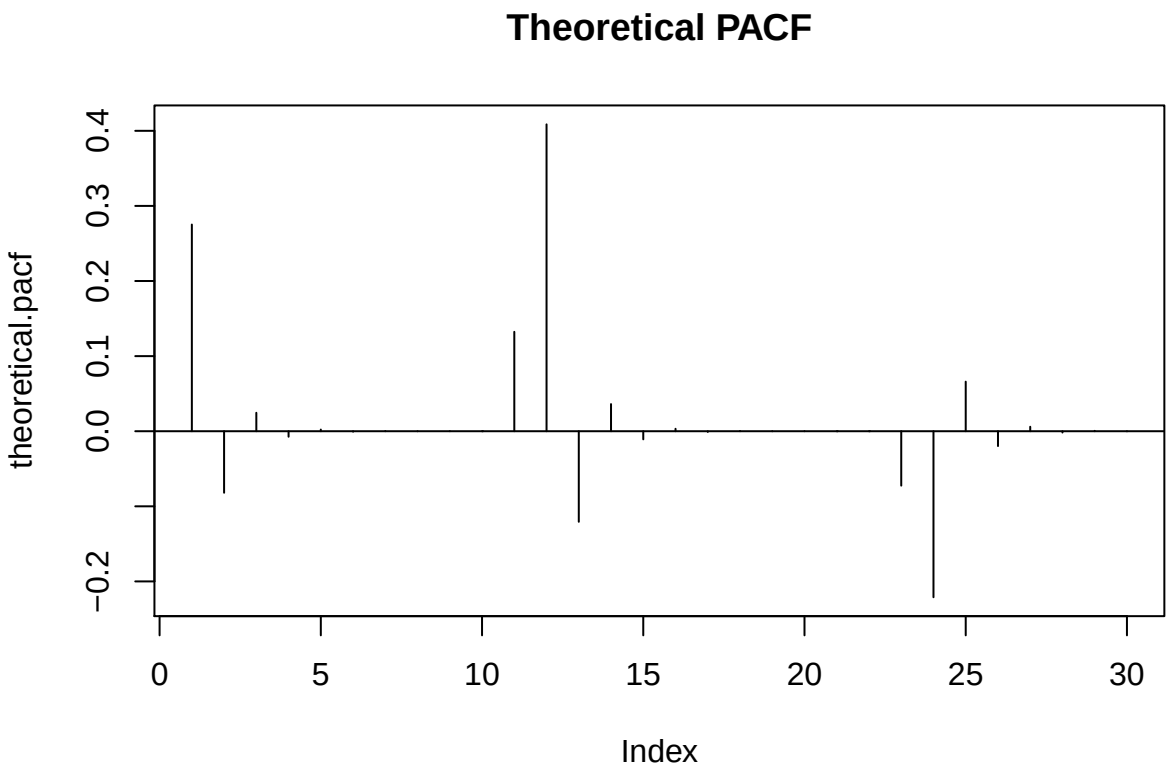
is inside the confidence-intervall for the ML estimate.

c)

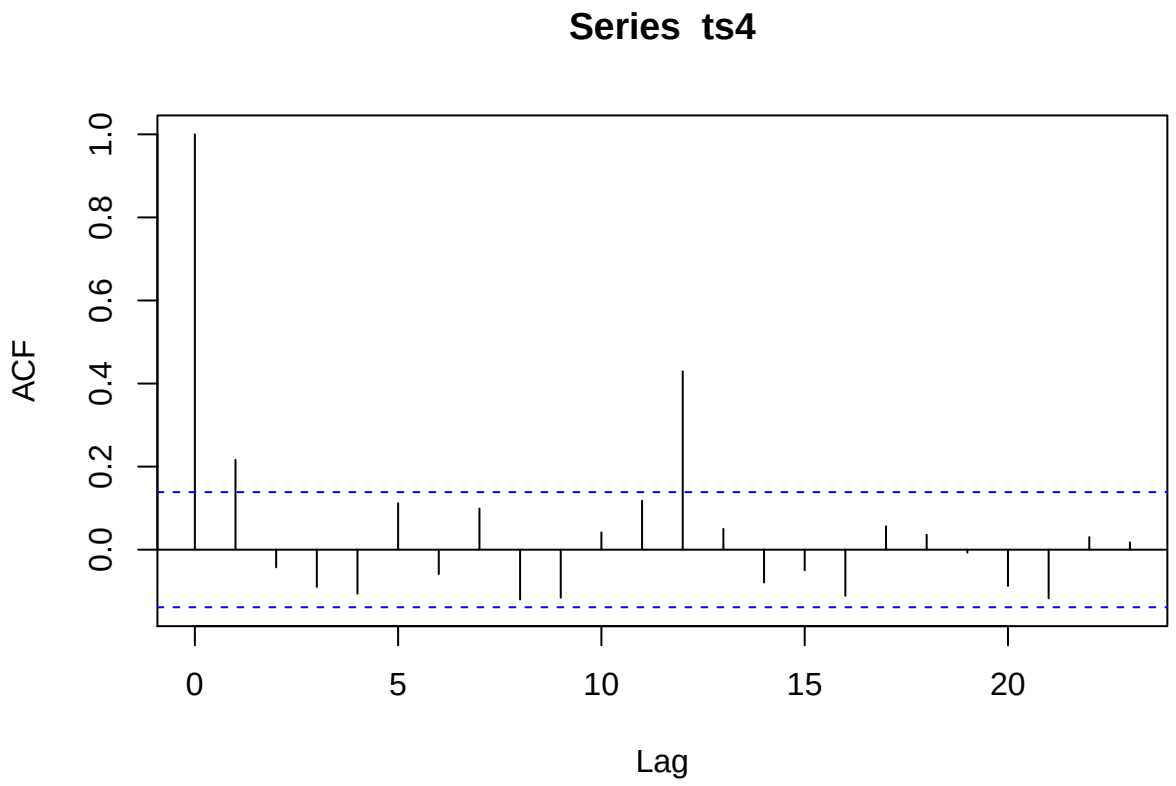
```
set.seed(12345)
ma.coef <- c(0.3, rep(0, 10), 0.6)
ts4 <- arima.sim(n=200, model=list(order=c(0, 0, 12), ma = ma.coef))

theoretical.acf <- ARMAacf(ma=c(ma.coef, 0.3 * 0.6), lag.max=30)
theoretical.pacf <- ARMAacf(ma=c(ma.coef, 0.3 * 0.6), lag.max=30, pacf=TRUE)

plot(theoretical.acf, type="h", main="Theoretical ACF")
abline(h=0)
```



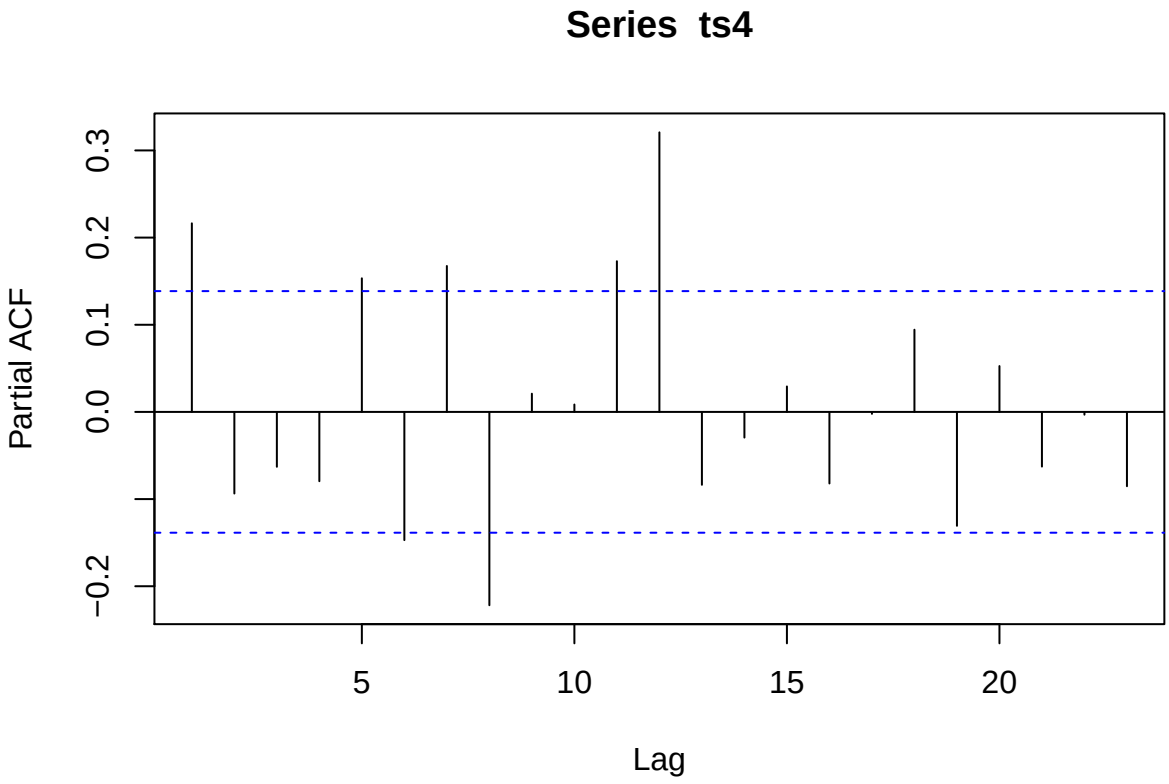

```
plot(theoretical.pacf, type="h", main="Theoretical PACF")
abline(h=0)
```




```
empirical.acf <- acf(ts4)
```

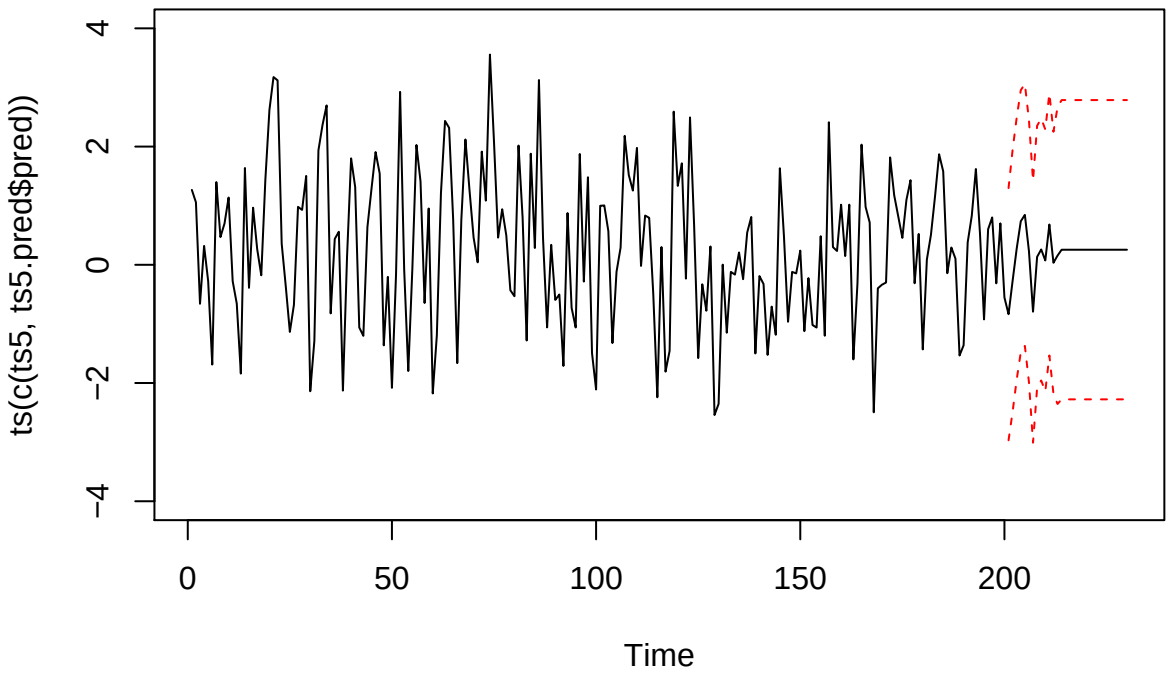



```
empirical.pacf <- pacf(ts4)
```



d)

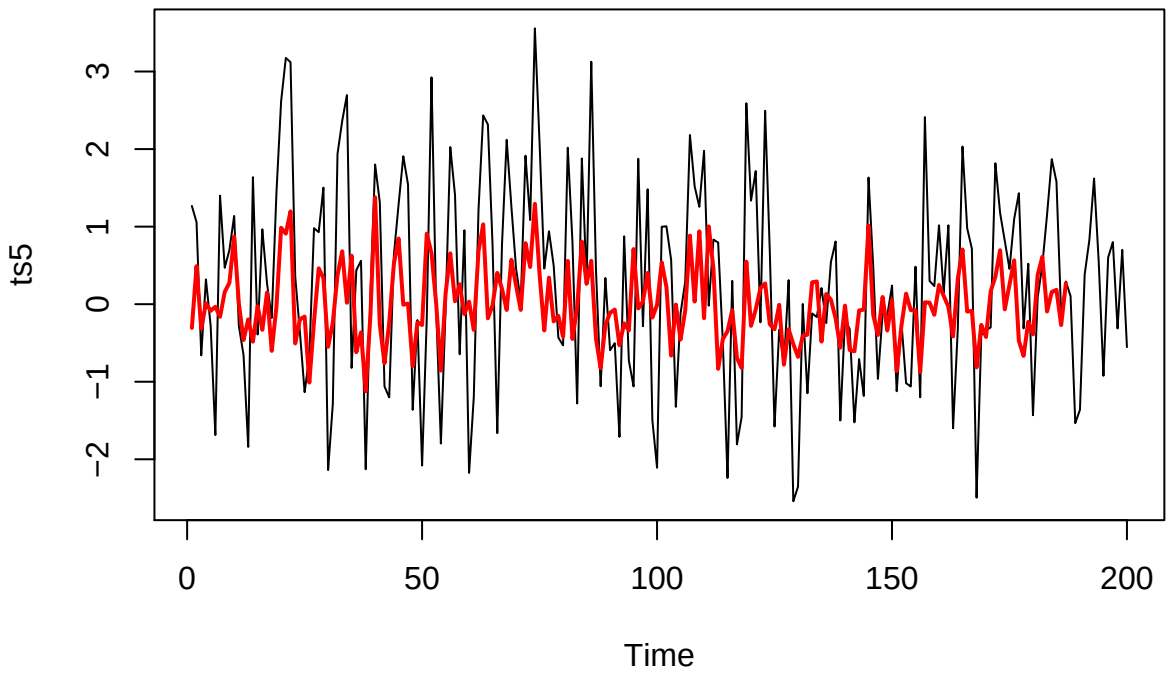
```
set.seed(12345)
ma.coef <- c(0.3, rep(0, 10), 0.6)
ts5 <- arima.sim(n=200, model=list(order=c(0, 0, 12), ma = ma.coef))


ts5.fit <- arima(ts5, order=c(0, 0, 1), seasonal=list(order=c(0, 0, 1), period=12))
ts5.pred <- predict(ts5.fit, n.ahead=30, se.fit=TRUE)

plot(ts(c(ts5, ts5.pred$pred)), ylim=c(-4, 4))
lines(200 + 1:length(ts5.pred$pred), ts5.pred$pred + 1.96 * ts5.pred$se, lty=2, col="red")
lines(200 + 1:length(ts5.pred$pred), ts5.pred$pred - 1.96 * ts5.pred$se, lty=2, col="red")
```




```
gausspr.data <- ts.intersect(x=ts5, x1=lag(ts5, 1), x12=lag(ts5, 12), x13=lag(ts5, 13))
gausspr.fit <- gausspr(x ~ ., gausspr.data)
```

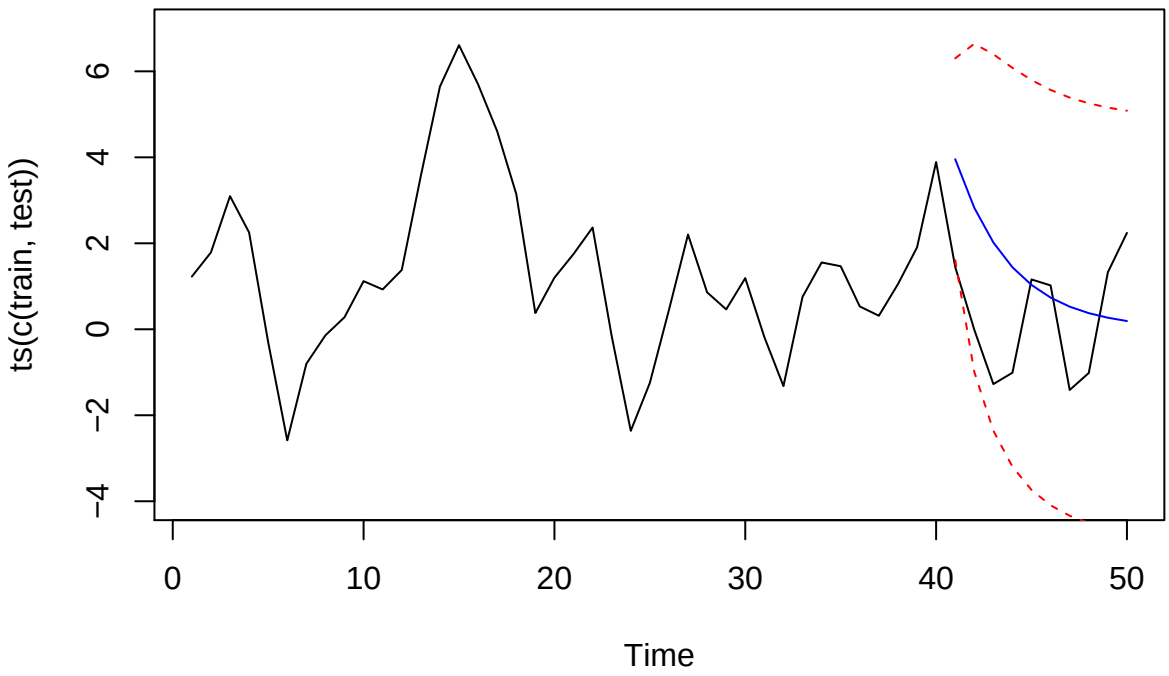
```
## Using automatic sigma estimation (sigest) for RBF or laplace kernel
```

```
plot(ts5)
lines(fitted(gausspr.fit), col="red", lwd=2)
```



e)

```
set.seed(12345)
ts6 <- arima.sim(model=list(ma=c(0.5), ar=c(0.7)), n=50)

train <- ts(ts6[1:40])
test <- ts(ts6[41:50])

ts6.fit <- arima(train, order=c(1, 0, 1), include.mean = F)
ts6.pred <- predict(ts6.fit, n.ahead=10)

plot(ts(c(train, test)), ylim=c(-4, 7))
lines(40 + 1:length(test), ts6.pred$pred, col="blue")
lines(40 + 1:length(test), ts6.pred$pred + 1.96 * ts6.pred$se, lty=2, col="red")
lines(40 + 1:length(test), ts6.pred$pred - 1.96 * ts6.pred$se, lty=2, col="red")
```


ts(c(train, test))
6
4
2
0
−2
−4
0
10
20
30
40
50
Time