Time Series Analysis: 5th laboratory

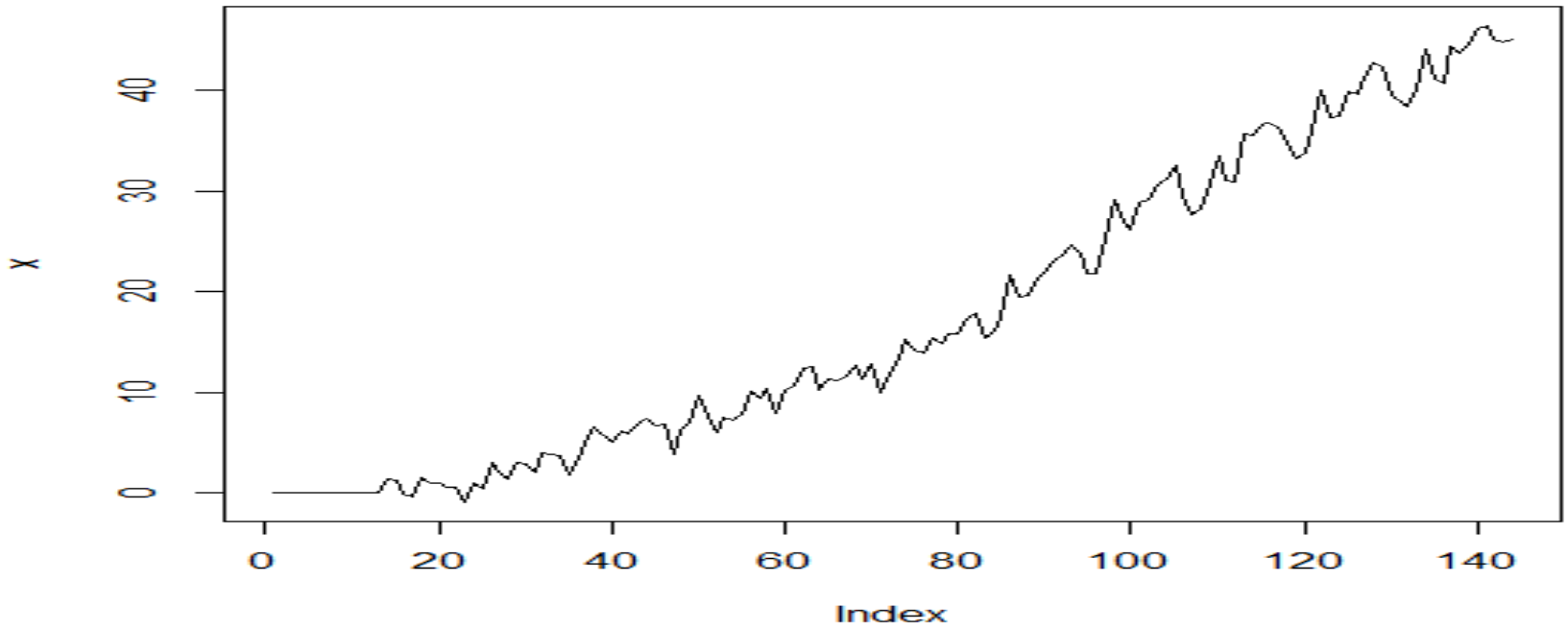
March 2019

Laboratory contents.

- Simulation of SARIMA(p,d,q)(P,D,Q) models.
- Simulation and prediction of white noise.
- Simulation and prediction of random walk with and without drift.
- Simulation and prediction of AR(1).
- Performance of one-step ahead for AR(1).
- Prediction of Lynx series.
- Prediction of MA(1).
- Prediction of MA(5).
- Prediction of ARMA(1,5).

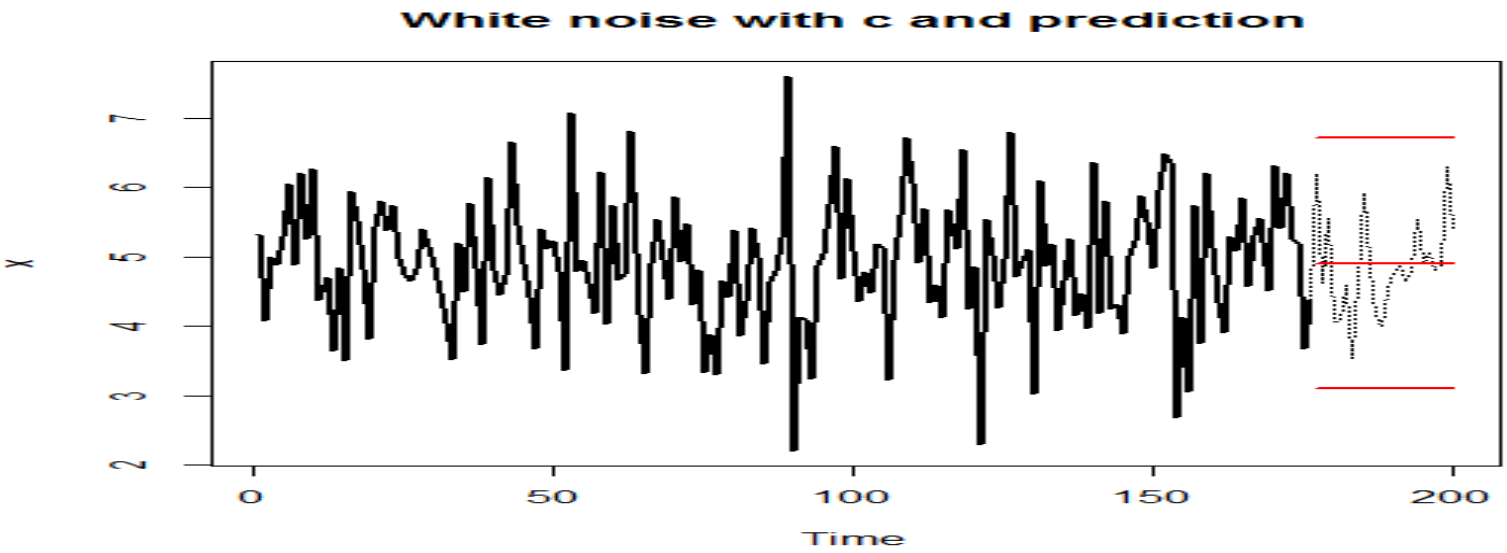
Simulation of SARIMA(p,d,q)(P,D,Q).

```
install.packages("sarima")
library(sarima)
x<-sim_sarima(n=144,model=list(ma=-0.36,sma=-0.48,iorder=1,siorder=1,nseasons=1))
```



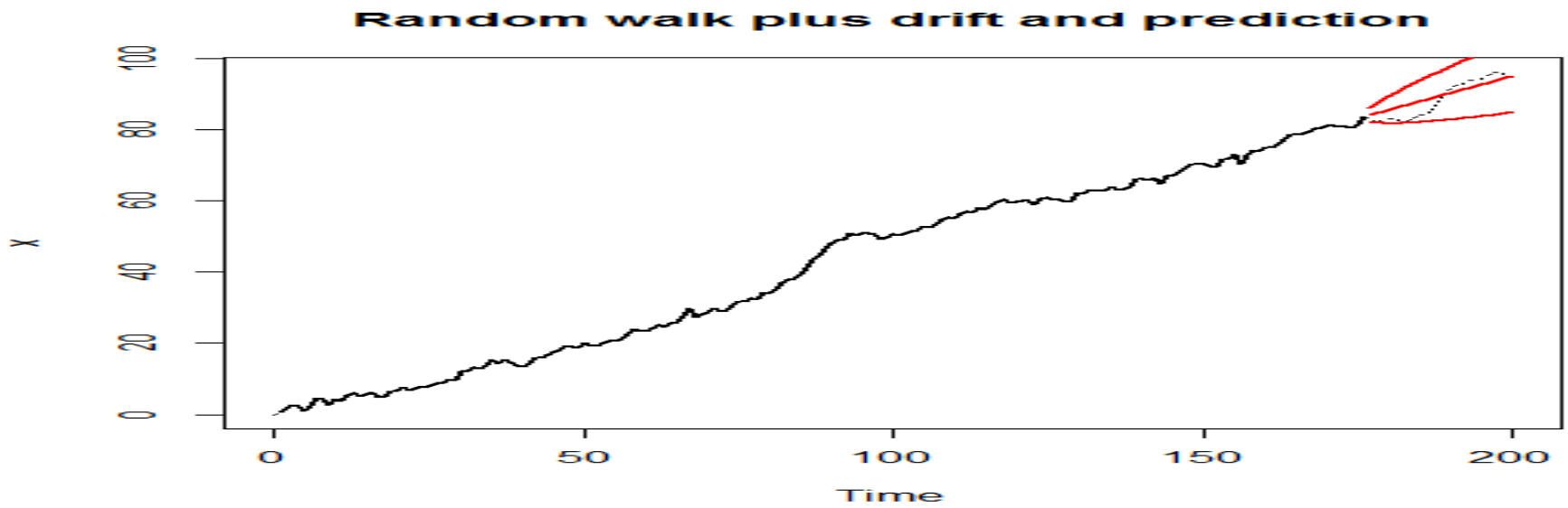
Simulation and prediction of white noise.

```
#Simulates a white noise plus constant
x=rnorm(200)+5
bt<-window(x,1,176)
fit<-ar.burg(bt)
forecast<-predict(fit,n.ahead=24)
ts.plot(x,lty=3, main="White noise with c and prediction")
lines(bt,lwd=2)
lines(forecast$pred,lwd=2,col="red")
lines(forecast$pred+forecast$se*1.96,lwd=2,col="red")
lines(forecast$pred-forecast$se*1.96,lwd=2,col="red")
```



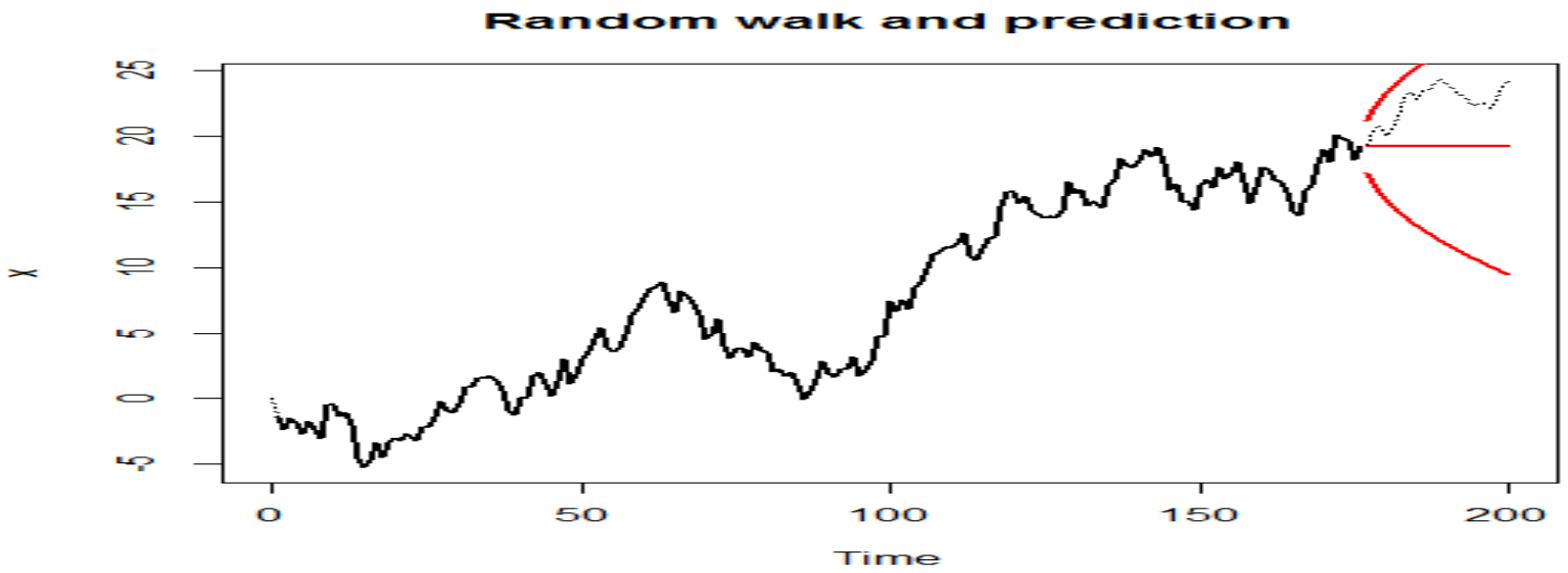
Simulation and prediction of random walk plus drift.

```
#Simulates random walk plus drift (needs library(forecast))
x=arima.sim(list(order=c(0,1,0)),mean=0.5,200)
bt<-window(x,1,176)
predz<-rwf(bt,h=24,drift=TRUE,level=95)
ts.plot(x,lty=3, main="Random walk plus drift and prediction")
lines(bt,lwd=2)
lines(predz$mean,lwd=2,col="red")
lines(predz$lower,lwd=2,col="red")
lines(predz$upper,lwd=2,col="red")
```



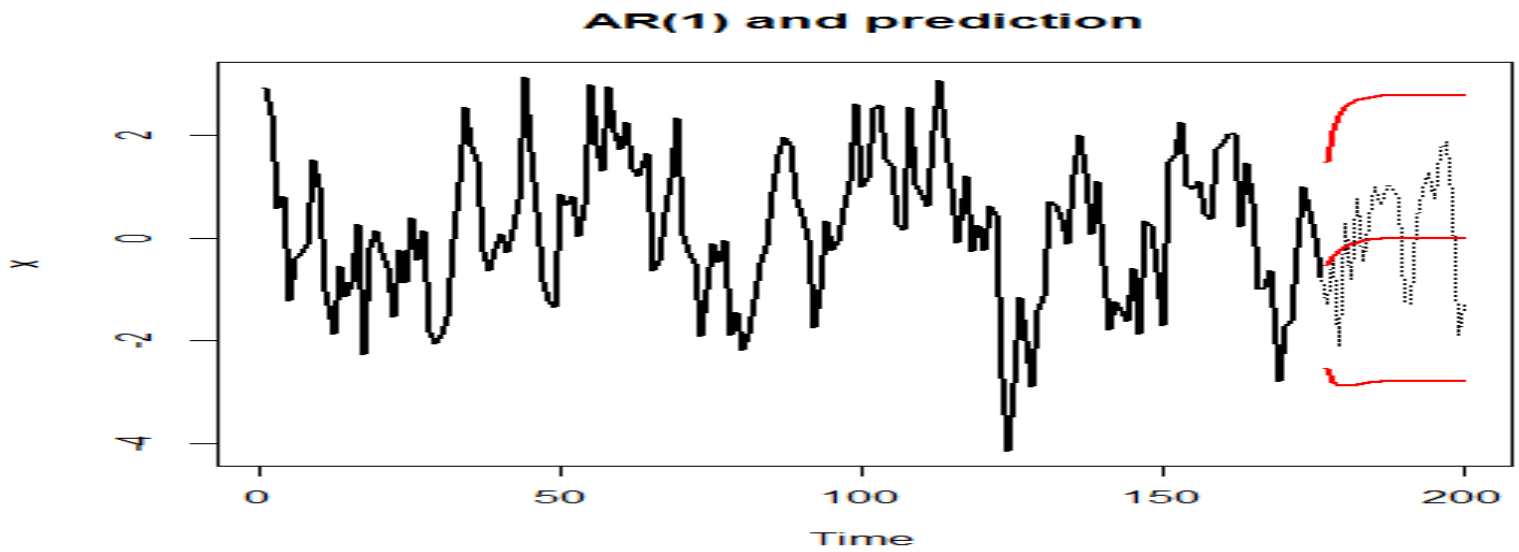
Simulation and prediction of random walk.

```
#Simulates random walk
x=arima.sim(list(order=c(0,1,0)),200)
bt<-window(x,1,176)
fit<-arima(bt,order=c(0,1,0),include.mean=TRUE)
forecast<-predict(fit,n.ahead=24)
ts.plot(x,lty=3, main="Random walk and prediction")
lines(bt,lwd=2)
lines(forecast$pred,lwd=2,col="red")
lines(forecast$pred+forecast$se*1.96,lwd=2,col="red")
lines(forecast$pred-forecast$se*1.96,lwd=2,col="red")
```



Simulation and prediction of AR(1).

```
#Simulates ar(1)
x=arima.sim(list(order=c(1,0,0), ar=0.7),200)
bt<-window(x,1,176)
fit<-arima(bt,order=c(1,0,0),include.mean=FALSE)
forecast<-predict(fit,n.ahead=24)
ts.plot(x,lty=3, main="AR(1) and prediction")
lines(bt,lwd=2)
lines(forecast$pred,lwd=2,col="red")
lines(forecast$pred+forecast$se*1.96,lwd=2,col="red")
lines(forecast$pred-forecast$se*1.96,lwd=2,col="red")
```



Performance of one-step ahead for AR(1).

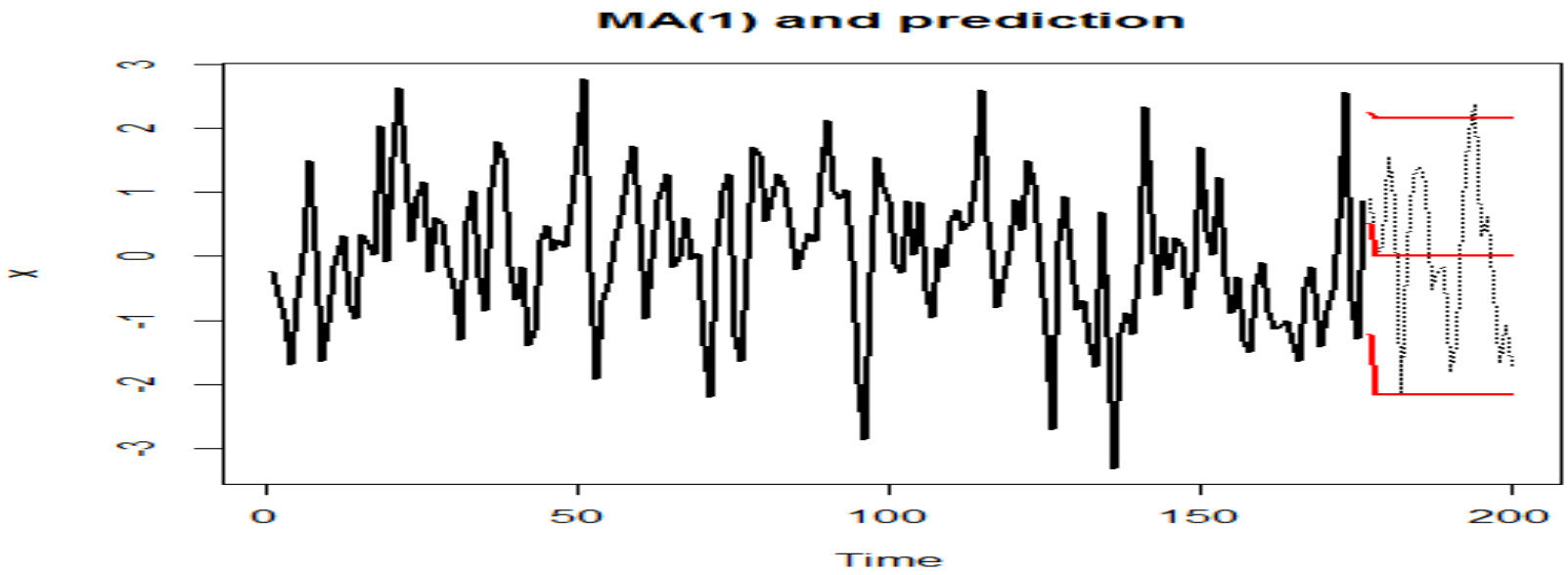
```
#Simulates ar(1)
I=numeric(2000)
for (i in 1:2000){
x=arima.sim(list(order=c(1,0,0), ar=0.2),50)
bt<-window(x,1,49)
fit<-arima(bt,order=c(1,0,0),include.mean=FALSE)
forecast<-predict(fit,n.ahead=1)
if (x[50]<forecast$pred-forecast$se*1.96){
I[i]=1}

if (x[50]>forecast$pred+forecast$se*1.96){
I[i]=1}

}
errorI=sum(I)/2000
confidence=1-errorI
```

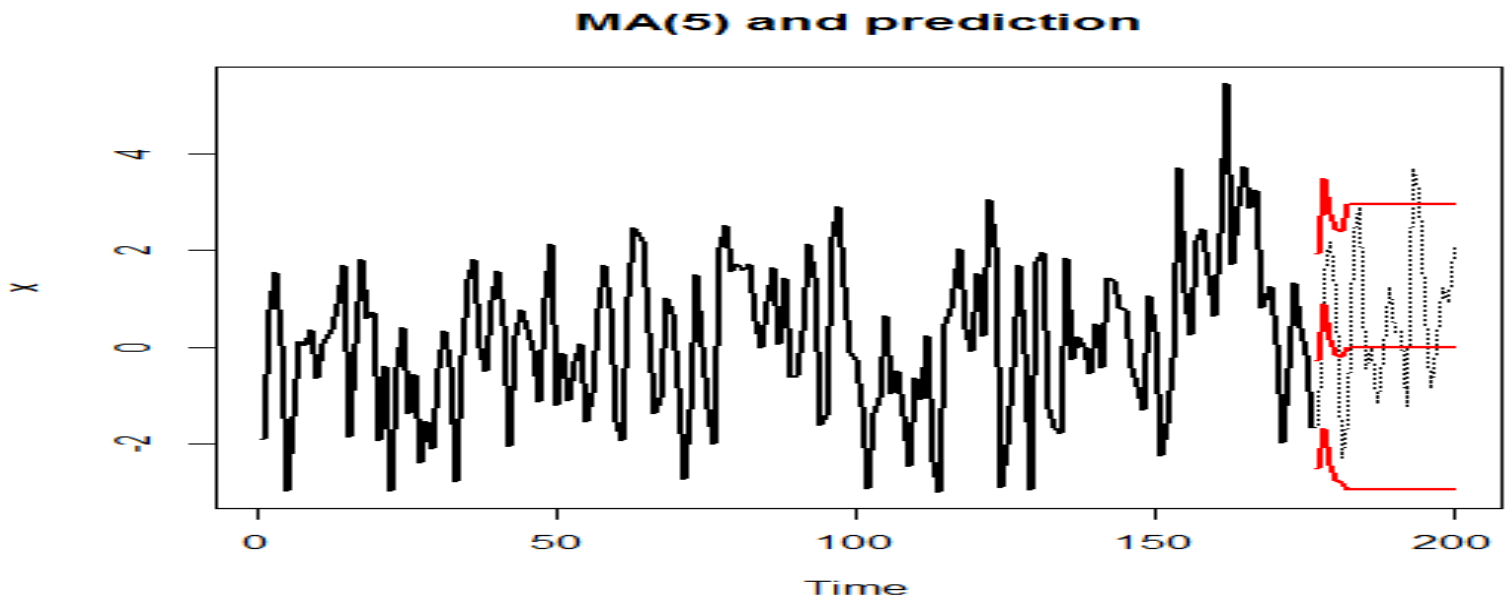
Prediction for MA(1).

```
#Simulates ma(1)
x=arima.sim(list(order=c(0,0,1), ma=0.7),200)
bt<-window(x,1,176)
fit<-arima(bt,order=c(0,0,1),include.mean=FALSE)
forecast<-predict(fit,n.ahead=24)
ts.plot(x,lty=3, main="MA(1) and prediction")
lines(bt,lwd=2)
lines(forecast$pred,lwd=2,col="red")
lines(forecast$pred+forecast$se*1.96,lwd=2,col="red")
lines(forecast$pred-forecast$se*1.96,lwd=2,col="red")
```



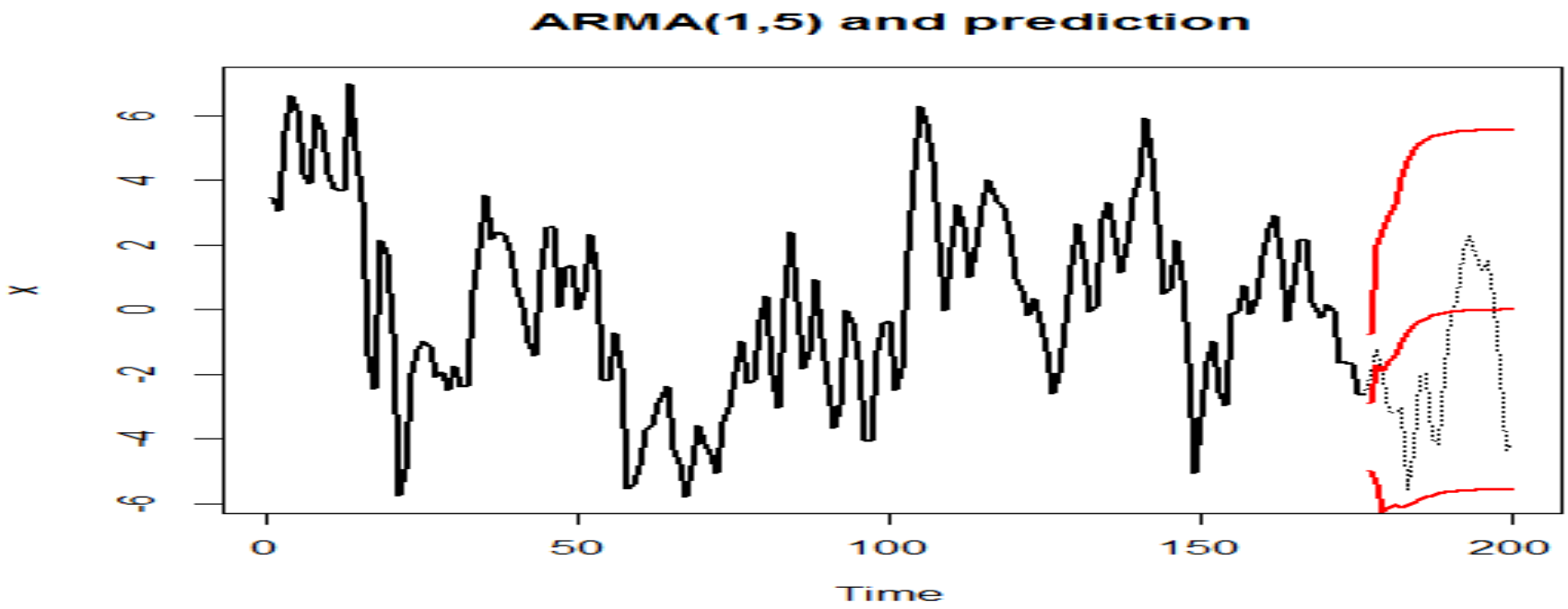
Prediction for MA(5).

```
#simulates ma(5)
x=arima.sim(list(ma=c(0.7,0.2,-0.3,-0.1,0.8)),200)
bt<-window(x,1,176)
fit<-arima(bt,order=c(0,0,5),include.mean=FALSE)
forecast<-predict(fit,n.ahead=24)
ts.plot(x,lty=3, main="MA(5) and prediction")
lines(bt,lwd=2)
lines(forecast$pred,lwd=2,col="red")
lines(forecast$pred+forecast$se*1.96,lwd=2,col="red")
lines(forecast$pred-forecast$se*1.96,lwd=2,col="red")
```



Prediction for ARMA(1,5).

```
#Simulates arma(1,5)
x=arima.sim(list(ar=0.7,ma=c(0.7,0.2,-0.3,-0.1,0.8)),200)
bt<-window(x,1,176)
fit<-arima(bt,order=c(1,0,5),include.mean=FALSE)
forecast<-predict(fit,n.ahead=24)
ts.plot(x,lty=3, main="ARMA(1,5) and prediction")
lines(bt,lwd=2)
lines(forecast$pred,lwd=2,col="red")
lines(forecast$pred+forecast$se*1.96,lwd=2,col="red")
lines(forecast$pred-forecast$se*1.96,lwd=2,col="red")
```



Next week assignment

- Check and discuss through simulation the performance of one-step ahead and k-step ahead forecast of AR(p) and MA(q) processes.