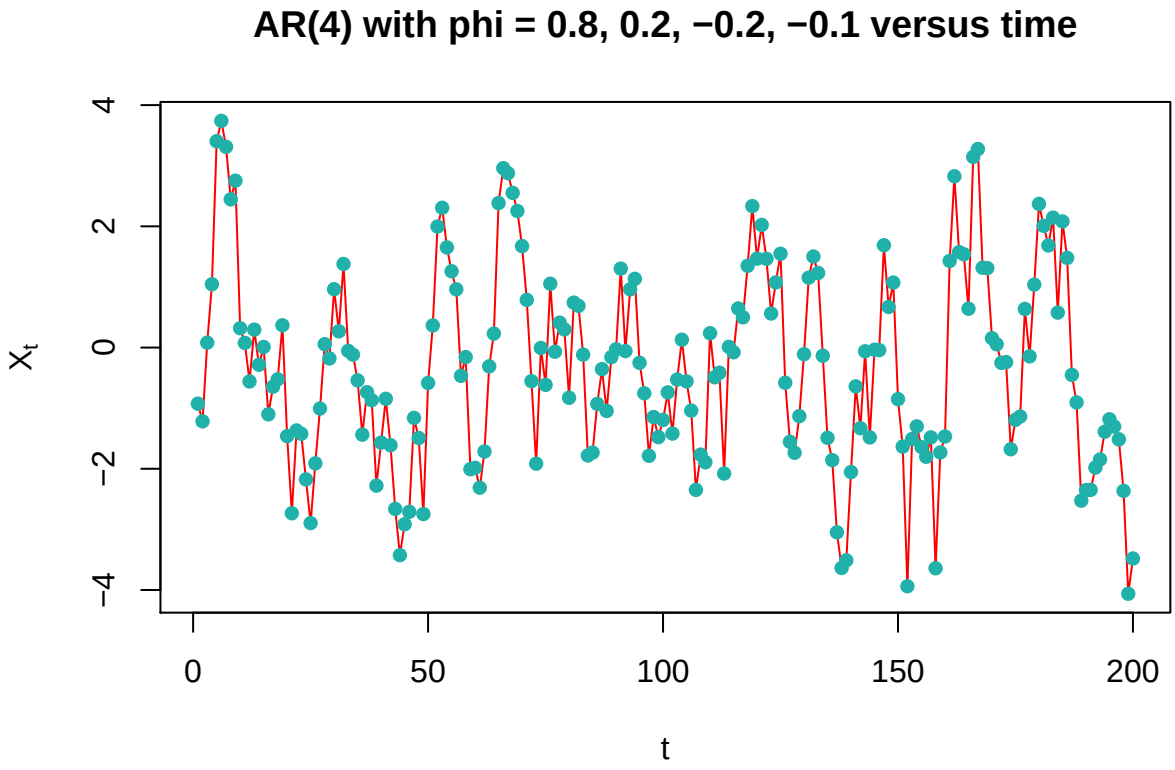
Prediction

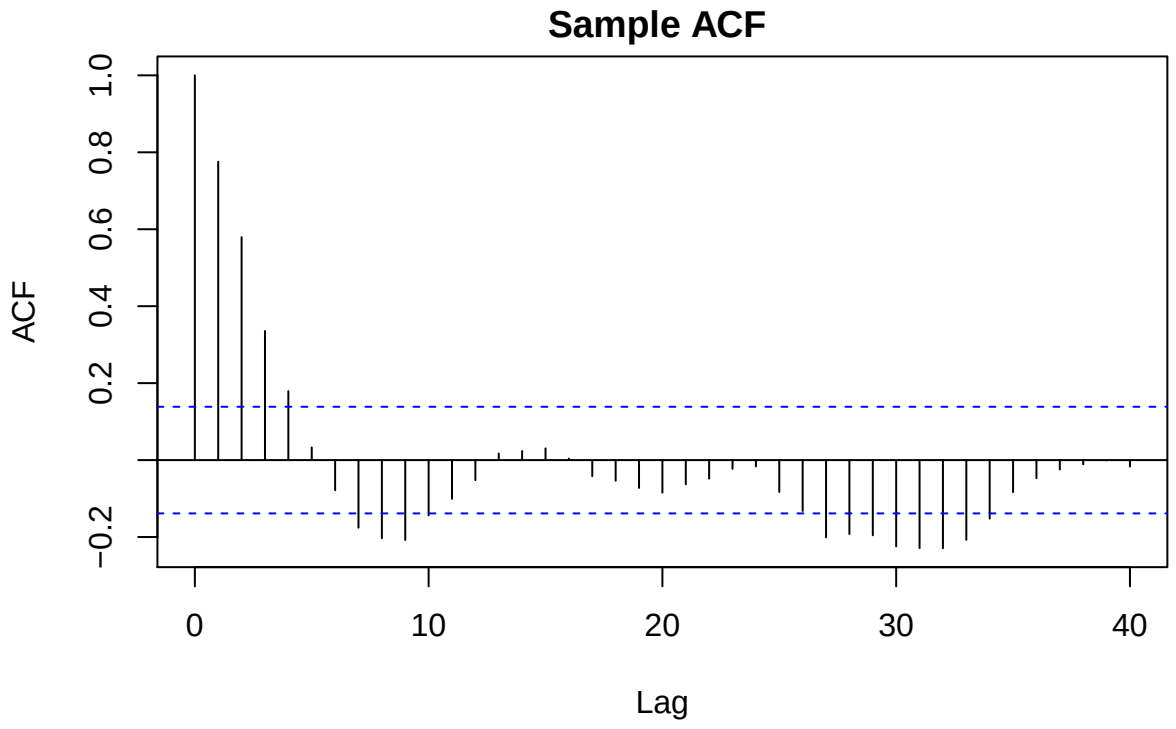
(a)

```
set.seed(485)
y = arima.sim(model = list(order = c(4, 0, 0),
                           ar = c(0.8, 0.2, -0.2, -0.1)),
              n = 200,
              rand.gen = rnorm,
              sd = 1)
plot.ts(y,
        col = "red",
        type = "l",
        main = "AR(4) with phi = 0.8, 0.2, -0.2, -0.1 versus time",
        xlab = "t",
        ylab = expression(X[t]))
points(y,
       pch = 16, col = "lightseagreen",)
```



(b)

```
AR.acf = acf(y, lag.max = 40, plot = F)
plot(AR.acf, main = "")
title( "Sample ACF ",line=0.5)
```



We observed many values of $\hat{\rho}$ fall outside the horizontal dash line, so we have evidence against the null hypothesis that ρ is 0. In other words, there are significant linear dependencies lags greater than 1.

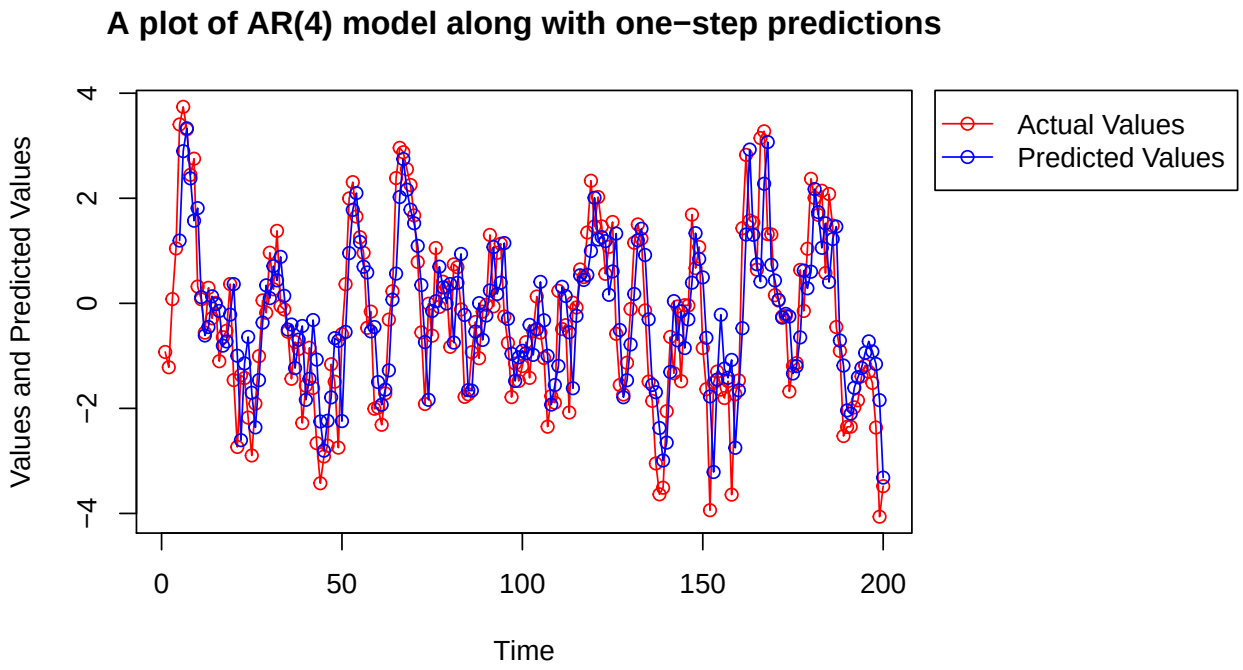
(c)

```
est = arima(y, order = c(4,0,0))
est$coef
```

```
##         ar1         ar2         ar3         ar4   intercept
##  0.81652737  0.17047421 -0.29261383  0.03104885 -0.34272145
```

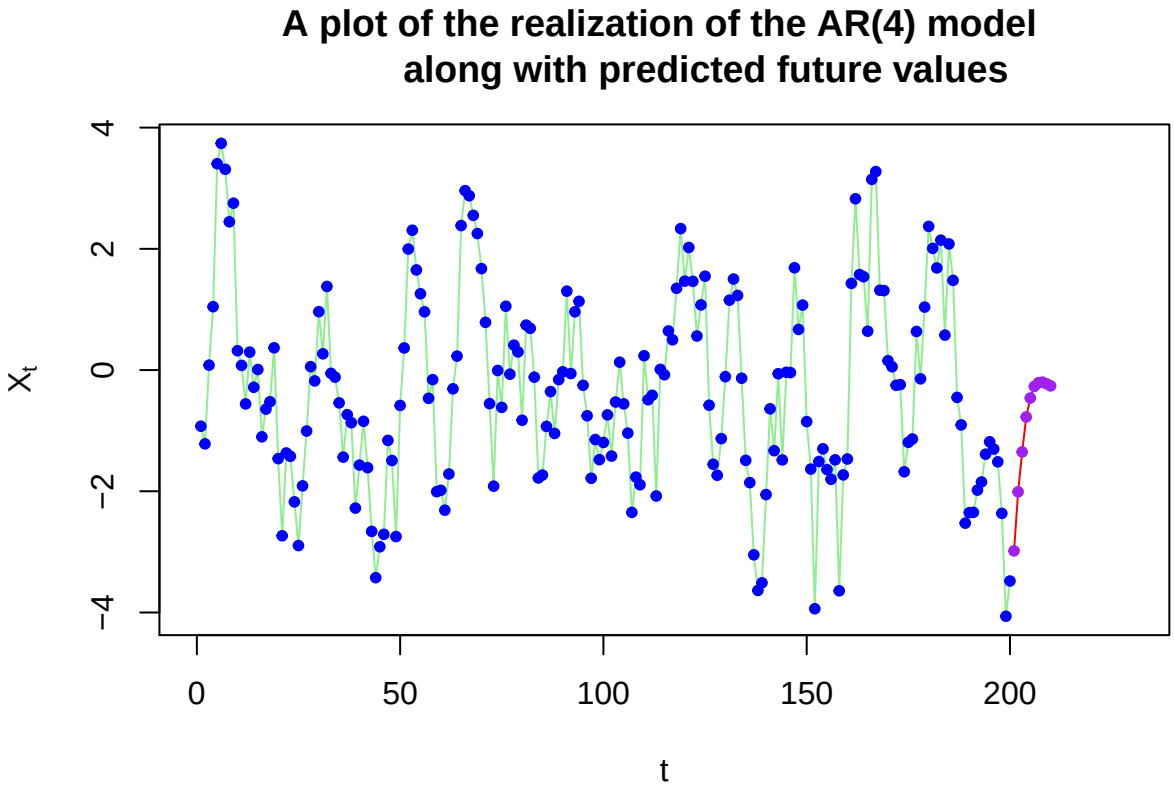
```
predy = vector("numeric", 200)
predy[1:4] = NA
for(t in 5:200){
  predy[t] = est$coef[1]*y[t-1] + est$coef[2]*y[t-2] +
    est$coef[3]*y[t-3] + est$coef[4]*y[t-4]
}
```

```
par(mar=c(5.1, 4.1, 4.1, 10.1), xpd=TRUE)
plot(y, type = 'o', col = 'red',
     ylab = 'Values and Predicted Values',
     main = 'A plot of AR(4) model along with one-step predictions')
lines(predy, type = 'o', col = 'blue')
legend(x = 'topright', inset=c(-0.42,0), col = c('red','blue'),
       lty = c(1,1), pch = c(1,1), c('Actual Values','Predicted Values'))
```



(d)

```
AR.pred = predict(est, n.ahead = 10)
plot.ts(y,
        xlim = c(0,230),
        col = "lightgreen",
        type = "l",
        main = "A plot of the realization of the AR(4) model
        along with predicted future values",
        xlab = "t",
        ylab = expression(X[t]))
points(y,
       pch = 20, col = "blue",)
lines(AR.pred$pred, col = 'red')
points(AR.pred$pred,
       pch = 20, col = 'purple')
```


A plot of the realization of the AR(4) model
along with predicted future values
X_t
4
2
0
−2
−4
0
50
100
150
200
t