STAT 443: Lab 5

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Question 1

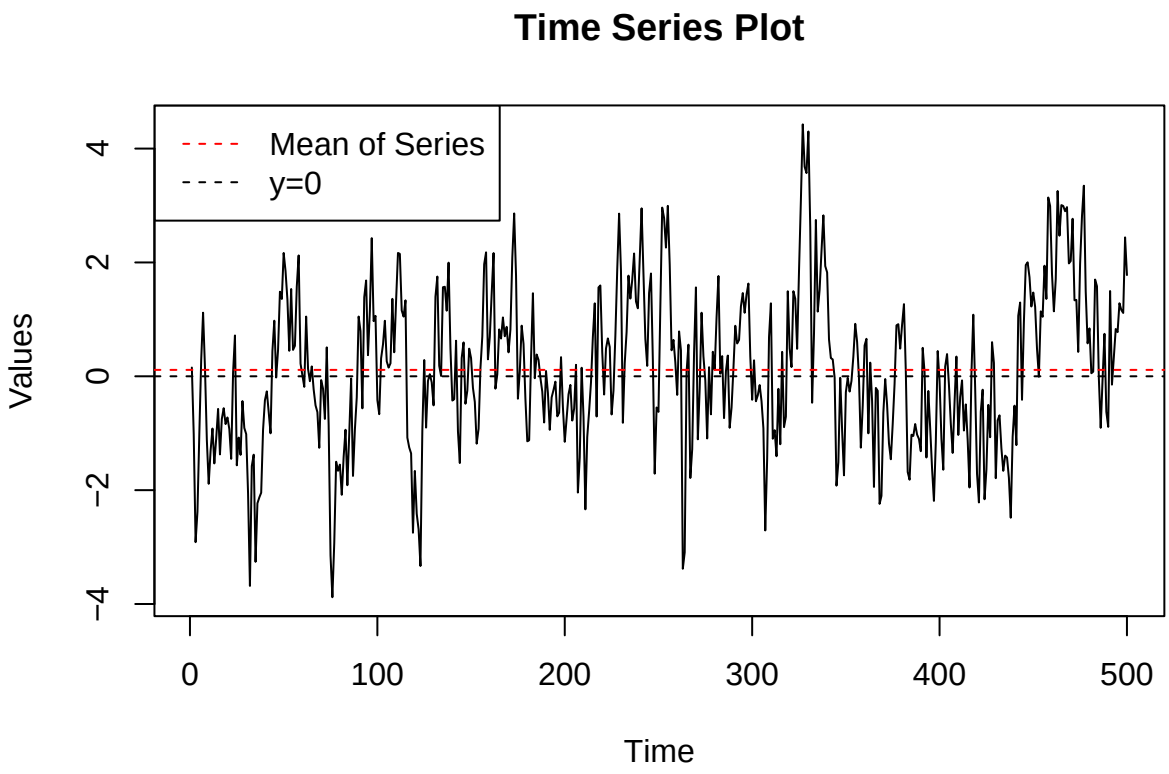
The process defined in the equation is an AR process of order 3.

Question 2

To recognize this process based on an observed time series, we can look at the ACF and PACF of the data. If it is an AR process, the ACF will resemble a dampened sine wave. To determine the order of the AR process, we can look at the generated PACF, which will cut off at lag 3.

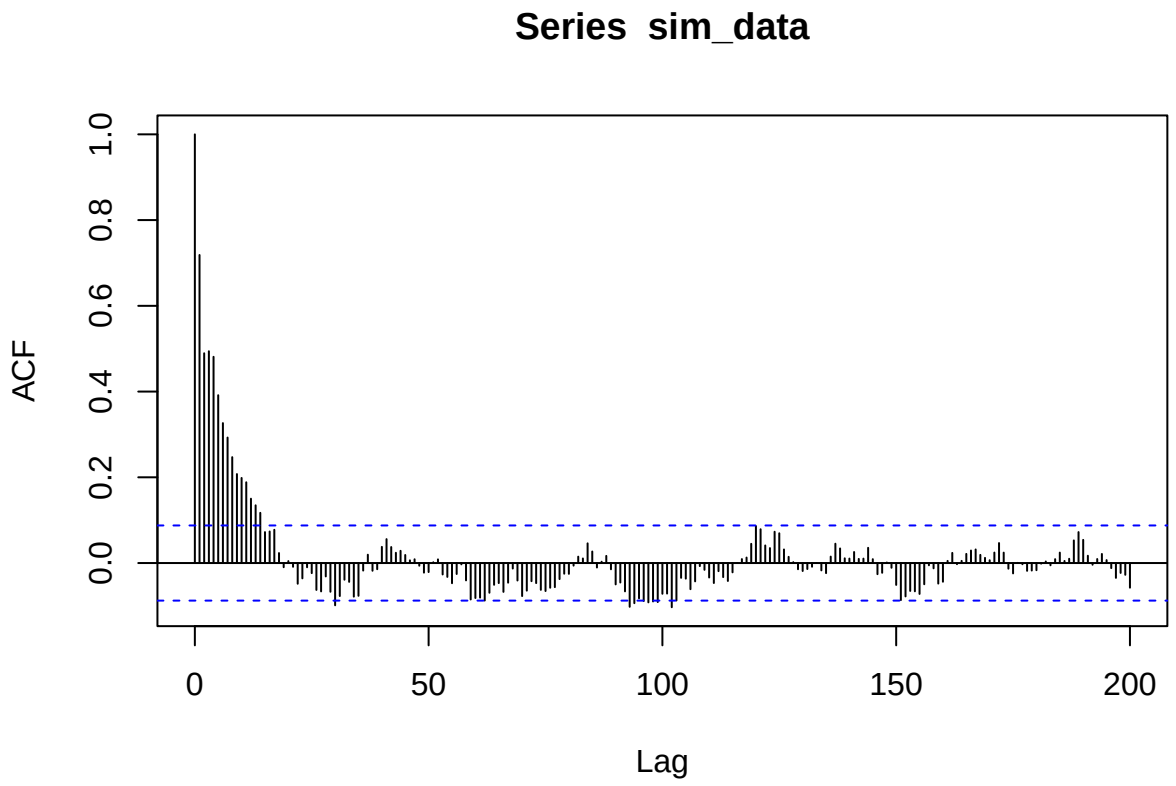
Question 3

```
set.seed(123456)
sim_data <- arima.sim(n = 500, list(ar = c(0.8, (-.3333), 0.6/sqrt(3))), sd = sqrt(0.8))
plot(sim_data, xlab = "Time", ylab = "Values", main = "Time Series Plot")
abline(h = mean(sim_data), col = c("red"), lty = 2)
abline(h = 0, lty= 2)
legend("topleft",legend=c("Mean of Series","y=0"), lty=c(2,2) ,col=c("red",1))
```



Question 4

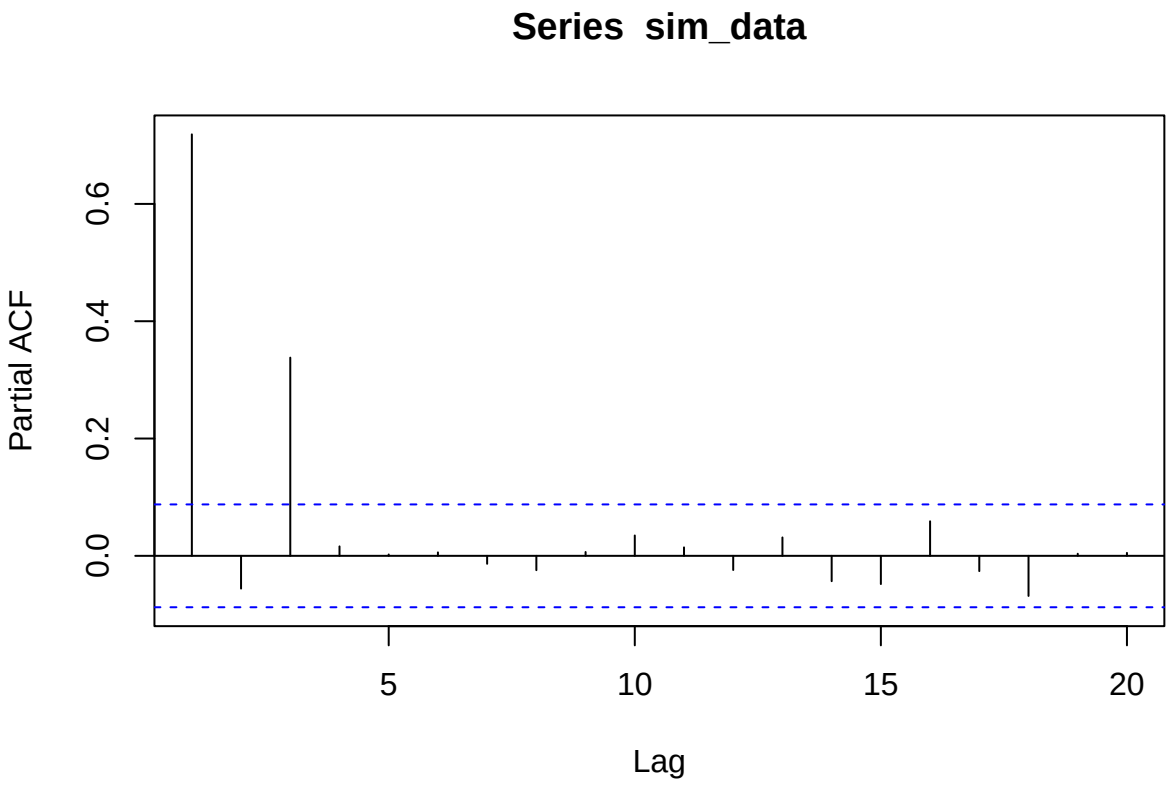
```
acf(sim_data, lag.max = 200)
```



The ACF resembles a dampened sinusoidal wave, which is exactly what we would expect given the equation.

Question 5

```
pacf(sim_data, lag.max = 20)
```



The PACF is non-significant at lags after 3, which means it cuts off at lag 3. This is what we would expect given the process defined by equation (1).

Question 6

```
arima(sim_data, order = c(3, 0, 0), include.mean = F)
```

```
##
## Call:
## arima(x = sim_data, order = c(3, 0, 0), include.mean = F)
##
## Coefficients:
##          ar1      ar2     ar3
##       0.7753  -0.3103  0.3424
## s.e.  0.0420   0.0528  0.0423
##
## sigma^2 estimated as 0.7947:  log likelihood = -652.59,  aic = 1313.18
```

We know that the series arises from a 0 mean, and so we should not include a mean in the fitting.

Question 7

```r
arima(sim_data, order = c(3, 0, 0), include.mean = F, method = c("CSS"))
```

```
##
## Call:
## arima(x = sim_data, order = c(3, 0, 0), include.mean = F, method = c("CSS"))
##
## Coefficients:
##          ar1      ar2     ar3
##       0.7728  -0.3056  0.3400
## s.e.  0.0418   0.0526  0.0419
##
## sigma^2 estimated as 0.7891:  log likelihood = -650.27,  aic = NA
```

The coefficient values here using the conditional sum-of-squares method are a little lower than the values obtained with the default method. We are not including a mean here as well as we know the series arises from a 0 mean.