STAT 443: Lab 5

Flora Zhang 52135365

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Question 1: The process in equation(1) is an AR process, of AR(3).

Question 2: To recognize this AR process, we can observe the properties to identify stationarity. The mean function, $E(X_t)$ should be constant, and the variance, $Var(X_t)$, should not depend on time. To determine the order, we can look at the acf and pacf graphs. The acf function for an AR process should gradually decay to zero, and the pacf should cut off at lag 3.

Notes: stationarity property of the process (weak stationarity) mean function E(X_t) variance function Var(X_t) is constant - doesn't depend on time - explain how it behaves

Determine order: (based on acf and pacf) - acf gradually decays to zero (correlation between Xt and Xt+h) - pacf cut off at lag 3 (cor(Xt, Xt+h) conditioned on middle numbers)
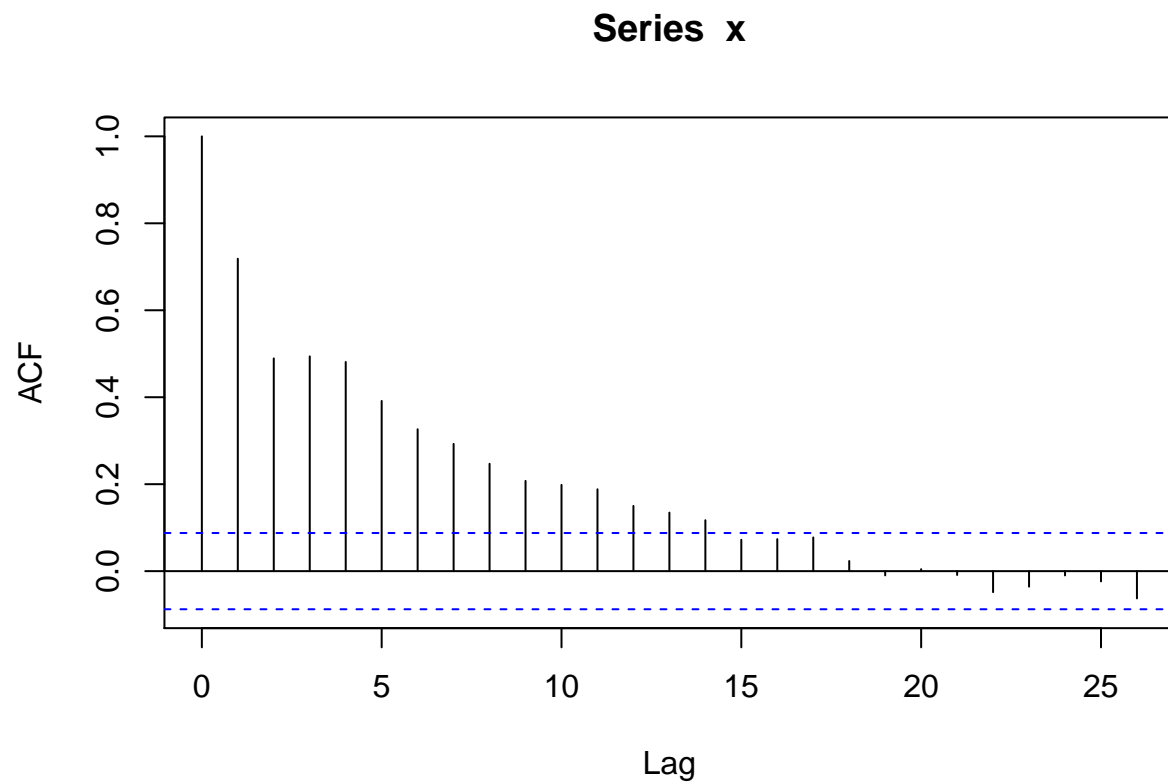
Question 3:

```
set.seed(123456)
x = arima.sim(n=500, list(ar=c(0.8, -1/3, 0.6/sqrt(3))), sd = sqrt(0.8))
plot(x, main="Simulated AR Process")
```

1

Simulated AR Process

Question 4:

```
acf(x)
```
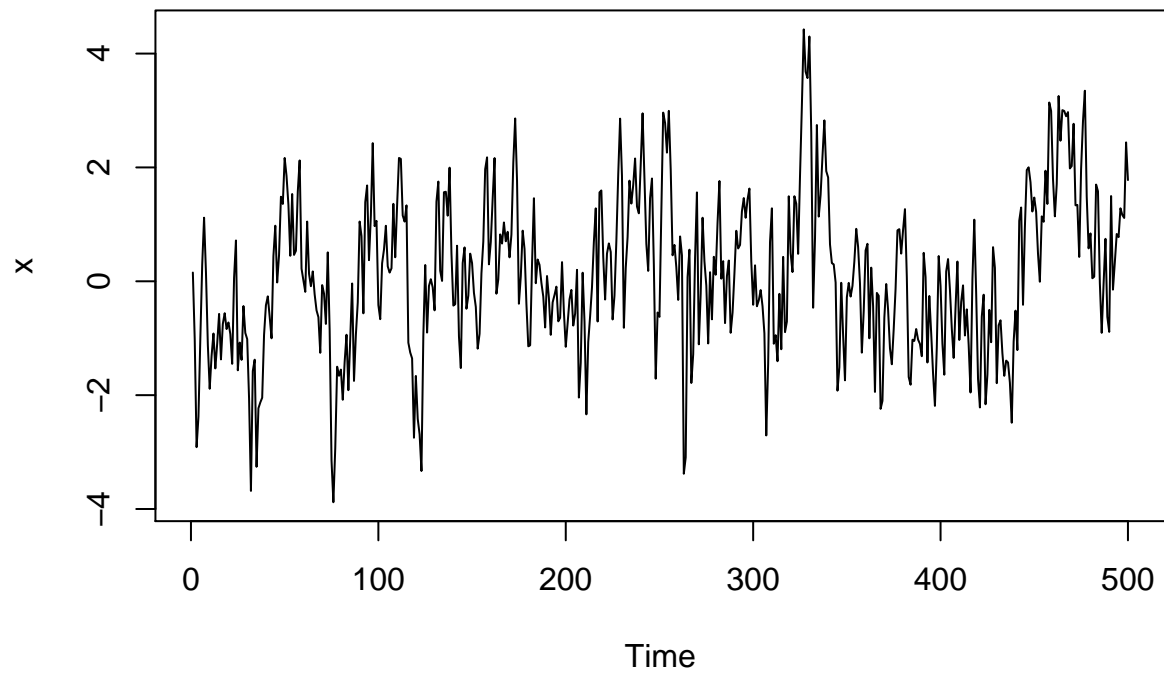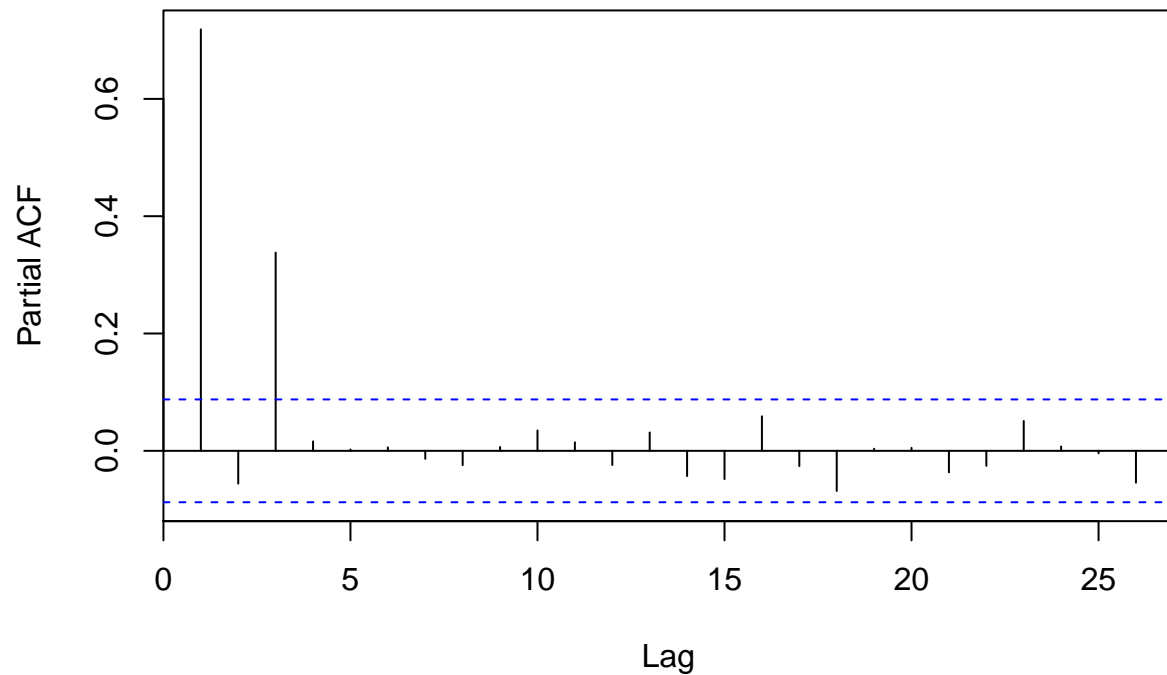
Series x

From this acf plot, we observe that the function gradually decreases to zero as lag increases.

Question 5:

```
pacf(x)
```

Series x

From this pacf plot, we observe that the function cuts off at lag 3, where the other lags are insignificant after lag 3.

Question 6:

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

```
##
## Call:
## arima(x = x, 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
```

The parameter estimates are: a1 = 0.7753, a2= -0.3103, a3= 0.3424

include.mean (set to T, determine if its true or f) - mean of zero: F - not mean of zero: T 4 parameters? (if mean is zero)

Question 7:

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

```
##
## Call:
## arima(x = x, order = c(3, 0, 0), include.mean = F, method = "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:  part log likelihood = -650.27
```

From modelling with Conditional Least Squares, we get parameter estimates: a1=0.7728, a2= -0.3056, a3=0.3400 The parameter estimates are very similar to those found in question 6, and theoretically should be the same.