Assignment 7

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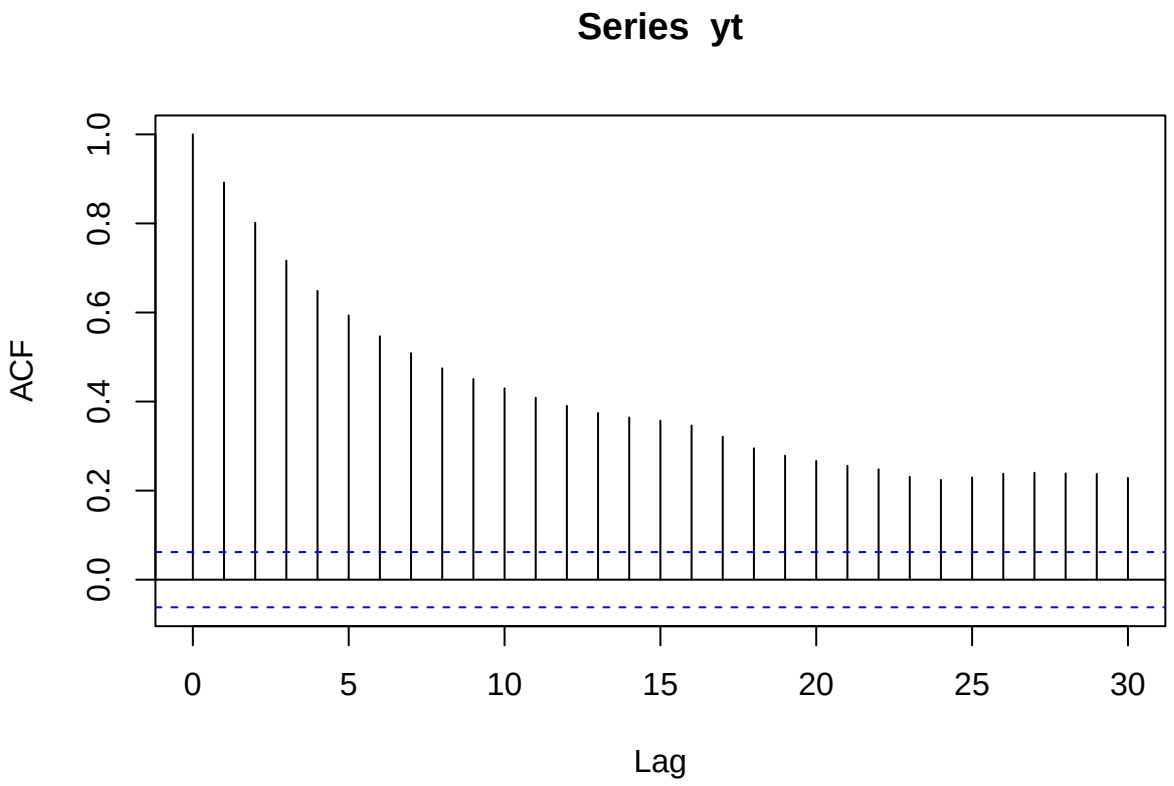
1. Simulate an AR(1) series with positive slope using the arima.sim function. Plot the ACF of the series. Comment on the ACF.

- The ACF exponentially decreases to 0 as the lag increases

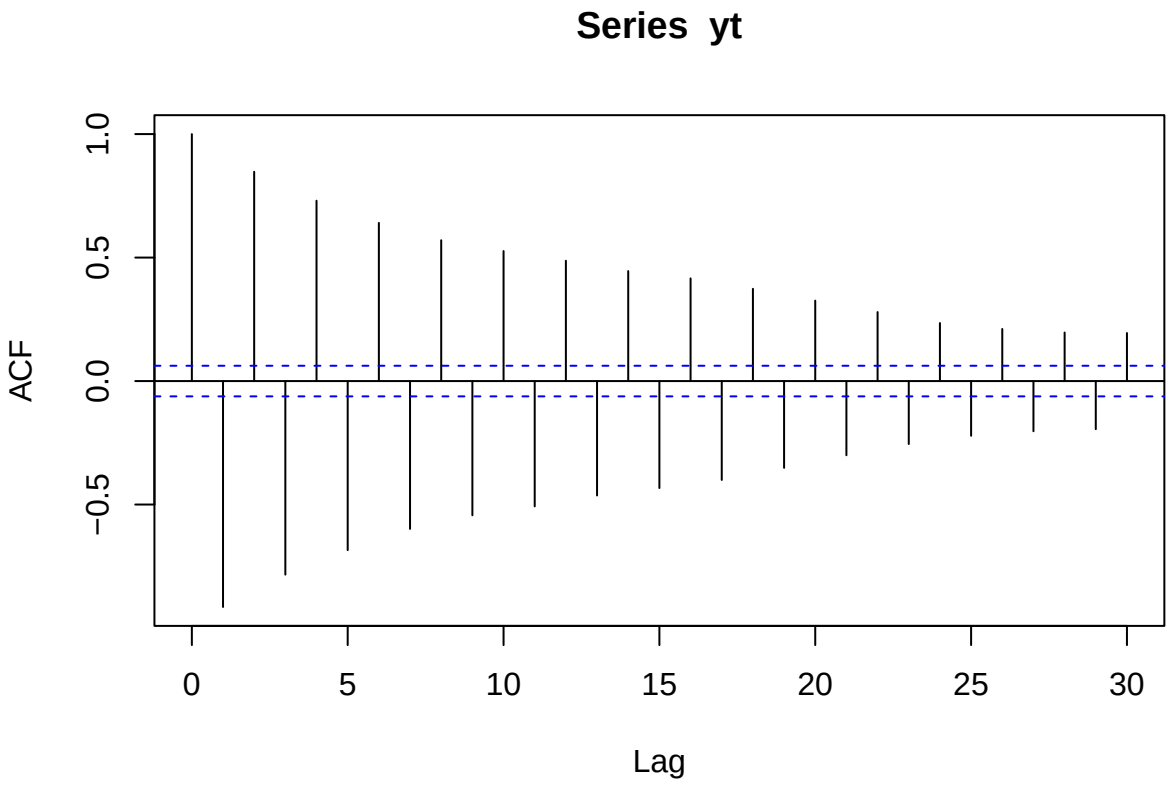
```
yt <- arima.sim(list(order=c(1,0,0), ar=c(.9)), n=1000)
b0 = 10
yt <- yt + b0
acf(yt)
```



2. Simulate an AR(1) series with negative slope using the arima.sim function. Plot the ACF of the series. Comment on the ACF.

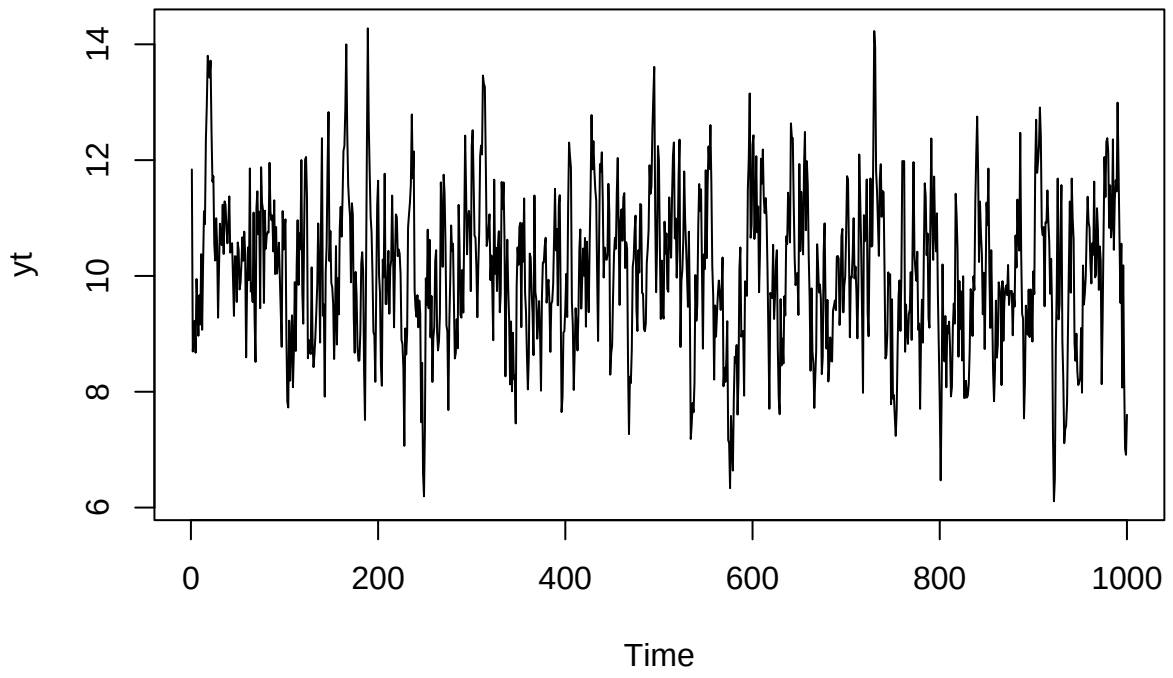
- The ACF exponentially decays to 0 as the lag increases, but the algebraic signs for the autocorrelations alternate between positive and negative

```
yt <- arima.sim(list(order=c(1,0,0), ar=c(-.9)), n=1000)
b0 = 10
yt <- yt + b0
acf(yt)
```



3. Simulate an AR(1) series. Use the arima function to estimate the coefficients of the series. Increase the length of the series to see if that improves the accuracy of the estimation.

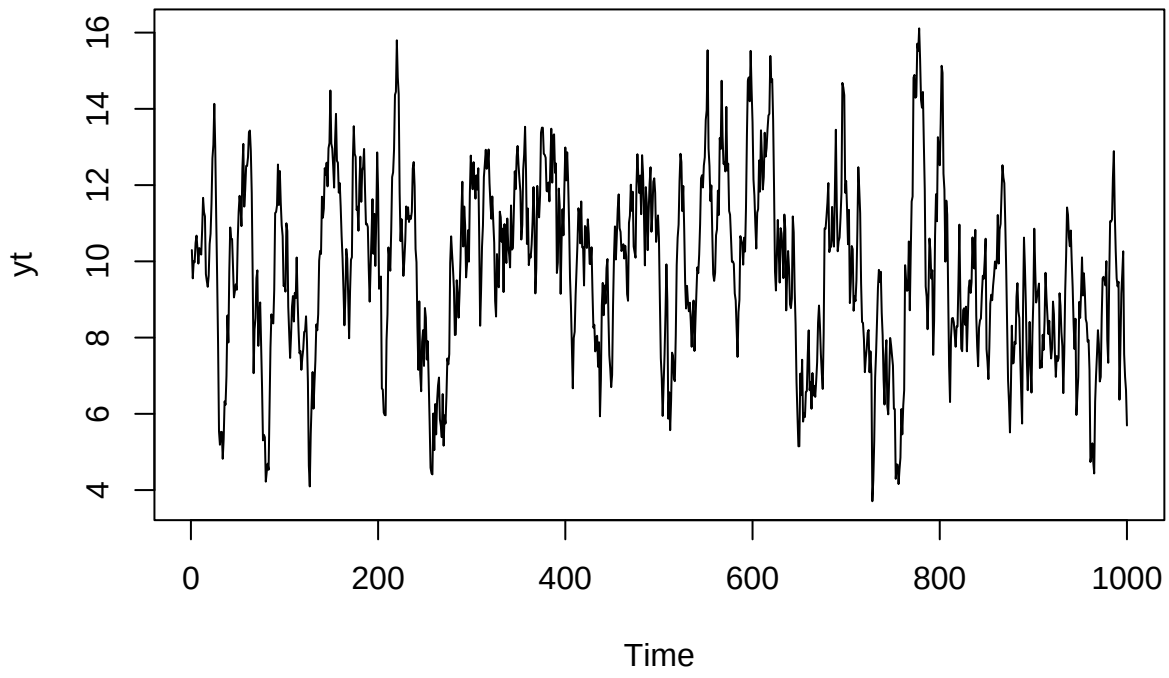
```
#estimate the coefficients of the series
yt <- arima.sim(list(order=c(1,0,0), ar=c(.7)), n=1000)
b0 = 10
yt <- yt + b0
plot(yt)
```




```
arima(yt, order = c(1,0,0))
```

```
##
## Call:
## arima(x = yt, order = c(1, 0, 0))
##
## Coefficients:
##          ar1  intercept
##       0.6821    10.0747
## s.e.  0.0232     0.0966
##
## sigma^2 estimated as 0.9468:  log likelihood = -1391.93,  aic = 2789.86
```

```
#increase the length of the series
yt <- arima.sim(list(order=c(1,0,0), ar=c(.9)), n=1000)
b0 = 10
yt <- yt + b0
plot(yt)
```




```
arima(yt, order = c(1,0,0))
```

```
##
## Call:
## arima(x = yt, order = c(1, 0, 0))
##
## Coefficients:
##          ar1  intercept
##       0.9060     9.7450
## s.e.  0.0134     0.3289
##
## sigma^2 estimated as 0.973:  log likelihood = -1406.11,  aic = 2818.21
```

```
#did not improve accuracy
```

4. Simulate an AR(1) series. Plot the ACF of the residual. Does the ACF of the residual look like that of white noise? Plot the series and the estimated series in the same plot with the forecasting of 10 points to the future.

- Yes, the ACF of the residual looks like that of white noise

```
library(ggfortify)
```

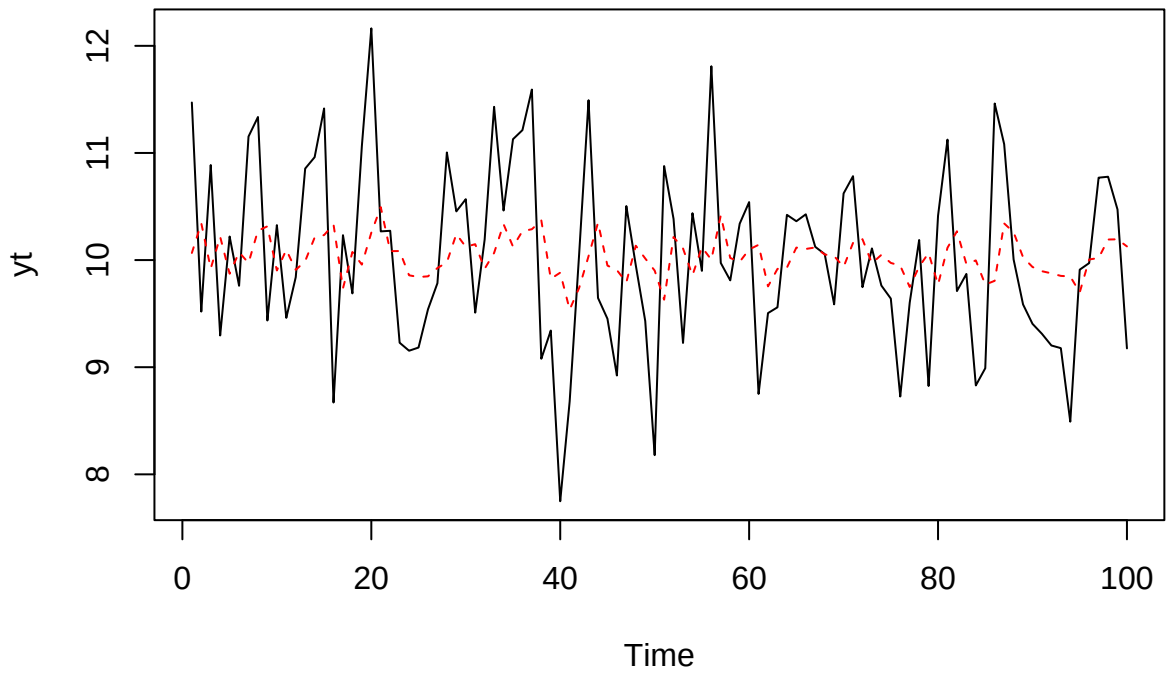
```
## Loading required package: ggplot2
```

```r
library(forecast)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

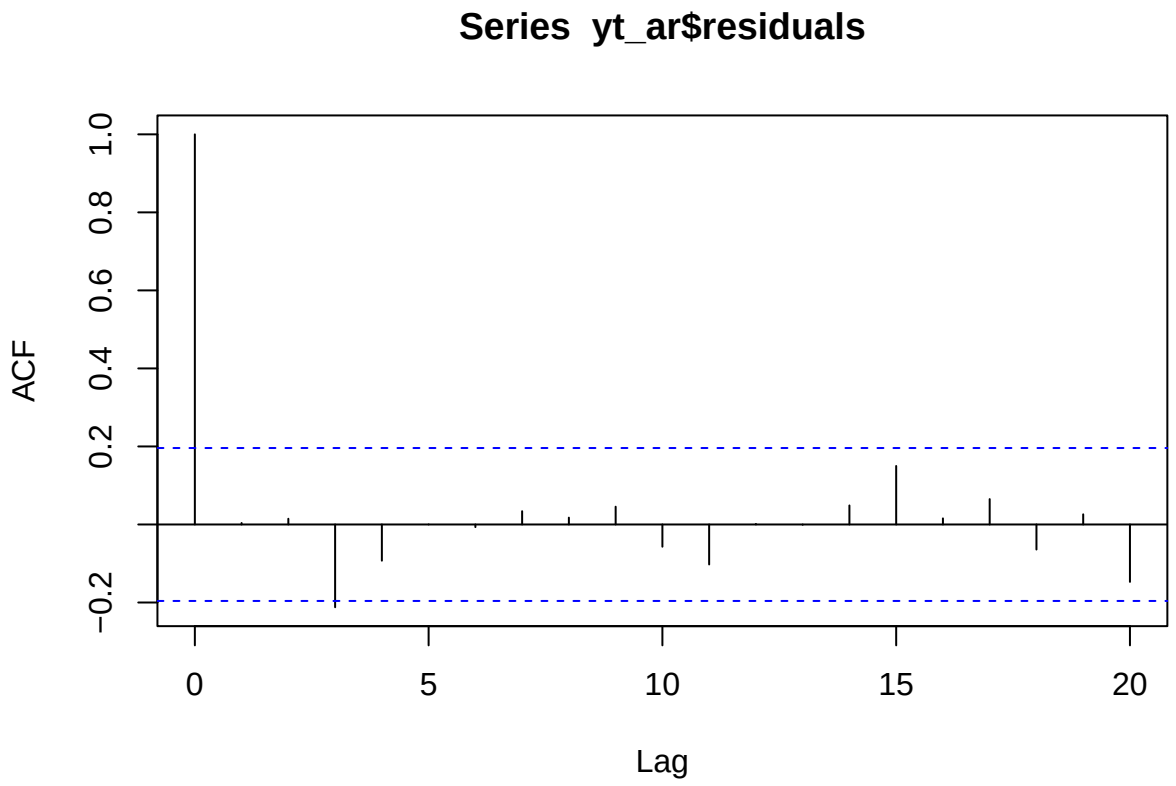
```
## Registered S3 methods overwritten by 'forecast':
##   method                 from
##   autoplot.Arima         ggfortify
##   autoplot.acf           ggfortify
##   autoplot.ar            ggfortify
##   autoplot.bats          ggfortify
##   autoplot.decomposed.ts ggfortify
##   autoplot.ets           ggfortify
##   autoplot.forecast      ggfortify
##   autoplot.stl           ggfortify
##   autoplot.ts            ggfortify
##   fitted.ar              ggfortify
##   fortify.ts             ggfortify
##   residuals.ar           ggfortify
```

```r
# create an AR(1) series
yt <- arima.sim(list(order=c(1,0,0), ar=c(.2)), n=100)
b0 = 10
yt <- yt + b0
plot(yt)

# estimate the series using AR(1) model
yt_ar  = arima(yt, order = c(1,0,0))

# plot the estimated series and the original series
yt_predicted <- yt - yt_ar$residuals
plot(yt)
points(yt_predicted, type = "l",
       col = "red", lty = 2)
```

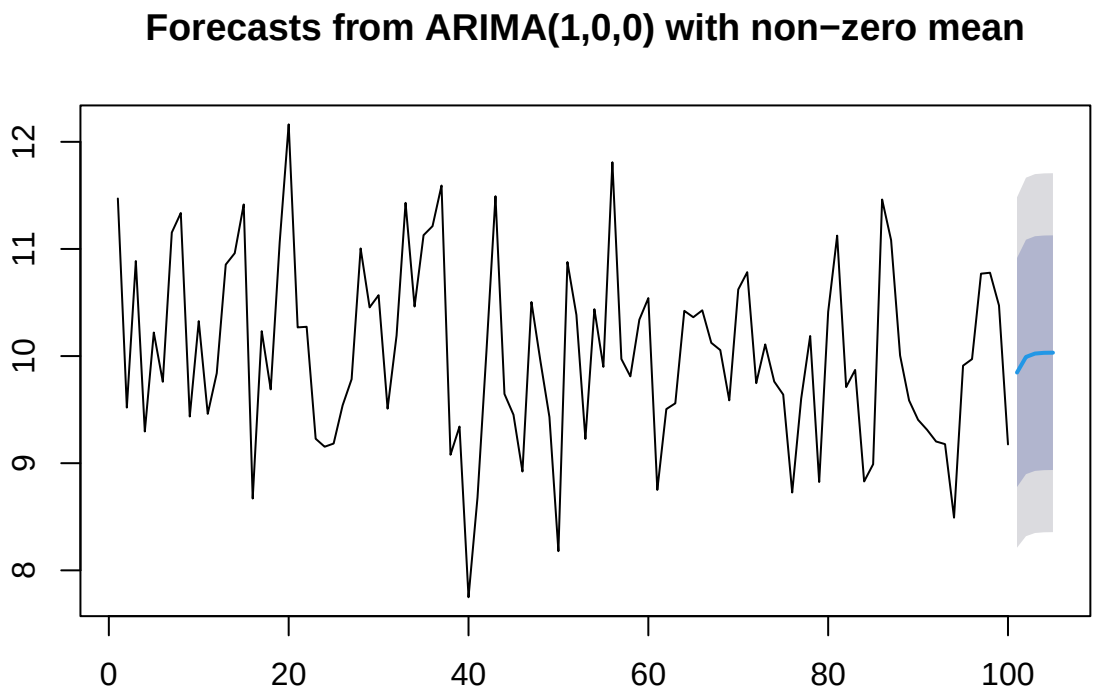



```
#histogram of residuals
hist(yt_ar$residuals)
```


```r
#acf of residuals
acf(yt_ar$residuals)
```




```
#forecasting withAR(1)
ts3_forecasts2 <- forecast(yt_ar, h=5)
plot(ts3_forecasts2)
```


Forecasts from ARIMA(1,0,0) with non−zero mean
8
9
10
11
12
0
20
40
60
80
100