HW1: Jin Kweon - 3032235207

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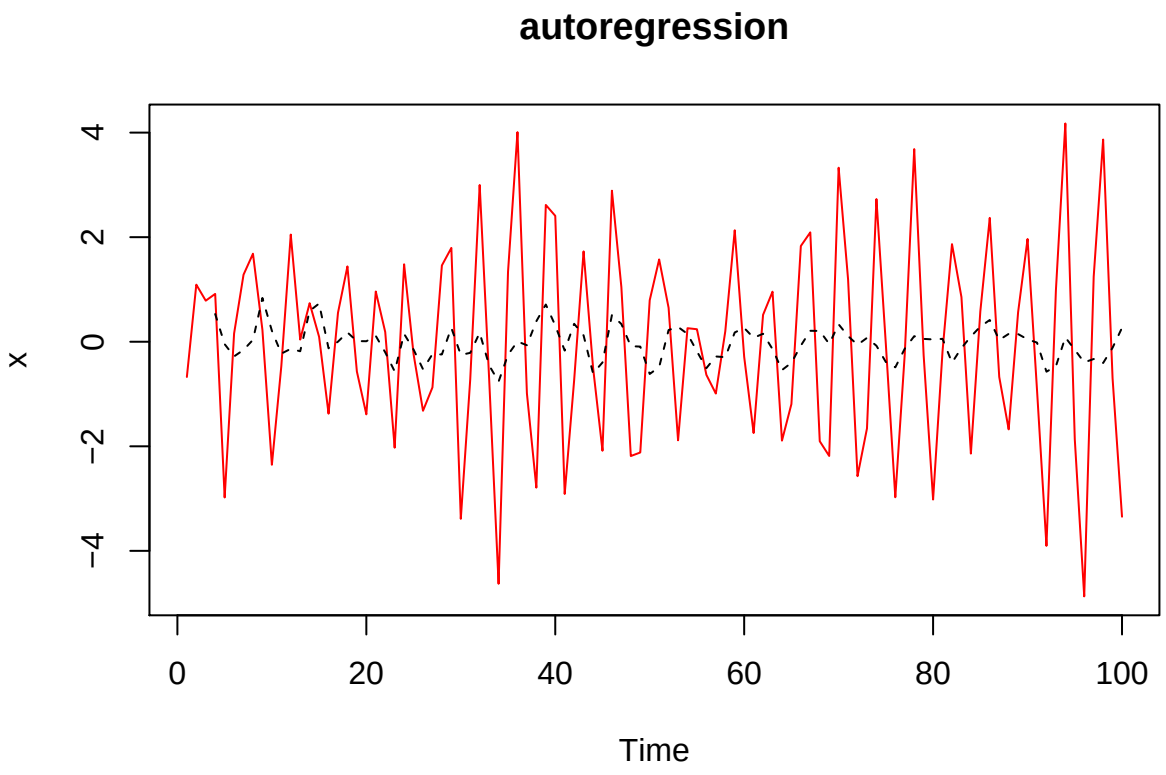
5-a

```
#Generate autoregression
set.seed(100)
w <- rnorm(150, 0, 1)
x <- filter(w, filter = c(0, -0.9), method = "recursive", init = rnorm(2, 0, 1))[-(1:50)]

#Apply moving average filter
set.seed(100)
v <- filter(x, filter = rep(1/4, 4), sides = 1, method = "convolution")

#plot
plot.ts(x, main = "autoregression", col = "red")
lines(v, lty = "dashed")
```



Comment:

They are showing kind-of periodic behavior (pseudo cyclical) of the series. They are showing high amplitudes on both sides, and realtively low one on the middle.

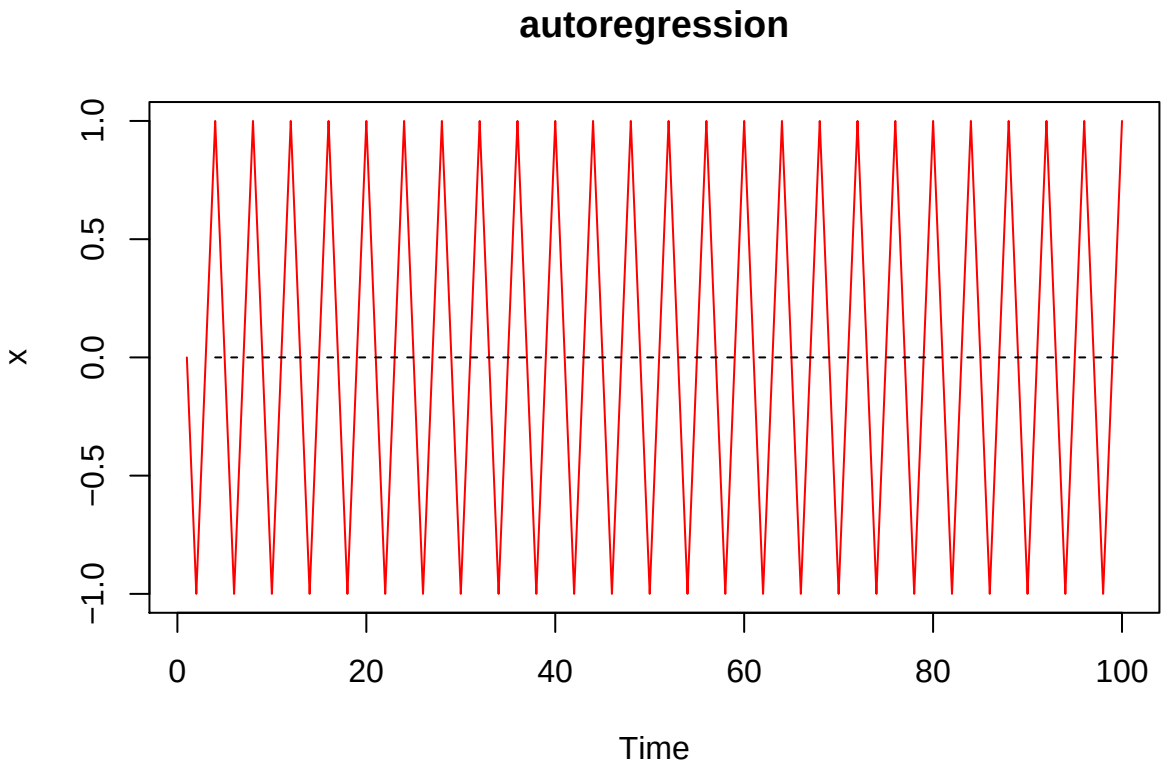
And, after applying moving average filter, I could see the series defintely get smoother and thus, amplitude went lower (because of averaging out of current value with its neighbours). Moving average reduces the noise, so we could actually know the trend and tendancy better!!!

5-b

```r
#Generate nont-autoregressive series with no white noise
t <- seq(1,100)
x <- cos((2 * pi * t) / 4)

#Apply moving average filter
set.seed(100)
v <- filter(x, filter = rep(1/4, 4), sides = 1, method = "convolution")

#plot
plot.ts(x, main = "autoregression", col = "red")
lines(v, lty = "dashed")
```



Comment:

They are showing periodic behavior of the series and it makes sense, since cosine is periodic. The amplitudes are all the same because it is a cosine function.

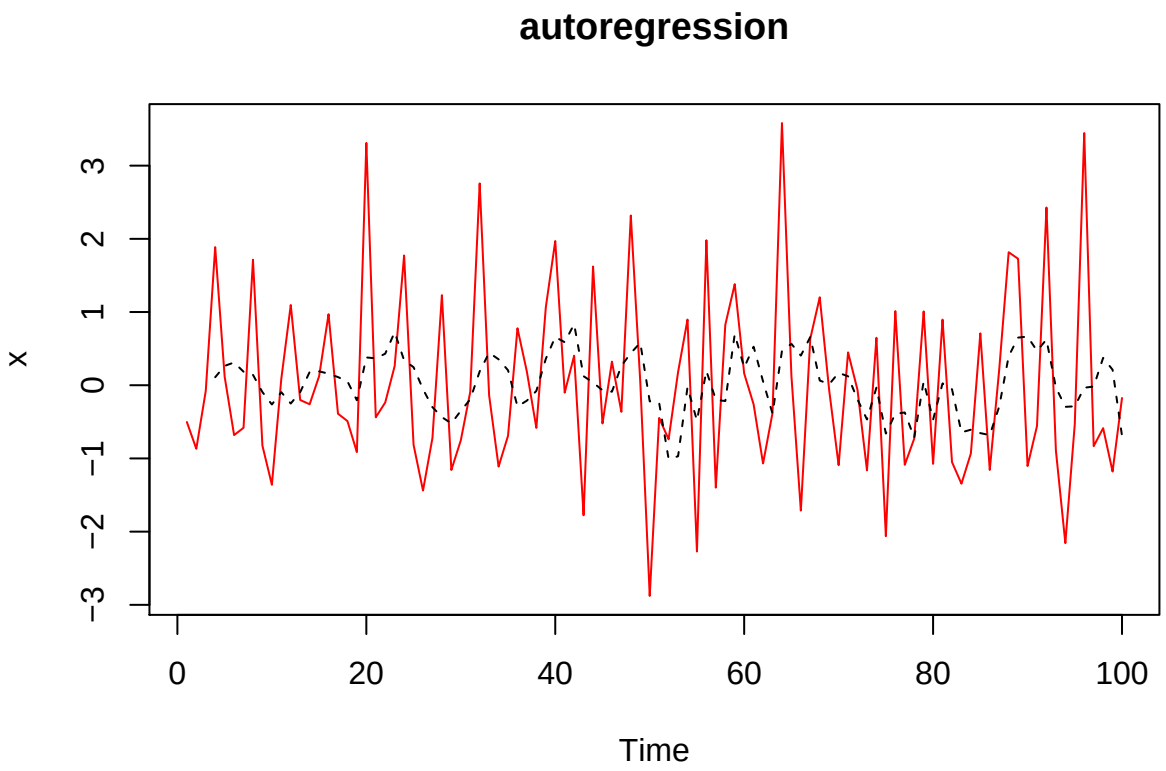
And, after applying moving average filter, I could see the series defintely get smoother and cleaned up entirely. It makes sense they are averaging out current value with the neighbours, and as they do this on perfect periodic function, cosine, it would be zero. (because there is no white noise either)

5-c

```r
#Generate nont-autoregressive series with white noise
set.seed(100)
t <- seq(1,100)
w <- rnorm(100, 0, 1)
x <- cos((2 * pi * t) / 4) + w

#Apply moving average filter
set.seed(100)
v <- filter(x, filter = rep(1/4, 4), sides = 1, method = "convolution")

#plot
plot.ts(x, main = "autoregression", col = "red")
lines(v, lty = "dashed")
```



Comment:

They are showing kind-of periodic behavior (psuedo cyclical) of the series and it makes sense, since cosine is periodic. However, because of the white noise, the oscillations are all different.

And, after applying moving average filter, I could see the series defintely get smoother, but it works worse compred to part a) and b)

Side notes:

Technically, periodic means either

1. formed as A $\cos(2\pi \text{wt} + \phi)$

or

2. $x_{t+p} = x_t$ for all t

So, that is why I said part a) is not technically periodic, but pseudo cyclical.