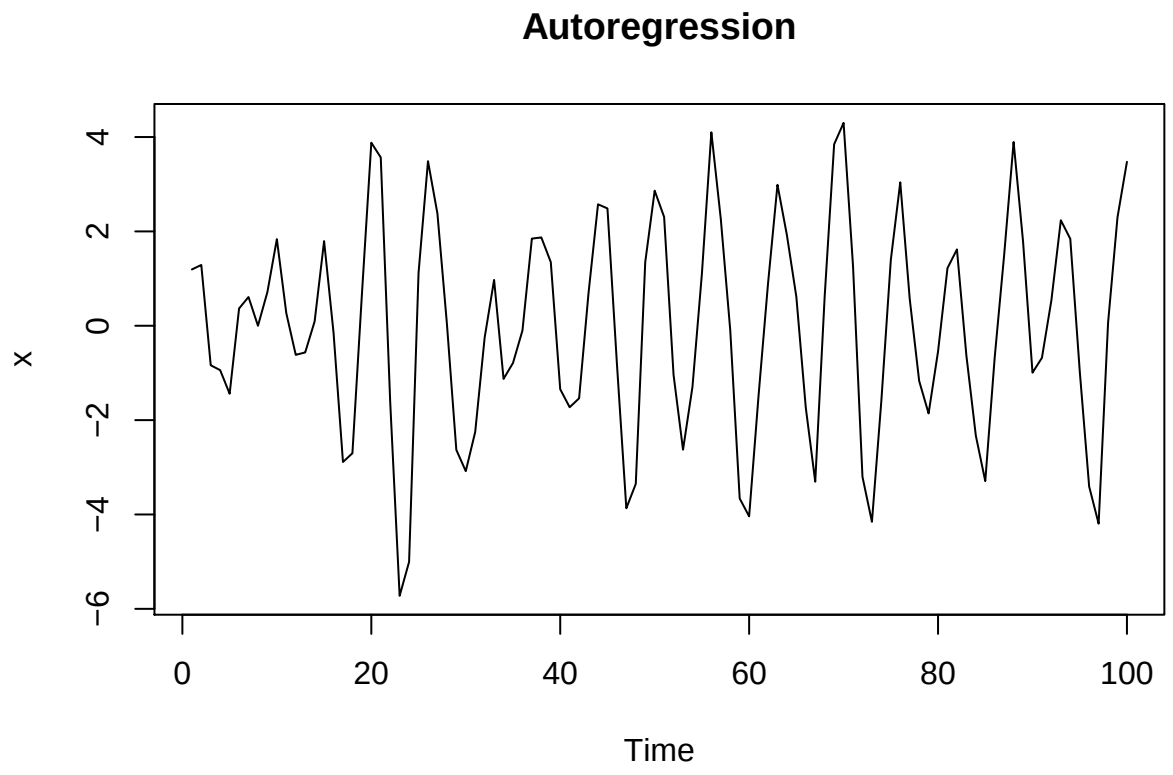
Chapter 1 Problem 3

Andira Putri

This problem studies white noise, moving average filters, and autoregression.

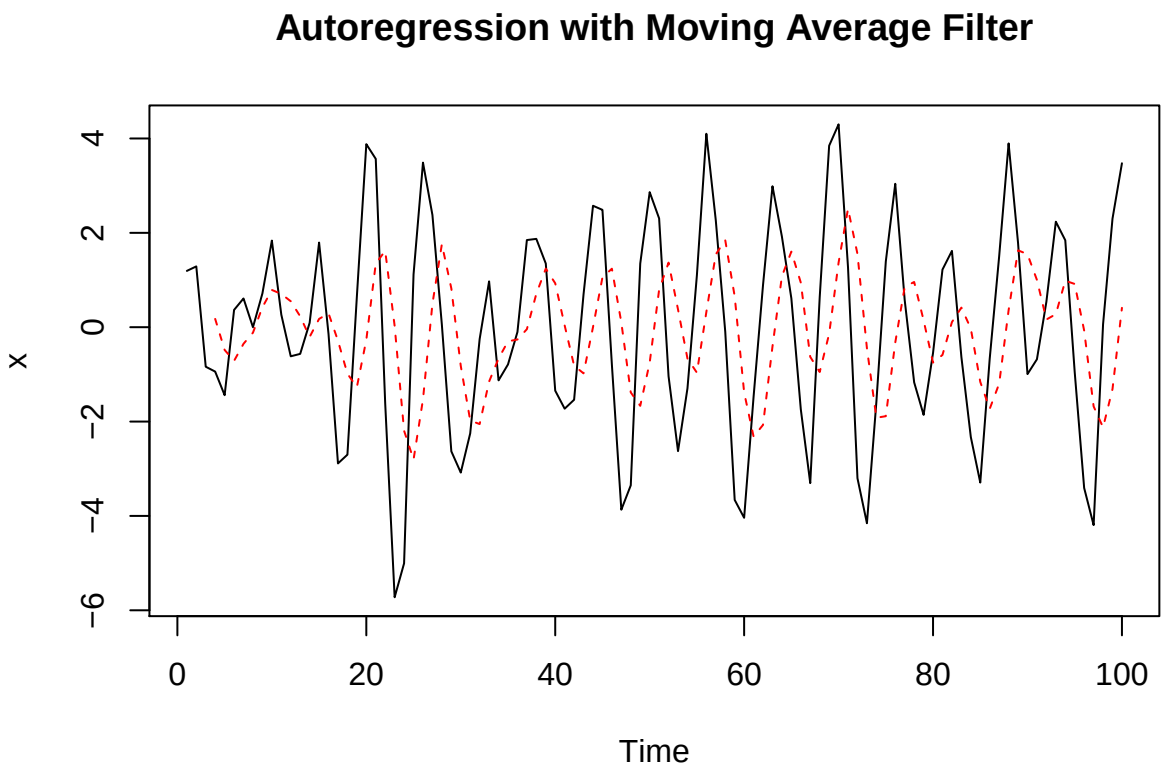
(a) Generate n = 100 observations from the autoregression $x_t = -.9x_t - 2 + w_t$ with $\sigma_w = 1$, using the method described in Example 1.10, page 13. Next, apply the moving average filter $v_t = (x_t + x_{t-1} + x_{t-2} + x_{t-3})/4$ to x_t, the data you generated. Now, plot x_t as a line and superimpose v_t as a dashed line. Comment on the behavior of x_t and how applying the moving average filter changes that behavior.

```
set.seed(89)
w=rnorm(150) #50 extra to avoid startup problems
x=filter(w,filter=c(1,-0.9),method="recursive")[-(1:50)]
plot.ts(x,main="Autoregression")
```



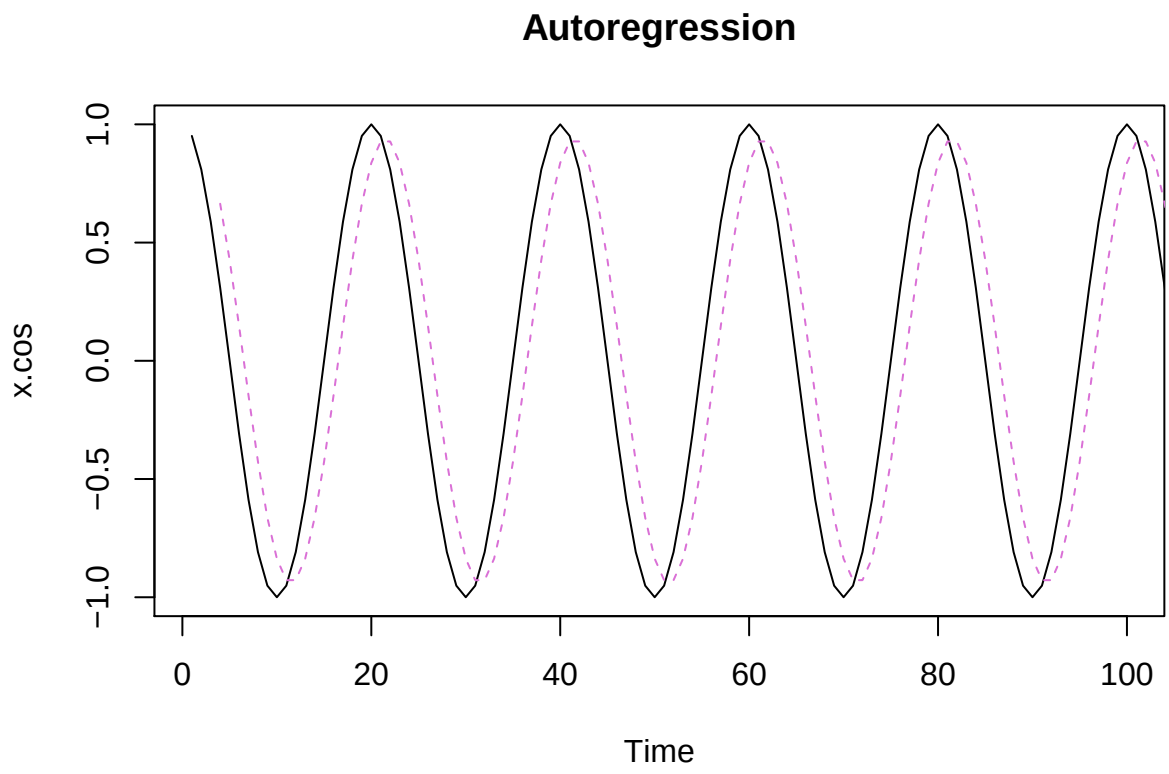
Now, we implement the moving average filter and superimpose it on the autoregression graph.

```
v=filter(x,sides=1,rep(1/4,4))
#sides=1 b/c we are only looking at past values
#rep(1/4,4) b/c we are averaging with 4 points
plot.ts(x,main="Autoregression with Moving Average Filter")
lines(v,col="red",lty="dashed")
```



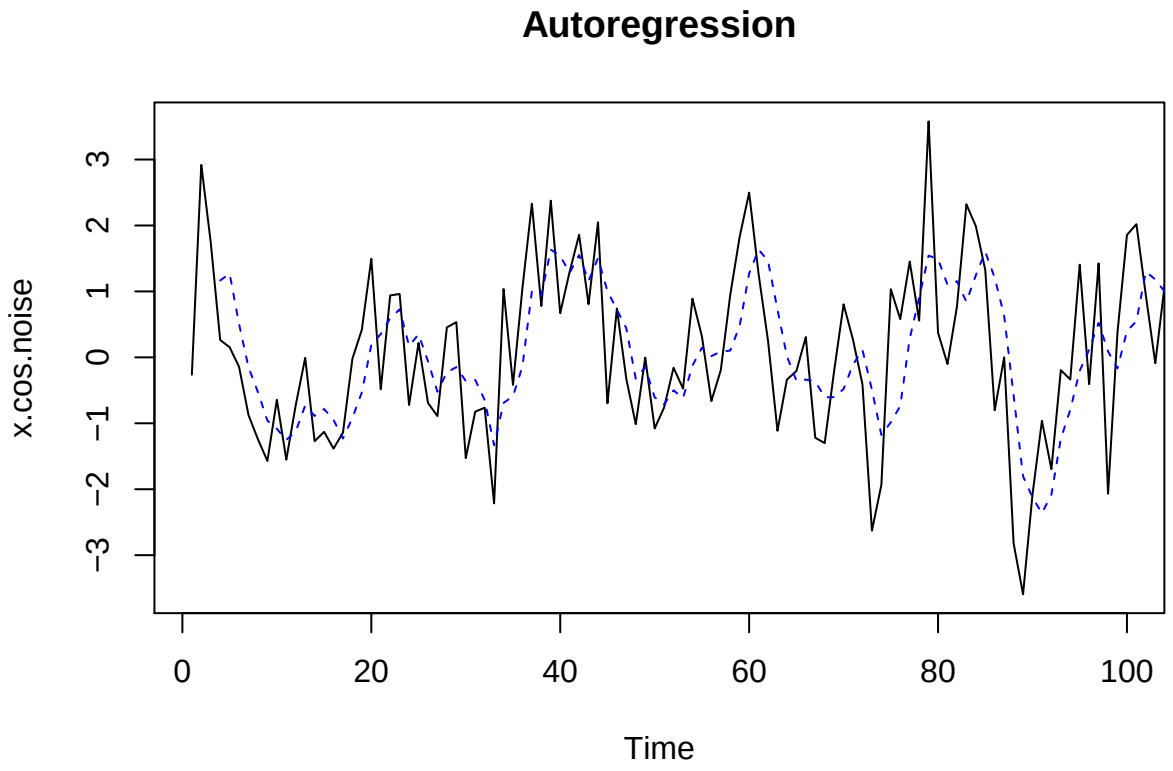
(b) Repeat but with $x_t = cos(2\pi t/4)$.

```
x.cos=ts(cos(2*pi*1:150*0.2/4))
v.cos=filter(x.cos,sides=1,rep(1/4,4))
plot.ts(x.cos,main="Autoregression",xlim=c(1,100))
lines(v.cos,col="orchid",lty="dashed")
```



(c) Repeat but with added N(0,1) white noise; $x_t = cos(2\pi t/4) + w_t$.

```
noise=rnorm(150,0,1)
x.cos.noise=ts(cos(2*pi*1:150*0.2/4)+noise)
v.cos.noise=filter(x.cos.noise,sides=1,rep(1/4,4))
plot.ts(x.cos.noise,main="Autoregression",xlim=c(1,100))
lines(v.cos.noise,col="blue",lty="dashed")
```



(d) Compare and contrast the models above.

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