```
R version 3.6.2 (2019-12-12) -- "Dark and Stormy Night"
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Platform: x86_64-w64-mingw32/x64 (64-bit)

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  Natural language support but running in an English locale

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Type 'demo()' for some demos, 'help()' for on-line help, or
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Type 'q()' to quit R.

[Previously saved workspace restored]

> #HW14
> if (FALSE)
+ {"
+ Use the presidents data set from HW13 and the R code below to plot the data and the smoothed
simple moving average:
+ a) using 5 data points
+ b) using 10 data points
+ "}
>
> #read in the data which is in a csv file
> presidents <- read.csv(file="C:/Users/jmard/OneDrive/Desktop/Computing and Graphics in Applied
Statistics2020/Homework/presidents.csv",header = TRUE)
>
> library(faraway)

Attaching package: 'faraway'

The following object is masked _by_ '.GlobalEnv':

    pima

> library(psych)

Attaching package: 'psych'

The following object is masked from 'package:faraway':

    logit

> library(smooth)
Loading required package: greybox
Registered S3 method overwritten by 'quantmod':
  method            from
  as.zoo.data.frame zoo
Package "greybox", v0.5.9 loaded.
This is package "smooth", v2.5.5
Warning messages:
1: package 'smooth' was built under R version 3.6.3
2: package 'greybox' was built under R version 3.6.3
>
> windows(7,7)
> #save graph(s) in pdf
>  pdf(file="C:/Users/jmard/OneDrive/Desktop/Computing and Graphics in Applied
Statistics2020/Homework/HW14_Figures.pdf")
>
> head(presidents,1L)
  quarter presidents
1       1         83
> str(presidents)
```

R version 4.0.0 is available - major revision. Explore the changes before deciding to update your R version. I plan to wait a little longer.

```
'data.frame':   120 obs. of  2 variables:
 $ quarter   : int  1 2 3 4 5 6 7 8 9 10 ...
 $ presidents: int  83 87 82 75 63 50 43 32 35 60 ...
>
> MovingAverage <- sma(presidents$presidents,order=5,silent=FALSE)   #HW assignment a)
> summary(MovingAverage)
Time elapsed: 0.02 seconds
Model estimated: SMA(5)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 146.16
Error standard deviation: 12.1917
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
942.7095 942.8120 948.2845 948.5300
>
> #c) Compute the Simple Moving Average using 5 data points at quarter =10.
>
> HW14c <- cbind(MovingAverage$y,MovingAverage$fitted)
> head(HW14c,20L)
Time Series:
Start = 1
End = 20
Frequency = 1
   MovingAverage$y MovingAverage$fitted
 1              83                 78.0
 2              87                 79.0
 3              82                 80.8
 4              75                 81.6
 5              63                 81.0
 6              50                 78.0
 7              43                 71.4
 8              32                 62.6
 9              35                 52.6
10              60                 44.6
11              54                 44.0
12              55                 44.8
13              36                 47.2
14              39                 48.0
15              42                 48.8
16              55                 45.2
17              69                 45.4
18              57                 48.2
19              57                 52.4
20              51                 56.0
>
> plot(MovingAverage$y[10],MovingAverage$fitted[10],xlab="original data",ylab="SMA(5)")
>
> MovingAverage <- sma(presidents$presidents,order=10,silent=FALSE)  #HW assignment b)
> summary(MovingAverage)
Time elapsed: 0 seconds
Model estimated: SMA(10)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 202.454
Error standard deviation: 14.3487
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
981.8068 981.9093 987.3818 987.6273
>
> #-------------------------------------------------------------------------#
> #by default sma provides optimal order based on AICc and returns the model with the lowest value
of AICc
> sma(presidents$presidents,silent=FALSE)
```

see HW14.xlsx for computations for Moving Average performed by sma

```
Time elapsed: 0.12 seconds
Model estimated: SMA(1)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 87.525
Error standard deviation: 9.4344
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
881.1762 881.2787 886.7512 886.9967
>
> sma(presidents$presidents,order=1,silent=FALSE)
Time elapsed: 0.01 seconds
Model estimated: SMA(1)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 87.525
Error standard deviation: 9.4344
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
881.1762 881.2787 886.7512 886.9967
> sma(presidents$presidents,order=2,silent=FALSE)
Time elapsed: 0 seconds
Model estimated: SMA(2)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 92.0979
Error standard deviation: 9.6778
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
887.2875 887.3901 892.8625 893.1080
> sma(presidents$presidents,order=3,silent=FALSE)
Time elapsed: 0 seconds
Model estimated: SMA(3)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 114.0444
Error standard deviation: 10.7693
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
912.9358 913.0384 918.5108 918.7563
> sma(presidents$presidents,order=4,silent=FALSE)
Time elapsed: 0 seconds
Model estimated: SMA(4)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 129.0278
Error standard deviation: 11.4549
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
927.7486 927.8512 933.3236 933.5691
> sma(presidents$presidents,order=5,silent=FALSE)
Time elapsed: 0 seconds
Model estimated: SMA(5)
Initial values were produced using backcasting.
```

```
Loss function type: MSE; Loss function value: 146.16
Error standard deviation: 12.1917
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
942.7095 942.8120 948.2845 948.5300
>
> #----------------------------------------------------------------------------#
> sma(presidents$presidents,order=1,silent=FALSE)
Time elapsed: 0 seconds
Model estimated: SMA(1)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 87.525
Error standard deviation: 9.4344
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
881.1762 881.2787 886.7512 886.9967
> MovingAverage1 <- sma(presidents$presidents,order=1,silent=FALSE)
> summary(MovingAverage1)
Time elapsed: 0.02 seconds
Model estimated: SMA(1)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 87.525
Error standard deviation: 9.4344
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
881.1762 881.2787 886.7512 886.9967
> plot(MovingAverage1$y,MovingAverage1$fitted,xlab="original data",ylab="SMA(1)")
> plot(MovingAverage1$y~MovingAverage1$fitted,xlab="original data",ylab="SMA(1)")
>
> sma(presidents$presidents,order=10,silent=FALSE)
Time elapsed: 0 seconds
Model estimated: SMA(10)
Initial values were produced using backcasting.

Loss function type: MSE; Loss function value: 202.454
Error standard deviation: 14.3487
Sample size: 120
Number of estimated parameters: 2
Number of degrees of freedom: 118
Information criteria:
     AIC     AICc      BIC     BICc
981.8068 981.9093 987.3818 987.6273
>
> #h=Length of forecasting horizon   holdout: If TRUE, holdout sample of size h is taken from the
end of the data.
> MovingAverage1 <- sma(presidents$presidents,order=1,h=20,holdout=TRUE,silent=FALSE)
> plot(MovingAverage1)
>
> MovingAverage10 <- sma(presidents$presidents,order=10,h=20,holdout=TRUE,silent=FALSE)
> plot(MovingAverage10)
> #----------------------------------------------------------------------------#
> print(MovingAverage1$accuracy)
          ME           MAE           MSE           MPE          MAPE           sCE
 -8.40000000  13.20000000 283.70000000  -0.33164796   0.40579724   2.89256198
        sMAE          sMSE          MASE         RMSSE          rMAE         rRMSE
  0.22727273   0.08410196   1.69055627   1.75826690   1.00000000   1.00000000
        rAME         cbias          sPIS
  1.00000000  -0.59254107   9.67630854
> print(MovingAverage10$accuracy)
```

```
          ME           MAE           MSE           MPE          MAPE           sCE
 -5.57984413  12.96986189 263.43261786  -0.26884963   0.38437591   1.92143393
        sMAE          sMSE          MASE         RMSSE         rMAE         rRMSE
  0.22331029   0.07809376   1.66108192   1.69429842   0.98256529   0.96361845
        rAME         cbias          sPIS
  0.66426716  -0.40389808  -2.05975351
>
> ##------------------------------------------------------------------------------##
> dev.off()
null device
          1
>
```