Code

MACT 4232 (Time Series) - Assignment 1

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This is an R Markdown (http://rmarkdown.rstudio.com) Notebook. When you execute code within the notebook, the results appear beneath the code.

Try executing this chunk by clicking the *Run* button within the chunk or by placing your cursor inside it and pressing *Cmd+Shift+Enter*.

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```
setwd("/Users/omar/desktop")
getwd()
```

```
[1] "/Users/omar/Desktop"
```

Question 1: Use R to plot the time series and comment on any trends or other features of the data

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```
df = scan("global_temps.dat")
```

```
Read 20 items
```

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```
head(df)
```

```
[1] -0.09 -0.22  0.11  0.04  0.10  0.19
```

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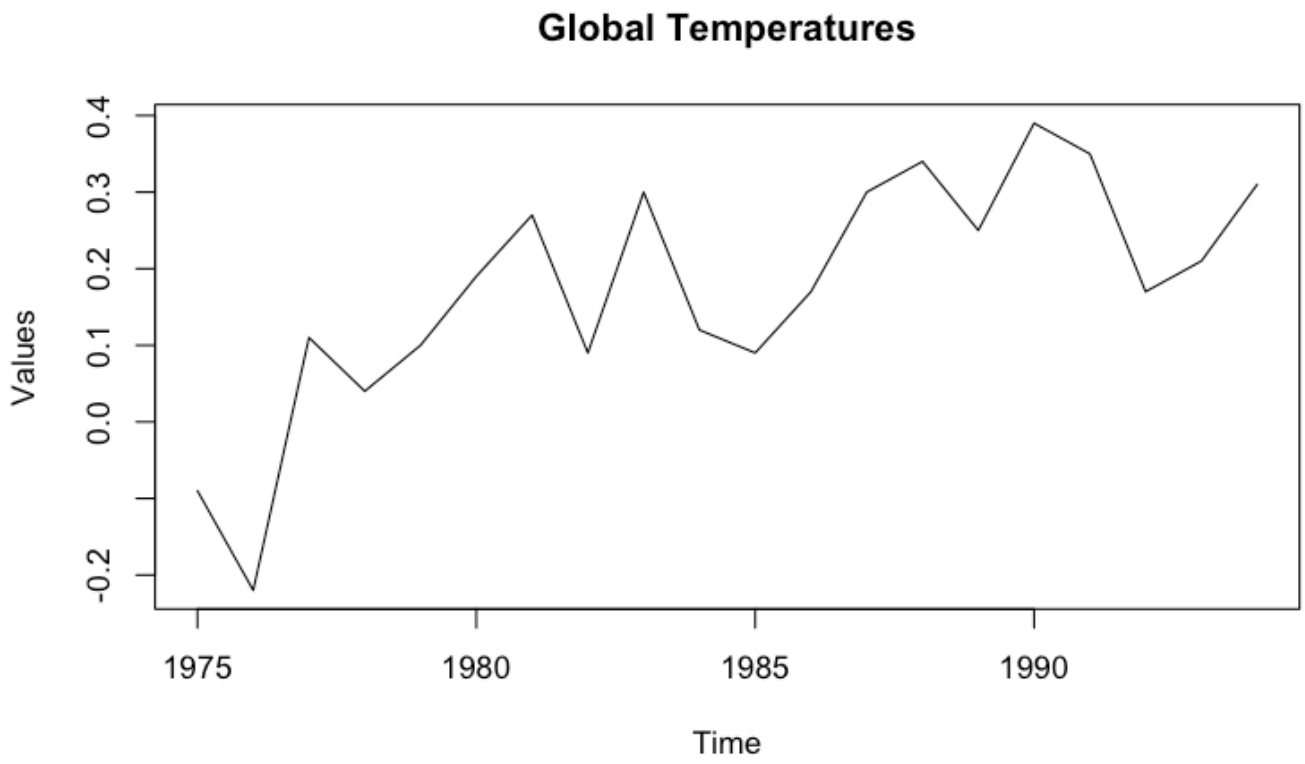
```
# 'ts' is short for time series

# frequency = 1 because we're dealing with ANUAL data

# start = c(1975) because the starting year is 1975 and the starting month is unknown

df_ts = ts(df, frequency = 1, start = c(1975))

# Plot the time series data
plot.ts(df_ts, main = "Global Temperatures", xlab = "Time", ylab = "Values")
```



Comments on the trends & other features of the data:

This data is more suitable for the additive model rather than the multiplicative model. This is because, the data exhibits an overall increasing trend indicating that the global temperatures increase over time. With that said, this particular trend is not perfectly increasing due to the noticeable fluctuations as there are a few clear peaks and dips which could be reflections of specific climate events.

Question 2: Use R to plot the series and a 4-point centered moving average. Is there any trend?

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```
df1 = scan("quarterly_arrivals_new_zealand.dat")
```

```
Read 16 items
```

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```
head(df1)
```

```
[1] 239 204 238 253 238 193
```

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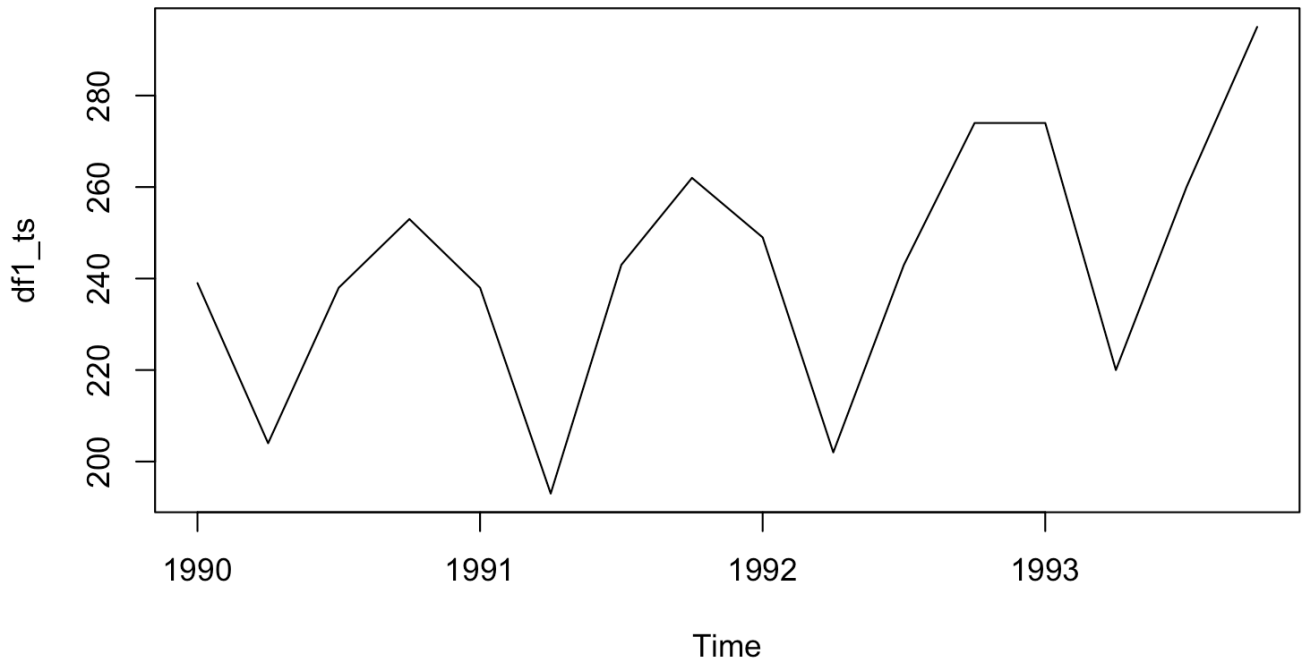
```
# frequncy = 4 because we're dealing with QUARTERLY data

# start = c(1990, 1) because the starting year is 1990 and the starting month is Marc
h which falls in the FIRST quarter of the year

df1_ts = ts(df1, frequency = 4, start = c(1990, 1))
plot.ts(df1_ts)
```



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```
View(df1)
```

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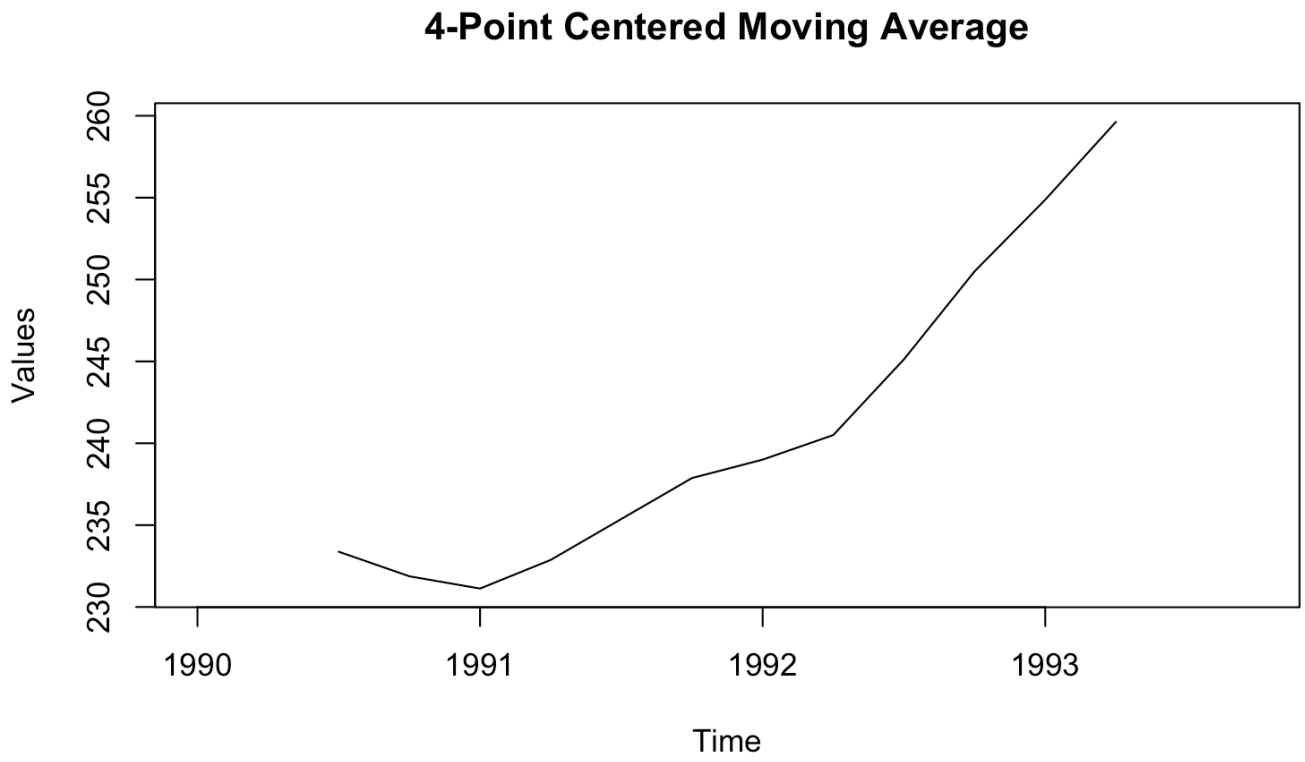
```
# To get the Centered Moving Average (CMA) for quarterly data we use the following:

# The standard for CMA is that sides = 2

# The first argument of 'filter' is equal to 1/(2*n)

n = 4 # This is also because we're dealing with quarterly data

df1_ts.ma = filter(df1_ts, filter = c(1/8, rep(1/n, n-1), 1/8), sides = 2)

plot.ts(df1_ts.ma, main = "4-Point Centered Moving Average", xlab = "Time", ylab = "V
alues")
```



Is there any trend?

Yes, there is indeed a trend, which is upward trend in the data over time. The 4-point CMA smooths out the short-term fluctuations and shows the overall trend and direction in the data over time, which is an increasing trend. There are some values that decrease slightly around 1990–1991 but then show a consistent increase from 1991 onwards, re-iterating that the existing trend is a rising one.

Question #3:

(a) Use the moving average to estimate the trend

Quarter	(y_t)	4-point	2-point
1996 (1)	18	—	
(2)	30	31	
(3)	44	37.75	34.375
(4)	32	45.75	41.75
1997 (1)	45	45.25	45.50
(2)	62	52.25	48.75
(3)	42	61.50	56.875
(4)	60	59	60.25
1998 (1)	82	67.25	63.125
(2)	52	77.25	72.25
(3)	75	—	
(4)	100	—	

(b) Compute the seasonal factors

$$\text{Seasonal Irregular Component} = \frac{\text{Value}}{\text{CMA}}$$

Year	Quarter	Value	CMA	Seasonal Irregular Component
96	3	44	34.375	1.28
96	4	32	41.75	0.7667
97	1	45	45.50	0.9890
97	2	62	48.75	1.2718
97	3	42	56.875	0.7385
97	4	60	60.25	0.9959
98	1	82	63.125	1.2990
98	2	52	72.25	0.7197

⇒ Quarter 1: $\frac{0.989 + 1.299}{2} = 1.144$

Quarter 2: $\frac{1.2718 + 0.7197}{2} = 0.996$

Quarter 3: $\frac{1.28 + 0.7385}{2} = 1.0093$

Quarter 4: $\frac{0.7667 + 0.9959}{2} = 0.881$

Question #4.

What's the exp. smoothed value for the next period if the forecast & actual values are 12 & 15 and $\alpha = 0.7$?

Single exp. smoothing: $F_{t+1} = \alpha X_t + (1-\alpha) F_t \Rightarrow \begin{matrix} X_t = 15 \\ F_t = 12 \end{matrix} \Big\} \alpha = 0.7$

$\Rightarrow F_{t+1} = 0.7(15) + (1-0.7)(12) = 10.5 + 3.6 \boxed{= 14.1}$

Question #5.

What'll be the forecast value of the # of rifles to be ordered in the next month if defense management ordered 120 rifles & the forecasted value for this month is 115, and $\alpha = 0.8$?

Forecast value for period $t+1 = F_{t+1} = ?$

$\Rightarrow$ Single exp. smoothing: $F_{t+1} = \alpha X_t + (1-\alpha) F_t \Rightarrow \begin{matrix} X_t = 120 \\ F_t = 115 \end{matrix} \Big\} \alpha = 0.8$

(X_t: actual value for this month; F_t: forecast value for this month)

$\Rightarrow F_{t+1} = 0.8(120) + (1-0.8)(115)$

$\Rightarrow F_{t+1} = 96 + 23 \boxed{= 119}$