

# stat443 assignment1

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## stat443 assignment1 problem 4

(a)

```
oz <- read.csv("MonthlyOzoneLA.csv", header = FALSE)
oz.ts <- ts(oz, start = c(1955,1), end = c(1972,12), frequency = 12)

# exploratory commands
# class
class(oz.ts)

## [1] "ts"

# starting date
start(oz.ts)

## [1] 1955    1

# ending date
end(oz.ts)

## [1] 1972    12

# frequency
frequency(oz.ts)

## [1] 12
```

(b)

```
# print  
print(oz.ts)
```

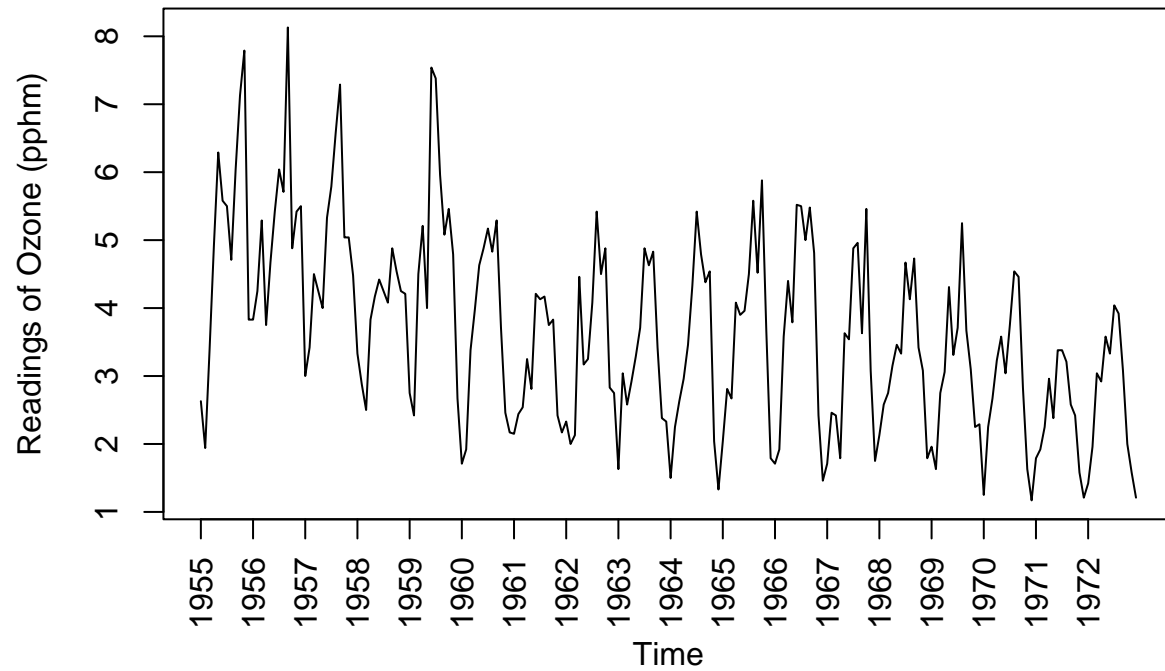
```
##      Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec  
## 1955 2.63 1.94 3.38 4.92 6.29 5.58 5.50 4.71 6.04 7.13 7.79 3.83  
## 1956 3.83 4.25 5.29 3.75 4.67 5.42 6.04 5.71 8.13 4.88 5.42 5.50  
## 1957 3.00 3.42 4.50 4.25 4.00 5.33 5.79 6.58 7.29 5.04 5.04 4.48  
## 1958 3.33 2.88 2.50 3.83 4.17 4.42 4.25 4.08 4.88 4.54 4.25 4.21  
## 1959 2.75 2.42 4.50 5.21 4.00 7.54 7.38 5.96 5.08 5.46 4.79 2.67  
## 1960 1.71 1.92 3.38 3.98 4.63 4.88 5.17 4.83 5.29 3.71 2.46 2.17  
## 1961 2.15 2.44 2.54 3.25 2.81 4.21 4.13 4.17 3.75 3.83 2.42 2.17  
## 1962 2.33 2.00 2.13 4.46 3.17 3.25 4.08 5.42 4.50 4.88 2.83 2.75  
## 1963 1.63 3.04 2.58 2.92 3.29 3.71 4.88 4.63 4.83 3.42 2.38 2.33  
## 1964 1.50 2.25 2.63 2.96 3.46 4.33 5.42 4.79 4.38 4.54 2.04 1.33  
## 1965 2.04 2.81 2.67 4.08 3.90 3.96 4.50 5.58 4.52 5.88 3.67 1.79  
## 1966 1.71 1.92 3.58 4.40 3.79 5.52 5.50 5.00 5.48 4.81 2.42 1.46  
## 1967 1.71 2.46 2.42 1.79 3.63 3.54 4.88 4.96 3.63 5.46 3.08 1.75  
## 1968 2.13 2.58 2.75 3.15 3.46 3.33 4.67 4.13 4.73 3.42 3.08 1.79  
## 1969 1.96 1.63 2.75 3.06 4.31 3.31 3.71 5.25 3.67 3.10 2.25 2.29  
## 1970 1.25 2.25 2.67 3.23 3.58 3.04 3.75 4.54 4.46 2.83 1.63 1.17  
## 1971 1.79 1.92 2.25 2.96 2.38 3.38 3.38 3.21 2.58 2.42 1.58 1.21  
## 1972 1.42 1.96 3.04 2.92 3.58 3.33 4.04 3.92 3.08 2.00 1.58 1.21
```

```
# comment on structure  
# The structure is a 18 x 12 matrix, with 18 rows as years and 12 columns as months.
```

(c)

```
plot(oz.ts, ylab="Readings of Ozone (pphm)", xaxt="n",  
      main = "Averages of hourly readings of Ozone in LA downtown")  
axis(1, at = start(time(oz.ts))[1]:end(time(oz.ts))[1], labels = TRUE, las=2)
```

### Averages of hourly readings of Ozone in LA downtown



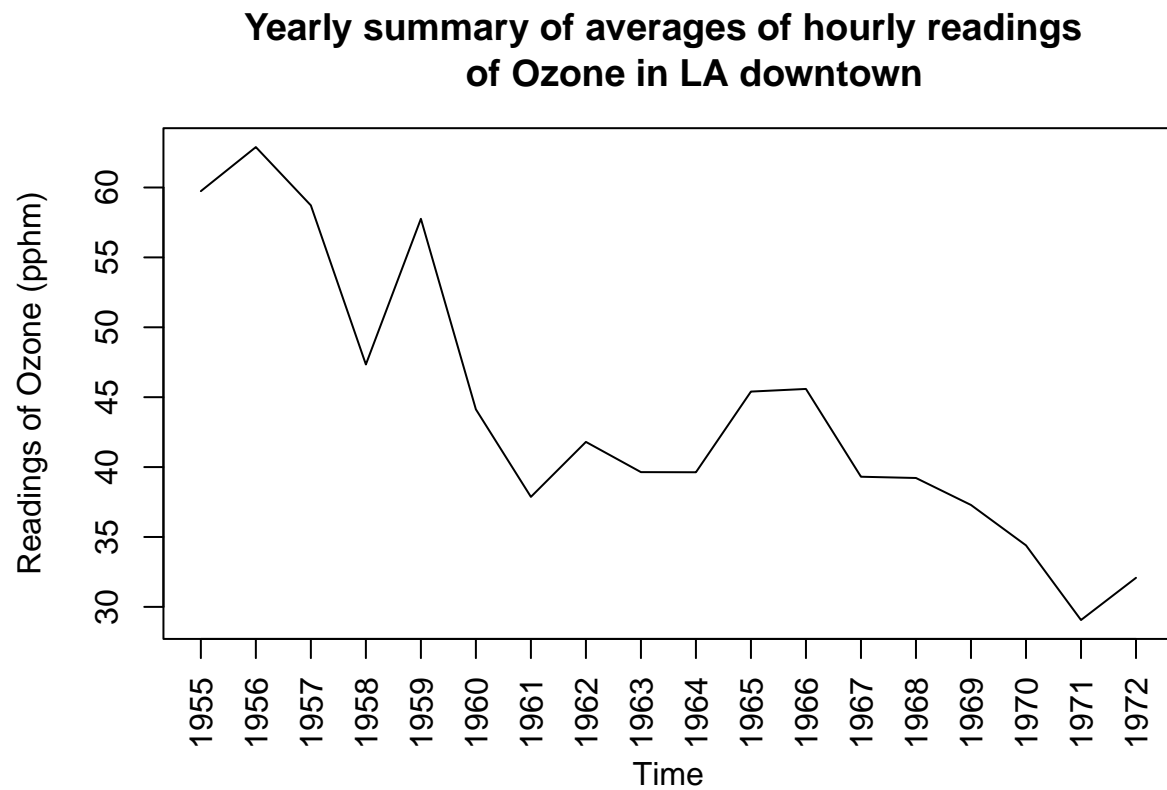
```
# period  
# The period of the time series is 12.
```

(d)

Based on visualied time series, it is non-stationary. Because the time series has a decreasing trend and seasonal cycle.

(e)

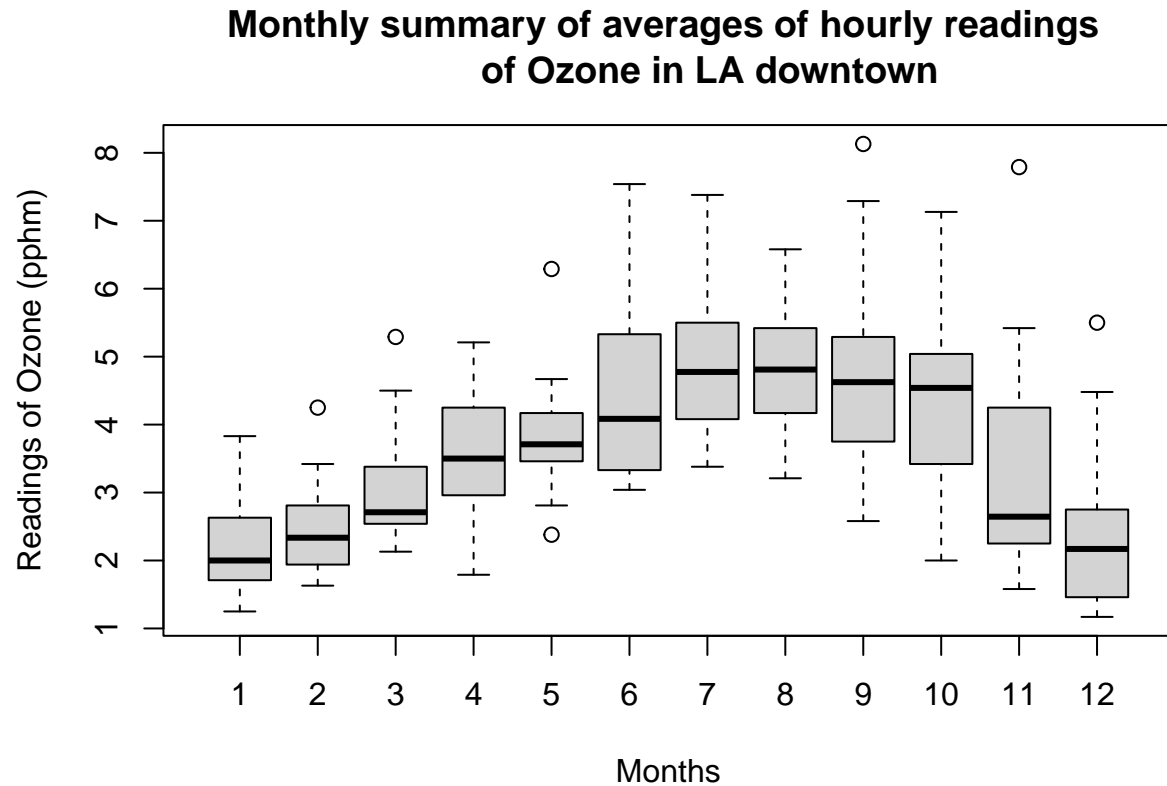
```
agg_oz.ts <- aggregate(oz.ts)
plot(agg_oz.ts, ylab = "Readings of Ozone (pphm)", xaxt="n",
     main="Yearly summary of averages of hourly readings
           of Ozone in LA downtown")
axis(1, at = start(time(agg_oz.ts))[1]:end(time(agg_oz.ts))[1],
     labels = TRUE, las=2)
```



```
# comment on observation
# I observed that the time series reached its peak in 1956 and reached its bottom in 1971.
# And overall, there is a decreasing trend.
```

(f)

```
boxplot(oz.ts~cycle(oz.ts), xlab="Months", ylab="Readings of Ozone (pphm)",  
        main="Monthly summary of averages of hourly readings  
        of Ozone in LA downtown")
```



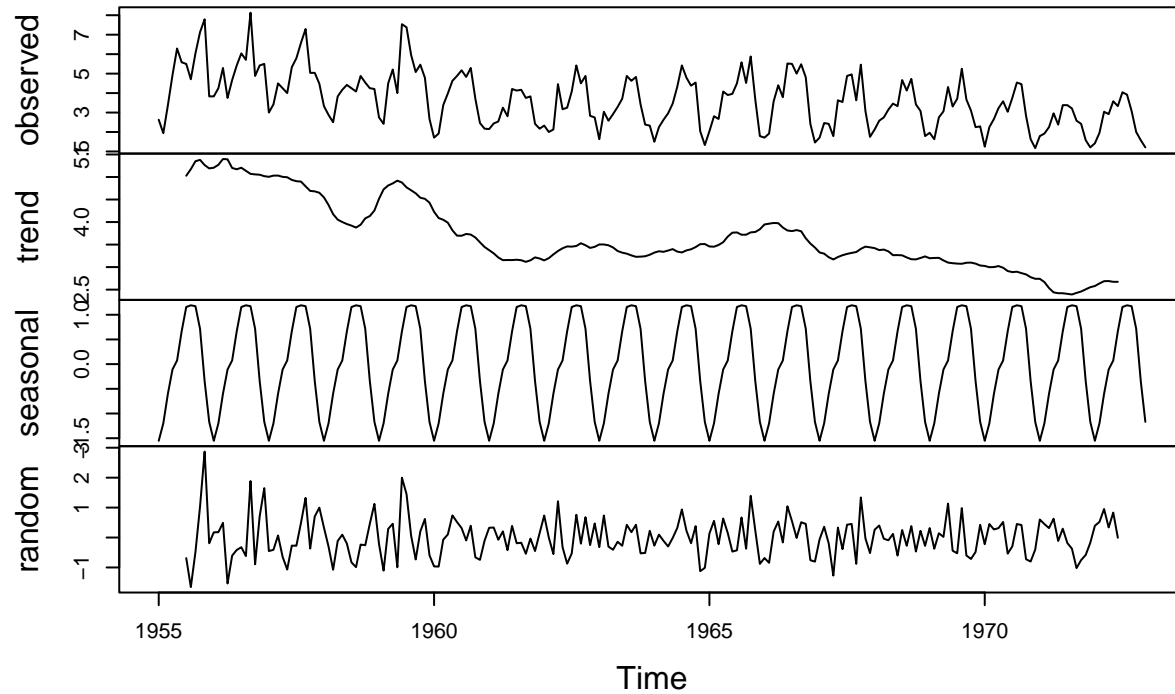
*# comment on observation*

*# I observed that there is seasonal effect, the values of readings are relative  
# high for 6-10 (summer) while the values are relative low for 1-3,12 (winter).*

(g)

```
plot(decompose(oz.ts))
```

### Decomposition of additive time series



```
# comment on observation
```

```
# Based on 'trend' part, I found that there is a decreasing trend.
```

```
# Based on 'seasonal' part, I found that there is a seasonal cycle.
```

```
# Based on 'random' part, I found that the variation between 1955 and 1960
```

```
# are relative large, while the variation between 1960 and 1972 are small.
```