STAT 443: Assignment 1

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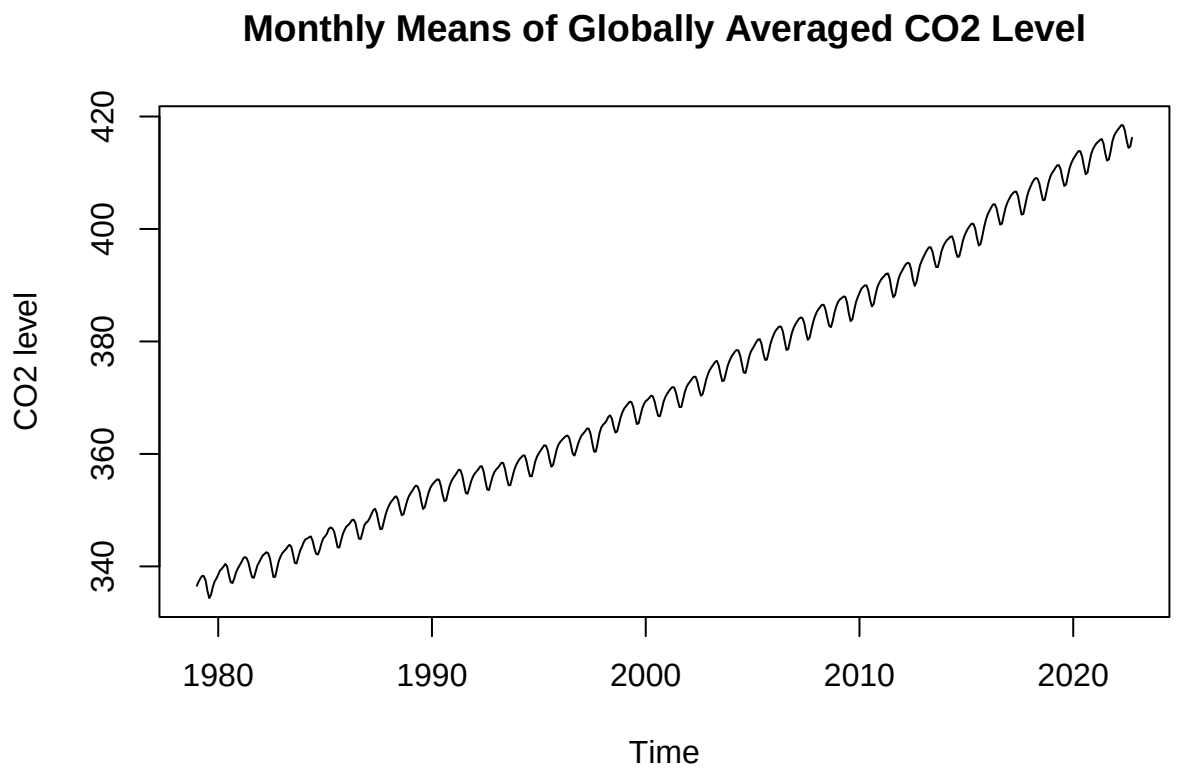
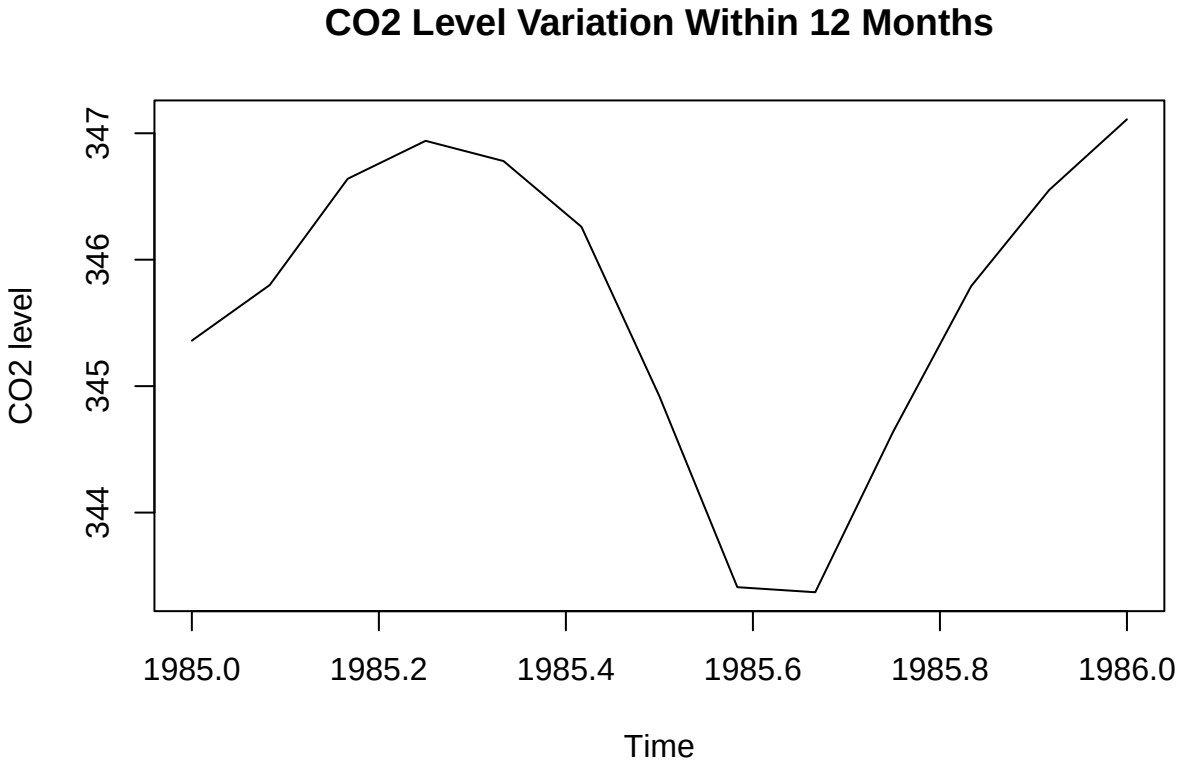
Question 1

a)

```
co2 <- read.csv("co2_mm_gl.csv", header = TRUE, skip = 55)
co2_ts <- ts(co2[,4], start = c(1979,1),frequency = 12)
plot(co2_ts,
     main = "Monthly Means of Globally Averaged CO2 Level",
     ylab = "CO2 level")
```




```
plot(window(co2_ts, start = c(1985,1),end = c(1986,1)),
     main = "CO2 Level Variation Within 12 Months",
     ylab = "CO2 level")
```



i) The above time series have a clear **upward trend** such that the monthly means of globally averaged CO2 level is increasing every year despite some variations.

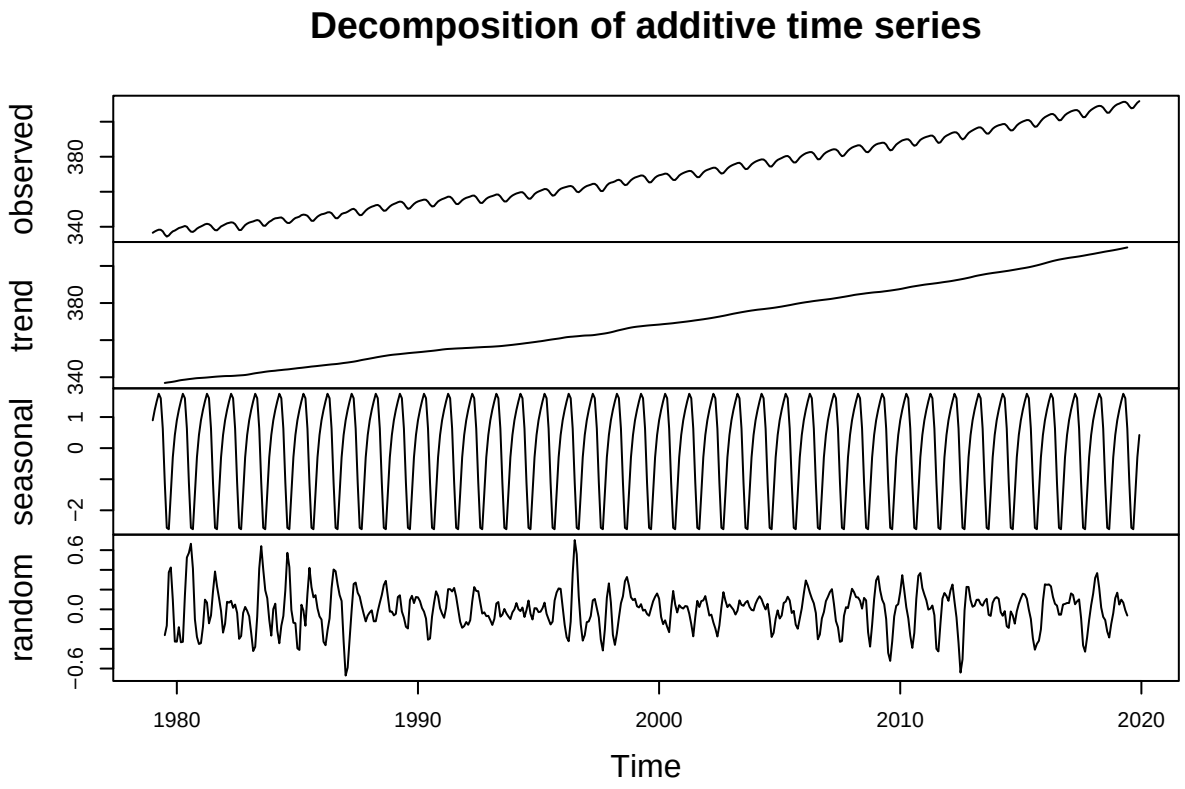
ii) There appears to be **seasonal variations** in the monthly CO2 level as when we restrict the plot to display the average CO2 level over a 12-month period, we can clear see the CO2 level is high around March and December, low around June.**An additive model is more suitable** as we can see the seasonal effect remains constant over time and the error is also constant over time, therefore an additive model would be more appropriate than a multiplicative model.

iii) **No**, the series have a clear upward increasing trend therefore it is not stationary.

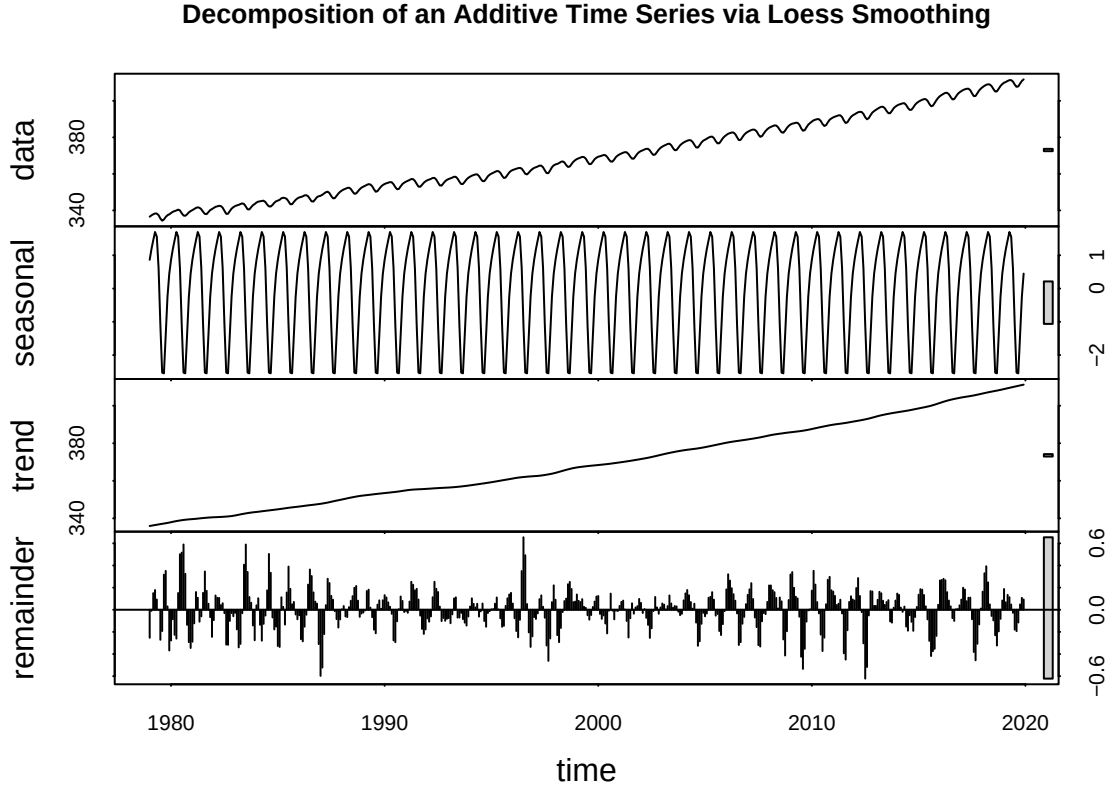
b)

```
co2_train <- window(co2_ts,start = c(1979,1),end = c(2019,12),frequency = 12)
co2_test <- window(co2_ts, start = c(2020,1), end = c(2022,10), frequency = 12)

co2_train_decom <- decompose(co2_train, type = "additive")
plot(co2_train_decom)
```




```
co2_train_loess <- stl(co2_train,s.window = "periodic")
plot(co2_train_loess,
     main = "Decomposition of an Additive Time Series via Loess Smoothing")
```



```r
# MA method
ma_trend <- co2_train_decom$trend
ma_seas <- co2_train_decom$seasonal
error <- co2_train_decom$random

# Loess smoothing
loess_trend <- co2_train_loess$time.series[,"trend"]
loess_seas <- co2_train_loess$time.series[,"seasonal"]
loess_error <- co2_train_loess$time.series[,"remainder"]
```