1. Based on your field of study, provide a Time Series example, and explain what benefits will you gain when knowing the future behavior of that variable?

**Time Series Decomposition**

1. Let’s decompose the time series co2 data set in R. Open a R Script and copy and paste following code in the R-Script (see the comments to understand what each line of code does)

### R Code for Time Series Decomposition ###

# Install “forecast” package if it is not already installed

if(!require(forecast)){install.packages("forecast")}

# Library for time series modeling

library(forecast)

# Time series decomposition function in R applied for co2 data set

decom = decompose(co2)

# Plot the decomposition of the co2 time series data

plot(decom)

1. **What is the frequency of measurement for co2 data set? (i.e., do we have daily, weekly, monthly, annual data?)**
2. **Copy and paste the Time Series Decomposition chart from R**

**Trend Forecast**

1. Let’s do some predictions using Trend Forecast for co2 data set in R. Open a R Script and copy and paste following code in the R-Script (see the comments to understand what each line of code does)

**### Trend Forecast: R Code with comments ###**

# Install “ggplot2” package if it is not already installed

if(!require(ggplot2)){install.packages("ggplot2")}

library(ggplot2)

library(forecast)

# Model with Linear Trend Model

co2\_lm = tslm(co2 ~ trend)

# Summary of the model

summary(co2\_lm)

# Forecast for next 120 time points (next 10 years)

forecast\_lm = forecast(co2\_lm, h = 120)

# Plot the time series with forecast

autoplot(forecast\_lm, PI=F, flwd=3)

1. **What is the regression equation for co2 dataset obtained from Trend model?**
2. **Interpret the slope of the line using your linear regression knowledge (hint: your time frequency is in months)**
3. **Using the regression equation, determine forecaste for co2 emission in the Feb-2000? (Hint: There are 494 months from Jan-1959 to Feb-2000)**
4. **Briefly explain why Trend model may not be suitable for co2 data set?**

**Trend + Season Forecast**

1. Let’s do some predictions using Trend+Season Forecast for co2 data set in R. Open a R Script and copy and paste following code in the R-Script (see the comments to understand what each line of code does)

**###Trend+Seasonal Forecast: R Code###**

library(forecast)

library(ggplot2)

# Model for Trend + Seasons (season mean model)

linear\_season\_lm = tslm(co2 ~ trend + season)

# Summary of the model

summary(linear\_season\_lm)

# Forecast for next 120 months

forecast\_lm = forecast(linear\_season\_lm ,h = 120)

# Plot the forecast

autoplot(forecast\_lm,PI=F,flwd=2)

1. **Write down the regression equation for this model**
2. **Using the regression equation determine forecasted co2 emission in the Feb-2000?**

**Autocorrelation**

1. Find the autocorrelation of following numbers using R and include the autocorrelation plot

(Refer to autocorrelation slide)

**###Autocorrelation R Code###**

y = c(4,10,5,11,6,12,4,16,5)

**Stationarity**

1. Do the following time series plots look stationary or nonstationary? Explain.

|  |  |
| --- | --- |
|  |  |
| A picture containing antenna  Description automatically generated | Chart  Description automatically generated |