1. Carry out the following exploratory time series analysis in R using the beer product in section 1.4.3.
   Data File Table cbe.dat attached.
   (a) EDA - produce a time plot of the data. Plot the aggregate annual series and boxplot that summaries the observed values for each season, and comment on the plots.
   (b) Decompose using both methods the series into the components trend, seasonal effect, and residuals, and plot the decomposed series. Produced a plot of the trend with a superimposed seasonal effect.
   (c) Compare the two results by different decomposition methods above (b). Which method make more sense and why.

2. **calculate sample autocorrelation**
   you are given the following ordered sample of size 6 from a time series

   1 1.5 1.6 1.4 1.5 1.7

   Calculate the sample lag 2 autocorrelation.

3. **calculation of forecast error** You are given:
   i The random walk model

   $$y_t = y_0 + c_1 + c_2 + \ldots + c_t$$

   where $c_t, t = 0, 1, 2, \ldots, T$ denote observations from a white noise process,
   ii The following nine observed values of c_t:

t	11	12	13	14	15	16	17	18	19
c_t	2	3	5	3	4	2	4	1	2

   iii The average value of $c_1, c_2, \ldots, c_{10}$ is 2.
   iv The 9 step ahead forecast of $y_{19}, \hat{y}_{19}$, is estimated based on the observed value of y_{10}

   calculate the forecast error, $y_{19} - \hat{y}_{19}$

4. **forecast an AR(1) model** An AR(1) model was fit to the following time series data through time $t = 7$.
   - The mean was subtracted from the data before the parameter was estimated.
   - The estimated parameter for the model is -0.79.

time(t)	y_t
1	8.7
2	7.0
3	8.6
4	7.4
5	8.3
6	7.6
7	8.5
mean	8.01

Calculate the forecast for the observation at $t = 9$, $\hat{y}_9$.

5. Use data set Global.dat attached for the following exercise.

   Create a time series $\{x_t\}$ object starting date of 1856 January and the ending date of 2005 December.

   (a) You are interested at the annual temperature, plot the annual average temperature from 1900 to 2005.

   (b) Suppose that you are interested to look at more recent the annual temperature from 1950 to 2005, please create a new annual temperature time series $\{x_t\}$ by first extracting data (using window() function) from $\{x_t\}$ and second aggregating the series into an annual time series. Plot the new series average annual temperature. Also superimpose a line using regression of the annual temperature on the new series.

   (c) Please fit the new annual Global Temperature series $\{x_t\}$ from 1950 to 2005 using the following model.

   $$y_t = \alpha + \beta t + z_t$$

   Report the coefficient estimates and the associated confidence intervals.

   (d) Please estimate ρ_1 of z_t obtained from (b).

   (e) Please fit a GLS model with $AR(1)$ residual correlation to y_t from 1950 to 2005. Report the coefficient estimates and the associated confidence intervals.

   (f) Please overlay the GLS fitted series $\hat{y}_t$ from 1950 to 2005 as a fitted line to your graph in (b). Commenting on the gls line and the regression line in did before in (b).