1 Summary

1. Why do we care about time series?
   (a) In regression, we assume the residuals are independent of one another
   (b) This assumption/condition can break down for time series data
   (c) Inference gets worse with larger sample sizes
   (d) Before working with time-series regression models, have to learn about univariate time series first
2. Time series plots: look for trend, seasonality and interventions (sudden jumps)
3. The additive decomposition is given by

$$x_t = m_t + s_t + z_t$$

   where m_t is the trend, s_t is the seasonal, and z_t is the random component
   (a) Let $\widehat{m}_t$ be an estimate of the trend component. The seasonal (additive) effect is given by

$$\widehat{s}_t = x_t - \widehat{m}_t$$

   (b) $\overline{s}_t$ is the average of the $\widehat{s}_t$ in each seasonal period (eg month)
   (c) The seasonally adjusted series is given by $x_t - \overline{s}_t$
   (d) The random/error component is given by $x_t - \widehat{m}_t - \overline{s}_t$
4. Seasonal vs. Cyclic
   (a) Seasonality occurs reliability according to a calendar
   (b) Cyclic effects are over longer periods and don't always occur according to a calendar (usually a function and defined by other variables)

2 Air Passengers

The workspace *AirPassengers* contains monthly totals of international airline passengers.

1. The data are loaded (fuzzy loading) when R begins, type *AirPassengers* in the command line to see the data. I also suggest that you read the help documentation.

2. Use the functions *class* and *is.ts* to verify the data are time series. You can also examine the structure of the data.

3. The functions *start*, *end* and *frequency* give information about the series. What do these functions tell you about the series?

4. Make a plot of the time series. Comment on the trend and seasonality.

5. Use the function *aggregate* to create a time series object for the annual number of passengers. Plot this series, what trends do you observe?

6. Working with the original data, use the function *cycle* to extract the seasons of the time series (eg months). Using this, make a boxplot of the number of passengers each month.

7. Obtain and plot an additive decomposition of the series. Comment on the trend, seasonality, and random components.