ARIMA\((p, d, q) (P, D, Q)_s\)

**Learning Outcomes**

- Analysing a time series.
- Selecting the best ARIMA model using BIC and/or AIC.

1. To fit the model ARIMA\((p = 1, d = 1, q = 0) (P = 0, D = 1, Q = 0)_{12}\) to beer data, type:

```r
arima(beer, order = c(1, 1, 0), seasonal = list(order = c(0, 1, 0), period = 12))
```

In the output, BIC and AIC are given: select the ARIMA model (i.e. find the coefficients \((p, d, q)(P, D, Q)_s\)) that minimizes either AIC or BIC for the beer. Here are a few rules:

(a) Always plot the data.

(b) Estimate the ACF and PACF. Decide on transformation, trend removal, seasonal pattern removal, etc. One way to do that is to start with all coefficients equal to 0, and visualise the residuals:

```r
tsdisplay(arima(beer, order = c(0, 0, 0), seasonal = list(order = c(0,0, 0), period=12))$residuals)
```

Then depending on your interpretation of the residuals behavior, their ACF and PACF, change the coefficients until you are satisfied. You can also look at the BIC or AIC in the output to check that any of your change is improving the fit.

2. Compare your answers with the solution given by the machine e.g.:

```r
auto.arima(beer)
```

3. Other time series:

- `housing[,1]`
- `housing[,2]`
- `housing[,3]`
- `hsales`
- `milk`
- `labour`