6 Simple Forecasting Methods

Later in the course we will consider sophisticated forecasting methods but in this topic we look at two very simple methods.

6.1 Extrapolating Regressions

If we have trends and cycles in a data set, one natural way to forecast the future would be to fit (using ordinary least squares methods), for example, a regression model of the form

\[ x(t) = \beta_0 + \beta_1 t + \beta_2 \cos(2\pi(t-1)/d) + \beta_3 \sin(2\pi(t-1)/d) + \epsilon(t), \]

to get \( \hat{\beta} \)'s as estimates of the \( \beta \)'s, and then get as forecasts

\[ \hat{x}(t) = \hat{\beta}_0 + \hat{\beta}_1 t + \hat{\beta}_2 \cos(2\pi(t-1)/d) + \hat{\beta}_3 \sin(2\pi(t-1)/d), \]

for \( t = n + 1, n + 2, \ldots \). As always, it is dangerous to extrapolate a regression outside the range of the independent variable (\( t \) in this case), but if you feel the trend and cycle will continue, this is a simple way to forecast the future.
6.2 Inverse Differencing

Another way to remove trends and cycles is by differencing. For example, for the log of the airline data (call it $x$), one typically does 1st and 12th differencing, giving a new data set $w(1), \ldots, w(n-13)$ where

$$w(t) = x(t+13) - x(t+12) - x(t+1) + x(t),$$

which substituting $n+1$ for $t+13$, would mean

$$x(n+1) = w(n-12) + x(n) + x(n-11) - x(n-12).$$

Thus one forecast for $x(n+1)$ would be obtained by substituting $\bar{w}$ for $w(n-12)$ and the known values of the three $x$’s to get

$$\hat{x}(n+1) = \bar{w} + x(n) + x(n-11) - x(n-12).$$

The next $x$ depends on the unknown $w(n-11)$ (for which we could again substitute $\bar{w}$), the unknown $x(n+1)$ (for which we can substitute the $\hat{x}(n+1)$ which we just calculated), and the known $x(n-10)$ and $x(n-11)$, to get

$$\hat{x}(n+2) = \bar{w} + \hat{x}(n+1) + x(n-10) - x(n-11).$$

We can continue this process recursively.

Later we will fit time series models to the $w$ series and use these models to get forecasts of the unknown $w$’s to substitute into the forecast formulas for $x$. 