Lesson 2.2

Decomposition Methods used by Statistical Agencies

Introduction

Official statistics agencies (such as the US Census Bureau and the Australian Bureau of Statistics) are responsible for a large number of official economic and social time series. These agencies have developed their own decomposition procedures which are used for seasonal adjustment. Most of them use variants of the X-11 method, or the SEATS method, or a combination of the two. These methods are designed specifically to work with quarterly and monthly data, which are the most common series handled by official statistics agencies. They will not handle seasonality of other kinds, such as daily data, or hourly data, or weekly data.

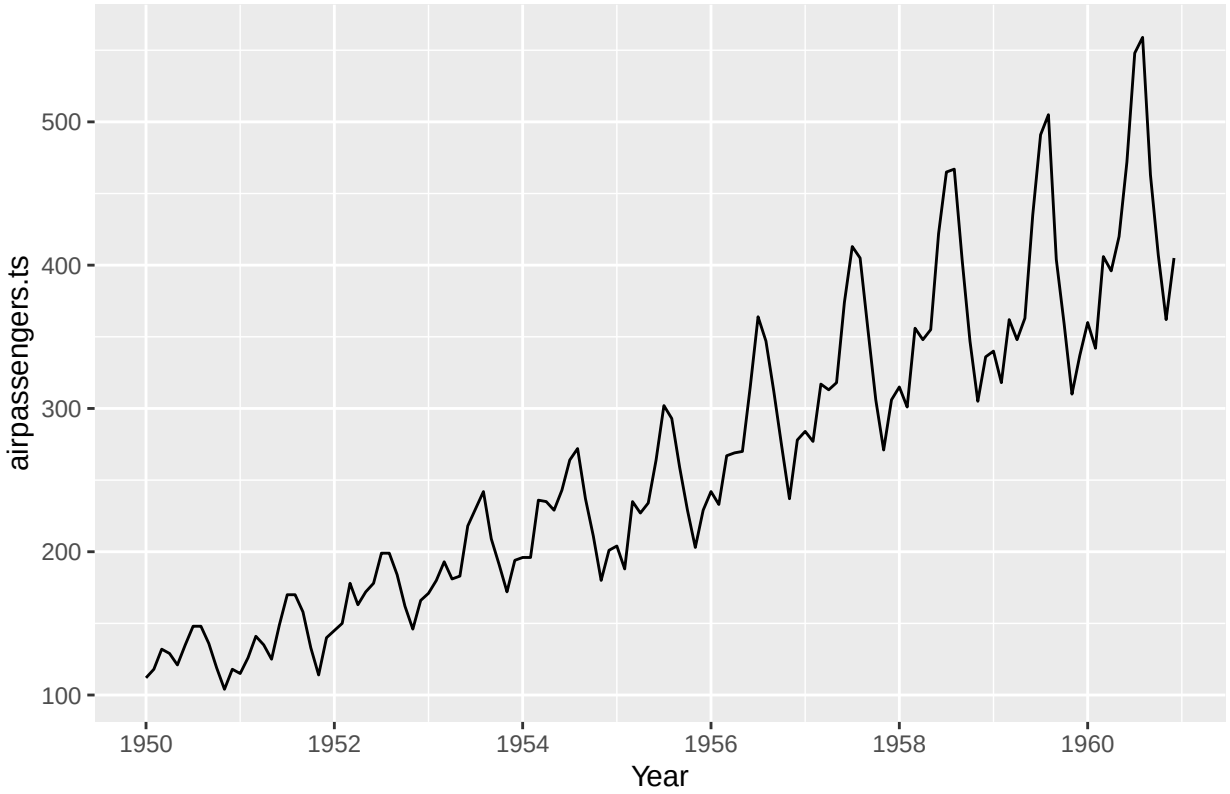
X11 decomposition

Another popular method for decomposing quarterly and monthly data is the X11 method which originated in the US Census Bureau and Statistics Canada. It involves many extra steps and features in order to overcome the drawbacks of classical decomposition. Consequently, trend-cycle estimates are available for all time periods and the seasonal component is allowed to vary slowly over time. Finally, it is highly robust to outliers and level shifts in the time series.

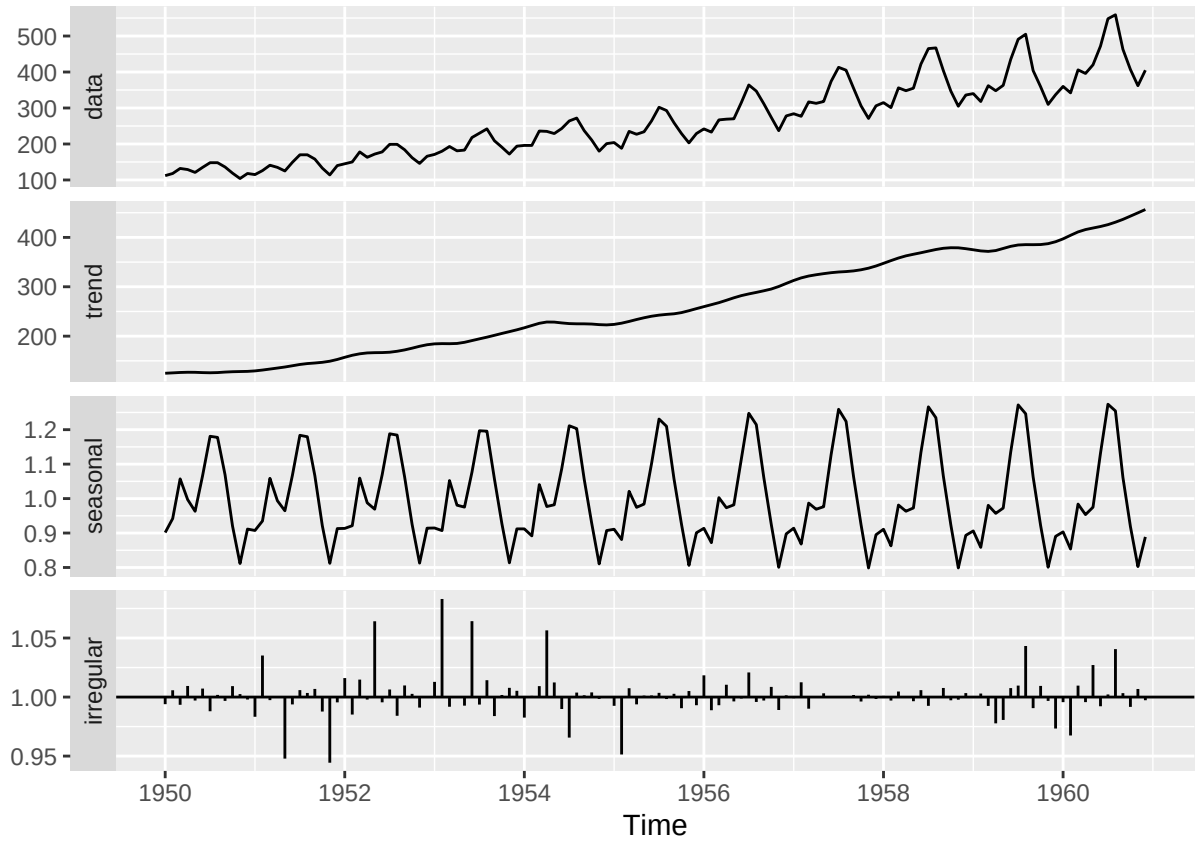
It has sophisticated methods for handling trading day variation, holiday effects and the effects of known predictors. It can also handle both additive and multiplicative decomposition.

The X11 method is available using the *seas()* function from the **seasonal** package

```
library(fpp2)
library(seasonal)
airpassengers <- read.csv("AirPassengers.csv")
airpassengers.ts <- ts(airpassengers$Passengers,
                frequency = 12,
                start = c(1950, 1),
                end = c(1960, 12))
autoplot(airpassengers.ts) + xlab("Year")
```




```
airpassengers.x11 <- seas(airpassengers.ts, x11="")
autoplot(airpassengers.x11)
```

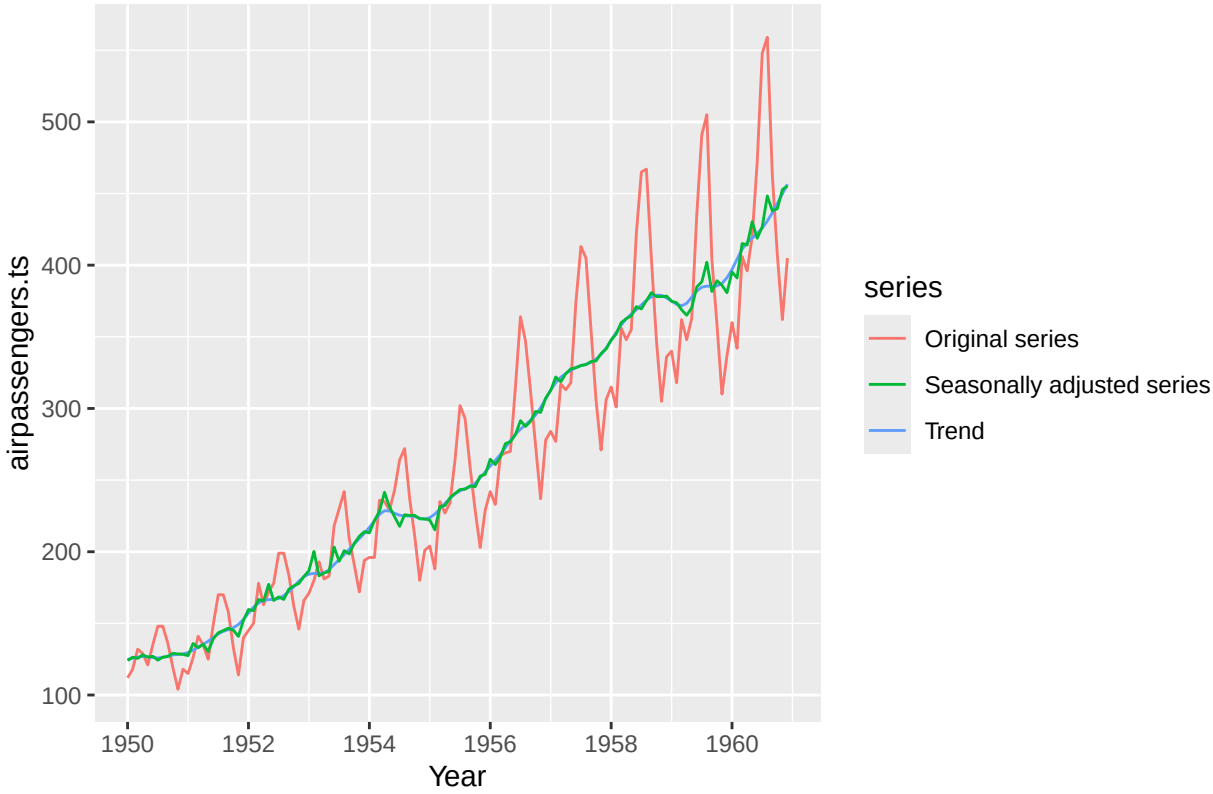


Given the output from the *seas()* function, we can use

- *seasonal()* to extract the seasonal component
- *trendcycle()* to extract the trend-cycle component
- *remainder()* to extract the remainder component
- *seasadj()* to compute the seasonally adjusted time series

The following code chunk will plot the original series together with the trend component and the seasonally adjusted series

```
autoplot(airpassengers.ts, series="Original series") +
  autolayer(trendcycle(airpassengers.x11), series="Trend") +
  autolayer(seasadj(airpassengers.x11), series="Seasonally adjusted series") +
  xlab("Year")
```

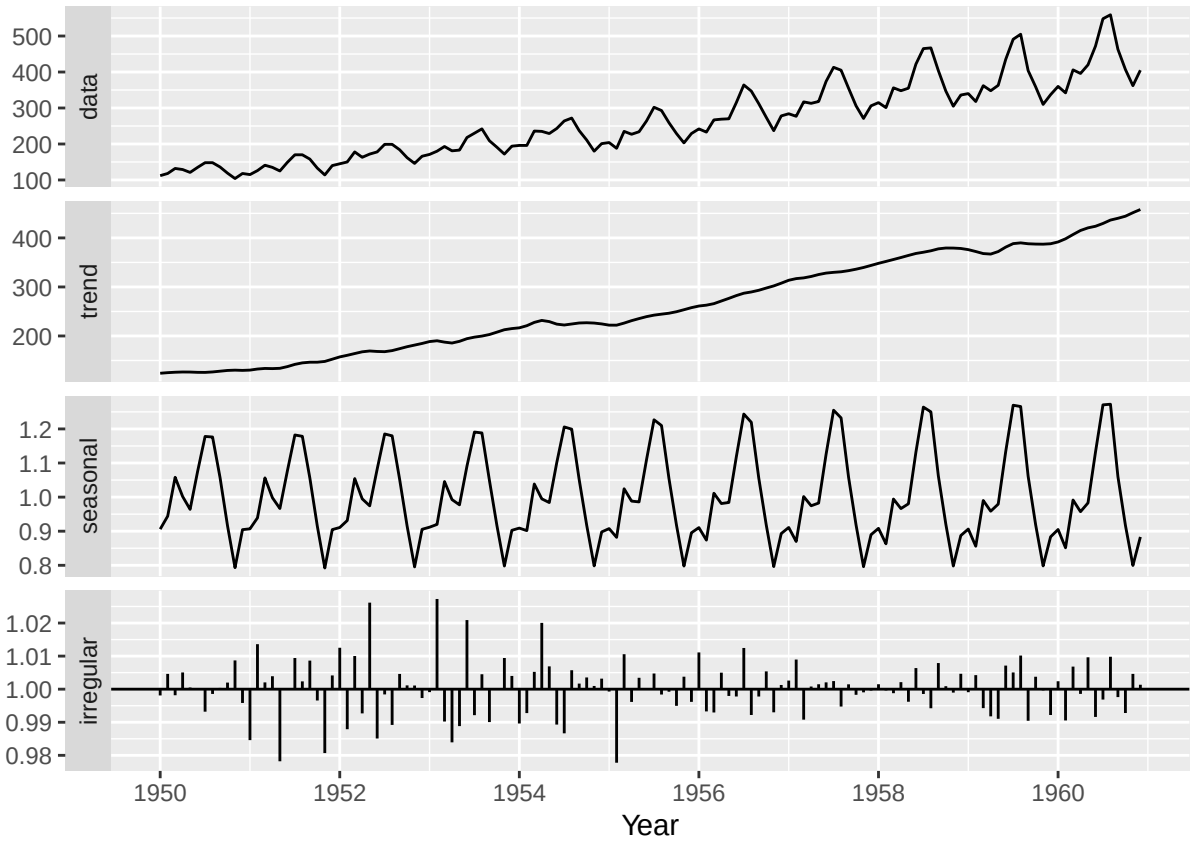


SEATS decomposition

Another method of decomposing a time series is SEATS. It stands for "Seasonal Extraction in ARIMA Time Series". Unfortunately, it only works with quarterly and monthly data.

It uses the same functions to extract the components and the seasonally adjusted series

```
airpassengers.seats <- seas(airpassengers.ts)
autoplot(airpassengers.seats) +
  xlab("Year")
```



As with the X11 method, we can use the *seasonal()*, *trendcycle()*, and *remainder()* functions to extract the individual components, and *seasadj()* to compute the seasonally adjusted time series.

The seasonal package has many options for handling variations of X11 and SEATS. See the package website for a detailed introduction to the options and features available.

Finally, note that both X11 and SEATS methods can handle additive and multiplicative models.