

# International Airline Passengers

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library(fpp2)
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1. Describe the monthly totals of international airline passengers from 1949 to 1960 (see Lecture\_Notes\_1) using its historical plot.

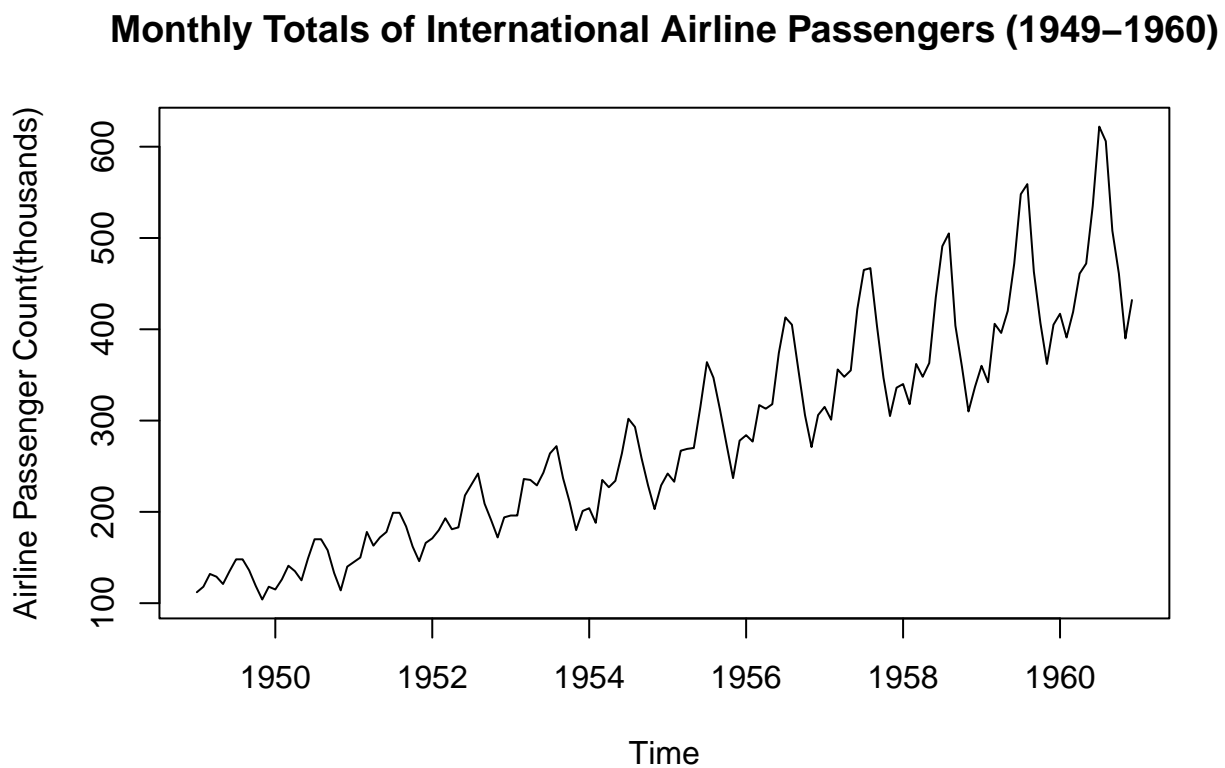


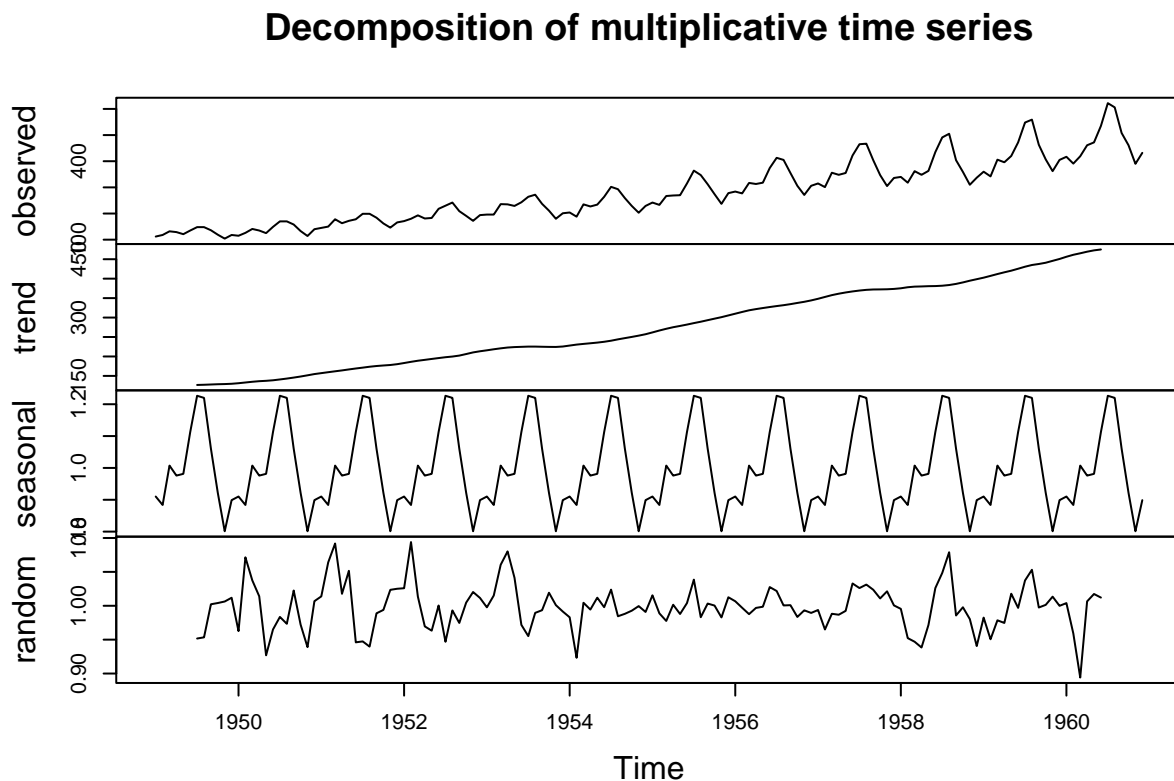
Figure 1: Monthly Totals of International Airline Passengers 1949 to 1960 (Box, Jenkins and Reinsel,1976).

A consistent upward trend is the first description one can tell by observing the historical plot of the monthly totals of international airline passengers from the year 1949 to 1960. It shows the number of international airline passengers in thousands on the y-axis and time (in years) on the x-axis. In the range of a few hundred thousand to a million passengers per month, the plot started in the year 1949 with a relatively low number of international airline passengers. As you move along time, one would observe fluctuations in passenger

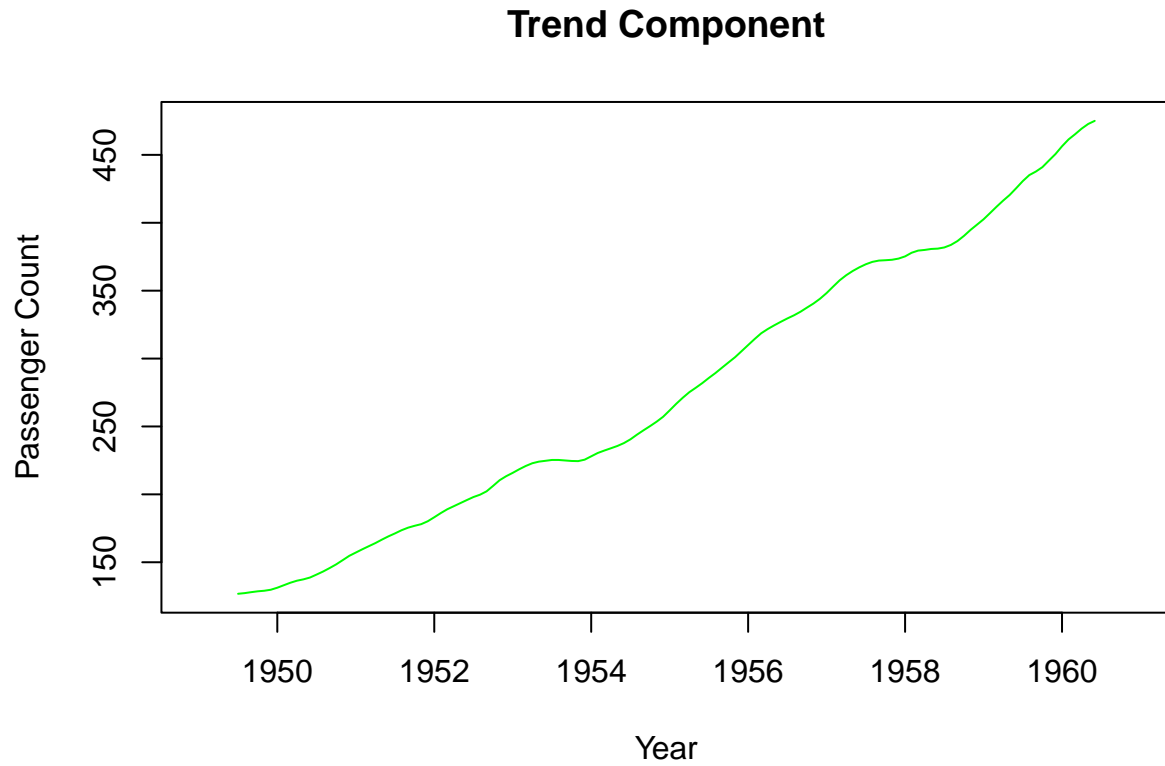
numbers may it be decreasing and increasing by month. Over the years, seasonal patterns emerge with peaks during certain months. These peaks would result in spikes in the plot. There is a noticeable increase in passenger numbers during the summer months and dips during the off-peak seasons such the months of July and August as the peak months which is summer in the US according to my research. As it progress through the later years, every month on top of the upward trend there is growth. It increased over time year on year without any fail. Towards the end of the 1960s, a steeper upward slope in the plot was observed, indicating a rapid increase in international airline passengers. Overall, the historical plot visually depicted the growth and fluctuations in international airline passenger numbers over the time of the 1949 to 1960 period, with not just a pattern of trend and season but there was exponential growth.

## 2. Apply appropriate decomposition.

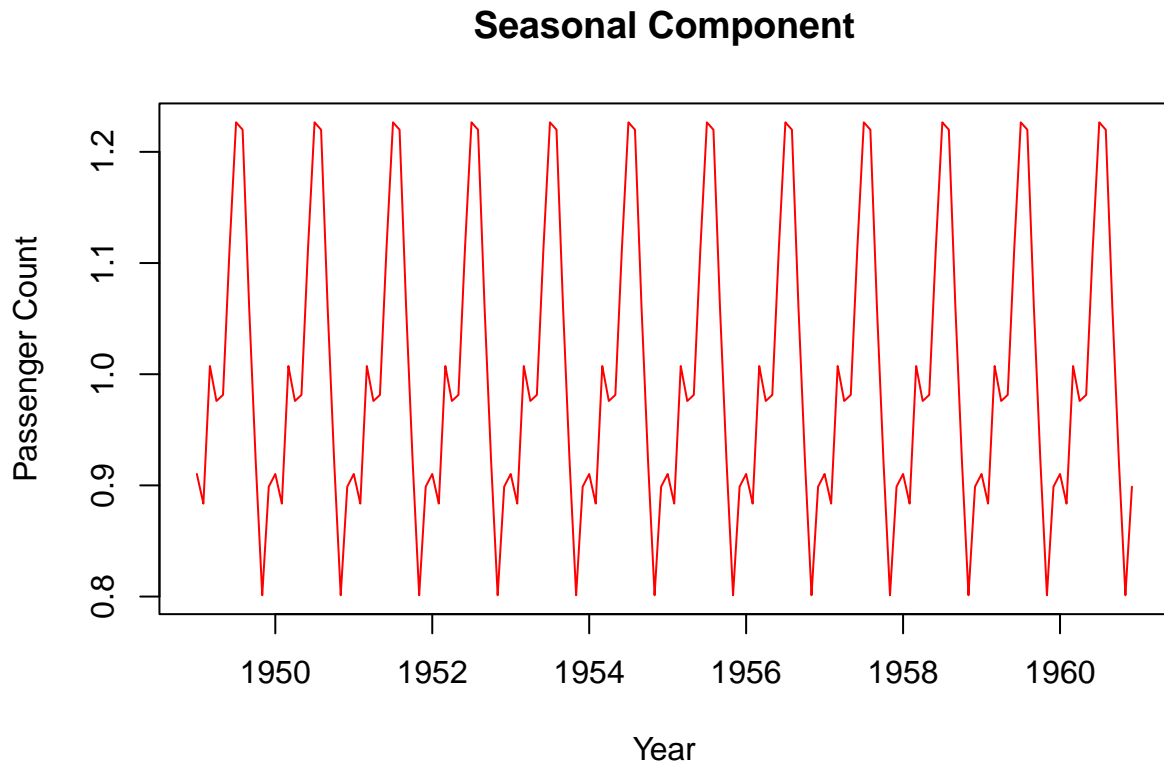
To better explain the underlying patterns and variations of the original time series, one can visually observe the plot as a time series to identify any apparent patterns or to get a sense of its overall trend and seasonality. Now, with Figure 1 showing a time series with trend and seasonality in which the number of passengers increase so as with the pattern of the seasonality overtime as it moves along with the increasing trend then in this time series the Multiplicative Model is used. For it has been discussed that the Multiplicative model is used when the peak of the seasonality changes in this one it is increasing overtime and it moves along with the trend. With the decomposition, it decomposes the time series into components such as the trend, seasonality, and random components which can be plotted separately to visualize each one. Thus, it has an equation of the product of the trend-cycle component times the seasonal component times the irregular or the random component in which we can identify if there are any significant trends over time, the pattern of seasonality, and whether there are any unusual spikes or drops in the residual component.



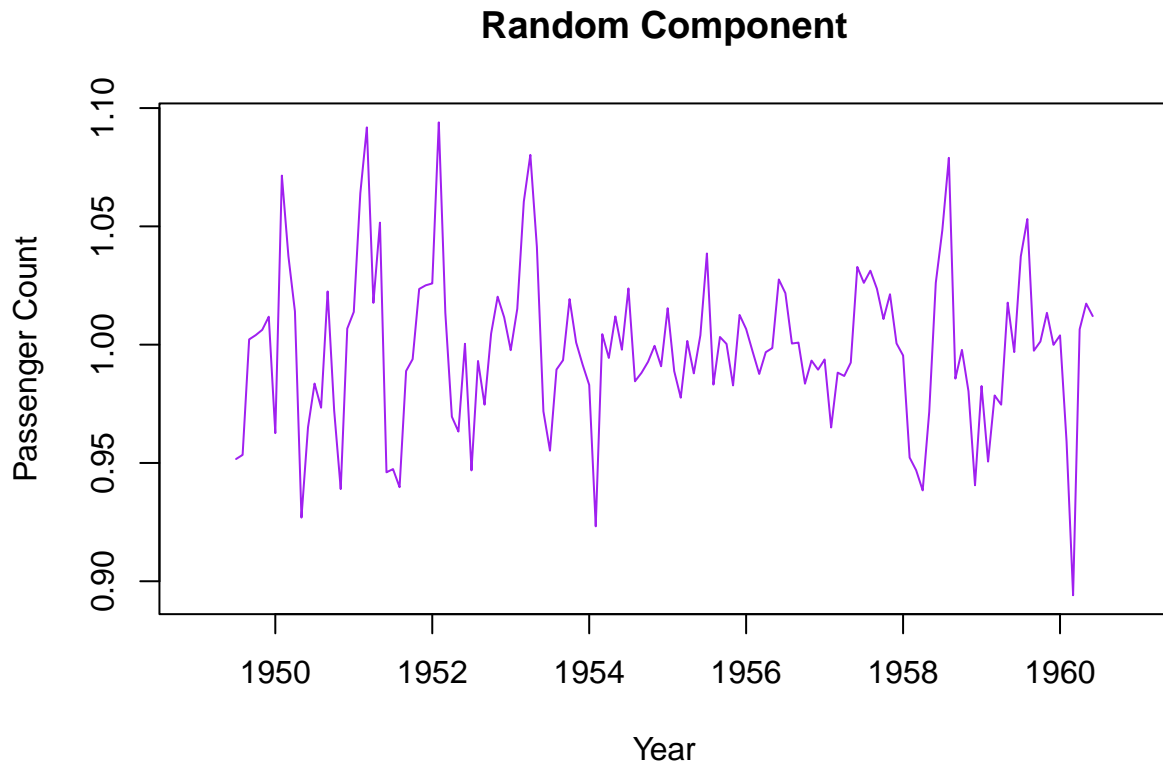
### 3. Describe its components.



1. **Trend Component:** By definition, the trend component represents the long-term direction or movement in the data. With the plot, we can depict that the trend is increasing, hence there is a general upward movement in the passenger counts over the years, indicating growth in international air travel. To visualize we see a line, a little curve, going in an upward direction that reflects the long run of growth in this time series.



2. **Seasonal Component:** As for the seasonal component it can be seen that there are recurring patterns or cycles in the data that repeat at regular intervals. As the peaks in the seasonal component correspond that there are higher passenger counts during the summer vacation season which is in the month of July and August and lower counts during the off-peak months which repeat yearly basis.



3. **Residual Component (Error):** A series of data points with no clear trend or seasonality is the residual component. In the plot it shows, that it is more random rather than a consistent pattern. Large spikes or deviations in the residual component of the year 1949 to 1954 and the year 1958-1960 might indicate unusual events or outliers, wherein the error is much smaller between the range.

Moreover, for the shift in pattern, the trend changes can be identified by cycles or a long-term change in the pattern. Regarding this instance, the trend seems to be unchanged. However, we can also see that the season varies over time. In contrast to early years, bigger spikes were seen in years that followed. This might imply that the seasonal effects follow the upward trend.