

# Technical note on seasonal adjustment for Port traffic

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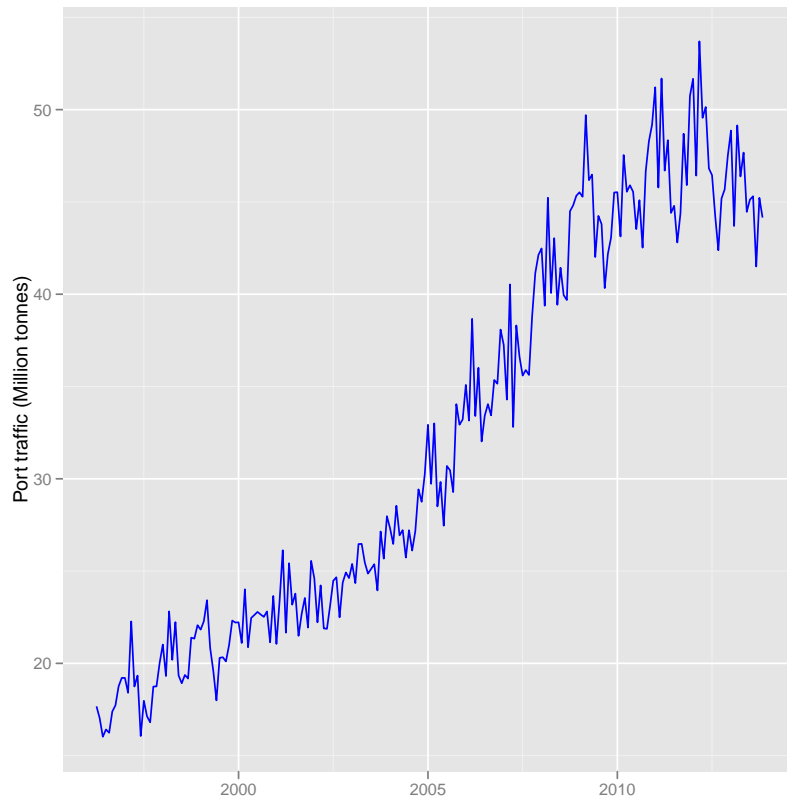
## 1 Port traffic

We analyse the monthly data for total commodity port traffic from April, 1995 onwards. Figure 1 below shows the original plot of port traffic. The plot shows seasonal peaks. In a non-seasonally adjusted series, it is difficult to discern a trend as the seasonal variations may mask the important characteristics of a time series.

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**Figure 1** Port traffic (Non seasonally adjusted)

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## 2 Additive versus multiplicative seasonality

X-12-ARIMA has the capability to determine the mode of the seasonal adjustment decomposition to be performed i.e whether multiplicative or additive seasonal adjustment decomposition is appropriate for the series. For port traffic, multiplicative seasonal adjustment is considered appropriate on the basis of the model selection criteria and diagnostic checks.

## 3 Steps in the seasonal adjustment procedure

Given that seasonality exists, it is important to model seasonality before the application of seasonal adjustment procedure. Seasonality in time series can be deterministic or stochastic.

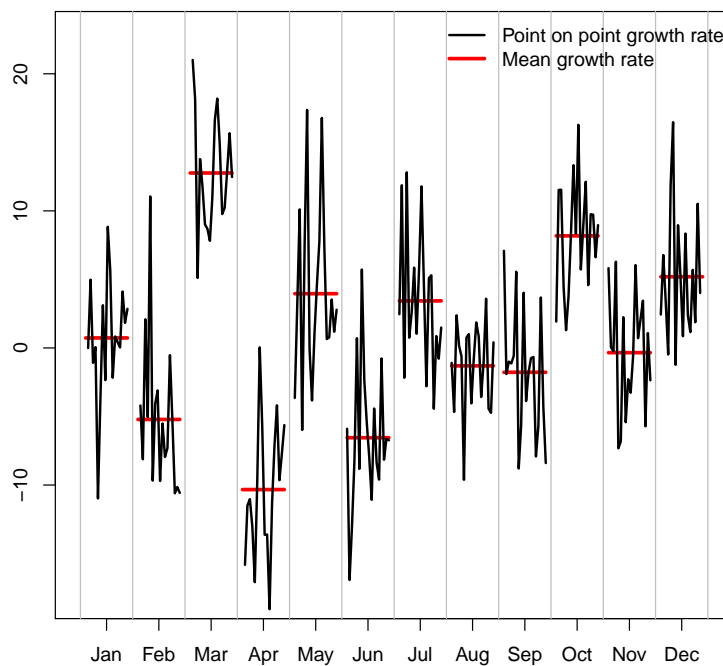
Stochastic seasonality can be stationary or non-stationary.

A visually appealing way of looking at the raw data is to plot the growth rates in each of the months across the years i.e the growth of April over March in each of the years from 1995 onwards. This gives us some idea of the presence of seasonal peaks, if any in the series. The nature of seasonality can also be inferred intuitively from the plot before the application of the testing procedures.

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**Figure 2** Monthly growth rates across the years

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Presence of seasonal variations can be inferred from Figure 2, since the monthly means of growth rates across the years are not uniform. The month of March, for instance, shows a seasonal peak.

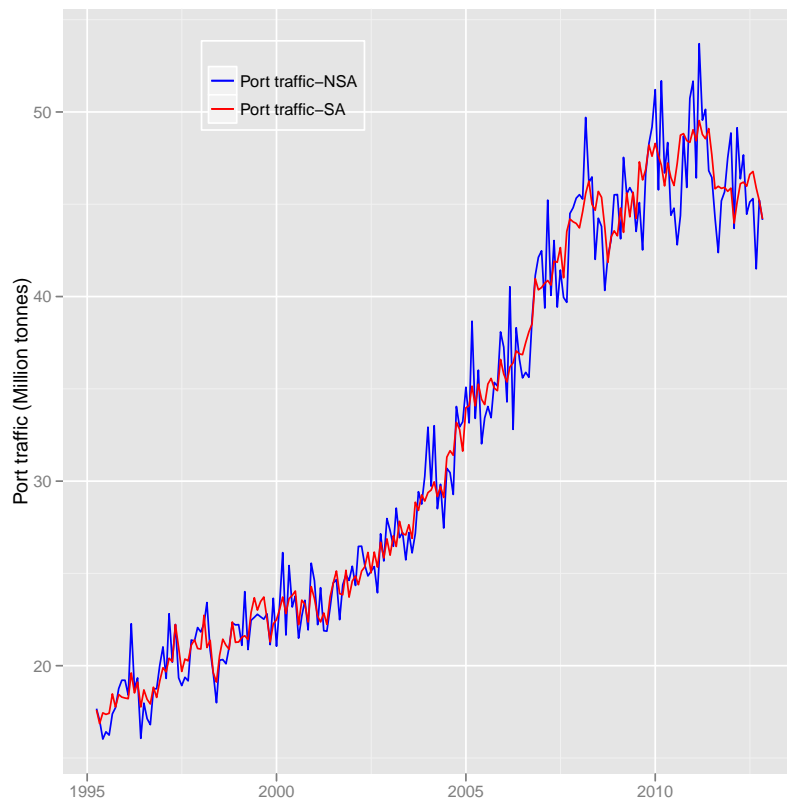
### 3.1 Seasonal adjustment of Port traffic with X-12-ARIMA

Seasonal adjustment is done with X-12-ARIMA method.

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**Figure 3** Port traffic (NSA and SA)

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Figure 3 shows the non-seasonally and seasonally adjusted port traffic. The plot reveals that the seasonal peaks are dampened after seasonal adjustment.

## 3.2 Diagnostic checks

After seasonal adjustment, a series of diagnostic checks are performed through relevant tests and quality assessment statistics.

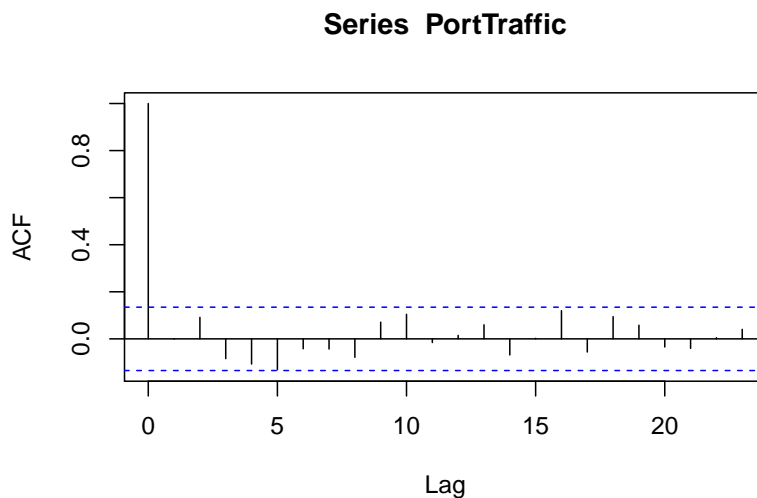
### 3.2.1 Validation of the automodel choice by X-12-ARIMA

A test of validation of the auto model choice by X-12-ARIMA is the randomness of residuals of the fitted ARIMA model. The Ljung-Box test is conducted on the residuals of the fitted ARIMA model to check whether or not the residuals are white noise. The ACFs of the residuals are plotted to check for randomness. Figure 4 reveals absence of autocorrelation amongst the residuals.

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**Figure 4** ACF of residuals

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### 3.2.2 Presence of identifiable seasonality

The statistic M7 shows the amount of moving seasonality present relative to stable seasonality. It shows the combined result for the test of stable and moving seasonality in the series. A value lesser than 1 is desirable to show identifiable seasonality in the series. The value of M7 for port traffic is 0.389 .

*Port traffic series shows identifiable seasonality on the basis of the M7 statistic.*

## 4 Spectral representation

Figure 5 shows the spectral plot of the growth rate of the unadjusted and seasonally adjusted series. Spectral plot, an important tool of the frequency domain analysis shows the portion of variance contributed by cycles of different frequencies.

The x-axis represent frequency from 0 to  $\pi$  (3.14). The seasonal frequencies are  $\pi/6$  (0.52 on the x-axis),  $\pi/3$  (1.04 on the x-axis) ,  $\pi/2$  (1.57 on the x-axis),  $2\pi/3$  (2.09 on the x-axis) and  $5\pi/6$  (2.6 on the x-axis). In terms of periods (months); they are 12 months, 6 months, 4 months, 3 months and 2.4 months.

The figure at the lower panel shows that peaks at seasonal frequencies are eliminated after seasonal adjustment. For example the peaks at 0.52 and 2.6 corresponding to 12 months, 2.4 months respectively, are eliminated after seasonal adjustment. Other peaks seen in the lower panel of the figure are not at seasonal frequencies.

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**Figure 5** Port traffic spectral plot (NSA and SA)

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