

# Technical Note on Seasonal Adjustment for Index of Industrial Production

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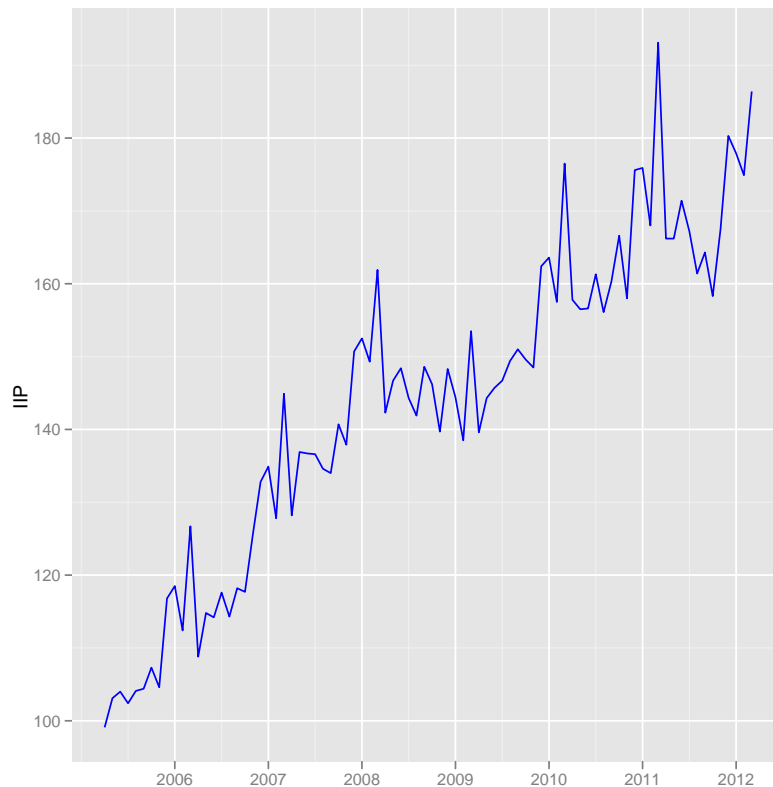
# 1 Index of Industrial Production

We analyse the monthly data for IIP from April, 1994 onwards. Figure 1 below shows the original plot of IIP. 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** IIP (Non Seasonally Adjusted)

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## 2 Steps in the Seasonal Adjustment Procedure

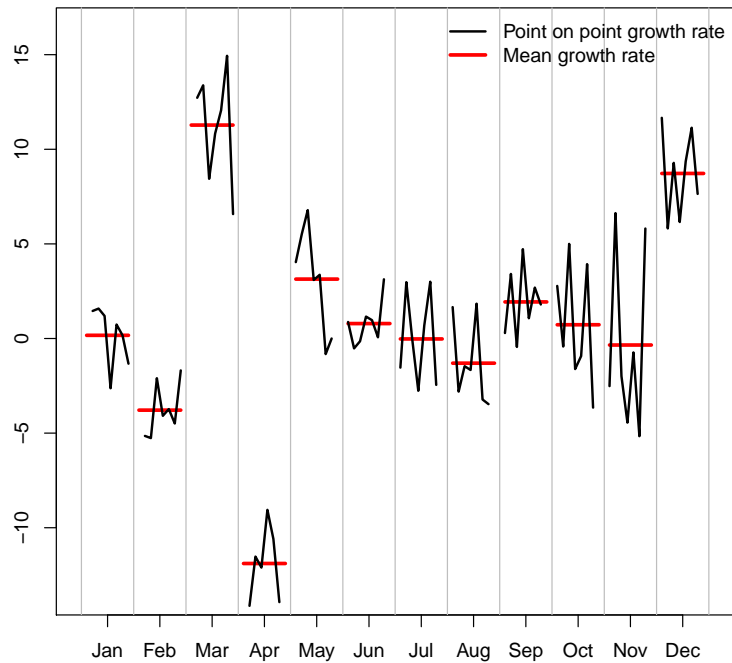
Given that seasonality exists, it is important to model seasonality before the application of seasonal adjustment procedure. Seasonality in time series can be deterministic or stochastic. Stochastic seasonality can be stationary or non-stationary.

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 2005 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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Figure 2 shows seasonal peaks in the month of March and December. The growth rates in each of the months across the years are not stable. Intuitively, seasonality in the series cannot be captured by seasonal dummy.

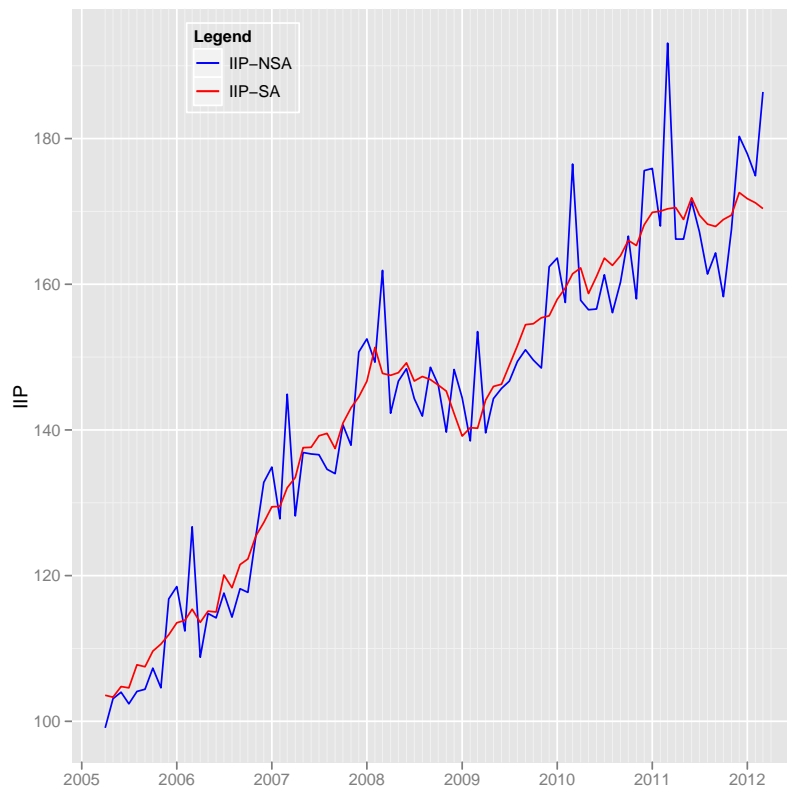
## 2.1 Seasonal Adjustment of IIP with X-12-ARIMA

Seasonal adjustment is done with X-12-ARIMA method. Since the test results point towards stochastic seasonality, seasonal dummy is not added in the regARIMA specification.

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**Figure 3** IIP (NSA and SA)

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Figure 3 shows the plot of the non seasonally and seasonally adjusted series. The plot reveals that the seasonal peaks are dampened after seasonal adjustment.

## 2.2 Diagnostic Checks

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

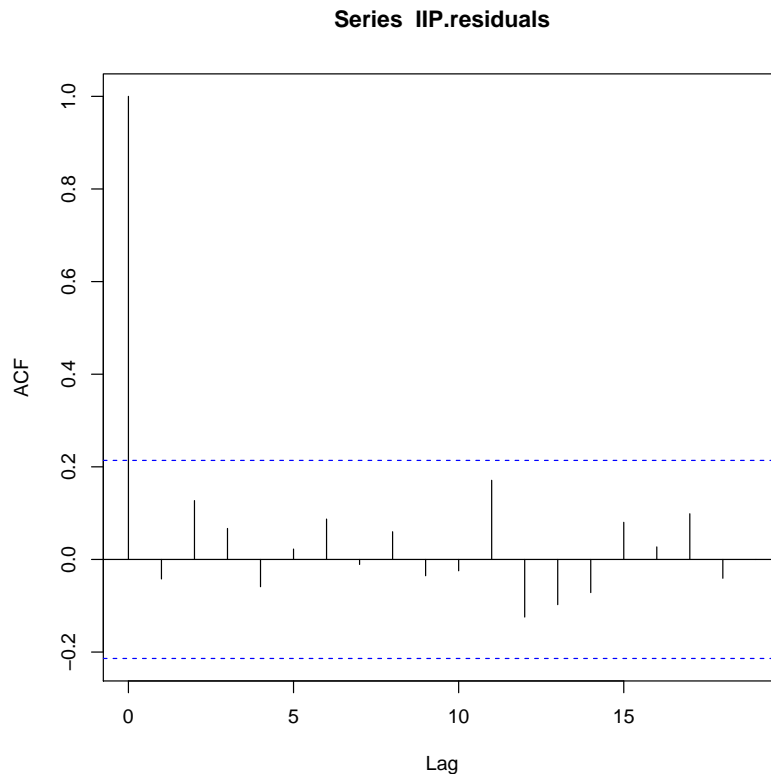
### 2.2.1 Validation of the automodel choice by X-12-ARIMA

A test of validation of the auto model choice by X-12-ARIMA is the randomness of the residuals of the 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.

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**Figure 4** ACF of residuals

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*The figure 4 does not reveal significant autocorrelation amongst the residuals.*

### 2.2.2 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 0.7 is desirable to show identifiable seasonality in the series. The value for IIP is 0.305.

*IIP series show identifiable seasonality on the basis of the M7 statistic.*

### 2.3 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.

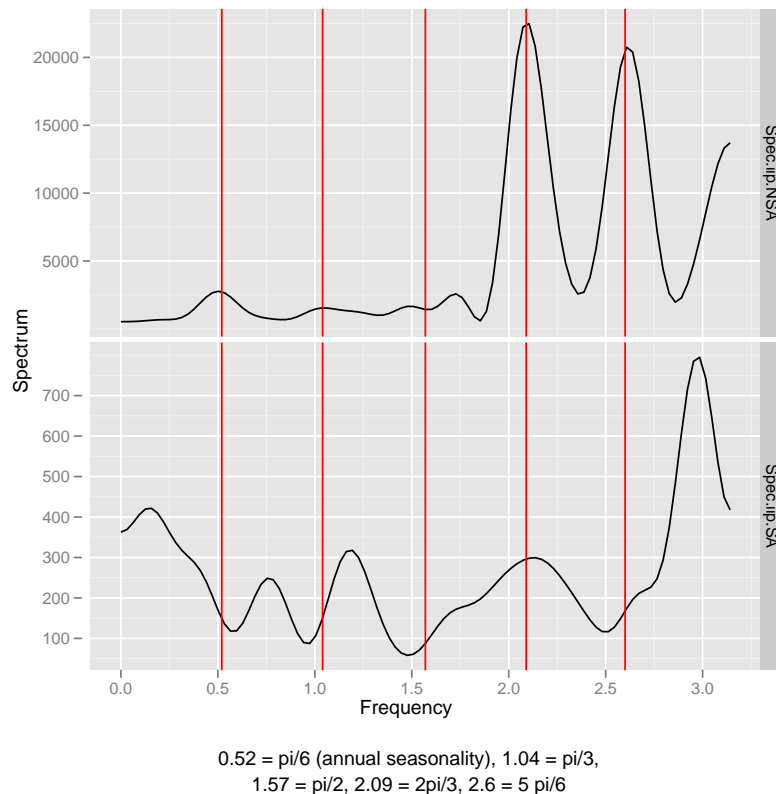
The x-axis represents frequency from 0 to  $\pi$  (3.14). The seasonal frequencies are  $\pi/6$  (0.52 on the x-axis),  $\pi/3$  (1.04 on the x-axis),  $\pi/2$  (1.57 on the x-axis),  $2\pi/3$  (2.09 on the x-axis) and  $5\pi/6$  (2.6 on the x-axis). In terms of periods (months); they are 12 months, 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 first peak at 0.52 correspond to 12 months which is 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** IIP Spectral plot (NSA and SA)

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## 2.4 Sliding spans diagnostics

Sliding span diagnostics are descriptive statistics of how the seasonal adjustments and their month-to-month changes vary when the span of data used to calculate them is altered in a systematic way.

It is based on the idea that for a month common to more than one overlapping spans, the percent change of its adjusted value from the different spans should not exceed the threshold value and for a month common to more than one span, the difference between the month on month change from the different spans should not exceed the threshold value (the threshold value being 0.03).

Sliding span gives the percentage of months ( $A\%$ ) for which the seasonal adjustment is unstable (the difference in the seasonally adjusted values for a particular month from more than one span should not exceed 0.03). It also gives the percentage of months ( $MM\%$ ) for which the month on month changes of the seasonally adjusted values is unstable i.e exceeding the threshold value. The seasonal adjustment produced by the procedure chosen should not be used if  $A\% > 25.0$  ( $> 15.0$  is considered problematic) or if  $MM\% > 40.0$ .

Since the length of the data for IIP is small, we do not rely on the sliding span diagnostics. **The sliding span diagnostics is not reliable when the range of the seasonal factors in a particular span is low (less than 5).**