

Technical note on seasonal adjustment for Index of industrial production (Consumer goods)

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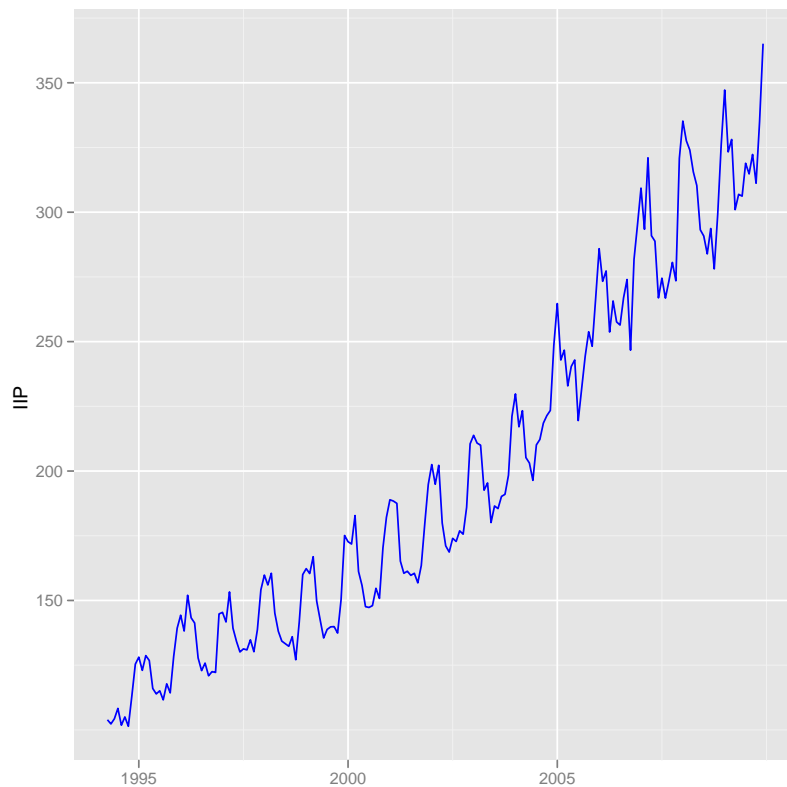
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1 Index of industrial production (Consumer goods)

We analyse the monthly data for IIP (Consumer goods) from April, 1994 onwards. Figure 1 below shows the original plot of the series. 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.

Figure 1 IIP (Consumer goods) (Non seasonally adjusted)



1.1 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 Index of industrial production (Consumer goods), multiplicative seasonal adjustment is considered appropriate on the basis of the model selection criteria.

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 1994 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.

Figure 2 Monthly growth rates across the years

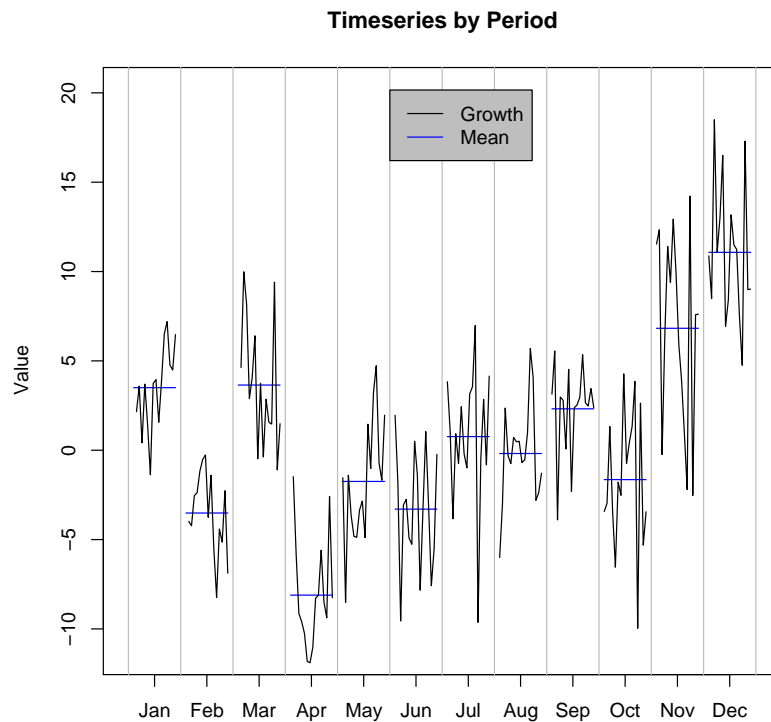


Figure 2 shows seasonal peaks in the month of March and December.

2.1 Tests for identifying the nature of seasonality

We test for the nature of seasonality using HEGY and Canova Hansen test.

Under the null hypothesis of the HEGY test, nonstationary unit root behavior exists not only at the long run (or zero) frequency, but also at some or all of the seasonal frequencies.

The Canova Hansen test takes the opposite approach. The null hypothesis is stationarity with deterministic seasonality.

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 Canova & Hansen test
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Table 1 HEGY test statistics

	Stat.	p-value
tpi_1	-1.47	0.10
tpi_2	-4.07	0.01
Fpi_3:4	10.85	0.10
Fpi_5:6	17.08	0.10
Fpi_7:8	12.60	0.10
Fpi_9:10	16.93	0.10
Fpi_11:12	6.39	0.03
Fpi_2:12	16.68	
Fpi_1:12	15.42	

Null hypothesis: Stationarity.

Alternative hypothesis: Unit root.

Frequency of the tested cycles: $\pi/6$, $\pi/3$, $\pi/2$, $2\pi/3$, $5\pi/6$, π ,

L-statistic: 1.927

Lag truncation parameter: 14

Critical values:

0.10 0.05 0.025 0.01

2.49 2.75 2.99 3.27

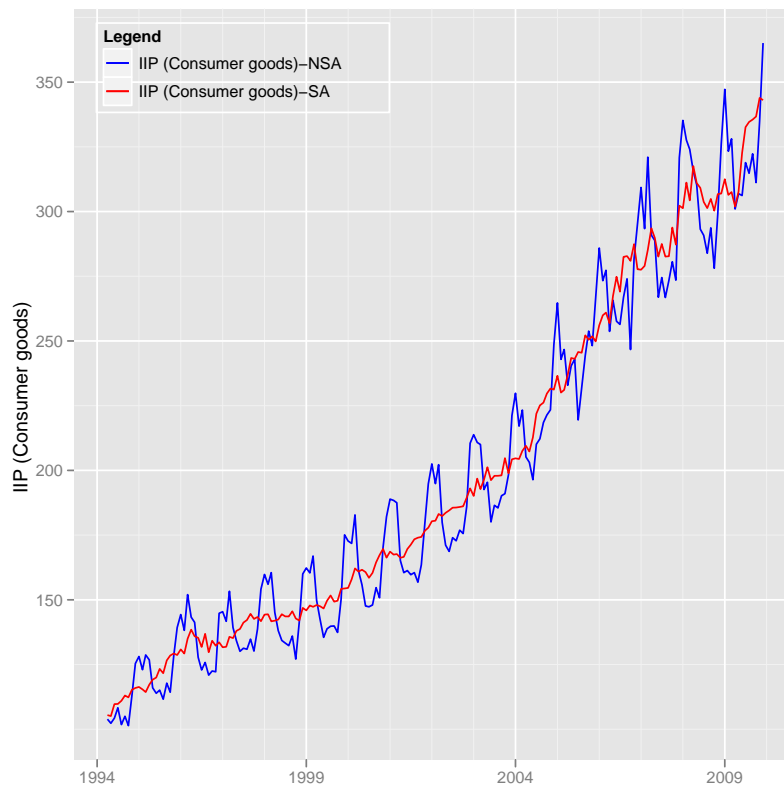
The test results suggest the presence of deterministic seasonality in IIP (Consumer goods).

2.2 Seasonal adjustment of IIP with X-12-ARIMA

Seasonal adjustment is done with X-12-ARIMA method. Since the test results point towards deterministic seasonality, seasonal dummy is added in the regARIMA specification.

Figure 3 shows the non-seasonally and seasonally adjusted IIP (Consumer goods). The plot reveals that the seasonal peaks are dampened after seasonal adjustment.

Figure 3 IIP (NSA and SA)



2.3 Diagnostic checks

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

2.3.1 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 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.

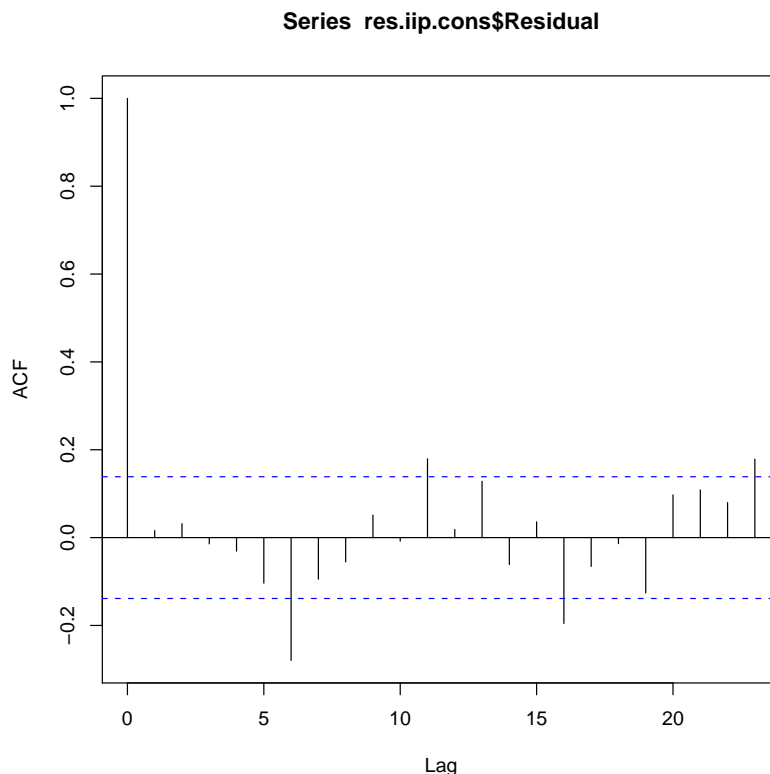
Figure 4 does not reveal significant autocorrelation amongst the residuals.

2.3.2 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 for IIP (Consumer goods) is 0.276.

IIP (Consumer goods) series show identifiable seasonality on the basis of the M7 statistic.

Figure 4 ACF of residuals



3 Sliding span 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 $MM\% > 40.0$.

For Index of industrial production (Consumer goods) A% is 0 and MM% is 1.9.

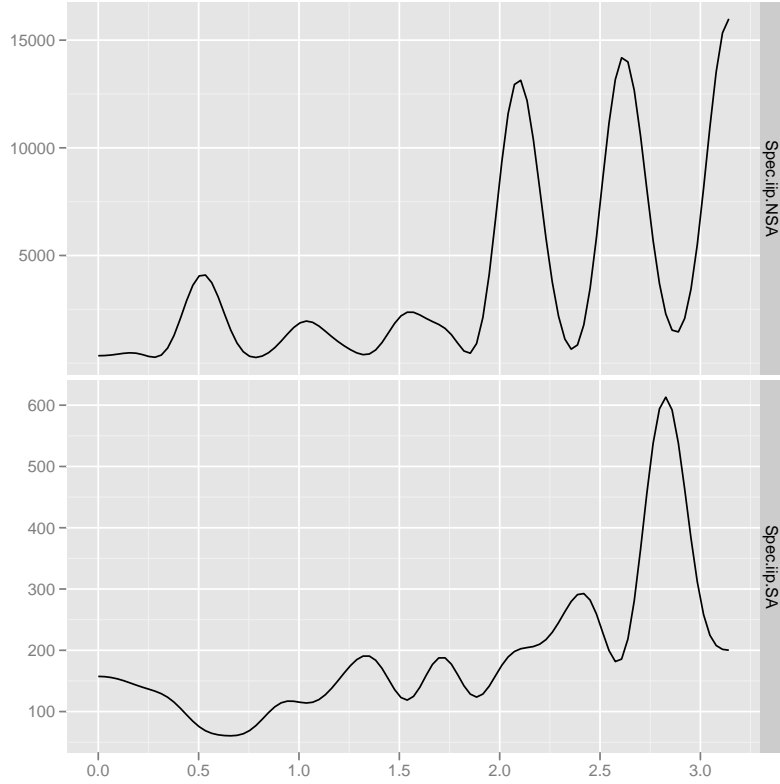
4 Spectral representation

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 π (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.

Figure 5 IIP Spectral plot (NSA and SA)



5 Accounting for India-specific moving holiday effects

Accounting for moving holiday effect is a crucial component of pre-treatment of the series before the application of seasonal adjustment method. X-12-ARIMA is capable of handling the moving holiday effects through the inclusion of regressors for Easter Sunday, Labor Day, and Thanksgiving Day. These are important moving holidays for U.S time series.

We use the GENHOL program of X-12-ARIMA to analyse India-specific moving holiday effect. The program generates regressor matrices from holiday date file to enable X-12-ARIMA, estimation of complex moving holiday effects. It has the capability to generate regressors for before the holiday interval, surrounding the holiday interval and past the holiday interval.

The key assumption is that the fundamental structure of a time series changes for a fixed number of days before, after or for a fixed interval surrounding the holidays. We estimate the effect of Diwali which is an important moving holiday in Indian scenario. For estimating Diwali effect, we assume that the level of economic activity changes 5 days before Diwali (including the day on which Diwali falls). Regression variable for Diwali is found to be significant for IIP (Consumer goods).

Table 2 Regression model for IIP (Consumer goods)

Variable	Parameter estimate	Standard error	t-value
User defined			
Diwali	-0.0275	0.00759	-3.62

The results in Table 2 show significant trading day effect on IIP (Consumer goods) on account of Diwali. There is a significant drop in IIP (Consumer goods) around Diwali on account of loss of working days. This can be seen with the latest October numbers for the series. If we do not take Diwali effect into account, the seasonally adjusted annualised rate (SAAR) is -25.07. After accounting for Diwali, the SAAR number for IIP (Consumer goods) improve to 7.01.