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

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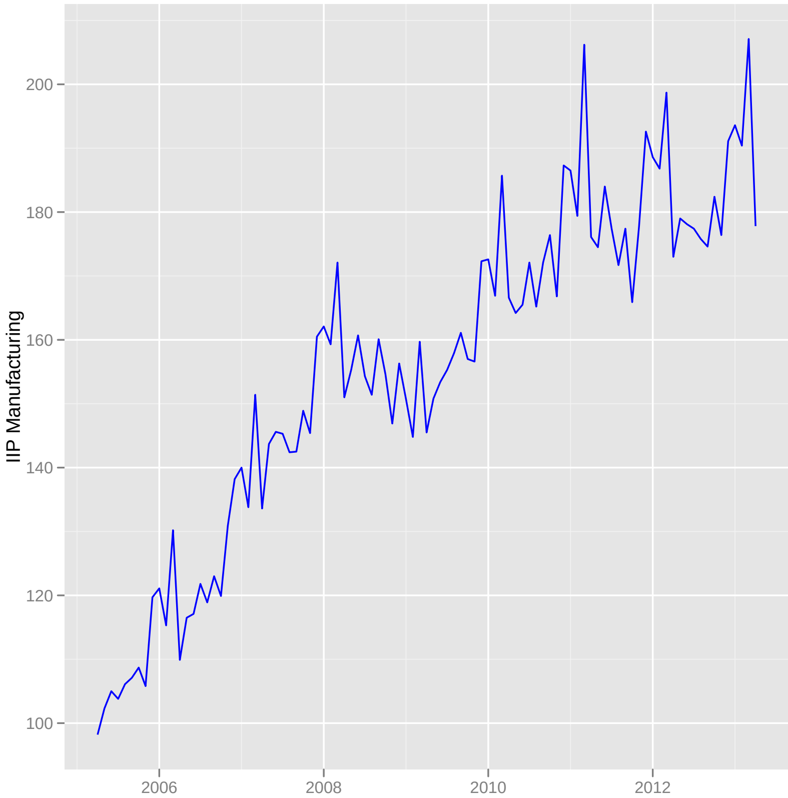
1 IIP Manufacturing

We analyse the monthly data for IIP Manufacturing from April, 1994 onwards. Figure 1 shows the original plot of IIP Manufacturing. 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.

The figure below also shows that the magnitude of the seasonal peaks is increasing with the level of the series.

Figure 1 IIP Manufacturing (Non seasonally adusted)



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 (Manufacturing), 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 intutively from the plot before the application of the testing procedures.

Figure 2 Monthly growth rates across the years

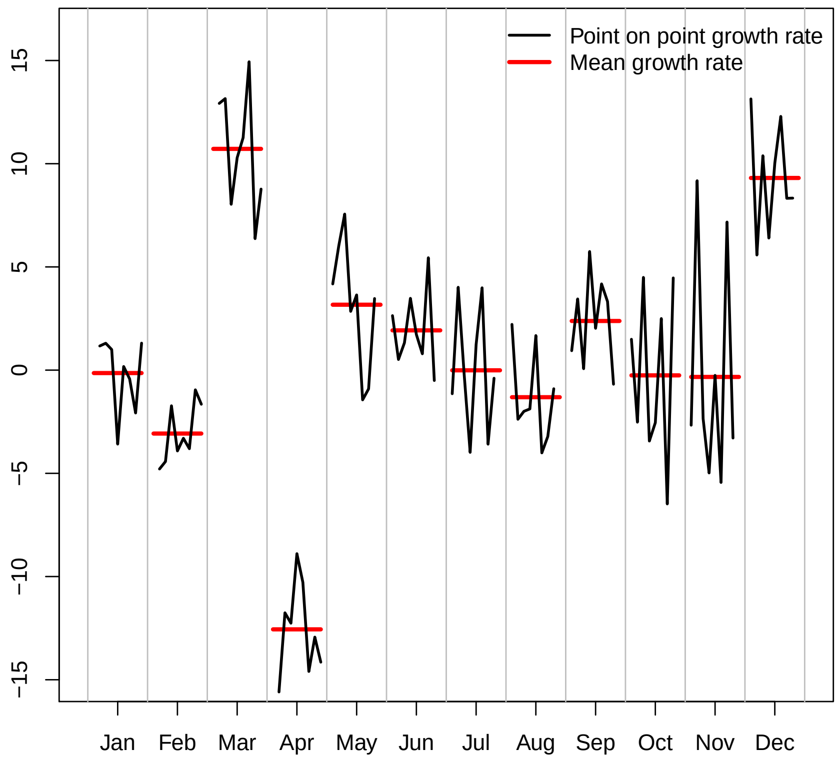


Figure 2 shows seasonal peaks in the month of March and December. The growth rates in each of the months across the years are not stable. Intuitively, seasonality in the series cannot be captured by seasonal dummy.

2.1 Seasonal adjustment of IIP Manufacturing with X-12-ARIMA

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

Figure 3 IIP Manufacturing (NSA and SA)

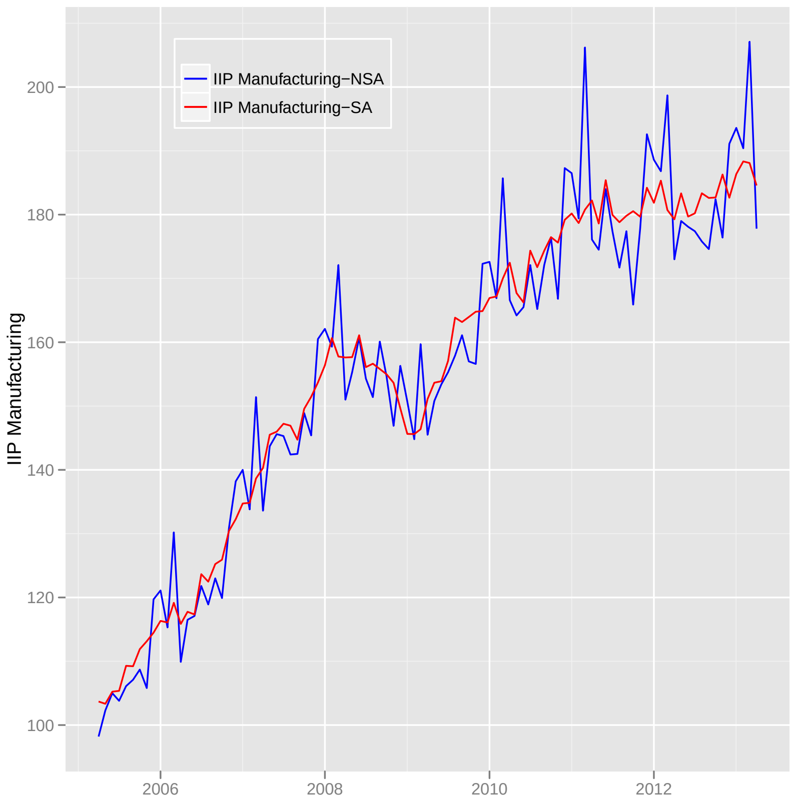


Figure 3 shows the non-seasonally and seasonally adjusted IIP Manufacturing. The plot reveals that the seasonal peaks are dampened after seasonal adjustment.

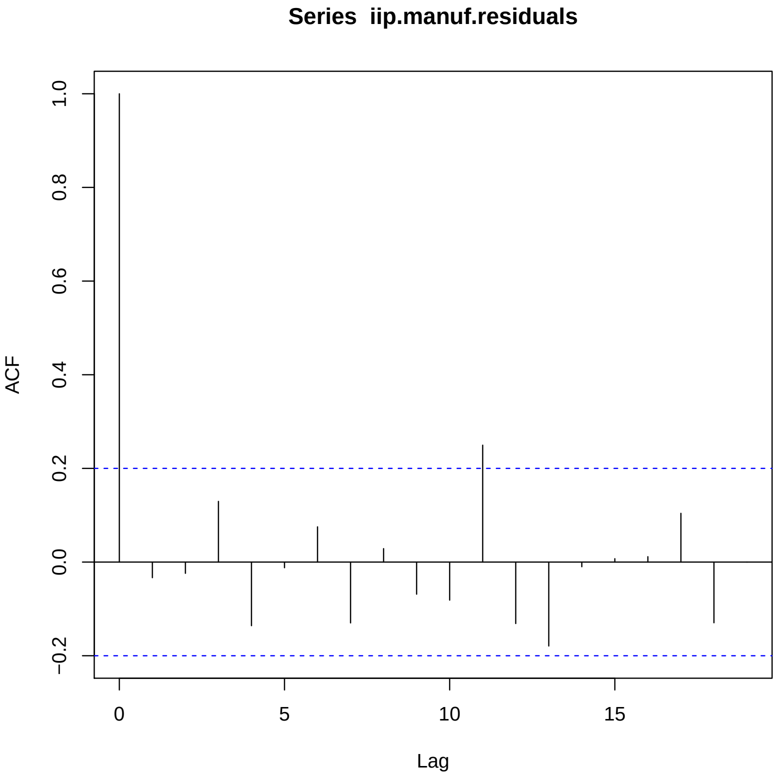
2.2 Diagnostic checks

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.

Figure 4 ACF of 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 of M7 is 0.172 for IIP Manufacturing
IIP Manufacturing series show identifiable seasonality on the basis of M7 statistic.

3 Year on year growth versus seasonally adjusted point on point growth

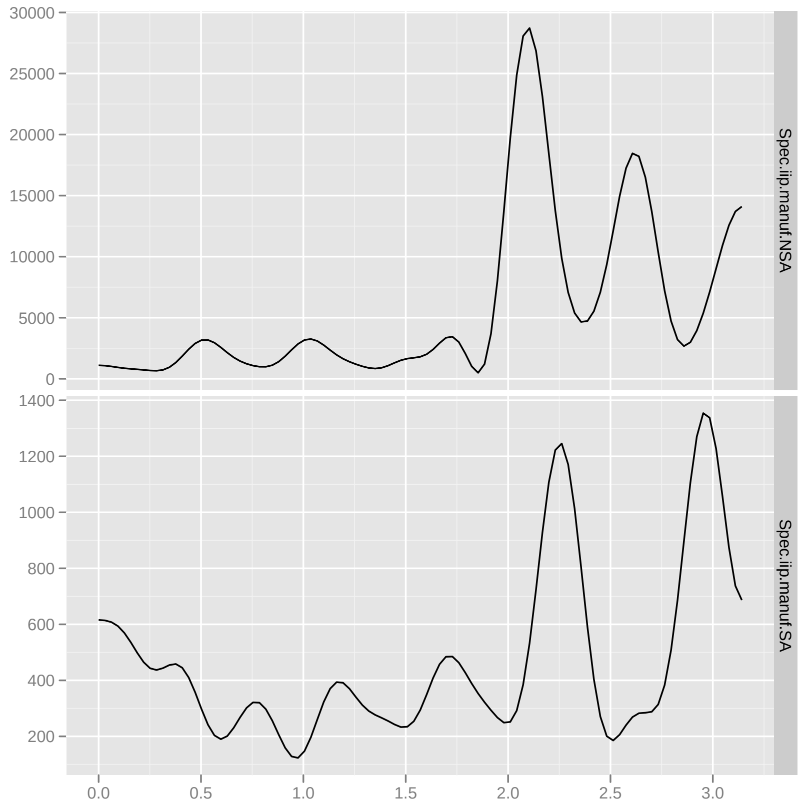
Growth rates can be computed either year on year or point on point. The year on year growth rate is computed as the percentage change with respect to the corresponding month (or quarter) in the preceding year, while the point on point growth rate is computed as the percentage change with respect to the preceding period.

Table 2 shows the year on year growth and seasonally adjusted annualized rate in percent, point on point.

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), 2pi/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 (Manufacturing) Spectral plot (NSA and SA)



5 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 M M % > 40.0. Since the length of the data is small, the slididng span diagnostic is not relied on. **The sliding span diagnostics is not reliable when the range of the seasonal factors in a particular span is low (less than 5).**

6 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 (Manufacturing).

The results in Table 2 show significant trading day effect on IIP (Manufacturing) on account of Diwali. There is a significant drop in IIP (Manufacturing) around Diwali on account of loss of working days.

Table 1 Year on year and point on point growth rates

	Y.o.Y.growth	Point.on.point.growth
2009 Jan	-7.03	-32.48
2009 Feb	-9.10	-0.21
2009 Mar	-7.21	6.26
2009 Apr	-3.64	38.20
2009 May	-2.90	20.13
2009 Jun	-4.54	1.79
2009 Jul	0.65	24.61
2009 Aug	4.29	50.70
2009 Sep	0.62	-5.04
2009 Oct	1.55	5.75
2009 Nov	6.60	6.08
2009 Dec	10.24	0.71
2010 Jan	14.53	14.85
2010 Feb	15.26	1.73
2010 Mar	16.28	19.93
2010 Apr	14.50	17.42
2010 May	8.89	-33.51
2010 Jun	7.89	-10.63
2010 Jul	10.82	57.25
2010 Aug	4.62	-17.99
2010 Sep	6.83	17.91
2010 Oct	12.36	14.56
2010 Nov	6.51	-5.88
2010 Dec	8.71	24.14
2011 Jan	8.05	6.70
2011 Feb	7.49	-10.04
2011 Mar	11.04	13.98
2011 Apr	5.70	9.55
2011 May	6.27	-24.02
2011 Jun	11.18	44.78
2011 Jul	3.08	-35.75
2011 Aug	3.93	-7.68
2011 Sep	3.08	6.76
2011 Oct	-5.95	4.79
2011 Nov	6.59	-5.78
2011 Dec	2.83	29.97
2012 Jan	1.13	-15.50
2012 Feb	4.12	22.69
2012 Mar	-3.64	-30.18
2012 Apr	-1.76	-9.67
2012 May	2.58	26.89
2012 Jun	-3.21	-24.03
2012 Jul	0.00	3.37
2012 Aug	2.39	20.76
2012 Sep	-1.58	-4.82
2012 Oct	9.95	0.48
2012 Nov	-0.79	23.43
2012 Dec	-0.78	-23.68
2013 Jan	2.65	24.14
2013 Feb	1.93	12.66
2013 Mar	4.23	-1.57
2013 Apr	2.77	-22.71

Table 2 Regression model for IIP (Manufacturing)

Variable	Parameter estimate	Standard error	t-value
User defined			
Diwali	-0.0540	0.01386	-3.90