Technical note on seasonal adjustment for Wholesale price index (Fruits and vegetables)

February 4, 2013

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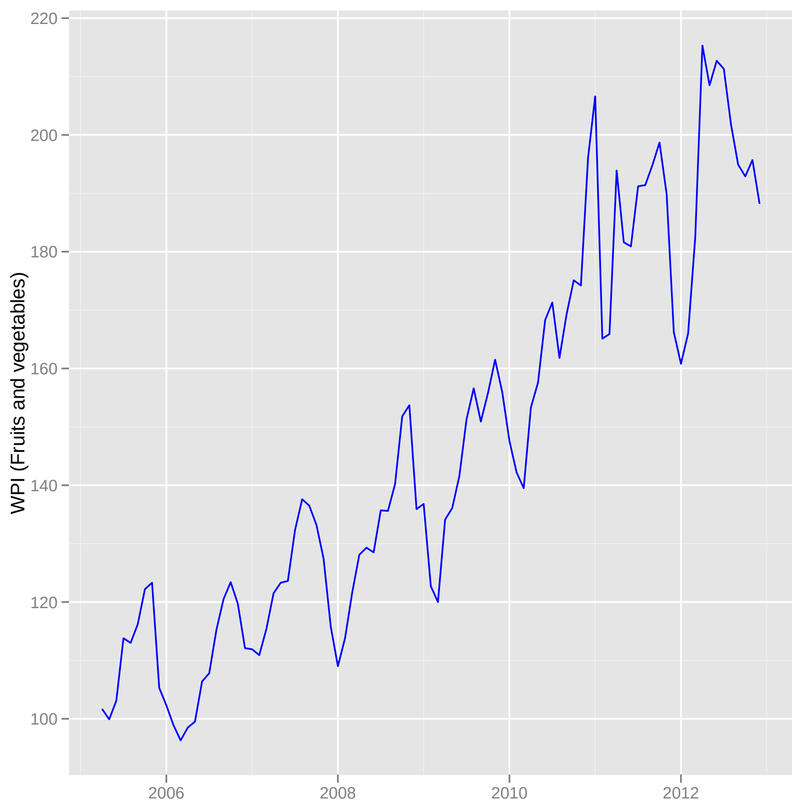
1 WPI (Fruits and vegetables)

We analyse the monthly data for Wholesale price index of fruits and vegetables at the new base year from April, 2005 onwards. Figure 1 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 WPI Fruits and vegetables (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 WPI (Fruits and vegetables), 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

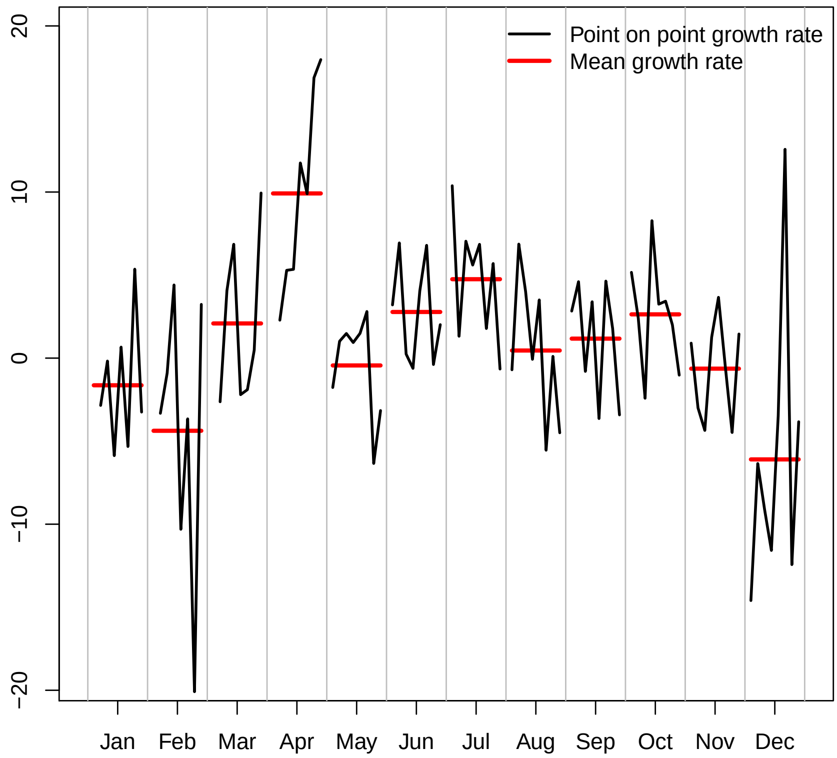


Figure 2 shows that the mean growth rate in April is higher than the other months.

2.1 Seasonal adjustment of WPI Fruits and vegetables with X-12-ARIMA

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

Figure 3 WPI (Fruits and vegetables) (NSA and SA)

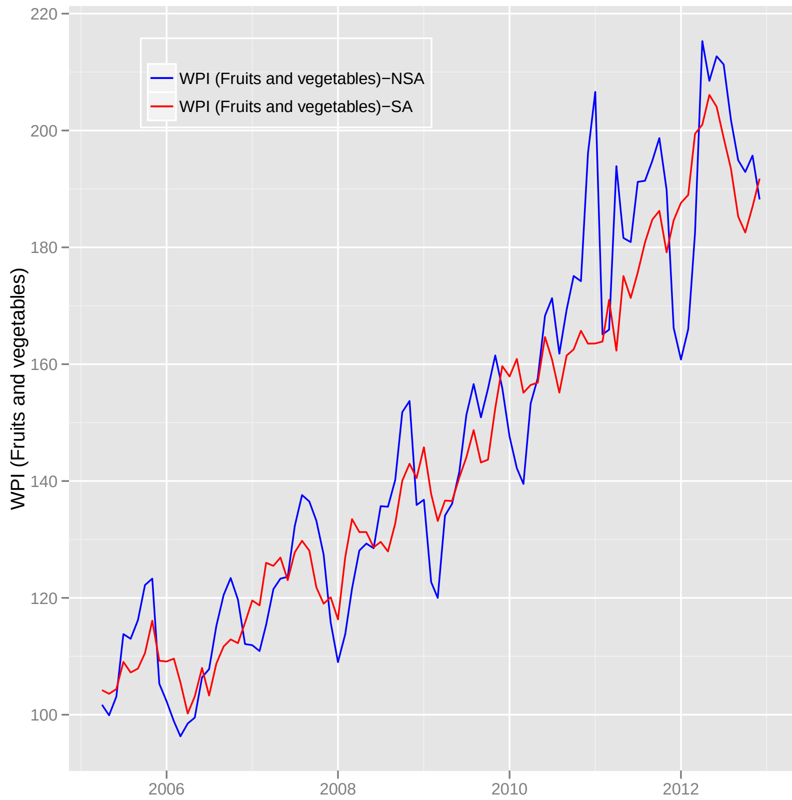


Figure 3 shows the non-seasonally and seasonally adjusted WPI (Fruits and vegetables). The plot reveals that the seasonal peaks are dampened after seasonal adjustment. We also look at the plots of the growth rates of the adjusted and raw series to examine the extent of noise reduction.

Figure 4 WPI (NSA and SA- point on point growth rates)

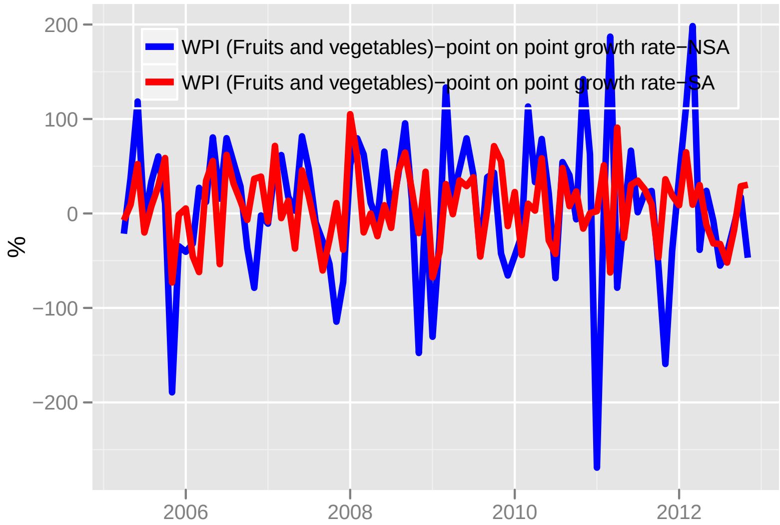


Figure 4 shows the point on point growth of the raw and seasonally adjusted series. The standard deviation of the growth rate of the raw series is 73.69 and that of the adjusted series is 38.67.

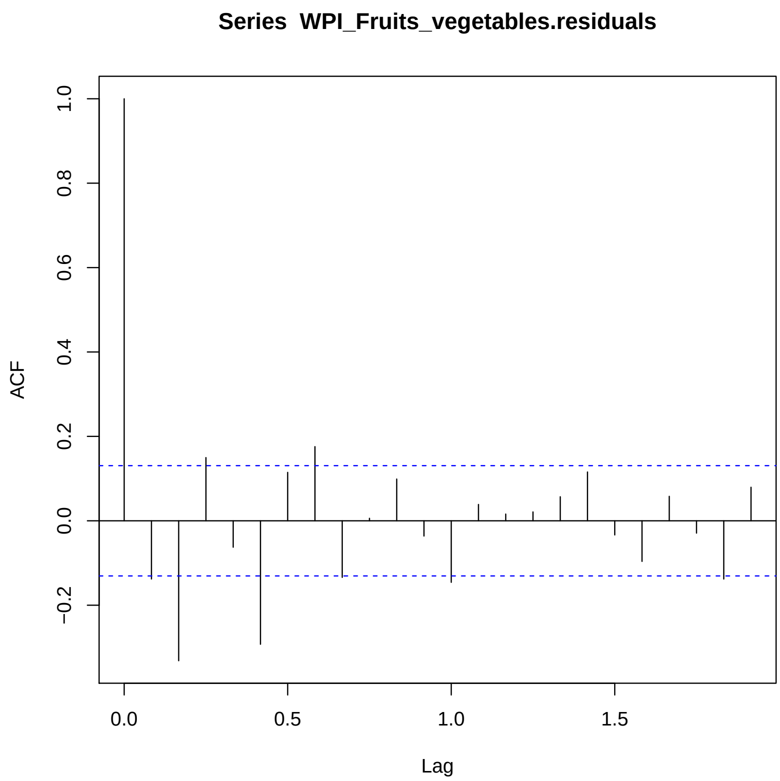
2.2 Diagnostic checks

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 5 ACF of residuals



The figure 5 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 of M7 is 0.39 for WPI (Fruits and vegetables)
WPI (Fruits and vegetables) series show identifiable seasonality on the basis of M7 statistic.

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

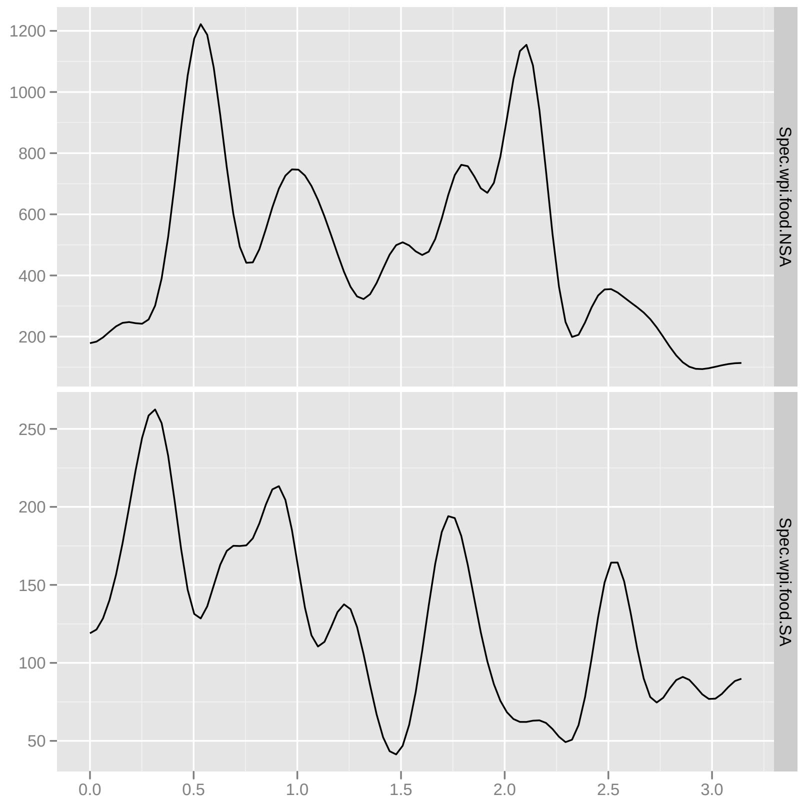
Growth rates can be computed either year on year or point on point. The year on year growth rate is computed as the percentage change with respect to the corresponding month (or quarter) in the preceding year, while the point on point growth rate is computed as the percentage change with respect to the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

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

4 Spectral representation

Figure 6 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 of the series 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 6 WPI (Fruits and vegetables) 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. We estimate the effect with different specifications about the number of days around the festival. However we did not find significant results for diwali effect on WPI (Fruits and vegetables).

Table 1 Year on year and point on point growth rates

	Y.o.Y.growth	Point.on.point.growth
2006 Jan	6.46	36.67
2006 Feb	9.38	39.00
2006 Mar	12.13	-8.53
2006 Apr	19.83	71.53
2006 May	23.35	-4.92
2006 Jun	23.92	13.44
2006 Jul	16.17	-37.16
2006 Aug	22.73	45.60
2006 Sep	19.44	18.45
2006 Oct	13.28	-15.73
2006 Nov	7.94	-60.39
2006 Dec	6.43	-27.86
2007 Jan	3.30	11.00
2007 Feb	-2.59	-38.39
2007 Mar	2.61	105.15
2007 Apr	5.37	60.05
2007 May	5.43	-20.09
2007 Jun	4.87	-0.09
2007 Jul	3.96	-24.06
2007 Aug	2.57	8.68
2007 Sep	-1.45	-15.30
2007 Oct	2.71	44.09
2007 Nov	13.96	64.45
2007 Dec	20.64	24.66
2008 Jan	17.36	-20.78
2008 Feb	25.50	44.16
2008 Mar	7.82	-67.69
2008 Apr	-1.32	-40.92
2008 May	4.68	31.08
2008 Jun	5.26	-0.78
2008 Jul	10.19	35.01
2008 Aug	11.50	28.94
2008 Sep	15.49	38.29
2008 Oct	7.63	-45.60
2008 Nov	2.64	4.06
2008 Dec	5.07	71.26
2009 Jan	14.72	55.53
2009 Feb	7.89	-13.39
2009 Mar	15.89	22.70
2009 Apr	16.25	-44.02
2009 May	14.32	10.26
2009 Jun	15.80	2.99
2009 Jul	18.86	58.35
2009 Aug	13.22	-28.58
2009 Sep	3.32	-42.87
2009 Oct	12.19	48.12
2009 Nov	12.39	7.76
2009 Dec	7.86	23.32
2010 Jan	25.79	-16.04
2010 Feb	39.97	0.22
2010 Mar	16.10	2.44
2010 Apr	18.92	51.06