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

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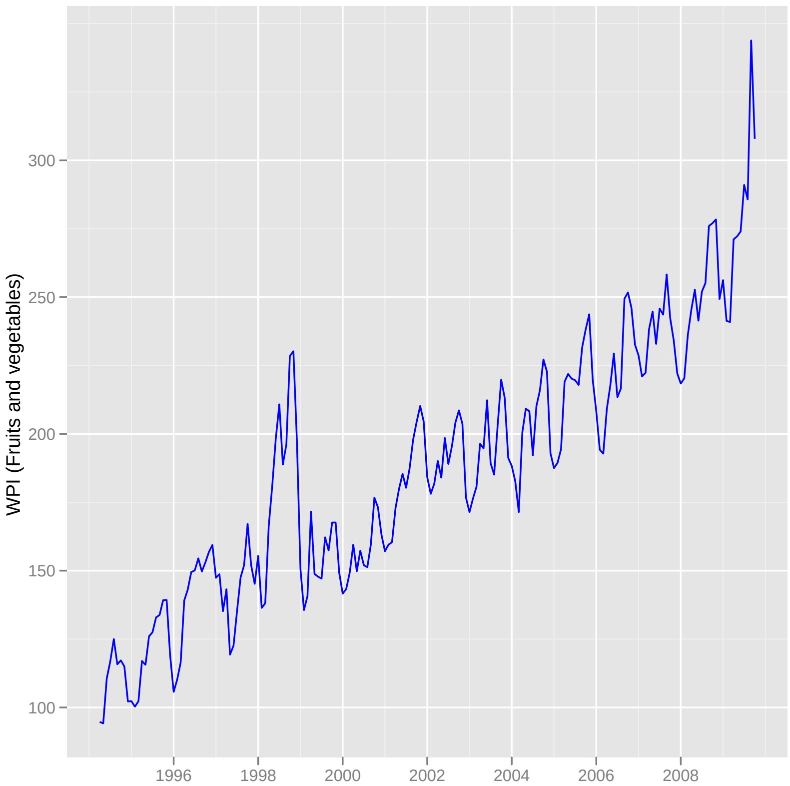
1 WPI (Fruits and vegetables)

We analyse the monthly data for Wholesale price index of fruits and vegetables from April, 1994 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), additive seasonal adjustment is considered appropriate on the basis of the model selection criteria. Figure 1 also shows that the magnitude of seasonal fluctuations are constant, irrespective of the level of the series hence additive model is appropriate.

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

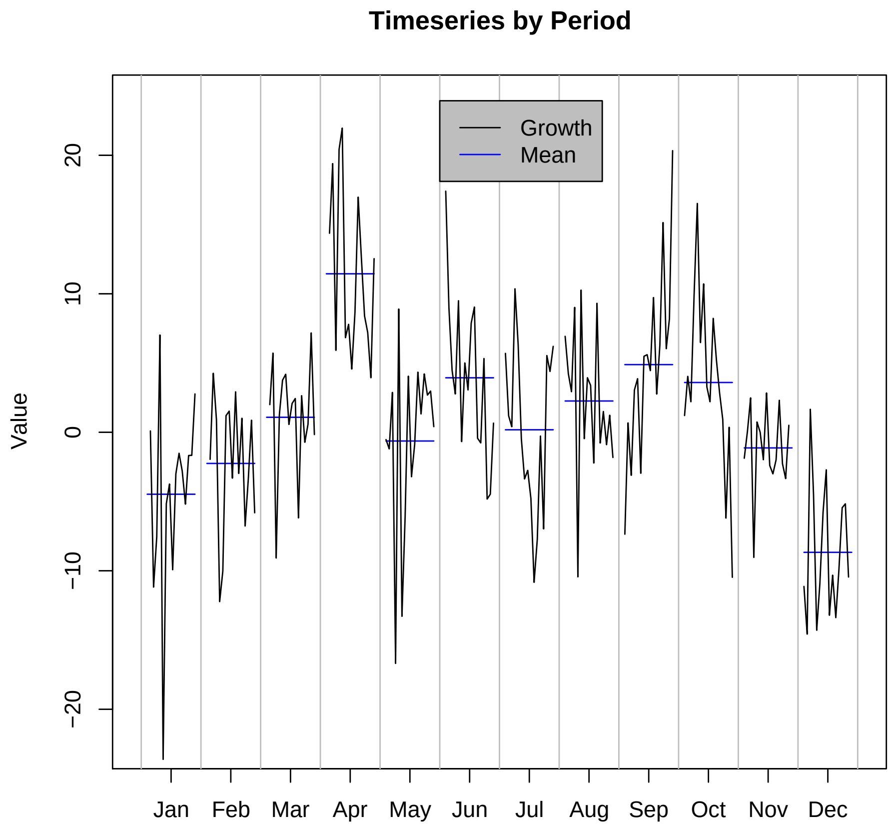


Figure 2 shows that the mean growth rate in April is higher than the other months.

2.1 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.

Table 1 HEGY test statistics

	Stat.	p-value
tpi_1	-2.47	0.10
tpi_2	-1.11	0.10
Fpi_3:4	12.07	0.10
Fpi_5:6	15.12	0.10
Fpi_7:8	11.80	0.10
Fpi_9:10	11.85	0.10
Fpi_11:12	14.71	0.10
Fpi_2:12	34.65	
Fpi_1:12	34.63	

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Canova & Hansen test
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Null hypothesis: Stationarity.
Alternative hypothesis: Unit root.
Frequency of the tested cycles: pi/6 , pi/3 , pi/2 , 2pi/3 , 5pi/6 , pi ,

L-statistic: 1.936
Lag truncation parameter: 14

Critical values:

 0.10 0.05 0.025 0.01
 2.49 2.75  2.99 3.27
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The Hegy test does not reject the null of stochastic seasonality.
The nature of seasonality in WPI (Fruits and vegetables) is taken to be stochastic.

2.2 Seasonal adjustment of WPI Food with X-12-ARIMA

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

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

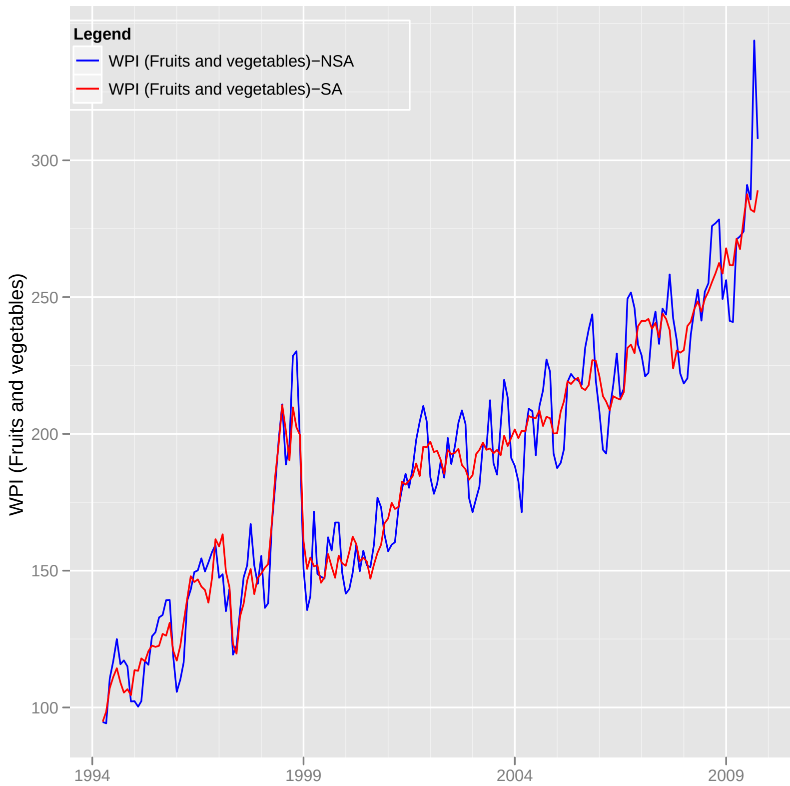


Figure 3 shows the non-seasonally and seasonally adjusted WPI (Fruits and vegetables). The plot reveals that the seasonal peaks are dampened after seasonal adjustment.

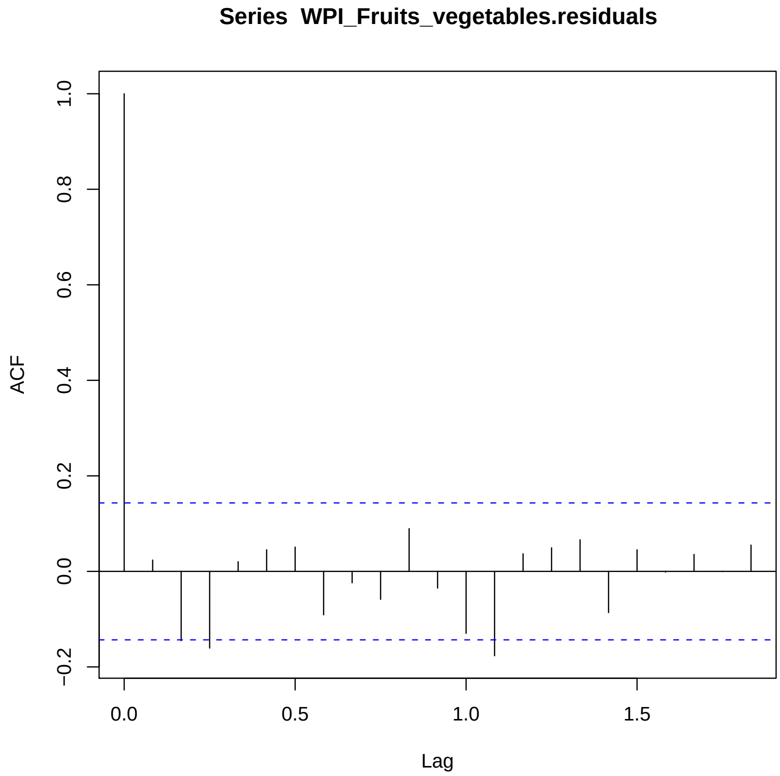
2.3 Diagnostic checks

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 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



The 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 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 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 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 5 WPI (Fruits and vegetables) Spectral plot (NSA and SA)

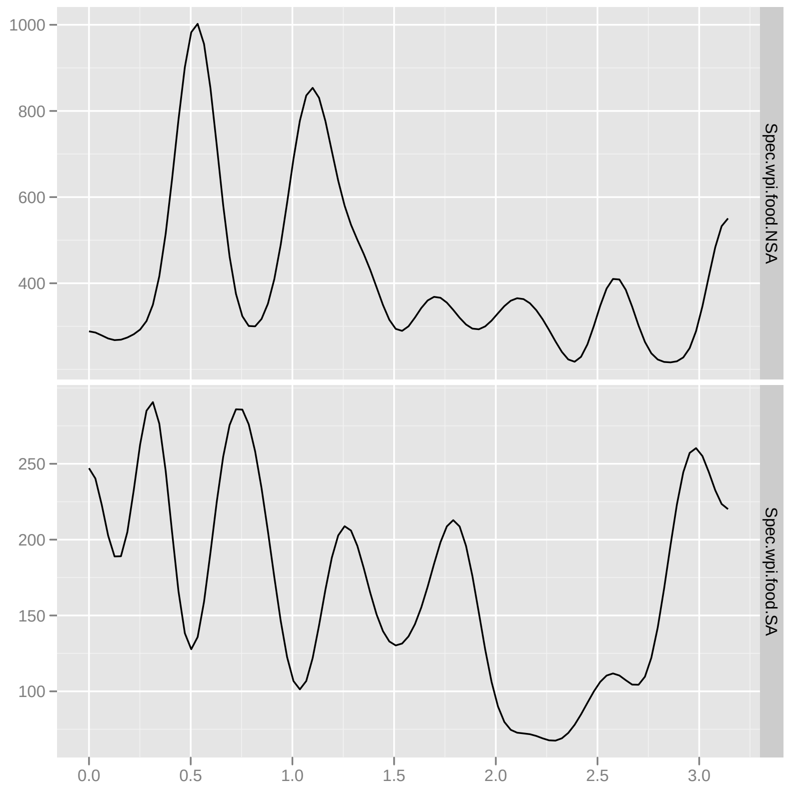


Table 2 Year on year and point on point growth rates

	Y.o.Y.growth	Point.on.point.growth
2006 Jan	11.09	-29.92
2006 Feb	2.53	-40.44
2006 Mar	-0.82	-11.23
2006 Apr	-4.57	-18.03
2006 May	-1.85	29.15
2006 Jun	4.18	-4.06
2006 Jul	-2.82	-2.89
2006 Aug	-0.60	15.61
2006 Sep	7.69	86.54
2006 Oct	5.67	6.18
2006 Nov	0.94	-16.20
2006 Dec	5.87	50.35
2007 Jan	9.79	9.88
2007 Feb	13.80	-0.61
2007 Mar	15.30	4.16
2007 Apr	14.02	-17.98
2007 May	12.35	10.62
2007 Jun	1.53	-26.50
2007 Jul	15.18	43.62
2007 Aug	12.47	-9.75
2007 Sep	3.57	-20.79
2007 Oct	-3.73	-72.62
2007 Nov	-4.80	34.90
2007 Dec	-4.51	-4.35
2008 Jan	-4.50	4.66
2008 Feb	-0.32	45.20
2008 Mar	6.21	7.79
2008 Apr	2.98	23.05
2008 May	3.27	13.52
2008 Jun	3.65	-18.39
2008 Jul	2.52	22.55
2008 Aug	4.72	13.07
2008 Sep	6.85	16.46
2008 Oct	14.32	14.79
2008 Nov	18.87	17.43
2008 Dec	12.25	-17.86
2009 Jan	17.31	42.22
2009 Feb	9.53	-27.76
2009 Mar	2.03	-0.67
2009 Apr	10.47	43.86
2009 May	7.72	-16.91
2009 Jun	13.50	47.34
2009 Jul	15.48	39.60
2009 Aug	12.00	-23.68
2009 Sep	24.57	-3.64
2009 Oct	11.12	33.19