Technical note on seasonal adjustment for Steel production

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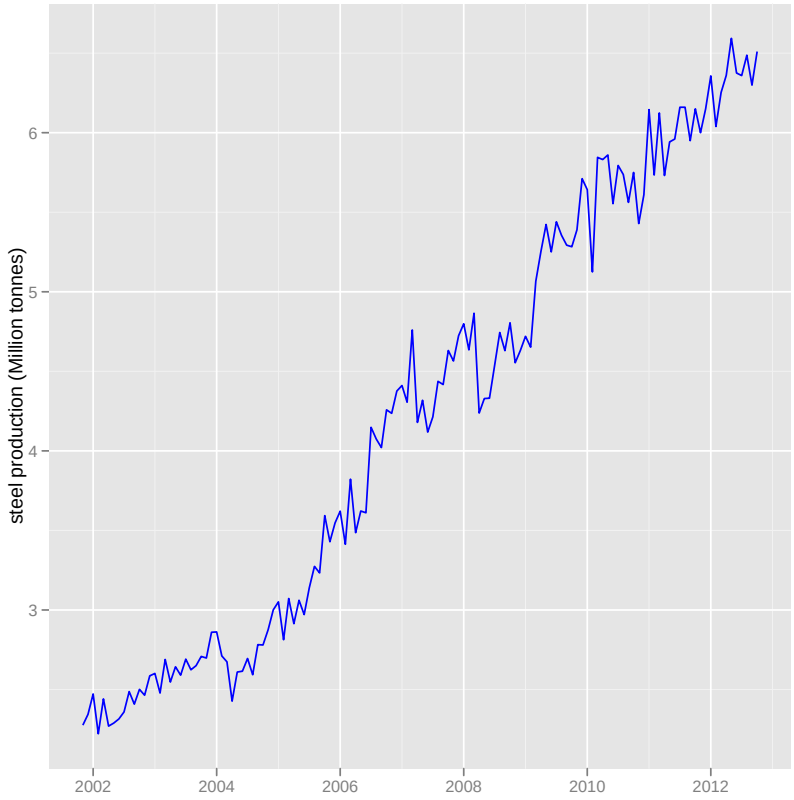
1 Steel production

We analyse the monthly data for steel production from November, 2001 onwards. Figure 1 below shows the original plot of steel production. 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 Steel production (Non seasonally adjusted)



2 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 steel production, multiplicative seasonal adjustment is considered appropriate on the basis of the model selection criteria and dignostic checks.

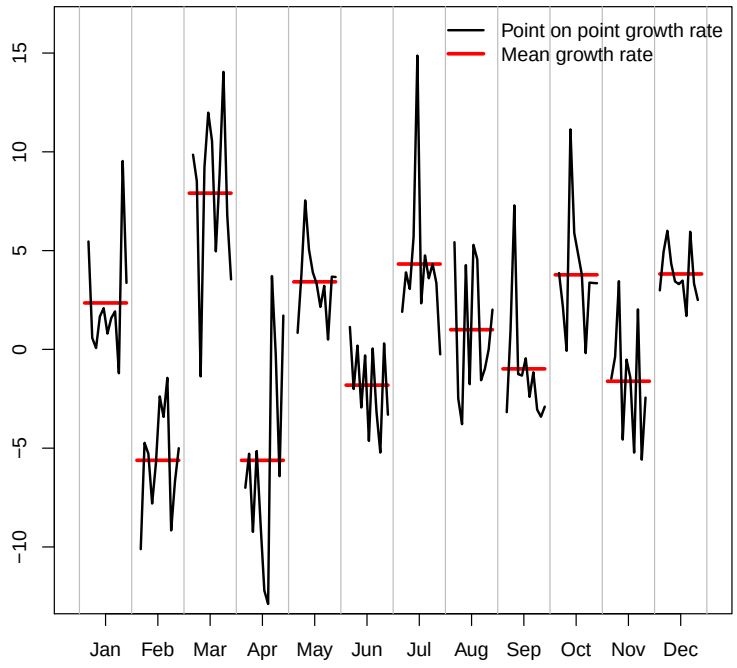
3 Steps in the seasonal adjustment procedure

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 Ocotober over September in each of the years from 2001 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



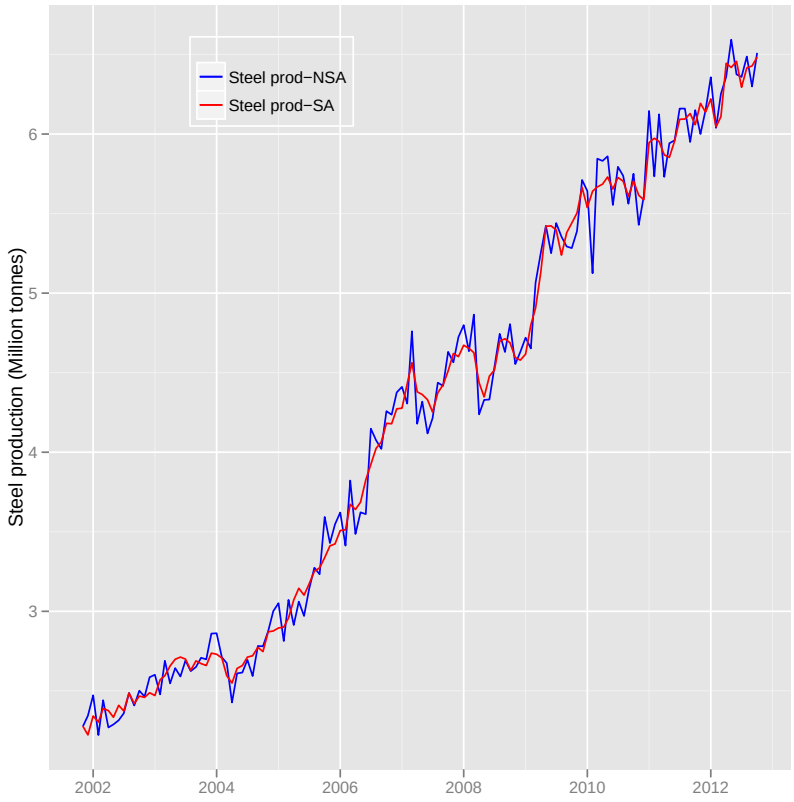
Presence of seasonal variations can be inferred from Figure 2, since the monthly means of growth rates across the years are not uniform. For instance, we observe a seasonal peak in the month of March.

3.1 Seasonal adjustment of Steel production with X-12-ARIMA

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

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

Figure 3 Steel production (NSA and SA)



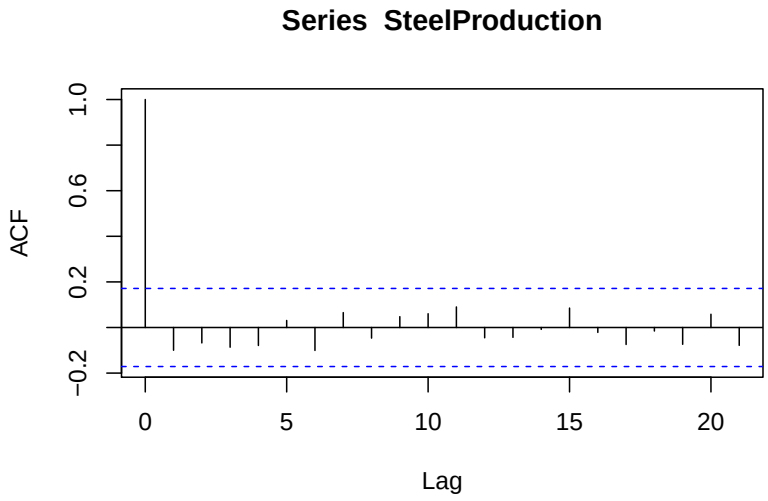
3.2 Diagnostic checks

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

3.2.1 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 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 reveals low levels of autocorrelation amongst the residuals.

Figure 4 ACF of residuals



3.2.2 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 1 is desirable to show identifiable seasonality in the series. The value of M7 for steel production is 0.688 .

Steel production series shows identifiable seasonality on the basis of the M7 statistic.

4 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 (month or quarter).

Table 1 shows the year on year growth and seasonally adjusted annualized rate in percent, point on point.

5 Spectral representation

Figure 5 Steel production spectral plot (NSA and SA)

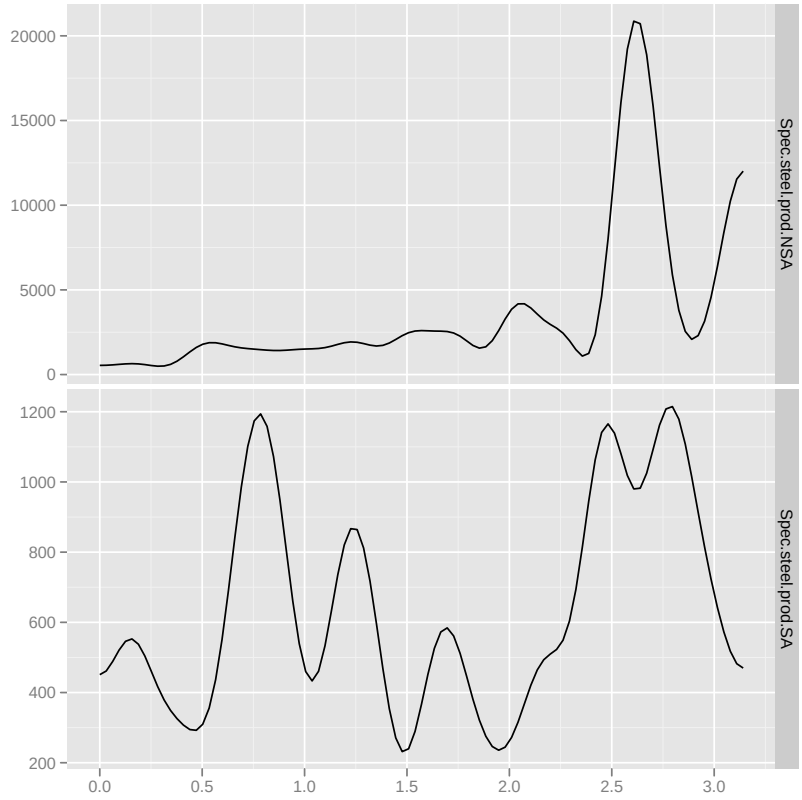


Figure 5 shows the spectral plot of the growth rate of the unadjusted and seasonally adjusted series. Spectral plot, an important tool of the frequency domain analysis shows the portion of variance contributed by cycles of different frequencies.
The x-axis represents frequency from 0 to pi (3.14). The 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), 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. As an example, the peaks at 2.09 and 2.6 are eliminated after seasonal adjustment. The other peaks seen in the lower panel of the figure are not at seasonal frequencies.

Table 1 Year on year and point on point growth rates

	Y.o.Y.growth	Point.on.point.growth
2007 Dec	-1.97	-4.13
2008 Jan	-1.65	9.83
2008 Feb	0.37	46.80
2008 Mar	4.13	26.28
2008 Apr	23.97	53.95
2008 May	25.27	65.54
2008 Jun	21.24	0.53
2008 Jul	19.90	-5.76
2008 Aug	12.88	-35.57
2008 Sep	14.32	31.80
2008 Oct	9.95	13.51
2008 Nov	18.36	13.76
2008 Dec	23.32	34.53
2009 Jan	19.53	-26.98
2009 Feb	10.17	22.00
2009 Mar	15.38	5.70
2009 Apr	10.98	3.69
2009 May	8.06	9.51
2009 Jun	5.77	-16.00
2009 Jul	6.51	15.29
2009 Aug	7.13	-4.83
2009 Sep	5.08	-20.13
2009 Oct	8.84	20.18
2009 Nov	0.72	-18.82
2009 Dec	-1.77	-6.11
2010 Jan	8.92	74.89
2010 Feb	11.88	5.47
2010 Mar	4.77	-4.02
2010 Apr	-1.71	-17.15
2010 May	1.40	-3.27
2010 Jun	7.31	20.95
2010 Jul	6.32	27.20
2010 Aug	7.37	0.29
2010 Sep	6.98	6.78
2010 Oct	6.96	-13.78
2010 Nov	10.52	26.26
2010 Dec	9.63	-10.76
2011 Jan	3.45	16.16
2011 Feb	5.32	-34.33
2011 Mar	2.11	12.60
2011 Apr	10.98	64.15
2011 May	10.96	-4.92
2011 Jun	6.96	7.26
2011 Jul	3.23	-30.68
2011 Aug	5.31	23.00
2011 Sep	5.87	2.23
2011 Oct	5.87	10.38
2011 Nov		
2011 Dec		
2012 Jan		
2012 Feb		
2012 Mar		