Technical note on seasonal adjustment for Railway goods traffic

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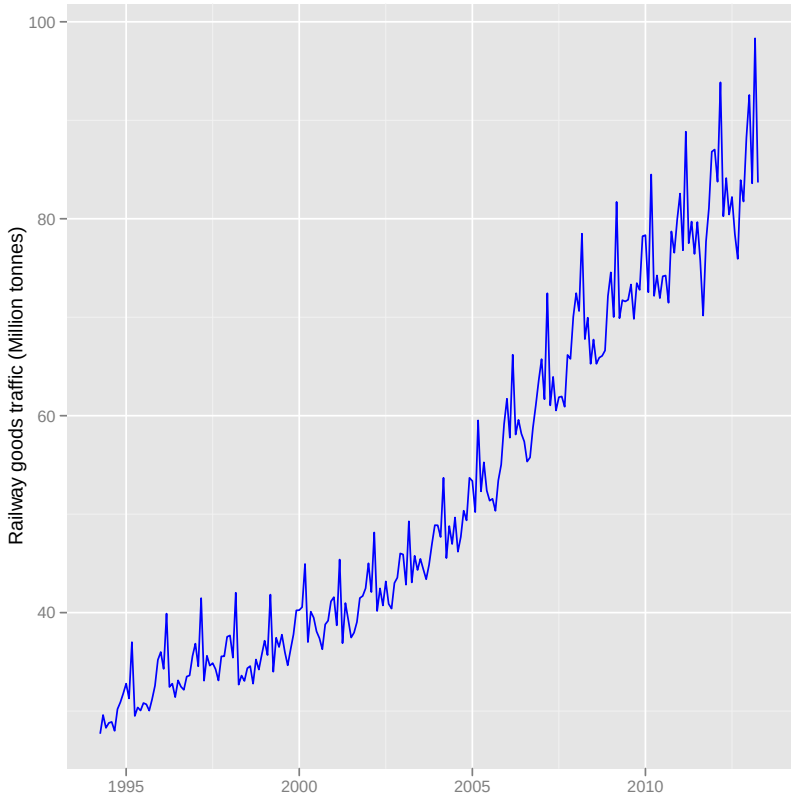
1 Railway goods traffic

We analyse the monthly data for railway goods traffic from April, 1994 onwards. Figure 1 below shows the original plot of railway goods traffic. 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 Railway goods traffic (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 railway goods traffic, multiplicative seasonal adjustment is considered appropriate on the basis of the model selection criteria.

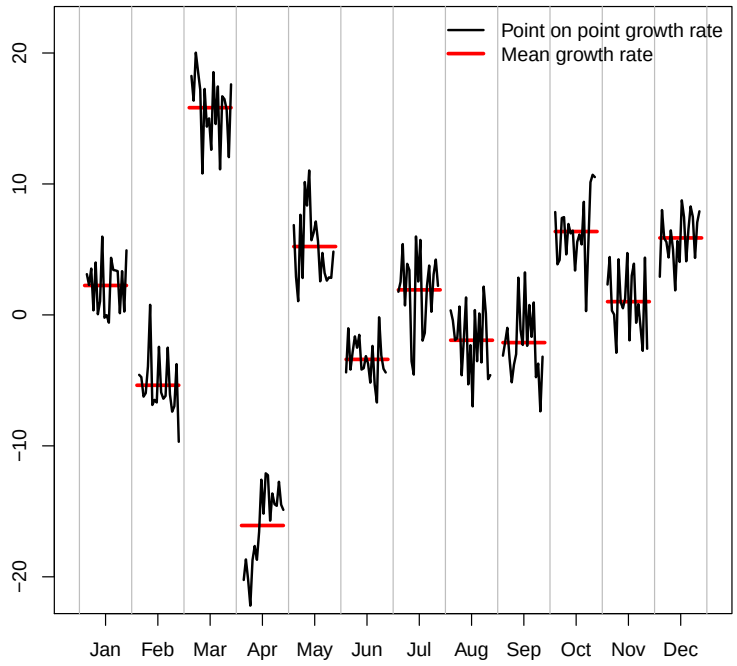
3 Steps in the seasonal adjustment procedure

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 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



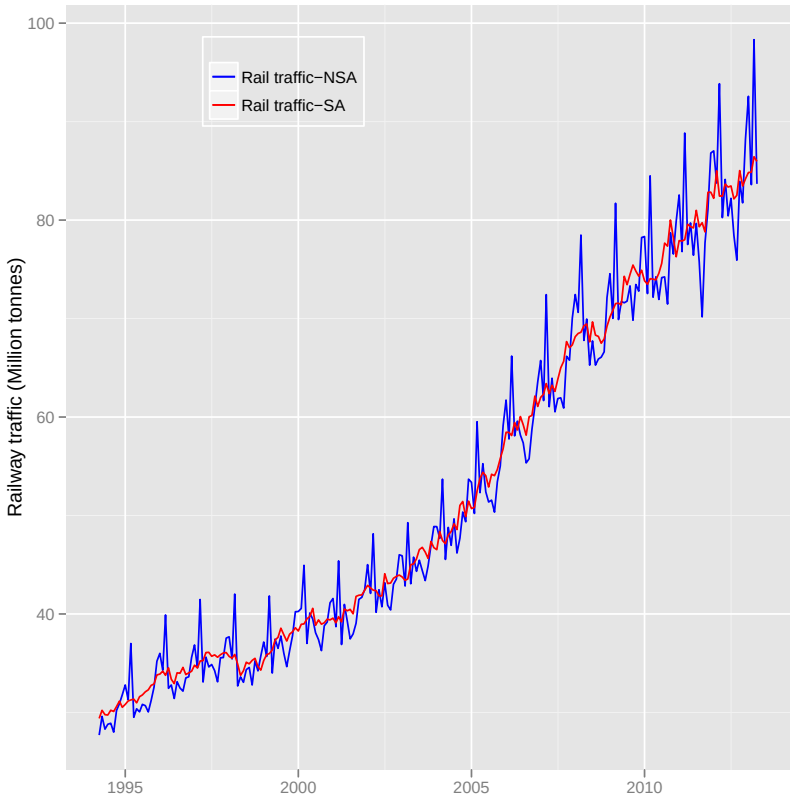
Presence of seasonal variations can be inferred from Figure 2, since the monthly means of growth rates across the years are not uniform. The month of March, for instance, shows seasonal peaks.

3.1 Seasonal adjustment of railway goods traffic with X-12-ARIMA

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

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

Figure 3 Railway traffic (NSA and SA)



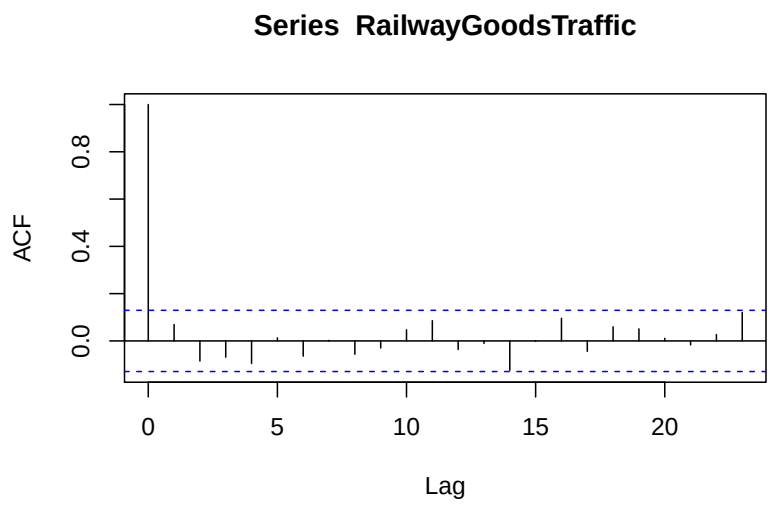
3.2 Diagnostic checks

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 that the residuals are white noise.

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 railway traffic is 0.15 .

Railway goods traffic series shows identifiable seasonality on the basis of the M7 statistic.

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

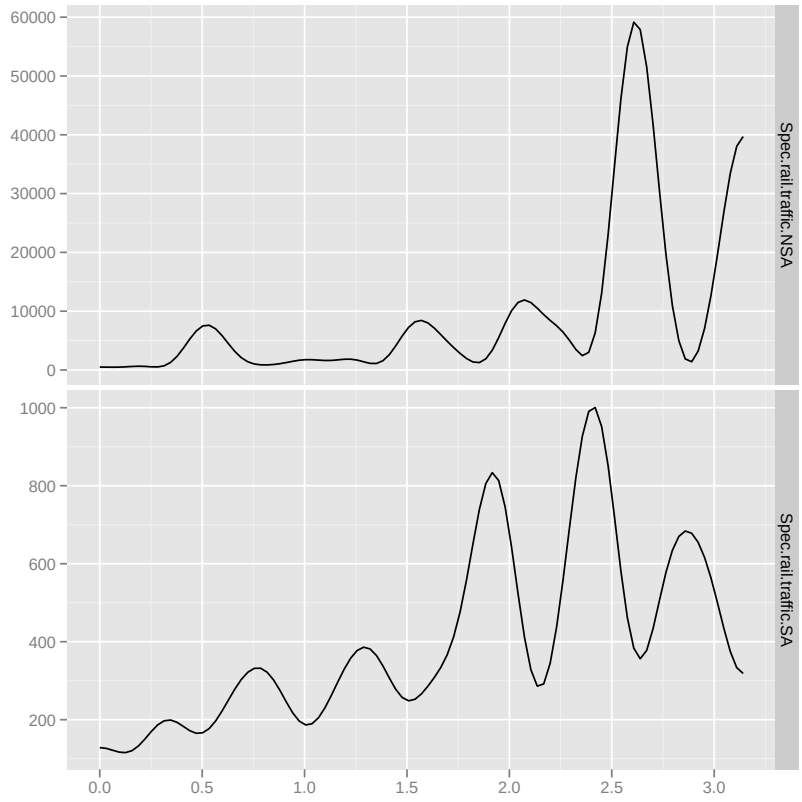
Growth rates can be computed either year on year or point on point. The year on year growth rate is computed as the percentage change with respect to the corresponding month (or quarter) in the preceding year, while the point on point growth rate is computed as the percentage change with respect to the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

Figure 5 Railway traffic spectral plot (NSA and SA)



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 peaks at 0.52, 1.57 and 2.6 corresponding to 12 months, 4 months and 2.4 months respectively, are eliminated after seasonal adjustment. 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
2008 Jan	10.19	14.76
2008 Feb	14.53	5.80
2008 Mar	8.35	2.01
2008 Apr	11.02	11.43
2008 May	9.40	3.17
2008 Jun	7.83	-31.74
2008 Jul	9.45	35.50
2008 Aug	5.36	-23.44
2008 Sep	8.18	-2.28
2008 Oct	-0.14	-12.36
2008 Nov	1.29	7.94
2008 Dec	2.97	22.49
2009 Jan	2.91	16.17
2009 Feb	-0.86	11.49
2009 Mar	4.12	11.57
2009 Apr	3.13	0.66
2009 May	2.54	-2.80
2009 Jun	9.70	47.72
2009 Jul	5.96	-13.84
2009 Aug	12.33	17.07
2009 Sep	5.98	15.13
2009 Oct	11.17	-9.74
2009 Nov	9.25	-8.46
2009 Dec	8.44	9.76
2010 Jan	5.07	-17.30
2010 Feb	3.60	-5.75
2010 Mar	3.40	9.28
2010 Apr	3.25	-0.83
2010 May	3.50	-1.16
2010 Jun	0.47	10.86
2010 Jul	3.33	15.93
2010 Aug	1.24	32.33
2010 Sep	2.35	-4.88
2010 Oct	7.15	40.57
2010 Nov	5.18	-27.15
2010 Dec	2.11	-30.17
2011 Jan	5.39	25.50
2011 Feb	5.87	-0.63
2011 Mar	5.15	1.99
2011 Apr	7.41	23.92
2011 May	7.37	-3.44
2011 Jun	6.24	-2.18
2011 Jul	7.42	26.75
2011 Aug	2.05	-24.95
2011 Sep	-1.82	6.25
2011 Oct	-1.31	-14.14
2011 Nov	5.92	59.73
2011 Dec	8.68	0.19
2012 Jan	5.43	-9.12
2012 Feb	9.06	40.13
2012 Mar	5.64	-36.77
2012 Apr	3.52	-0.06