Technical note on seasonal adjustment of Car production

July 1, 2013

Contents

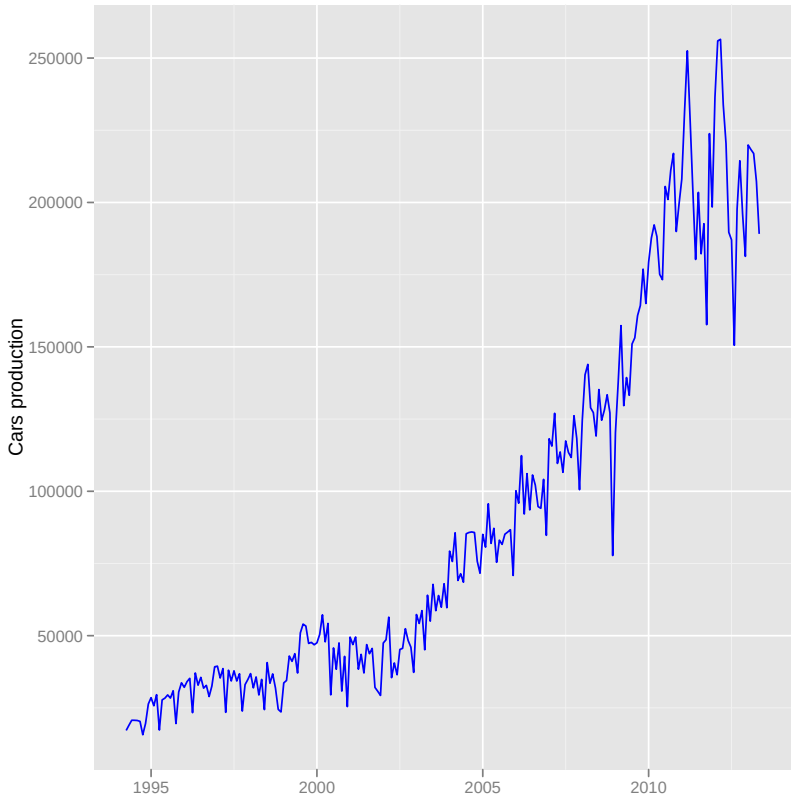
List of Figures

List of Tables

1 Car production

We analyse the monthly data for car production from April, 1994 onwards. Figure 1 below 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 Car production (Non seasonally adjusted)



1.1 Additive versus multiplicative seasonality

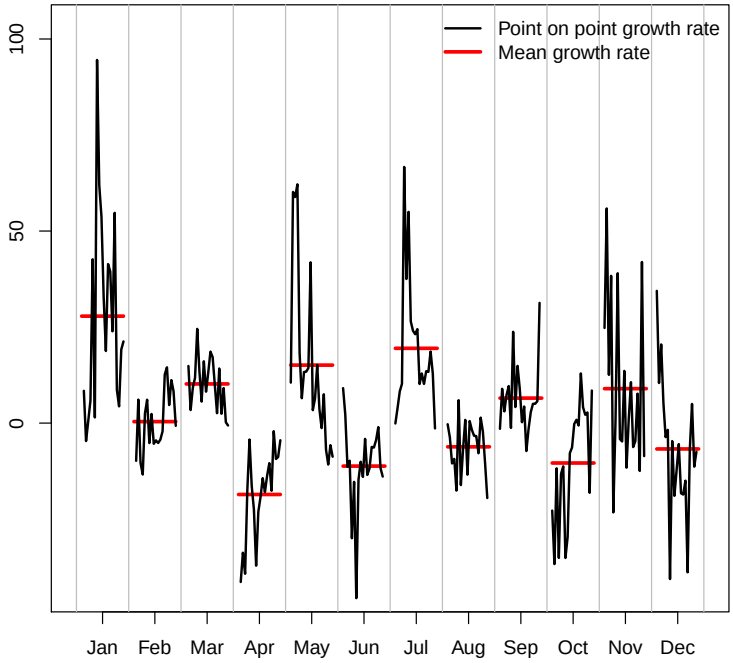
X-12-ARIMA has the capability to determine the mode of seasonal adjustment decomposition to be performed i.e whether multiplicative or additive seasonal adjustment decomposition is appropriate for the series. For car production, multiplicative seasonal adjustment is considered appropriate on the basis of the model selection criteria.

2 Steps in the seasonal adjustment procedure

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.

2.1 Seasonal adjustment of Car production with X-12-ARIMA

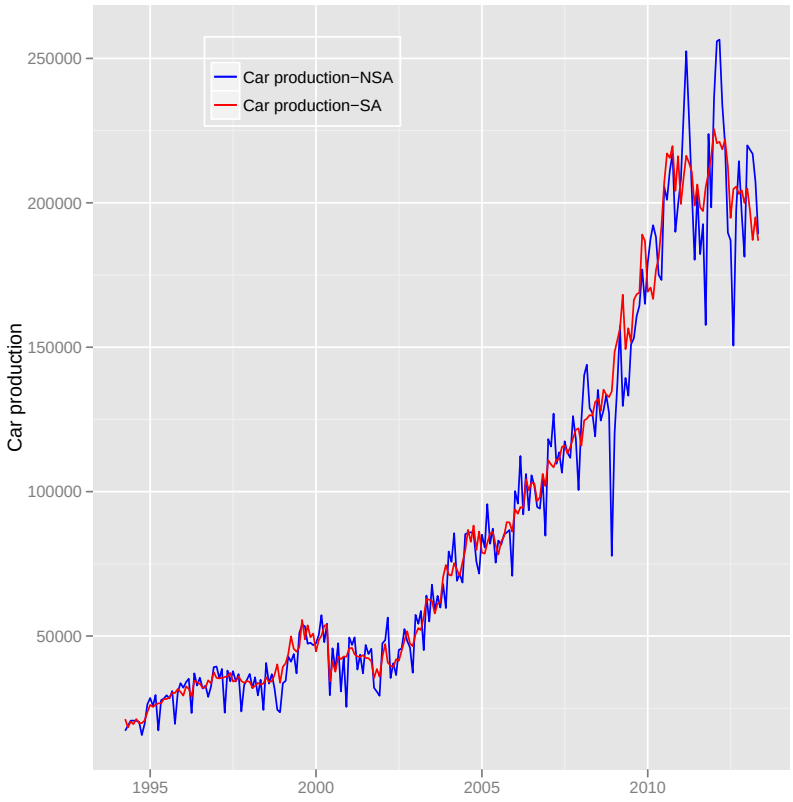
Seasonal adjustment is done with X-12-ARIMA method. Since the model selection criteria point towards multiplicative seaonality, log transformation of the series is performed.

Figure 3 shows the non-seasonally and seasonally adjusted car production. 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.

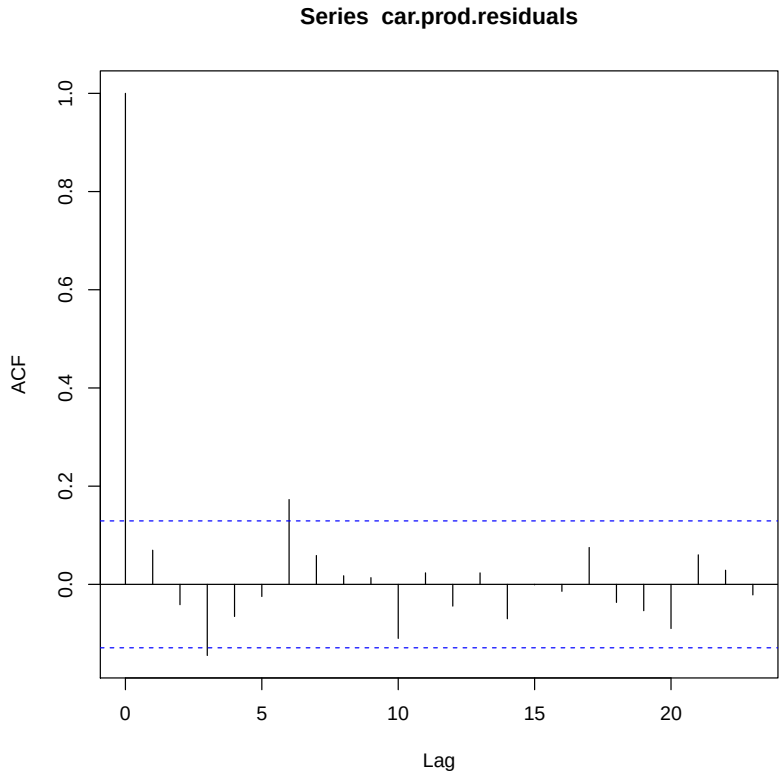
Figure 3 Car production (NSA and SA)



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 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 does not reveal significant autocorrelation amongst the residuals.

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 1 is desirable to show identifiable seasonality in the series. The value of M7 for car production is 0.554 .

Car production series show identifiable seasonality on the basis of the 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 (month or quarter).

Table 1 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 peak at 1.04 correspond to 6 months which is eliminated after seasonal adjustment. Other peaks seen in the lower panel of the figure are not at seasonal frequencies.

Figure 5 Car production Spectral plot (NSA and SA)

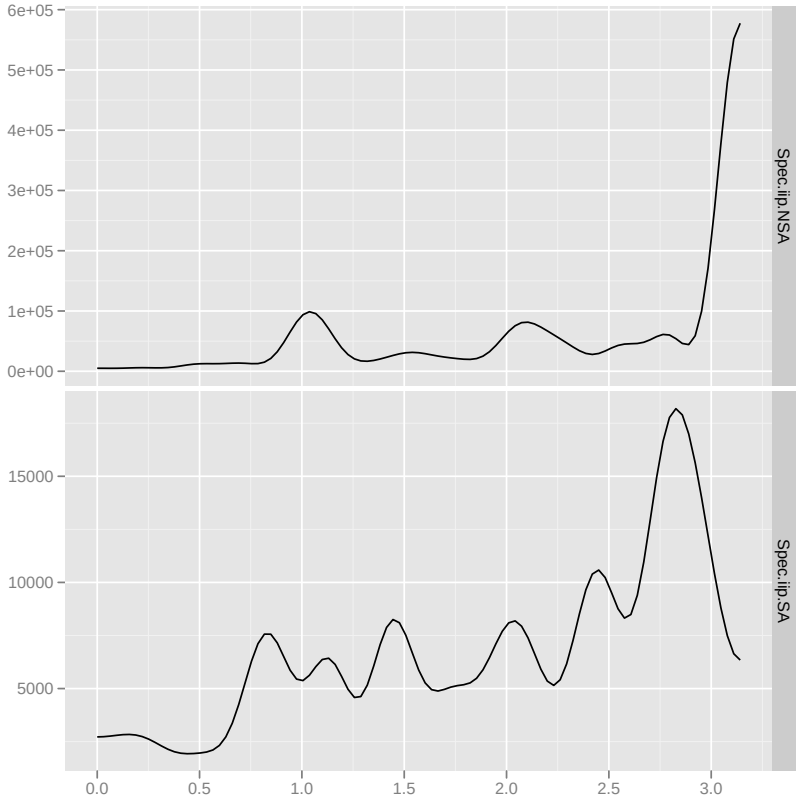


Table 1 Year on year and point on point growth rates

	Y.o.Y.growth	Point.on.point.growth
2008 Jan	7.50	-7.71
2008 Feb	-22.67	17.87
2008 Mar	-3.42	115.86
2008 Apr	-1.81	33.13
2008 May	9.33	30.02
2008 Jun	0.57	86.87
2008 Jul	9.55	-142.44
2008 Aug	11.84	56.68
2008 Sep	11.66	-37.43
2008 Oct	22.90	110.56
2008 Nov	25.52	14.00
2008 Dec	23.16	3.77
2009 Jan	39.14	135.22
2009 Feb	112.24	-14.40
2009 Mar	49.01	-118.44
2009 Apr	36.22	10.08
2009 May	22.17	-28.04
2009 Jun	45.15	69.74
2009 Jul	25.64	29.26
2009 Aug	30.06	70.07
2009 Sep	36.13	89.85
2009 Oct	31.29	58.13
2009 Nov	31.29	-8.68
2009 Dec	32.06	22.57
2010 Jan	7.37	-87.92
2010 Feb	20.85	68.78
2010 Mar	16.08	-95.69
2010 Apr	23.29	55.84
2010 May	31.34	40.69
2010 Jun	21.64	-13.91
2010 Jul	16.61	-17.57
2010 Aug	4.04	-68.40
2010 Sep	-1.00	43.24
2010 Oct	-9.35	-47.10
2010 Nov	-8.77	-7.63
2010 Dec	-27.33	49.38
2011 Jan	17.83	28.83
2011 Feb	-0.50	31.11
2011 Mar	13.61	52.13
2011 Apr	10.61	-26.33
2011 May	1.58	2.60
2011 Jun	2.15	-14.12
2011 Jul	7.93	18.43
2011 Aug	5.22	-51.62
2011 Sep	-8.08	-105.03
2011 Oct	-17.39	60.20
2011 Nov	2.61	4.91
2011 Dec	35.98	-14.95
2012 Jan	-12.44	7.50
2012 Feb	-8.61	-26.03
2012 Mar	-6.99	29.63
2012 Apr	-14.70	-48.27