

Seasonal Adjustment of Car Rental Rate Survey Results

This description is designed to help understand the theory of calculating seasonal adjustment factors and the techniques that were used in calculating the seasonal factors of the Auto Rental News/Rate Highway/Tennant Group rate surveys. Please contact Jim Tennant of The Tennant Group, jim@tennantgroup.com, 707-287-1311, with questions.

Seasonal Adjustment of Economic Data. Most economic data varies up and down depending on the season. It is often useful to be able to look at data that have had the seasonal component removed, referred to as “deseasonalized.”

To look at trends in data that have a definite seasonal component that has not been deseasonalized, comparison to the same month in previous years is usually the most reliable way to spot trends. Comparing June data, for example, to May or April might not be meaningful, because possibly June is always stronger than April and May, so because June is up from the previous two months, without knowing how they usually compare, is less meaningful than comparing to previous Junes.

A year to year comparison also has problems, because possibly last June was especially strong (or weak) so we might have to wait for July’s comparison to confirm a trend.

These issues were recognized many years ago, probably first by the Census Bureaus of various countries, including the United States, Canada and Australia. They have developed mathematical techniques based on some generally accepted theories. The general field of study is sometimes referred as “Time Series Analysis” and calculating seasonal factors is part of that field.

The technique begins by postulating that economic data studied over time has four components affecting it: (1) a long term trend, (2) a shorter term cycle (maybe a business cycle), (3) a seasonal component, including the effect of holidays and (4) other variations from external factors, called “noise” in this context. The Census Bureau techniques are designed to analyze and isolate long term trends, shorter term cycles and if significant, trading day and holiday effects.

Seasonal Adjustment of Car Rental Rate Quotes. We have only four years of data (considered the minimum required to calculate reliable seasonal components), so for this purpose we merged the long term trend and business cycle components and treated them as one. Trading days were ignored and except for Easter, holidays were handled as part of the monthly seasonal adjustment.

The Recall Rate Spike of 2014. There is quite a bit of “noise” in the rate survey data, because

Remove Recall Effect					
Jul	Aug		10 Mths	Jul	Aug
57.34	47.21		505.94	0.1133	0.0933
71.64	44.97		486.47	56.67	45.37
54.40	41.42		462.78	0.1176	0.0895
53.51	43.78		451.36	0.1186	0.0970

the rate quotes can go up or down quite dramatically due to a small mismatch between capacity (fleet size) and demand by even one company. There is little we can do about this because we do not have access to the internal

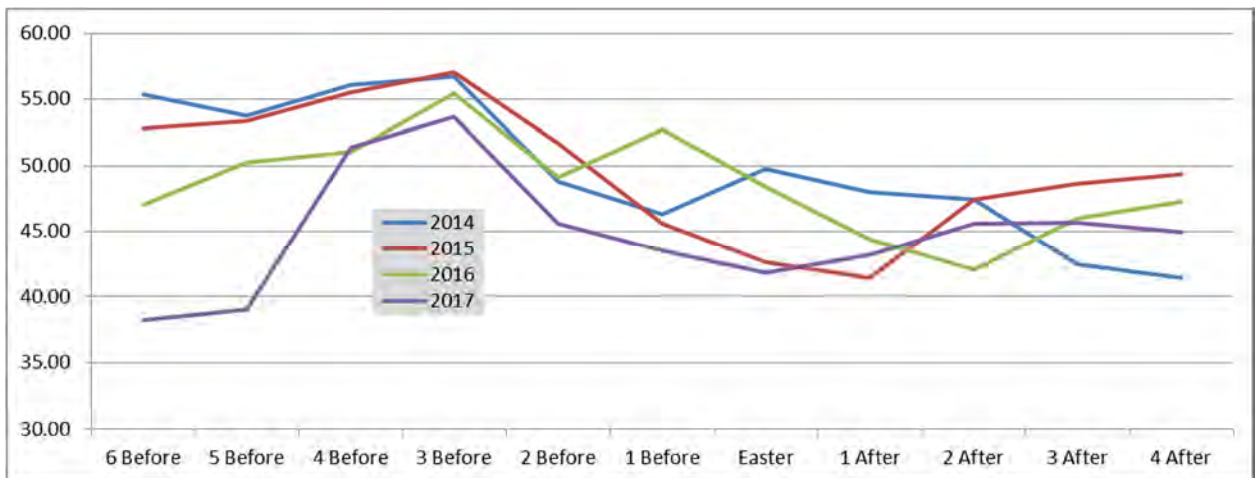
workings of the industry’s rate management systems. However, there is one bit of significant noise that we do understand – the very large spike in rates in the summer of 2014 caused by large, mostly unforeseen, recalls by the manufacturers. If we did not adjust for it, we would show that July has a much stronger seasonal factor than it really does. For purposes of calculating the moving average and seasonal factors (explained below) we adjusted July and August, 2014 to have the same relationship to the other 10 months of 2014 as they did, on average, in the other three years. The table above shows the calculation.

The Easter Effect. Parts of seasonal factors are the various holidays throughout the year. Many have a strong effect on rental rates, but as long as they are always at roughly the same time in the same month, they will be included in other monthly seasonal factor calculations and do not have to be treated separately. However, Easter and the accompanying Spring Break have a major effect on rates and they can fall in different months from year to year. Therefore we have adjusted for the Easter Effect before calculating other seasonal factors as shown below

Easter can fall anywhere between March 20 and April 25. We looked at weekly rates quote averages for six weeks before and four weeks after Easter for the four years for which we have data.

Actual Results												
2014	03/07/14	03/14/14	03/21/14	03/28/14	04/04/14	04/11/14	04/18/14	04/25/14	05/02/14	05/09/14	05/16/14	
	55.35	53.74	56.08	56.72	48.77	46.34	49.79	47.98	47.45	42.46	41.42	
2015	02/20/15	02/27/15	03/06/15	03/13/15	03/20/15	03/27/15	04/03/15	04/10/15	04/17/15	04/24/15	05/01/15	
	52.80	53.39	55.51	57.01	51.72	45.58	42.64	41.42	47.42	48.60	49.36	
2016	02/12/16	02/19/16	02/26/16	03/04/16	03/11/16	03/18/16	03/25/16	04/01/16	04/08/16	04/15/16	04/22/16	
	47.00	50.22	51.02	55.43	49.16	52.72	48.38	44.38	42.04	46.00	47.26	
2017	03/03/17	03/10/17	03/17/17	03/24/17	03/31/17	04/07/17	04/14/17	04/21/17	04/28/17	05/05/17	05/12/17	
	38.24	39.02	51.35	53.65	45.64	43.54	41.83	43.21	45.62	45.66	44.97	

	6 Before	5 Before	4 Before	3 Before	2 Before	1 Before	Easter	1 After	2 After	3 After	4 After	Average
2014	55.35	53.74	56.08	56.72	48.77	46.34	49.79	47.98	47.45	42.46	41.42	49.64
2015	52.80	53.39	55.51	57.01	51.72	45.58	42.64	41.42	47.42	48.60	49.36	49.59
2016	47.00	50.22	51.02	55.43	49.16	52.72	48.38	44.38	42.04	46.00	47.26	48.51
2017	38.24	39.02	51.35	53.65	45.64	43.54	41.83	43.21	45.62	45.66	44.97	44.79



There is a very visible and consistent rate spike four weeks and three weeks before Easter. Since the rate survey pulls rate quotes for pickup every day from 15 to 21 days out, and the average rental is three or four days, it makes sense that the rate spike would be three or four weeks before the pickup date of the reservation.

% of Average	6 Before	5 Before	4 Before	3 Before	2 Before	1 Before	Easter	1 After	2 After	3 After	4 After
2014	111.5%	108.3%	113.0%	114.2%	98.2%	93.3%	100.3%	96.6%	95.6%	85.5%	83.4%
2015	106.5%	107.7%	112.0%	115.0%	104.3%	91.9%	86.0%	83.5%	95.6%	98.0%	99.5%
2016	96.9%	103.5%	105.2%	114.3%	101.3%	108.7%	99.7%	91.5%	86.7%	94.8%	97.4%
2017	85.4%	87.1%	114.6%	119.8%	101.9%	97.2%	93.4%	96.5%	101.8%	101.9%	100.4%
Average	100.1%	101.6%	111.2%	115.8%	101.4%	97.8%	94.8%	92.0%	94.9%	95.1%	95.2%

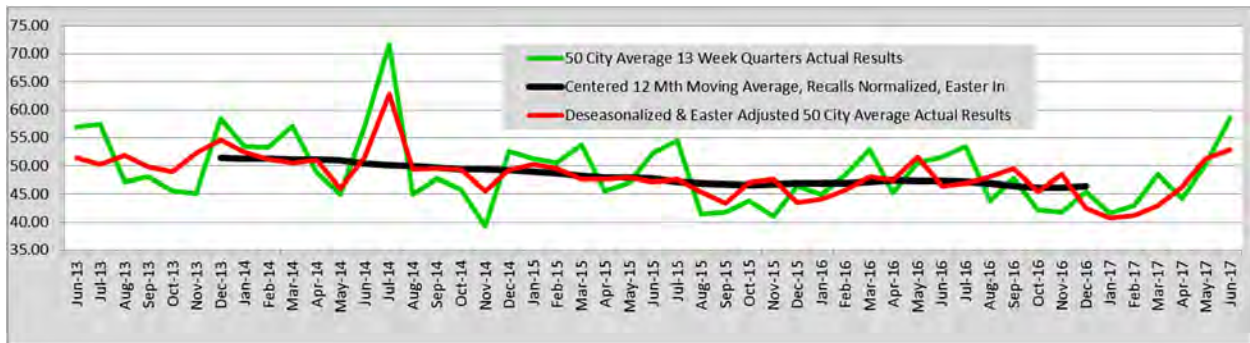
We have adjusted February and March for the four years results by dividing the four week out average by 111.2% and the three week out average by 115.8% and recalculating the February and/or March monthly averages each year before calculating the monthly seasonal component, described below. (Three or four weeks before Easter, or actually Good Friday, because the surveys are done on Fridays, will always fall in February or March, even if Easter is April 25, the latest possible date.)

Seasonal Factor Calculation. A month’s seasonal effect is the difference between an average or typical month’s values and the observed values, so the first question is “What is an average month?” To arrive at this, we calculate a 12 month moving average. However, a 12 month average of January through December, for example, would be centered between June and July. We want it to be centered on a month, not between months, so we “center” the average by using 13 months, not 12, but only counting one half of the value of each of the 1st and 13th month and the full value of the other 11 months, then dividing the total by 12. This gives us a “Centered 12 Month Moving Average.”

50 City Average Survey Results, Easter Effect & Recalls Removed												
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
2013-2014	56.99	57.34	47.21	48.04	45.50	45.08	58.41	53.47	52.60	52.13	48.74	44.99
2014-2015	57.13	56.55	45.28	47.75	45.88	39.31	52.61	51.27	50.90	49.11	45.54	46.96
2015-2016	52.29	54.40	41.42	41.83	43.75	41.09	46.50	45.00	47.01	49.53	45.29	50.50
2016-2017	51.55	53.51	43.78	47.71	42.20	41.79	45.47	41.57	42.28	44.29	44.26	50.23
Centered 12 Month Moving Average												
2013-2014							51.35	51.33	51.23	51.14	51.14	50.92
2014-2015	50.44	50.10	49.89	49.64	49.36	49.31	49.19	48.90	48.64	48.23	47.89	47.88
2015-2016	47.69	47.18	46.82	46.70	46.65	46.79	46.91	46.84	46.90	47.24	47.42	47.39
2016-2017	47.38	47.19	46.82	46.42	46.19	46.14						
50 City Average, Easter & Recalls Removed % of Avge												
2013-2014							113.7%	104.2%	102.7%	101.9%	95.3%	88.4%
2014-2015	113.3%	112.9%	90.8%	96.2%	92.9%	79.7%	107.0%	104.9%	104.6%	101.8%	95.1%	98.1%
2015-2016	109.6%	115.3%	88.5%	89.6%	93.8%	87.8%	99.1%	96.1%	100.2%	104.8%	95.5%	106.6%
2016-2017	108.8%	113.4%	93.5%	102.8%	91.4%	90.6%						
Average Seasonal	110.6%	113.9%	90.9%	96.2%	92.7%	86.0%	106.6%	101.7%	102.5%	102.9%	95.3%	97.7%
Normalized to 100%	110.8%	114.1%	91.2%	96.4%	92.9%	86.3%	106.9%	102.0%	102.8%	103.1%	95.6%	97.9%
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jan - Dec	102.0%	102.8%	103.1%	95.6%	97.9%	110.8%	114.1%	91.2%	96.4%	92.9%	86.3%	106.9%

These tables show the calculations that yield the average seasonal factors. The first table's data are the original surveys' 50 city average results with the recall spike and the Easter Effect taken out. The next table is the 12 month centered moving average. The next table is the percentage relationship between the actual results and the moving average, which is the seasonal effect that year, plus "noise". The three observations are averaged, then "normalized" to bring them to a 100% average. These are the seasonal factors that we use.

The Deseasonalized Results. Using these seasonal factors and the Easter Effect calculation we can deseasonalize our actual results and show the difference between the original data and the deseasonalized data.



The red line shows the deseasonalized data. While there is still substantial noise, the deseasonalized data are clearly closer the 12 month moving average (the black line) and will provide a more meaningful look at the month to month results, not just the year to year comparison. As an example, the last few months' deseasonalized data show a very clear turnaround in rates and is a better look than the somewhat jagged raw data shown by the green line.

Definition of a Month. To arrive at the monthly averages used in the Auto Rental News columns, we have averaged the weekly data for every Friday (the day of each week's survey) in that month. There can be four or five Fridays in a month and the number of Fridays in each month varies from year to year. We have addressed this issue in the column on a couple of occasions when the number of Fridays has changed from year to year and it had an effect on the year to year comparison. For example, suppose a month had five Fridays one year and four the next and the year to year comparison would have been different if we had included five this year (by including the Friday that happened to fall on the first day of the next month or the last day of the previous month).

We took the occasion of analyzing the last four years' data to look at alternative ways of defining months for this purpose. Ideally, each month would have the same number of weeks each year. Because there are not exactly 52 weeks in a year, this is not possible, but we can come close by using a constant 13 week quarter. Under this technique, each quarter would have a four week

month, then a five week month, then a four week month. Every five or six years, December would have five weeks to make up for the extra day or two more than 52 weeks in a year.

We analyzed the last four years' data using this technique and found that the data are more consistent. This makes sense, because most months are the same using the former calendar technique or the 13 week quarter technique but, under the new technique, there would be no year to year discrepancies in the number of weeks and therefore the definition of each month is constant year to year.