

Seasonal Adjustments to the *Nonmanufacturing Business Outlook Survey*

January 26, 2016

The Federal Reserve Bank of Philadelphia is now seasonally adjusting the results of its *Nonmanufacturing Business Outlook Survey (NBOS)*. Starting with the January 2016 release, the Philadelphia Fed will present seasonally adjusted values in the reports. This document describes:

- the method used to compute seasonally adjusted data;
- the tests used to assess the presence of seasonality, including important caveats; and
- some examples of the results.

The full set of historical data — seasonally adjusted (SA) and nonseasonally adjusted (NSA) — is available in an Excel spreadsheet.

Computing Seasonally Adjusted Data

The Philadelphia Fed uses the U.S. Census Bureau's X-12 program with the additive seasonal factors option to adjust the *NBOS* data. Each question's components — increase, decrease, and no change — are seasonally adjusted.

- In the event a seasonal factor for a component series results in a negative percentage, the percentage is set to zero; if a result exceeds 100, the percentage is set to 100.
- If the sum of the three adjusted components exceeds 100 percent, the components are proportionally adjusted to equal 100 percent. The sum may fall short of 100 percent — typically representative of nonresponses — and is left as is.

The diffusion index for each question is then recalculated using the adjusted component series and is computed as the difference between the percentage of increases and the percentage of decreases.

Testing for Seasonality

Prior to computing the SA data, the U.S. Census Bureau's X-12 program with the additive seasonal factors option was used to test for seasonality in the NSA data for each survey question's diffusion index. Table 1 shows F-test and Kruskal-Wallis (KW) chi-square test results for seasonality for each diffusion index, as well as the corresponding probability for the absence of seasonality.

Using a subjective set of criteria to assess acceptance or rejection of the presence of stable seasonality, evidence of seasonality is indicated for seven series (see Table 1), is uncertain or mixed for six series, and is rejected for three series (as indicated by color coding).

Despite these mixed indications for seasonality, SA data are produced for all 16 series.

Table 1: Seasonality Tests on the Diffusion Indexes of NBOS Series

Code	Series Name	F-Test	Prob	KW Test	Prob
GARBN	Current Activity for the Region	9.5	0.0%	40.0	0.0%
GABN	Current Activity for the Company	5.1	0.0%	33.4	0.0%
NOBN	New Orders	5.5	0.0%	35.9	0.0%
SRBN	Sales or Revenues	4.6	0.0%	31.3	0.1%
UOBN	Unfilled Orders	1.5	15.9%	17.2	10.0%
IVBN	Inventories	1.7	11.0%	18.8	6.6%
PPBN	Prices Paid	1.3	24.9%	14.2	22.0%
PRBN	Prices Received	2.7	0.9%	22.2	2.3%
NFBN	Number of Employees — Full-time Permanent	2.2	2.8%	19.9	4.7%
NPBN	Number of Employees — Part-time, Temporary ...	3.9	0.1%	27.5	0.4%
AWBN	Average Hours Worked Per Week	3.0	0.5%	26.7	0.5%
WBBN	Wage and Benefit Costs	2.6	1.3%	25.3	0.8%
CPBN	Capital Expenditures — Physical Plant	1.6	13.4%	15.5	16.0%
CEBN	Capital Expenditures — Equipment and Software	1.9	7.0%	20.2	4.3%
GARFBN	Future Activity for the Region	5.0	0.0%	35.1	0.0%
GAFBN	Future Activity for the Company	2.2	3.4%	19.0	6.0%

The F-test and KW test indicate whether the null hypothesis *that no stable seasonality is present* is:

Rejected (at 1% level)	Uncertain (at 1% to 10% level)	Accepted (at 10% level)
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Important Caveats

In addition to examining other tests of seasonality, users of the SA data should be mindful of the following caveats:

- **The period adjusted is short:** The seasonal adjustment process was based on 58 months of data (from March 2011 to December 2015, inclusive). This exceeds the 36-month minimum required to run the procedure but falls short of a seven-year (or 84-month) length that some sources advise to avoid potential problems with short series.
- **The sample sizes each month are small:** Over the 58-month period, the number of responses in any given month averaged 36, with a median of 38, a minimum of 13, and a maximum of 61. Sample sizes are improving. From the first full year to the last, the average number of responses in any given month has grown from 23 to 43, with the median rising from 20 to 40, the minimum increasing from 13 to 34, and the maximum growing from 38 to 57.
- **The sample sizes are themselves seasonal:** The maximum number of responses in any given year tend to occur after major recruiting efforts in February or March and sometimes in June. Responses tend to drop off in subsequent months following each specific effort.
- **The direction of the seasonal adjustment results requires further study:** At present, the industry sectors of respondents are not stratified to be a representative sample of the Third District's actual industry mix for nonmanufacturing. The direction of the resulting seasonal factors appears to be generally appropriate for education services, health services, and government sectors, but not for construction, trade, information, finance, and other service sectors.

Results of the Seasonal Adjustment Process

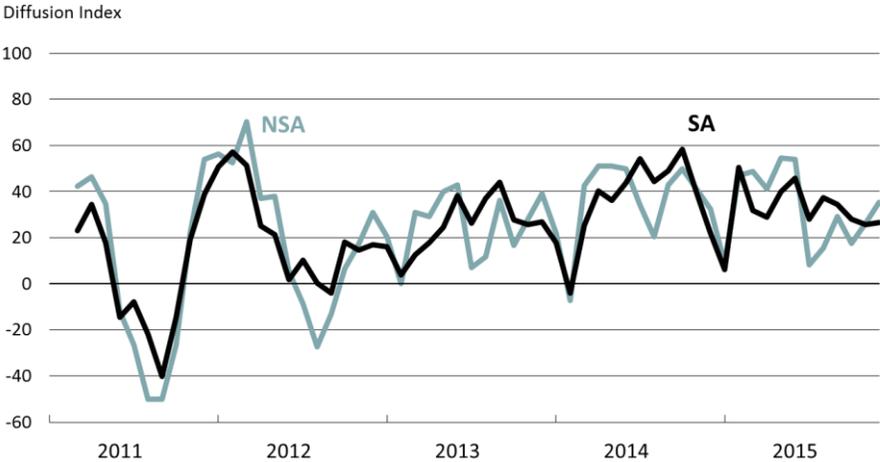
Table 2 shows the summary statistics for the SA and NSA series of the current activity indexes over the sample period for the region and the firm. As expected from a seasonal adjustment process on these two indexes, the averages of the SA and NSA series are similar, while the standard deviations of the SA series are smaller than their NSA counterparts.

**Table 2: NBOS Summary Statistics
for Nonseasonally Adjusted and Seasonally Adjusted Diffusion Index Levels**

Code	Series Name	NSA		SA	
		Avg.	St. Dev.	Avg.	St. Dev.
GARBN	Current Activity for the Region	24.5	26.7	24.3	20.5
GABN	Current Activity for the Company	30.3	21.1	29.9	16.0
NOBN	New Orders	20.4	17.6	20.3	13.9
SRBN	Sales or Revenues	23.5	19.7	23.2	15.6
UOBN	Unfilled Orders	5.6	8.1	5.5	7.2
IVBN	Inventories	4.1	6.4	4.1	5.5
PPBN	Prices Paid	20.6	8.2	20.6	7.0
PRBN	Prices Received	11.8	9.7	11.7	7.8
NFBN	Number of Employees — Full-time Permanent	14.9	10.0	14.7	8.6
NPBN	Number of Employees — Part-time, Temporary, ...	15.2	12.4	14.9	9.8
AWBN	Average Hours Worked Per Week	16.1	11.0	15.9	8.7
WBBN	Wage and Benefit Costs	30.4	9.5	30.3	8.2
CPBN	Capital Expenditures — Physical Plant	15.0	7.6	14.8	6.7
CEBN	Capital Expenditures — Equipment and Software	21.6	9.8	21.5	8.5
GARFBN	Future Activity for the Region	45.2	22.0	45.4	18.3
GAFBN	Future Activity for the Company	50.7	16.6	50.6	14.6

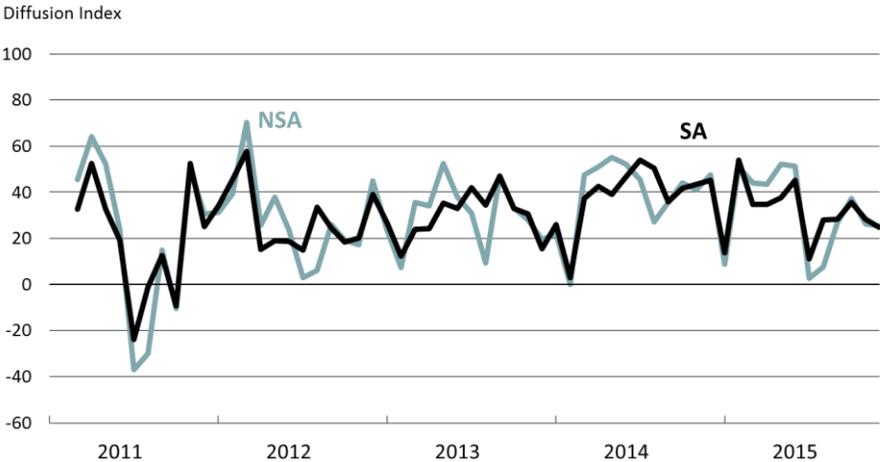
The following charts display the full history of the SA and NSA series of the current activity diffusion indexes for the region and at the firm level. These charts show that the seasonal adjustments tend to reduce extreme values throughout the entire history.

NBOS Current General Activity in the Region
March 2011 to December 2015



Note: The diffusion index is computed as the percentage of respondents indicating an increase minus the percentage indicating a decrease; the data are seasonally adjusted.

NBOS Current General Activity at the Firm Level
March 2011 to December 2015



Note: The diffusion index is computed as the percentage of respondents indicating an increase minus the percentage indicating a decrease; the data are seasonally adjusted.