Survey of Construction

Seasonal Adjustment FAQS

1. What is an economic time series?

An economic time series is a sequence of successive measurements of an economic activity (that is, variable) obtained at regular time intervals (such as every month or every quarter). The data must be comparable over time, so they must be consistent in the concept being measured and the way that concept is measured.

2. What is seasonal adjustment?

Seasonal adjustment is the process of estimating and removing seasonal effects from a time series in order to better reveal certain non-seasonal features. Examples of seasonal effects include a July drop in automobile production as factories retool for new models and increases in heating oil production during September in anticipation of the winter heating season. (Seasonal effects are defined more precisely in 5. and 6. below.) Sometimes we also estimate and remove trading day effects and moving holiday effects (see 7. below) during the seasonal adjustment process.

3. Why do you seasonally adjust data?

Seasonal movements are often large enough that they mask other characteristics of the data that are of interest to analysts of current economic trends. For example, if each month has a different seasonal tendency toward high or low values it can be difficult to detect the general direction of a time series' recent monthly movement (increase, decrease, turning point, no change, consistency with another economic indicator, etc.). Seasonal adjustment produces data in which the values of neighboring months are usually easier to compare. Many data users prefer seasonally adjusted data because they want to see those characteristics that seasonal movements tend to mask, especially changes in the direction of the series.

4. In the original (unadjusted) series, this year's April value is larger than the March value. But the seasonally adjusted series shows a decrease from March to April this year. What does this discrepancy mean?

This difference in direction can happen only when the seasonal factor for April is larger than the seasonal factor for March, indicating that when the underlying level of the series isn't changing, the April value will typically be larger than the March value. This year, the original series' April increase over the March value must be smaller than usual, either because the underlying level of the series is decreasing or because some special event or events abnormally increased the March value somewhat, or decreased the April value somewhat. (When trading day or moving holiday effects are present and are being adjusted out, other explanations are possible.)

5. What kinds of seasonal effects are removed during seasonal adjustment?

Seasonal adjustment procedures for monthly time series estimate effects that occur in the same calendar month with similar magnitude and direction from year to year. In series whose

seasonal effects come primarily from weather (rather than from, say, Christmas sales or economic activity tied to the school year or the travel season), the seasonal factors are estimates of average weather effects for each month, for example, the average January decrease in new home construction in the Northeastern region of the U.S. due to cold and storms. Seasonal adjustment does not account for abnormal weather conditions or for year-to-year changes in weather. It is important to note that seasonal factors are estimates based on present and past experience and that future data may show a different pattern of seasonal factors.

6. What is the seasonal adjustment process?

The mechanics of seasonal adjustment involve breaking down a series into trend-cycle, seasonal, and irregular components.

Trend-Cycle: Level estimate for each month (quarter) derived from the surrounding year-or-two of observations.

Seasonal Effects: Effects that are reasonably stable in terms of annual timing, direction, and magnitude. Possible causes include natural factors (the weather), administrative measures (starting and ending dates of the school year), and social/cultural/religious traditions (fixed holidays such as Christmas). Effects associated with the dates of moving holidays like Easter are not seasonal in this sense, because they occur in different calendar months depending on the date of the holiday.

Irregular Component: Anything not included in the trend-cycle or the seasonal effects (or in estimated trading day or holiday effects). Its values are unpredictable as regards timing, impact, and duration. It can arise from sampling error, non-sampling error, unseasonable weather, natural disasters, strikes, etc.

7. What are trading day effects and trading day adjustments?

Monthly (or quarterly) time series that are totals of daily activities can be influenced by each calendar month's weekday composition. This influence is revealed when monthly values consistently depend on which days of the week occur five times in the month. For example, building permit offices are usually closed on Saturday and Sunday. Thus, the number of building permits issued in a given month is likely to be higher if the month contains a surplus of weekdays and lower if the month contains a surplus of weekend days. Recurring effects associated with individual days of the week are called trading-day effects.

Trading-day effects can make it difficult to compare series values or to compare movements in one series with movements in another. For this reason, when estimates of trading-day effects are statistically significant, we adjust them out of the series. The removal of such estimates is called trading day adjustment.

8. How is the seasonal adjustment derived?

We use a computer program called X-13ARIMA-SEATS to derive our seasonal adjustment and produce seasonal factors.

It is difficult to estimate seasonal effects when the underlying level of the series changes over time. For this reason, the program starts by detrending the series with a crude estimate of the trend-cycle. It then derives crude seasonal factors from the detrended series. It uses these to obtain a better trend-cycle and detrended series from which a more refined seasonal

component is obtained. This iterative procedure, involving successive improvements, is used because seasonal effects make it difficult to determine the underlying level of the series required for the first step. Crude and more refined irregular components are used to identify and compensate for data that are so extreme that they can distort the estimates of trend-cycle and seasonal factors.

The seasonal factors are divided into the original series to get the seasonally adjusted series. For example, suppose for a particular January, a series has a value of 100,000 and a seasonal factor of 0.80. The seasonally adjusted value for this January is 100,000/0.80=125,000.

If trading day or moving holiday effects are detected, their estimated factors are divided out of the series before seasonal factor estimation begins. The resulting seasonally adjusted series is therefore the result of dividing by the product of the trading day, holiday, and seasonal factors. The product factors are usually called the combined factors, although some tables refer to them as the seasonal factors for simplicity.

9. What is X-13ARIMA-SEATS?

X-13ARIMA-SEATS is a seasonal adjustment program developed at the U.S. Census Bureau. The program is based on the Bureau's earlier X-12-ARIMA program.

The X-13ARIMA-SEATS software improves upon the X-12-ARIMA seasonal adjustment software by providing enhanced diagnostics as well as incorporating an enhanced version of the Bank of Spain's SEATS (Signal Extraction in ARIMA Time Series) software, which uses an ARIMA model-based procedure instead of the X-11 filter-based approach to estimate seasonal factors. The SEATS routines are included due to collaboration with the developers of the software (Agustin Maravall, Chief Economist of the Bank of Spain, and Gianluca Caporello).

Improvements in X-13ARIMA-SEATS as compared to X-12ARIMA include:

- additional regressors for modeling calendar effects in stock time series
- other built in regressors for temporary level shifts and seasonal outliers
- the ability to designate groups of user-defined holiday regressors and generate model diagnostics for the different groups
- model-based F-tests for stable seasonal and trading day regressors
- accessible HTML output generated directly by the software rather than by a separate utility

The X-13ARIMA-SEATS and X-12-ARIMA software produce identical results when using the X-11 filter-based adjustment methodology.

10. What diagnostics do you publish?

The X-13ARIMA-SEATS program that we use to derive our seasonal adjustment calculates numerous diagnostic statistics. Annually, we plan to publish at least the statistics listed below. In this listing, the term "header" refers to the column heading in the published table. The values of the statistic appear under these headings. The headers themselves refer to the series and its seasonal adjustment output:

- O: Original series
- CI: Seasonally adjusted series (product of the I and C components)
- I: Irregular series

- C: Trend-Cycle series

Name	Header	X-13 Table	Description
Original Series	O	Table F2.A Span 1	The average month-to-month (quarter-to-quarter) percentage change, without regard to sign, of the original (not seasonally adjusted) series.
Seasonally adjusted series	CI	Table F2.A Span 1	The average month-to-month (quarter-to-quarter) percentage change, without regard to sign, of the seasonally adjusted series.
Irregular component	I	Table F2.A Span 1	The average month-to-month (quarter-to-quarter) percentage change of the irregular component. This component is obtained by dividing the trend-cycle component into the seasonally adjusted series.
Trend-cycle component	C	Table F2.A Span 1	The average month-to-month (quarter-to-quarter) percentage change of the trend-cycle component. This component is a smoothed version of the seasonally adjusted series obtained by means of a moving average.
Ratio of irregular to trend-cycle component	I/C	Table F2.A Span 1	The average month-to-month (quarter-to-quarter) percentage change of the trend-cycle component. This component is a smoothed version of the seasonally adjusted series obtained by means of a moving average.
Moving seasonality present relative to stable seasonality	M7	Table F3	A function of the F-test assessing the significance of stable seasonality and the F-test assessing the significance of moving seasonality. It is one of the 11 quality monitoring statistics that X-13ARIMA-SEATS produces. M7 may range from 0 to 3 with an acceptance range from 0 to 1.
Overall quality assessment statistic	Q	Table F3	A weighted average of M1-M11 (quality monitoring statistics from X-13ARIMA-SEATS). An indicator of the overall quality of the adjustment. Q has an acceptance range of 0 to 1. Values from 1.0 to 1.2 may be accepted if other diagnostics indicate suitable adjustment quality.
F-test statistic for stable seasonality	F	Table D8	An F-test measure of the presence of stable seasonality. It is the quotient of two variances: (1) the between-months (between-quarters) variance and (2) the residual variance.

Summary of average percent changes and related measures for:

- New Residential Construction PDF [8k]
- New Residential Sales PDF [8k]
- Construction Spending
- Manufactured Homes

11. What indicates a good quality seasonal adjustment?

No residual seasonal effect

Once we adjust the series for seasonality, there should be no remaining seasonal effect in the adjusted series. The seasonally adjusted series is the combination of the trend-cycle and the irregular. Neither of these components should contain seasonality.

Passing values for quality assessment diagnostics

We look for M7 and Q statistics less than 1.0. (See 10. above.) These diagnostics help us decide if X-13ARIMA-SEATS can adequately adjust the series.

Stability (small revisions) of the estimates

X-13ARIMA-SEATS contains several different stability diagnostics to help us select X-13ARIMA-SEATS options to keep revisions of the estimates low.

12. Why do you revise seasonal factors?

There are two reasons that we revise seasonal factors:

- We revise factors when we revise the unadjusted data to achieve a better fit to the revised data.
- The estimate of a seasonal factor for a given month, say January, 1995, is most strongly influenced by the data from surrounding Januaries (especially from 1994 and 1996). In 1999, when the January data for 2000 and later are not available, the seasonal factor estimate for January 1999 will be of reduced quality, unless X-13ARIMA-SEATS has calculated good forecasts of data for 2000 and later years and has used them in place of the data that is not yet available. In any case, when future data become available, we use them to obtain improved seasonal factor estimates for the most recent years of the series. These revised factors lead to revised seasonal adjustments of higher quality.

13. What is an annual rate? Why are seasonally adjusted data often shown as annual rates?

Very generally, what we call the seasonally adjusted annual rate for an individual month (quarter) is an estimate of what the annual total would be if non-seasonal conditions were the same all year.

This "rate" is not a rate in a technical sense but is a level estimate.

The seasonally adjusted annual rate is the seasonally adjusted monthly value multiplied by 12 (4 for quarterly series). For example,

Seasonally Adjusted Annual Rate=(Unadjusted Monthly Survey Estimate)/(Seasonal Factor)*12

The benefit of the annual rate is that we can compare one month's data or one quarter's data to an annual total, and we can compare a month to a quarter.

The Bureau of Economic Analysis (BEA) publishes quarterly estimates of the United States gross domestic product (GDP) at an annual rate, and many of the Census Bureau data series are inputs to GDP. Annual rates for input series help users see the data at the same level as GDP estimates.

14. Why can't I get the annual total by summing the seasonally adjusted monthly values (or by summing the annual rates for each month (quarter) of the year and dividing by 12 (4))?

When seasonal adjustment is done by dividing the time series by seasonal factors (or combined seasonal-trading day-holiday factors) it is arithmetically impossible for the adjusted series to have the same annual totals as the unadjusted series (except in the uninteresting case in which the time series values repeat perfectly from year to year). "Benchmarking" procedures can be used to modify the adjusted series so as to force the adjusted series to have the same totals as the unadjusted series, but these procedures do not account for evolving seasonal effects or for trading day differences due to the differing weekday compositions of different years.

15. For the Construction series, how do I get seasonally adjusted quarterly values when you publish monthly seasonal adjustments (or rates)?

For monthly Construction series (Permits, Starts, Completions, Houses Sold, Construction Spending, and Manufactured Homes Shipments and Placements), which are flow series,

averaging values for each month in a quarter will produce a corresponding seasonally adjusted quarterly rate.

For the monthly Construction series which are stock (inventory) series (Houses For Sale, Under Construction, and Dealers' Inventory of Manufactured Homes), the monthly seasonally adjusted value for the last month of the quarter is the seasonally adjusted quarterly value.

Note that these methods will not produce the same result as directly seasonally adjusting the quarterly series.

16. What is an indirect adjustment? Why is it used?

If an aggregate time series is a sum (or other composite) of component series that are seasonally adjusted, then the sum of the adjusted component series provides a seasonal adjustment of the aggregate series that is called the indirect adjustment. This adjustment is usually different from the direct adjustment that is obtained by applying the seasonal adjustment program to the aggregate (or composite) series. When the component series have quite distinct seasonal patterns and have adjustments of good quality, indirect seasonal adjustment is usually of better quality. Indirect seasonal adjustments are preferred by many data users because they are consistent with the adjustments of the component series. For example,

United States = Northeast Region + Midwest Region + South Region + West Region

Because seasonal patterns are different in the different regions of the country, we can estimate the seasonality better by adjusting at the regional level and summing the results to obtain the seasonal adjustment for the U.S. total.

17. For the Construction series, are the February estimates adjusted for leap-year effects prior to seasonal adjustment?

For monthly Construction series (Permits, Starts, Completions, Houses Sold, Construction Spending, and Manufactured Homes Shipments and Placements), which are flow series, we handle multiplicative leap-year effects as part of the trading-day adjustment in X-13ARIMA-SEATS, which is performed prior to seasonal adjustment. A given February estimate is re-scaled, prior to applying a log transformation, by multiplying the estimate by the ratio of the average length of February (28.25 days) to the length of the given February (either 28 or 29 days).

For the monthly Construction series which are stock (inventory) series (Houses For Sale, Under Construction, and Dealers' Inventory of Manufactured Homes), no adjustment for leap-year effects is made in X-13ARIMA-SEATS prior to seasonal adjustment. The U.S. Months' Supply series is derived from the ratio of the seasonally adjusted U.S. Total Houses For Sale estimate (directly adjusted) and the seasonally adjusted U.S. Total Houses Sold estimate (indirectly adjusted by summing up the four regions). Therefore, only part of the U.S. Months' Supply series (i.e. the Houses Sold estimate) is adjusted for leap-year effects prior to seasonal adjustment.