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Seasonal adjustment: Concepts and interpretation, 2026

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Seasonal adjustment: Concepts and interpretation, 2026

This reference document provides nontechnical answers on selected topics related to the use and interpretation of seasonally adjusted data. It is designed to complement more technical discussions of seasonal adjustment found in Statistics Canada publications and reference manuals.

This document is divided into two sections. Section 1 is a review of concepts and definitions that are central to the theory and practice of seasonal adjustment. Section 2 is a discussion of selected issues that are related to the analysis and interpretation of seasonally adjusted data.

Note that Statistics Canada also has a two-minute video primer on seasonal adjustment: [Statistics for all seasons](#).

1 Context, definitions and terminology

1.1 Time series data

A **time series** is a sequence of observations collected at regular time intervals. These data provide information on a well-defined statistical concept for a specific reference period, and are presented at different points in time. Most economic data disseminated by Statistics Canada are presented as a time series. Examples include the monthly data on consumer prices, retail sales, employment and gross domestic product. These data correspond to monthly reference periods that are available for a long sequence of months, to facilitate comparisons over time.

1.2 Seasonally adjusted time series

Monthly or quarterly time series data are sometimes influenced by seasonal and calendar effects. These effects can bring about changes in the data that normally occur at the same time, and in about the same magnitude, every year. For example, monthly retail sales have historically been at their highest level for the year in December as a result of holiday shopping and then declined to lower levels in January. This occurs year after year and affects the extent to which information on trends in retail industries can be informed by comparing raw sales data for these two months.

A **seasonally adjusted time series** is a monthly or quarterly time series that has been modified to eliminate the effect of seasonal and calendar influences. The seasonally adjusted data allow for more meaningful comparisons of economic conditions from period to period. A **raw time series** is the equivalent series before seasonal adjustment and is sometimes referred to as the **original** or **unadjusted time series**.

1.3 The importance of seasonal adjustment

Many users of economic and social statistics rely on time series data to understand changes in socio-economic phenomena over time. Important statistical properties of a time series include its direction and turning points, as well as its relationship to other socio-economic indicators. A seasonal pattern in a series can obscure these important features by making period-to-period movements in the data more difficult to interpret. Many users of time series data do not consider movements in the data that relate to seasonal and other calendar effects to be analytically meaningful. These seasonal and calendar effects can obscure “true” underlying movements in the data series related to the business cycle, or to non-seasonal events, such as strikes or unanticipated disruptions in production. Consequently, seasonal adjustment techniques that remove the effect of seasonal and calendar influences from the original data can sharpen the extent to which a time series can be used to evaluate meaningful changes in economic conditions over time.

1.4 When seasonal adjustment is not required

Seasonal adjustment may not always be appropriate or required. It is not necessary to seasonally adjust a series that does not exhibit an identifiable seasonal pattern or other calendar-based influences. It is also not always advisable to use seasonally adjusted data when the raw estimate represents the true statistic of interest. For example, decision makers who rely on the Consumer Price Index (CPI) for indexation purposes are advised to use unadjusted data—as these reflect the actual price movements observed from period-to-period. However,

data users who are more interested in analyzing underlying price trends in the economy are encouraged to use seasonally adjusted indexes.

Similarly, analysts who are interested in calculating the **raw change** in the number of young adults working from April 2024 to May 2024 should examine the raw estimates for these two months and calculate the difference. This month-to-month change in raw employment might not yield much useful information about changes in the labour market conditions facing young adults if seasonal or calendar effects have a significant influence on employment levels in either or both months. However, the raw data show the extent to which actual employment for this group grew, or contracted, from April to May—which may be useful information for other purposes.

1.5 Common practice at Statistics Canada

Statistics Canada seasonally adjusts almost all of its major sub-annual economic indicators, including quarterly and monthly estimates of gross domestic product, and monthly employment estimates from the Labour Force Survey. Although the vast majority of the agency's releases highlight seasonally adjusted data, both the seasonally adjusted series and unadjusted series are often made available.

1.6 Estimating seasonally adjusted data

Seasonally adjusted data are estimated by breaking down time series data into various components. Using well-established statistical techniques, this process involves decomposing a time series into four separate components: (1) the trend-cycle, (2) seasonal effects, (3) other calendar effects such as trading days and moving holidays, and (4) the irregular component. The seasonally adjusted series is the original time series with the estimated seasonal and calendar effects removed, or equivalently, the estimated combination of the trend-cycle and the irregular components.

1.7 Defining the components

A time series can be split into four separate time series components: (1) the trend-cycle, (2) seasonal effects, (3) other calendar effects such as trading days and moving holidays, and (4) the irregular component. Here is an overview of each:

The trend-cycle: This represents the smoothed version of the time series and indicates its general pattern or direction. The trend-cycle can be interpreted as the long-term movement in the time series, the result of different factors (or determinants) that condition long-run changes in the data over time. As its name suggests, the trend-cycle also reflects periodic expansions and contractions in economic activity, such as those associated with the business cycle.

Seasonal effects: These represent regular movements or patterns in time series data that occur in the same month or quarter every year. On the basis of past movements of the time series, these regular patterns repeat themselves from year to year. These seasonal patterns are fairly stable in terms of timing, direction and magnitude. Often these seasonal effects relate to well-established calendar-based variations in economic activity, such as the increase in retail sales in the lead up to Christmas or increases in construction employment in the spring. Seasonal effects identify these regularly occurring patterns in the data.

Other calendar effects such as trading days and moving holidays: Aside from seasonal effects, other systematic calendar-based effects can influence the level of economic activity in a specific period. The most important of these are the trading-day effects. These effects can be present when the level of economic activity varies depending on the day of the week. For example, retail sales are usually higher on Saturdays than on any other day of the week. Consequently, a five-Saturday month is more likely to result in higher retail sales than a month with only four Saturdays. Another common example of a calendar effect is the date of Easter, which can be expected to increase retail sales in March or April depending on the month in which it occurs. This particular calendar effect is referred to as a moving holiday effect.

The irregular component: This component includes unanticipated movements in the data that (1) are not part of the trend-cycle, and (2) are not related to current seasonal factors or calendar effects. The irregular component could relate to unanticipated economic events or shocks (for example, strikes, disruptions, unseasonable weather, etc.), or can simply arise from noise in the measurement of the unadjusted data (due to sampling and non-sampling errors).

1.8 Seasonally adjusted series inclusions and exclusions

Seasonal effects and other calendar effects such as trading days and moving holidays are excluded from seasonally adjusted series. Consequently, the seasonally adjusted series is the combination of the trend-cycle and the irregular component. The contribution of the irregular component is worth emphasizing, because seasonally adjusted data are sometimes misinterpreted as providing users with “pure” information on the trend-cycle.

1.9 Reasons for data revisions

The raw data can be revised to take into consideration additional data that were reported late, to correct data that were initially misreported, or for various other reasons. In such cases, the seasonally adjusted data that are based on unadjusted data also need to be revised.

Hindsight is very important for time series analysis. Even when the raw series has not been revised, it is often useful to revise the seasonally adjusted data. To estimate the seasonal effects at any given point in time, statisticians use information from previous, current and future observations. Information about future observations is not available in real time, so seasonal adjustment is conducted using previous and current values, along with projected values. These projections are based on a statistical model that uses past information. As new data becomes available, the various time series components can be estimated more accurately. This results in revised, more accurate estimates of the seasonally adjusted data.

Periodically, the methods used to estimate time series components for specific data series are also reviewed. Each statistical program at Statistics Canada has its own revision strategy, and schedules are routinely made available to data users in advance of these revisions.

1.10 Limitations of year-over-year comparisons

Comparing raw data for the same period in each year provides information on long-term trends and economic cycles, but these comparisons do not necessarily remove all the seasonal patterns from the data. Certain holidays, like Easter, do not fall on the same date or even in the same month from year to year. If the timing of these holidays influences the variable being measured, such as monthly retail sales, raw year-over-year comparisons can be misleading. For example, in 2024, Easter was on March 31, whereas in 2023, it was on April 9. Thus, it may be misleading to conclude that the change in sales from March 2023 to March 2024 reflects underlying trends in retail industries, as differences in sales may have been influenced by the timing of the Easter holiday.

Similarly, year-over-year comparisons of raw data ignore the trading day effect, which occurs in many series, and can affect the validity of year-over-year comparisons. For example, many businesses generate less output on Saturday and Sunday than during weekdays. In 2023, July began on a Saturday and included five full weekends and 21 weekdays. In 2024, July began on a Monday and included four full weekends and 23 weekdays. A simple year-over-year comparison between these two months will not account for these differences and could affect the analysis of changes in economic output over time.

Even when no other calendar effects are present in the data, comparing the same periods in each year can still be problematic. In general, it can be shown that this type of comparison lacks timeliness for the identification of turning points (the point at which a decreasing series, for example, begins to increase).

Comparing a current value with only one past value (the value of the series 12 months before the current reference month) can also be misleading if that particular value is unusual. For example, comparing economic data for British Columbia for February 2011 to data for February 2010 (the month in which the province hosted the Winter Olympics) may not yield useful information about changes in trends. To partially mitigate this effect, data for the current month (February 2011) can be compared with an average of the data for previous Februarys (for example, the past five years). A similar technique can be applied to examine month-to-month movements. For example, the December to January movement of this year could be compared with a historical average of December to January movements for the last five years. Although this method may yield some additional insight, some measure of caution is warranted as it does not take the place of more formal seasonal adjustment techniques.

2 Issues related to analysis and interpretation

2.1 Interpreting period-to-period changes

Period-to-period changes in raw data and period-to-period changes in seasonally adjusted data provide different information. To illustrate this, consider hypothetical employment data from a monthly industry survey. Every month, these data are collected and processed to obtain an estimate of total industry employment. This estimate is **raw** (not seasonally adjusted)—it is a measure of the number of people working in the industry in the reference month, without distinguishing between (or disentangling) the various time series components that contribute to this estimate.

Before publication, this estimate of industry employment is seasonally adjusted, to remove the influence of seasonal and calendar effects from the raw data (using current and past information on industry employment). This adjusted estimate is the official estimate of industry employment released in [The Daily](#).

An important note about comparisons over time—the difference between the seasonally adjusted employment estimates for two consecutive months cannot be interpreted as the raw difference in the number of people actually working in the industry in these months. The raw difference is the difference in the unadjusted employment estimates obtained directly from the survey.

Rather, the difference in the month-to-month seasonally adjusted estimates is a direct measure of the change in the number of people working, **after expected changes due to the variation in seasonal employment between these two months are taken into account**. The resulting number may be less than the raw difference or it may be more, depending on how seasonal effects are changing from month to month.

The example below illustrates the distinction between raw and seasonally adjusted data, using hypothetical employment data for an industry, collected over two consecutive months. In this example, it is assumed that there are no other calendar effects.

Table 1
Industry employment, raw and seasonally adjusted

Time Period	Unadjusted data	Seasonally adjusted data	Trend-cycle	Irregular component	Seasonal effects
Month 1	6,200	7,200	6,650	550	-1,000
Month 2	5,400	6,800	6,500	300	-1,400
Change (month 2 minus month 1)	-800	-400	-150	-250	-400

Source: Statistics Canada, authors' calculations.

In month 1, the unadjusted estimate of industry employment was 6,200; the seasonally adjusted employment estimate was larger, at 7,200. Accordingly, the employment attributed to seasonal effects in month 1 was -1,000. What does this mean?

It means that about 1,000 fewer employees were expected to be working in month 1 when compared with a **generic average level of industry employment throughout the year**. These “expected” and “average” levels are based on historical patterns that reflect typical seasonal movements in these data.

Accordingly, these 1,000 fewer employees are added back into the employment estimate for month 1, yielding a seasonally adjusted estimate that is larger than the unadjusted, or raw, estimate collected from the survey. Why is this done? This occurs because the objective of seasonal adjustment is to make the month-to-month data more comparable so that they provide better information about trends and cyclical movements. Seasonally adjusting the data puts month-to-month comparisons on equal footing.

The estimate of industry employment for month 2 exhibits a similar pattern, with the final seasonally adjusted estimate exceeding the unadjusted estimate. In this month, 1,400 fewer employees would be expected to be working in the industry (compared with a generic average level of monthly employment throughout the year), based on regularly occurring seasonal movements. Adding this employment back into the unadjusted estimate from the survey data brings the published (seasonally adjusted) estimate to 6,800.

Both months are examples of “adding back” – supplementing the survey data with additional employment – because the seasonal effects are negative. In these cases, less employment is expected in the reference month because of past seasonal patterns, so employment has to be added back in to make the data comparable from month to month. For other months, the reverse could apply—because the seasonal factors are positive. In these months, more employees are expected to be working than in the hypothetical average month, so seasonal adjustment removes some employment from the unadjusted data to put these months (in statistical terms) on an equal footing with other months during the year.

2.2 Influence of seasonal patterns

The interpretation of month-to-month changes can be complex because it involves some of the more technical aspects of the data modelling used in seasonal adjustment routines. Seasonal patterns can be modelled “additively” or “multiplicatively”. If seasonal patterns are modelled as additive, the extent to which month-to-month changes in employment are being influenced by changes in the seasonal effects can be examined in a fairly straightforward fashion.

To see this, consider again the hypothetical employment data used in the example from the previous subsection. Seasonally adjusted employment fell from 7,200 in month 1 to 6,800 in month 2, a net decline of 400 workers.

This is different from the unadjusted change calculated directly from the survey data. The unadjusted estimate fell from 6,200 in month 1 to 5,400 in month 2, a net decline of 800 workers, or twice the decline in the seasonally adjusted data.

What accounts for the large difference in these two estimates? As noted above, both months had negative seasonal effects. This means that, in view of past patterns of seasonality, lower industry employment is expected in each of the two months when compared with an annual generic monthly average. But the negative seasonal effect in the second month was larger in absolute terms, by some 400 workers. While about 1,000 workers were added to the raw survey data in month 1 to obtain the seasonally adjusted estimate, some 1,400 workers were added back in month 2.

Numerically, about 40% of this reduction in the seasonally adjusted estimate can be attributed to changes in the trend-cycle. The remaining 60% is due to the irregular component.

2.3 Both raw and seasonally adjusted estimates are correct but should be interpreted in context

Month-to-month or quarter-to-quarter comparisons with the original unadjusted (raw) data can be misleading because they do not take into account the typical seasonal pattern or the calendar effects. In fact, it is not unusual for the unadjusted and seasonally adjusted data to move in opposite directions. This occurs when the change in the unadjusted data is less in magnitude than what was expected based on calendar effects and the seasonal movement observed in recent years.

For example, suppose that the unadjusted retail trade sales for a certain product increase by 20% from November to December this year while they were expected to increase by 30% based on the seasonal pattern from recent years and predictable calendar effects (e.g., the weekday composition of November and December this year). Despite the significant unadjusted increase, sales are 10% lower than anticipated, which translates into a corresponding decrease in the seasonally adjusted data.

The reverse situation also occurs, where a smaller than expected decrease in the unadjusted data will translate into an increase in the seasonally adjusted data. The two cases best highlight the purpose and importance of seasonal adjustment in preventing recurring seasonal patterns and predictable calendar effects from obscuring the underlying economic movement.

Both the raw and seasonally adjusted data are correct as both derive from legitimate statistical processes. The choice of one over the other depends on the purpose of the analysis.

If users are interested in estimates of the actual level of industry employment in a particular period (the number of people working), or in the period-to-period changes in these actual employment levels, these estimates can be obtained directly from surveys without any seasonal adjustment.

A problem arises when trying to use these unadjusted data to interpret changes in economic conditions. The raw data reflect the combined effect of all components that contributed to the observed level of employment in a monthly or quarterly period. This includes the trend-cycle, the seasonal effects, the other calendar effects and the irregular component. In the example in subsection 2.1, it is correct to say that industry employment declined by 800 workers from month 1 to month 2— the decline tabulated directly from the raw data. But it is less appropriate to attribute this decline to specific factors, such cyclical downturns, while ignoring the potential influence of other components, such as routine changes in seasonal hiring patterns, which also contribute to changes in the raw data.

The key point is that the choice between seasonally adjusted and raw data is context-driven. It depends on the issue that the data are attempting to inform, and whether period-to-period movements in these data that derive from seasonal influences are relevant to that issue.

2.4 Interpreting data during structural change

Seasonal adjustment is designed to help uncover economic changes in a time series and attribute them to the appropriate component in the decomposition of the series (trend-cycle, seasonality or irregular). Changes corresponding to situations in which some fundamental aspect of a time series is changing, resulting in new conditions that differ from past norms, are referred to as structural changes. These could involve major technological innovations that alter the nature of production. They could also involve more routine changes in hiring patterns in response to new administrative practices. The changes can be gradual (e.g., evolving consumer shopping habits) or occur more suddenly (e.g., economic shocks or crises, administrative changes). This relates to the reliability of seasonally adjusted data when such changes occur.

Change can bring about new seasonal patterns in a time series that contrast with previous seasonal patterns. It can therefore be more difficult to interpret movements in seasonally adjusted data when economic behaviours are evolving or changing, as irregular factors can exert a large impact on seasonally adjusted estimates.

How is this reflected in the seasonally adjusted data? In the short run, the changes would be regarded as irregular movements in the data, to the extent that they deviate suddenly from expected patterns. Over time, these new patterns would become established and gradually incorporated into the historical record, as new time series information on these changes becomes available. This assumes that these changes are becoming a regular feature of the data—and not the result of irregular events or shocks. For shocks, special intervention may be required (see the following subsection).

During periods of economic volatility such as the onset of the economic crisis, the COVID-19 pandemic, or the U.S. tariffs, results have been monitored closely to detect structural changes due to the increased likelihood of behavioural changes in the population during these global events. Based on this experience, structural changes have been most common in the trend-cycle and irregular components while sustained changes to seasonal and calendar patterns have been relatively rare.

2.5 How seasonal adjustment adapts to structural change

The seasonal adjustment method used at Statistics Canada includes steps specifically designed to limit the impact of individual time periods on the seasonal adjustment, making the process more robust in general. Individual time periods with unexpected movements are often associated with well-known economic events, but the lasting effects of those events may not be immediately clear.

Ideally, we would adjust our estimated patterns to account for lasting structural changes as soon as they occur. At the same time, we would ensure that temporary effects are not absorbed into the estimated patterns. Unfortunately, while changes are evolving in real-time, it can be challenging to distinguish lasting structural changes from transitory impacts. Without intervention in the seasonal adjustment process, the method will implicitly treat unexpected data points as transitory, until there is sufficient evidence of a structural change. When a shift that becomes a regular feature of the data first occurs, it is typically regarded in the short run as an irregular movement in the data, to the extent that it deviates suddenly from expected patterns. Over time, as these new patterns become established, they are gradually incorporated into the historical record, as new time series information on these changes becomes available.

At Statistics Canada, time series experts work with subject matter analysts to monitor series and detect economic changes to assess whether they are best treated as structural changes or transitory impacts. There are three broad categories of structural changes, each associated with individual components in the seasonal adjustment decomposition:

Structural changes to the trend-cycle represent a change in the underlying level of the series. They can occur suddenly, or as a gradual effect, but with an identifiable beginning and end, and the pace of the change is more rapid than the evolution of the trend-cycle typically seen in the series. These effects can be identified and estimated approximately six months after the change has taken place and can be incorporated in the trend-cycle component of the seasonal adjustment through an intervention in the seasonal adjustment process.

Changes to seasonal patterns and calendar effects represent sudden changes to seasonal or calendar effects, to the extent that the standard methodology does not adequately reflect the changing seasonal or calendar-based behaviour of the series. Note that the methodology used to estimate seasonal effects reacts to gradual evolution of seasonal behaviour, but interventions may be required when changes are more sudden. Due to the annual length of the seasonal cycle, at least two years are required to establish a seasonal break, and interventions are not typically applied until three years after the break occurs to ensure their reliability and avoid future revisions. In the interim, partial measures can be applied to expedite the transition to new patterns.

Changes to the magnitude and frequency of transitory effects generally appear as increased noise in the time series and tend to be absorbed appropriately into the irregular component, in effect increasing its magnitude. Interventions are not typically required for these changes but may sometimes be necessary to stabilize the estimation of other components so that the increased noise is not attributed to other components.

2.6 How seasonal adjustment accounts for weather

There is a common misconception about seasonally adjusted data—namely, that it is a technique whose sole purpose is to remove the effect of changes in weather or climate from the data. Seasonal adjustment removes the average or anticipated effect of seasonal factors from monthly or quarterly data, many of which have to do with changes in weather or climate. But it is more accurate to state that these seasonal factors relate to all things seasonal—weather and climate-related or otherwise—that have the potential to affect the analysis of trend or cyclical patterns in the data.

The idea of the “average” effect noted earlier is important, as the magnitude of these period-specific seasonal adjustments are again based on historical patterns. If weather or climate conditions are generally reflective of these past patterns, the seasonal adjustment routines can be expected to do a fairly complete job of factoring out movements in the unadjusted data that are attributable to these weather or climate changes. But unseasonable weather, such as the extreme heat wave in western Canada in 2021, is, by definition, not indicative of the average pattern, and will influence seasonally adjusted estimates.

2.7 Statistics Canada’s seasonal adjustment method

Statistics Canada seasonally adjusts sub-annual time series data using the X-12-ARIMA method, which uses well-established statistical techniques to remove the effect of regular, calendar-related patterns from unadjusted data. Although less complex alternatives may be used, such as comparing the original data in the same period in each year, these techniques have limitations when it comes to removing calendar effects. Accordingly, Statistics Canada recommends the use of formal, established methods for dealing with seasonality. In practice, seasonal adjustment is performed following [Statistics Canada Quality Guidelines](#).

2.8 Additional information

As mentioned at the start, this document is intended as a practical guide that provides users with additional perspective on issues related to the use and interpretation of seasonally adjusted data. It is designed to complement a paper by Wyman (2010), who illustrated many of these points with Statistics Canada data. In addition, the extensive literature on seasonal adjustment can provide readers with a fuller examination of the issues discussed in this document.

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