Australian
Bureau of
Statistics

Are you being misled by the
SEASONS?

WINTER

AUTUMN

SPRING

SUMMER

Have you ever wondered...

How can I be confident my interpretation of statistics is not misleading?

Am I using the right estimates in making important decisions?

What does seasonal adjustment mean for me?

WHY SEASONALLY ADJUST?

Why seasonally adjust?

Data collected regularly over time may display seasonal patterns. These patterns can make it difficult to see the effects of other influences on your data. Seasonal adjustment is a process for removing seasonal patterns. This process can help explain underlying activity in your data.

What is a seasonal pattern?

Regular highs (or lows) at certain times of the year indicate a seasonal pattern.

Figure 1: Example Seasonal Pattern and Trend
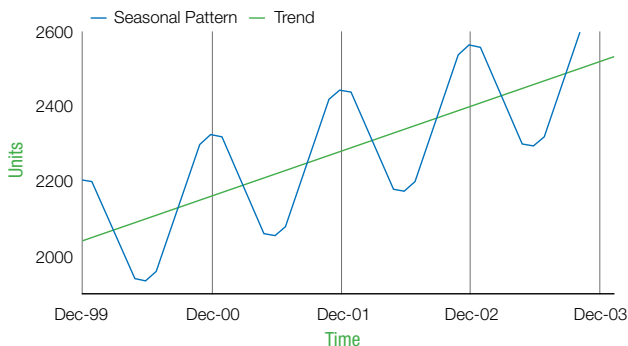
Some causes of seasonal patterns

Seasonal patterns are caused by regularly repeating cycles in the real world. For example:

a.   Retail sales are always larger in December due to Christmas.

b.   Crops are harvested in the same season each year.

c.   School and public holidays, especially during summer, are popular times to go travelling.

What if we remove seasonal patterns?

Removing seasonal patterns can help you understand what has been happening to your data. This is because there is more to your data than just seasonal patterns. There is also some sort of underlying direction, known as the trend. Once you know the trend and the seasonal pattern everything left over is known as the residual noise or irregular part of the series.

KEY POINT:

The process of estimating and removing seasonal patterns is known as seasonal adjustment.

Tell me more about the trend

The trend is the underlying direction of the series - "what's normal". It smooths out most of the noise and short-term effects present in the seasonally adjusted. If the noise is strong then the seasonally adjusted data will be quite volatile, but the trend will give you a much better idea of the long term behaviour of the data.

KEY POINT:

***The trend is estimated by smoothing noise out of the seasonally adjusted series.***

Why is my data noisy?

Noisy, or volatile, data is caused by a number of factors:

a. It may depend on what we're looking at, for example, ***actual*** crop yields are naturally volatile due to factors such as the weather.

b. It may also be related to the way data is collected, for example, ***estimates*** of the unemployment rate will contain further volatility if we don't survey the entire population.

If there is lots of noise in a series, this can obscure any regular patterns, and make it very difficult to understand what has been happening in your data.

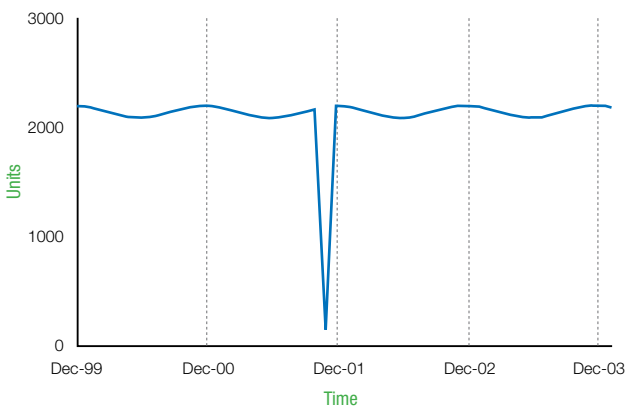**Figure 2: Example Residual Series**
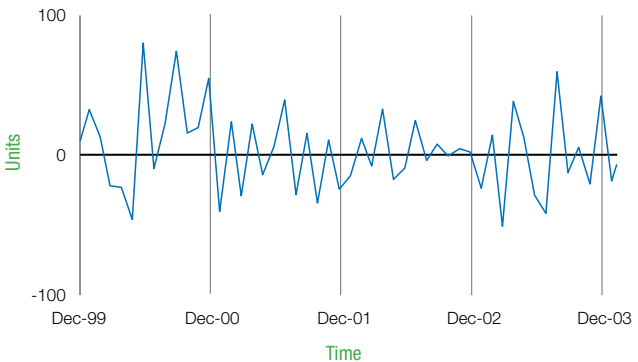
If your data is very noisy or has weak seasonal patterns it may be difficult to obtain reliable seasonally adjusted estimates.

Irregular events

Sometimes once-off, irregular events will have an impact on your data. For example, a strike by pilots would lead to a sudden reduction in air travel. Irregular events can affect our ability to identify seasonal patterns, leading to potentially misleading seasonally adjusted estimates.

Irregular events must be corrected to obtain reliable estimates of the seasonal pattern.

Figure 3: Example Irregular Event

The impact of irregular events and noise can be seen in the seasonally adjusted but are removed from the trend.

Seasonal patterns, irregular events and residual noise can all make it difficult to understand what has been happening to our data.

Seasonal adjustment is a process for separating these influences. Seasonally adjusted and trend estimates allow us to highlight underlying characteristics of data.

WHICH INDICATOR SHOULD I USE?

Which series should I use?

The original, seasonally adjusted and trend estimates are three separate series describing different aspects of the same data. These series are useful for different purposes.

Original estimates

The original is the best estimate we can make of the level of activity at any particular point in time.These are the estimates you'd use when focusing on history - e.g. auditing, comparing different data sources, assessing market share. Note that different months are not directly comparable.

Seasonally adjusted estimates

Seasonally adjusted estimates are produced by removing seasonal patterns from the original estimates. They are good for performance measures and comparisons - was that advertising campaign effective, how much tourist traffic did we lose because of the Tsunami, is unemployment doing better in QLD than in TAS. Again, they're very history focused. Different months are comparable but month-to-month movements are usually dominated by irregular effects.

Trend estimates

Trend estimates are produced by smoothing noise from the seasonally adjusted estimates. This is the best source of information for forecasting or making decisions about what to do in the future. It is directly comparable at different points in time. Trend estimates are revised as new original estimates become available. This makes sure we have the most up-do-date and best possible estimate.

For some questions you need to consider more than one series. Few retailers would hire many staff in late December, because sales consistently drop in January - something you can see from the seasonal pattern, the original minus the seasonally adjusted.

KEY POINT:

The original estimates, seasonally adjusted estimates and trend estimates are series that present different but complementary information.

Why shouldn't I compare original data from one period to the next?

The original data contains the seasonal patterns, residual noise and irregular influences. A comparison of original data from consecutive periods may lead to misleading conclusions if there is a strong seasonal pattern in the data.

For example, if you are looking at the unemployment rate, the original value for December 2009 is lower than January 2010; you might conclude that the underlying unemployment rate is going up. But January unemployment is seasonally high compared to December, and the underlying unemployment rate was actually falling; the Dec-Jan increase was not as big as usual.

How about comparing seasonally adjusted data from one period to the next?

Seasonal patterns have been removed from the seasonally adjusted data, however the residual noise and irregular influences are still present. If the residual noise is high it may distort a comparison of seasonally adjusted estimates. Similarly, an unusual event or irregular influence may affect a comparison. For example, consider a series which has an underlying increasing trend. An unusual event such as a strike may lead to a 'once-off' low value for one period.

WINTER

AUTUMN

Which indicator should I use to compare month-to-month or quarter-to-quarter percentage changes?

Series	Recommendation	Benefits and disadvantages
Original estimates	Do not use	Usually dominated by seasonal effects; also residual noise and irregular influences.
Seasonally adjusted estimates	Use with caution	Provides useful information on the effects of short term, major events. Dominated by irregular and noise, except for series with very little volatility.
Trend estimates	Preferred option	The best indicator of underlying behaviour for month-to-month or quarter-to-quarter changes. Recent estimates, usually the last 3 or 4, may be revised.

KEY POINT:

Trend estimates are usually preferred to compare data at different points in time as potentially misleading seasonal patterns, residual noise and irregular influences have been removed.

Why shouldn't I just compare original data from the same period in each year?

Comparing original data from the same period in each year is a crude form of seasonal adjustment which assumes that the seasonal patterns do not change. It does not completely remove all seasonal effects.

Certain holidays such as Easter and Chinese New Year fall in different periods in each year and their effects may distort the observed values. This comparison also ignores trading day effects caused by different day type compositions of the month in each year.

Each month consists of 4 complete weeks plus an extra 1, 2 or 3 days. Different levels of daily activity on the extra days may cause differences in the original estimates for the same month in consecutive years, even though the underlying level of activity is unchanged. Similarly, this type of comparison will ignore any changes to the seasonal pattern over time.

Since the original estimates also contain the influence of the irregular component, a comparison of original estimates may also be distorted if the magnitude of the irregular component is strong when compared with the magnitude of the trend.

However, the major disadvantage of comparing year to year data, whether original, seasonally adjusted, or trend, is lack of precision and time delays in the identification of turning points in a series.

Turning points occur when the direction of underlying level of the series changes, for example, when a consistently decreasing series begins to rise steadily. Using year to year changes in original data may cause delays of up to 6 months in the identification of turning points.

Which indicator should I use to compare year apart changes?

Series	Recommendation	Benefits and disadvantages
Original estimates	Do not use	Crude form of seasonal adjustment assuming seasonal patterns do not change. May be misleading as it ignores evolving seasonal patterns, trading day and moving holiday effects. May contain high contribution from residual noise.
Seasonally adjusted estimates	Use with caution	May be misleading, because year apart percentage changes in the seasonally adjusted estimates usually contain a high contribution from the residual noise.
Trend estimates	**Preferred option**	Stable measure indicating average trend movement over the year. May not reflect current direction of the trend if there has been a change in the direction of the trend during the year.

REVISIONS TO TIME SERIES ESTIMATES

What are revisions?

Revisions are minor improvements to original, seasonally adjusted and trend estimates that are made as further information about a time series becomes available. Revisions are implemented so that we produce the most appropriate original, seasonally adjusted and trend estimates at any particular point in time.

KEY POINT:

Revisions are improvements to the original, seasonally adjusted and trend estimates.

When will estimates of the original series be revised?

For some series, original estimates are routinely revised as better quality source data becomes available. For most series, revisions to original estimates are rare, and will be noted in ABS publications. Isolated points have been corrected where flawed data or processes have escaped normal quality checks. Sometimes there is a change in the way data is collected, or the scope or definitions used in a survey change; in this case, the original series may need revision so that it is consistent over time. Revisions to the original estimates will also lead to revisions in the seasonally adjusted and trend estimates.

KEY POINT:

Revisions to the original estimates will lead to revisions in the seasonally adjusted and trend estimates.

When will seasonally adjusted estimates be revised?

Seasonally adjusted estimates will generally face several years of small revisions as more original estimates of the same month or quarter become available. These revisions usually become even smaller over time, and can be expected for up to 7 years after an initial estimate is made.

The largest revisions to the seasonally adjusted estimates usually occur in each of the first three years after our initial estimate is made and after this time we can make a relatively stable estimate of the seasonal pattern. This occurs because changes to the seasonal pattern become most apparent when we see more original estimates of the same month or quarter.

Figure 4: Short term visitor arrivals to Australia from Japan

Seasonally Adjusted Estimates

Estimate calculated at July 1990
Estimate calculated at July 1991
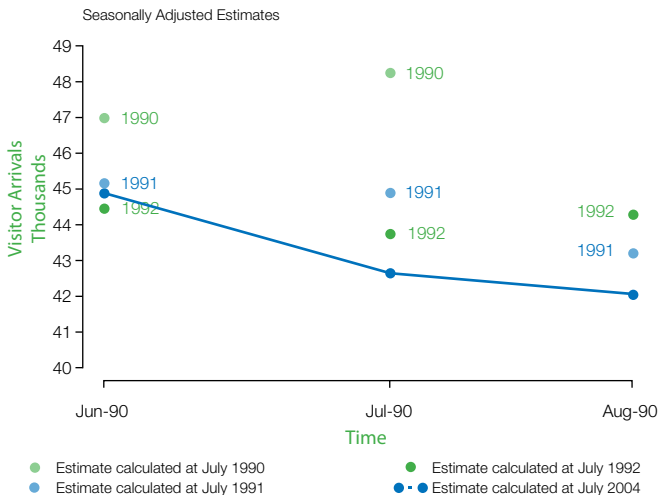Estimate calculated at July 1992
Estimate calculated at July 2004

Figure 4 shows seasonally adjusted estimates for June, July and August 1990. The different estimates produced in different years shows how the seasonally adjusted estimates change as additional information becomes available.

KEY POINT:

Revisions are improvements to the seasonally adjusted estimates as seasonal patterns in the original estimates become clearer over time.

When will trend estimates be revised?

Trend estimates also face minor levels of revision as more data becomes available. This occurs as both the seasonal pattern and the underlying direction of the series become clearer. Usually the largest revisions occur in the three time periods following the initial trend estimate. For example September 2005 trend estimates will normally face revision in October 2005 and be relatively stable after December 2005.

Figure 5: Short term visitor arrivals to Australia from Japan

Trend Estimates

Estimate calculated at Sep 1990
Estimate calculated at Oct 1990
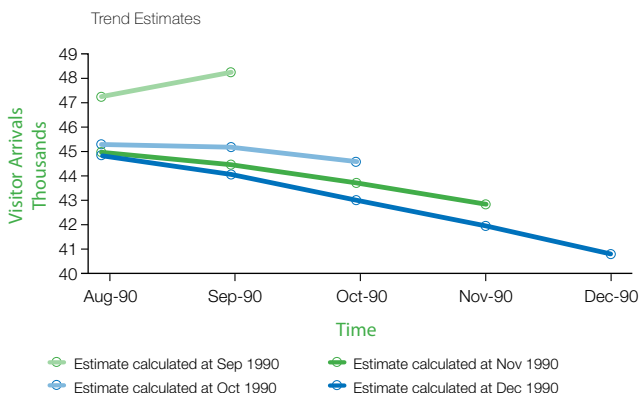Estimate calculated at Nov 1990
Estimate calculated at Dec 1990

Figure 5 shows that trend estimates for September 1990 are revised as more original estimates become available. The size of these revisions becomes smaller over time. We have selected an unusually drastic example for clarity.

KEY POINT:

Revisions are improvements to the trend estimates as seasonal patterns and the underlying level of the original estimates become clearer over time.

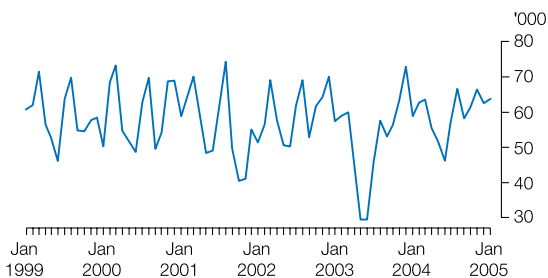## EXAMPLE OF A SEASONAL ADJUSTMENT

Step One:

Start with the original series of data regularly recorded each month or quarter
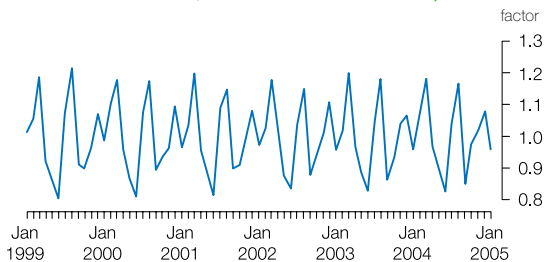
1. ORIGINAL SERIES, Short-term visitor arrivals - Japan

Step Two:
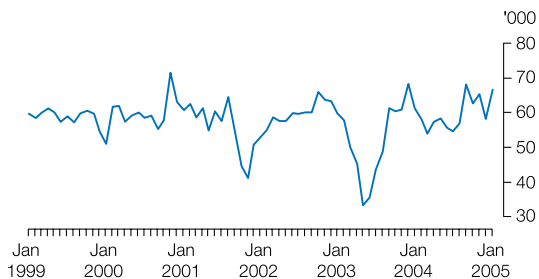
Estimate seasonal pattern

2. SEASONAL FACTORS, Short-term visitor arrivals - Japan

Step Three:

Remove estimated seasonal pattern to produce seasonally adjusted estimates
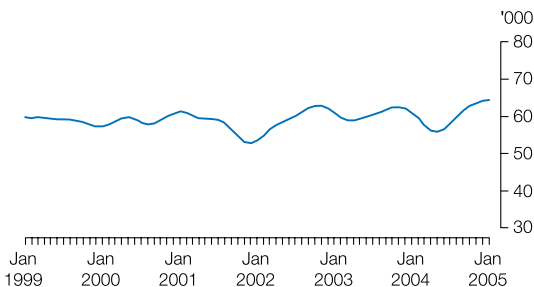
3. SEASONALLY ADJUSTED SERIES, Short-term visitor arrivals - Japan

Step Four:

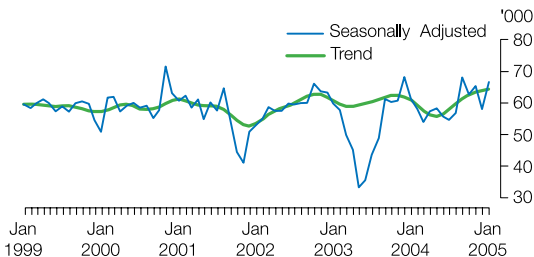Smooth noise from seasonally adjusted estimates to produce trend estimates

4. TREND SERIES, Short-term visitor arrivals - Japan

Step Five:

Seasonally adjusted and trend estimates are produced

5. TREND AND SEASONALLY ADJUSTED SERIES,
Short-term visitor arrivals - Japan

Note: The difference between seasonally adjusted estimates and the trend estimates is the residual noise and irregular series. In the above example, the irregular includes the effects of major short-term events: the September 2001 terrorist attacks in the USA, and the SARS epidemic in 2003s

FURTHER QUESTIONS

What seasonal adjustment tools does the ABS use?

The main tool used in the ABS is called SEASABS (SEASonal analysis, ABS standards). SEASABS is a software package that applies successive moving averages using the X11 processing method) to produce seasonally adjusted estimates. SEASABS is available free to most organizations on signing an agreement.

What is a moving average?

Moving averages successively average a shifting time span of data in order to produce a smoothed estimate of a time series. This smoothed series can be considered to have been derived by running an input series through a process which filters out certain cycles.

What is the end point problem?

It is not possible to use a symmetric filter at either the beginning or the end of a time series as there are not enough time points. This is one problem that leads to the revision of time series estimates.

What models can be used to decompose a time series?

Time series of original estimates are decomposed into seasonal, trend and irregular components through the application of decomposition models. These models are usually additive or multiplicative, but can also take other forms such as pseudo-additive. We usually choose the one that yields the most stable seasonal component, and leaves the residual noise component in an appropriate form.

What are stock and flow time series?

Time series can be classified into two different types: stock and flow. Stock series are a measure of certain attributes at a point in time and can be thought of as "stocktakes". Flow series measure a volume of activity over a given period. For example, the total profits taken in a month is a flow measure.

What are moving holiday effects?

Moving holiday effects are calendar related effects caused by holidays which occur each year, but whose exact timing shifts in the Gregorian calendar. Examples are Easter and Chinese New Year.

SPRING

SUMMER

What are trading day effects?

Trading day effects are calendar related effects related to the number of occurrences of each of the day of the week in a given month. For example having 4 weekends in March in 2000, but 5 weekends in March 2002 would **cause** higher turnover at a public swimming pool for March 2002.

When is seasonal adjustment inappropriate?

Any series that contains seasonal patterns should be seasonally adjusted. However, if your data is very noisy or has weak seasonal patterns it may be difficult to seasonally adjust. In this case the seasonal patterns will be harder to identify and seasonal adjustment will be less reliable.

What is direct and indirect seasonal adjustment?

Often time series are related in an aggregative way. For example, estimates in individual states should sum to the national total. When seasonally adjusting aggregate time series we can either adjust the aggregate (e.g. national) series directly or sum the seasonally adjusted estimates derived from the component (e.g. state) series to get an indirectly seasonally adjusted total.

What is concurrent seasonal adjustment?

Concurrent adjustment is a seasonal adjustment process in which updated estimates of the seasonal pattern are prepared each month using all of the available data. Concurrent seasonally adjusted estimates are much faster at identifying any changes to the seasonal pattern and will usually lead to more appropriate seasonally adjusted and trend estimates than a forward factor adjustment in which the seasonal pattern is only estimated once per year.

What do I need to know to do seasonal adjustment myself?

For each series, you need to choose between a few different decomposition models, and choose between seasonal filters and between trend filters. You need to recognise large extremes, trend breaks, and seasonal breaks, and you may need an understanding of other effects like Trading Day and Moving Holiday corrections. You can study the ABS publications listed overleaf or attend a nearby offering of "Understanding Time Series", where you can learn more and discuss your data with an ABS Time Series expert.

Where can I find out more about seasonal adjustment?

The ABS produces a number of publications providing in-depth reference material, such as

1. Information Paper: A Guide to Interpreting Time Series – Monitoring Trends. Catalogue # 1349.0

2. Information Paper: An Introductory Course on Time Series Analysis – Electronic Delivery.
   Catalogue # 1346.0.55.001

3. Time Series Frequently Asked Questions
   Catalogue # 1346.0.55.002

All these are available free from www.abs.gov.au.

For further questions, or to enquire about data analysis or training opportunities such as "Understanding Time Series", contact **time.series.analysis@abs.gov.au** or visit **www.abs.gov.au** .