Seasonal adjustment within Statistics New Zealand[1]

Introduction

This article provides an overview of Statistics New Zealand's seasonal adjustment process and shows how seasonal adjustment is used to reveal movement in a time series.

A broad aim of studying time series of economic data is the prompt recognition of significant changes in the direction and level of economic activity. Many time series have a recurring seasonal pattern that obscures the underlying behaviour of the series. Seasonal adjustment is the process of estimating and removing the varying seasonal effects from a time series in order to reveal non-seasonal features.

Components of an economic time series

Underlying trend

Most economic time series have a long-term underlying trend present. It is often associated with some basic characteristic of the economy, such as population growth. In some series the trend may be steadily upwards, while in others it may show considerable variability. In general the trend makes little contribution to the short-term month-to-month (or quarter-to-quarter) movements of the series, but it is the most important component for indicating the general level and broader movement of the activity as measured by the series. Figure 1 shows the trend of the clothing sub-series from quarterly retail sales.

Cyclical movements

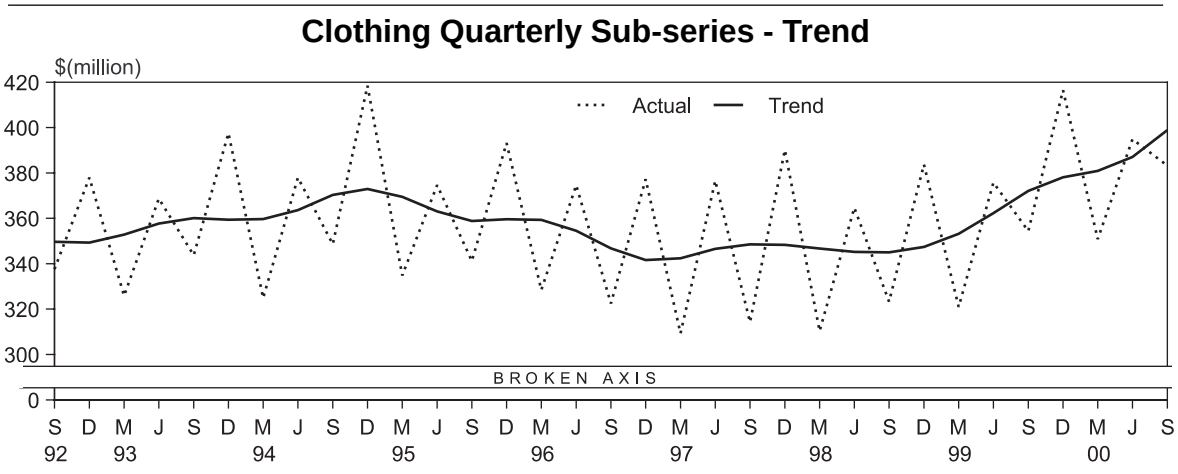
These are composed of cumulative, reversible, short-run movements. They are characterised by alternating periods of expansion and contraction as they reflect general economic activity. In some large overseas economies these accelerations and recessions are self-generating. In New Zealand, however, they are often the direct or indirect result of fluctuation in the terms of trade, as New Zealand is heavily dependent on overseas trade.

Whenever cyclical variations are present in a New Zealand time series, they merge with the underlying trend to form a component that is usually referred to as trend, though more correctly it is the "trend cycle".

Seasonal component

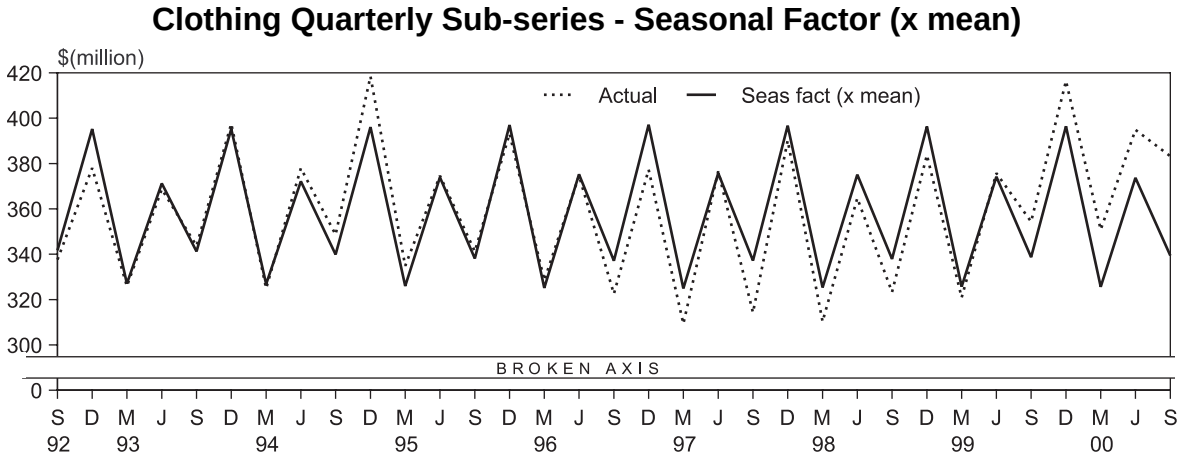
The seasonal component represents the seasonal patterns found in many sub-annual (quarterly or monthly) economic series. It is reasonably stable in terms of annual timing, direction, and magnitude.

Figure 1



1 This paper was prepared by Philippa Graham of the Analytical Support Division of Statistics New Zealand.

Figure 2



Possible causes include:

- Natural factors (eg seasonal weather patterns).
- Administrative measures (eg the starting and ending dates of the school year).
- Social/cultural/religious traditions (eg fixed holidays such as Christmas).
- The length of the months (28, 29, 30 or 31 days) or quarters (90, 91 or 92 days).

Effects associated with the dates of moving holidays like Easter are not seasonal in this sense, because they occur in different calendar months and different quarters, depending on the date of the holiday.

The extent and nature of this seasonality can vary markedly between series. For example, it is especially prominent in the case of electricity generation, or agricultural production, but relatively insignificant for a series such as total New Zealand population.

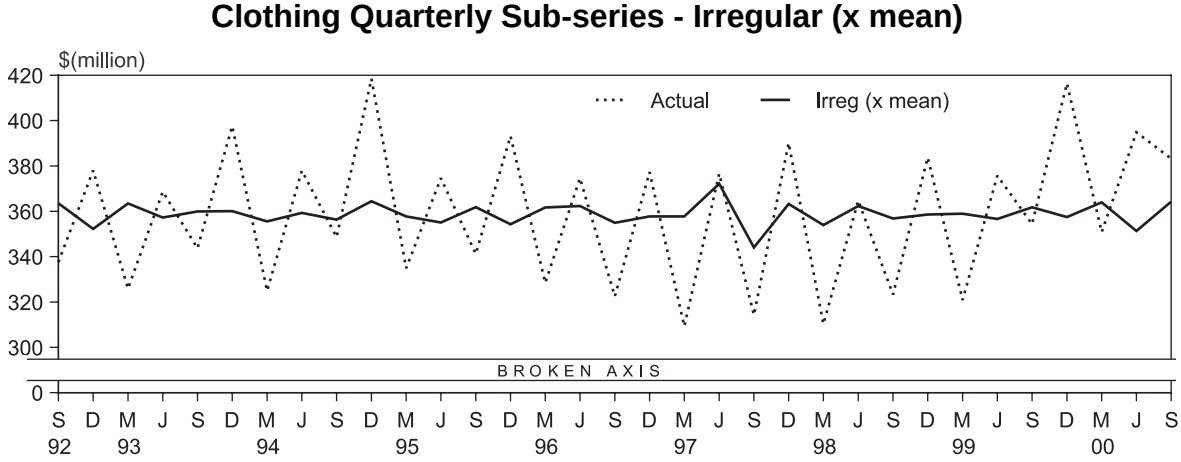
The effect of normal seasonal influences on a series can only be determined by observing the outcome of seasonal effects in immediate past years. The usefulness of measures of these seasonal effects depends on either their continuance in accordance with the historical pattern, or a gradually changing pattern. Not all seasonal influences are regular or pronounced enough to be usefully quantified. Figure 2 shows the seasonal factor of the clothing sub-series from quarterly retail sales.

Irregular component

This is the part of the observed value that is 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 a combination of sampling error, non-sampling error, unseasonable weather, natural disasters, strikes, etc. Random fluctuations are the main cause of the irregular

Figure 3



component. While every member of the population is affected by general economic or social conditions, each member is affected slightly differently. So there will always be some random variation in the series. This is not a problem, as long as it is small. If it is generally large, then it can become difficult to quantify the other components. Figure 3 shows the irregular component of the clothing sub-series from quarterly retail sales.

Trading day effects

Monthly time series that are based on a daily flow of goods, services, or money 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 the month of January will have five Sundays in some years and four in others.

Because these fluctuations are most easily illustrated in retail trade it is commonly referred to as "trading day" effect. In reality the effect may have more to do with the way the data are collected, than with the actual daily flow.

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, they are quantified and removed. The removal of such estimates is called trading day adjustment.

The seasonal model

A seasonal model gives a simplified description of the data. It is used to assist in analysis. At Statistics New Zealand, we use the model to help us understand what is happening now, and what has happened in the past. We do not use it for forecasting future values.

The standard seasonal model assumes the actual (observed) series (A) is composed of the following factors or components:

C - the trend cycle

S - the seasonal component

I - the irregular component

We assume that some relationship exists between the components of the seasonal time series. Generally it is either

multiplicative: $A = C \times S \times I$
or
additive: $A = C + S + I$

The multiplicative model is usually the best model for economic time series.

Seasonally adjusted series

The seasonally adjusted series is the actual series with the seasonal component removed.

Multiplicative: $Seasadj = C \times I = A / S$
Additive: $Seasadj = C + I = A - S$

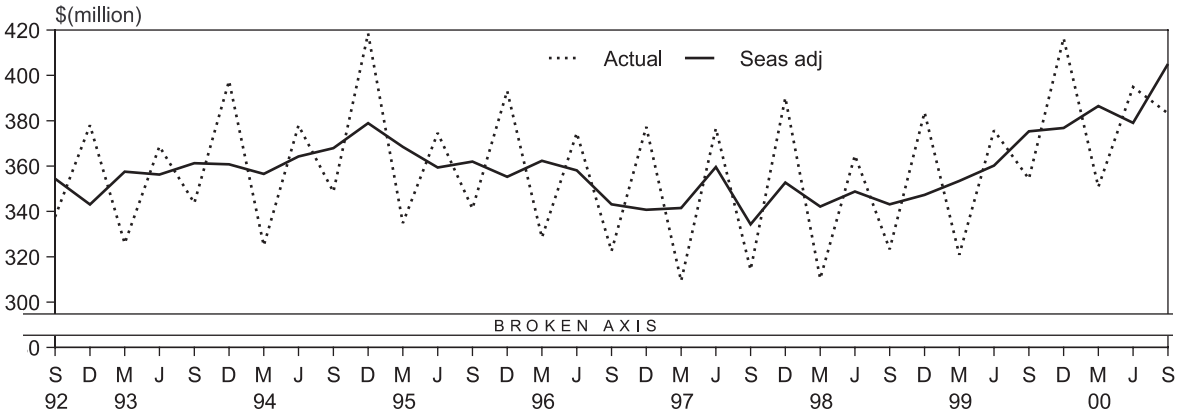
Figure 4 shows the seasonally adjusted series of the clothing sub-series from quarterly retail sales. It illustrates how the removal of the seasonal effects from the data provides a clearer picture of what is happening in the series.

How Statistics New Zealand computes the components using X-12-ARIMA

Statistics New Zealand uses X-12-ARIMA (predominately version 0.2.6) to estimate the

Figure 4

Clothing Quarterly Sub-series - Seasonally Adjusted Trend Factor x Irregular (x mean)



trend, seasonal and irregular component components of the seasonal model. X-12-ARIMA is a seasonal adjustment program developed at the United States Bureau of the Census. The program is based on the bureau's earlier X-11 program and the X-11-ARIMA/88 program developed at Statistics Canada.[2]

How to make use of output from seasonal decomposition

Actual series

The actual series shows the current quarterly or monthly level. It will give an idea of what happened that particular month or quarter.

The problem with the actual series is that it is influenced by seasonal effects. These seasonal effects may be masking the true movements. For example, in retail trade, December is a very high month due to Christmas sales. If we compare November sales with December sales, we would report an increase in sales. But this increase is largely due to seasonal fluctuations and is not an informative measure.

The same-month-year-ago comparisons of actual values are an attempt to eliminate seasonal variations by only comparing months with the assumed same seasonality. This method is particularly poor in identifying turning points. On average there will be a lag of six months in the identification of a turning point when using this type of analysis.

Seasonally adjusted

The seasonally adjusted series should be used:

- When performing statistical analyses. In this way the variability attributable to the known seasonal pattern is already removed. The analysis is not affected by the combination of start and ending seasons.
- To derive the trend series (see below). In this way the trend estimate is not affected by the starting and ending seasons, and changing seasonality is allowed for.
- To compare short-term movements (monthly or quarterly) between series. The movement is attributable to changes in the irregular component and changes in the trend. If the movement of a set of seasonally adjusted series were similar then it would suggest that there is a common underlying cause which is independent of any individual series. If the movement of a member of a set of seasonally adjusted series were markedly different from the majority of the others, then it would suggest that there is a cause peculiar to that series which is worthy of investigation.
- To compare different periods of the same series. Because the seasonal component has been removed from the whole series, we can uncover interesting movements in the series.

Trend

The trend cycle looks at long-term movements of individual series. The trend cycle shows the relatively long-term movements underlying the time series. Changes in the prevailing conditions are expected to be reflected by changes in the trend movement.

The choice of trend estimator will affect the movements that are retained. A linear regression estimator will give the "big picture" of movement over the time interval. A moving average estimator tends to suppress all effects with a duration shorter than the span of the moving average. Therefore the longer the span of the moving average, the smoother the trend is, and the less detail on local features of the data retained.

Statistics New Zealand moving average trend estimates have the advantage of being objectively selected, able to be replicated, and using an internationally accepted methodology. Most of the effects of less than 12 months' duration have been removed.

The trend is useful for indicating turning points in the underlying series. But there is an uncertainty attached to the trend direction for the most recent points. This is because of revisions to trend estimates in the most recent quarters.

Further information on seasonal adjustment within Statistics New Zealand

Visit the seasonal adjustment pages at: www.stats.govt.nz\seasonaladjustment for more information.

2 A diagram and description summarising the key points in the X-12 process within X-12-ARIMA is available at www.stats.govt.nz\seasonaladjustment.