Elucidating Easter's Economic Effects

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Abstract

Statistics New Zealand not only provides users the measured time series, but also the series with identifiable seasonal and calendar effects removed. Although these effects are easily modelled, they are not easy to estimate because of the volatility of New Zealand's time series. To remove seasonal variation Statistics New Zealand uses X-12-ARIMA. Possible calendar effects are trading day and moving holidays (eg Easter). Regular calendar effects are easily modelled and are thus relatively straight-forward to estimate. However, estimating the effect of moving holidays is more difficult because the period over which they affect the series needs to be quantified, and there is only one measurement per year. Statistics New Zealand has been investigating using GenHol to estimate the effect of Easter on its time series.

Easter is of particular interest because it moves between both months and quarters. Were it not for this behaviour the effect could simply be subsumed into the usual seasonal factors. On the other hand, this movement allows us to estimate its effect. Historically it has been difficult to estimate the effect of Easter due to it shifting both between and within March and April, affecting both monthly and quarterly statistics. This reduces the number of observations available on the same economic basis for estimating the effect. Nevertheless, the effect is much more discernable in a monthly series while in a quarterly series the effect is less easy to distinguish from the irregular or noise component. The new methodology available through using GenHol allows us to make better use of all observations to estimate the overall effect.

GenHol is a supplementary tool for X-12-ARIMA which creates variables linked to the time periods of interest. GenHol has potential application to any moving holiday that has an effect on a particular series. Examples of such moving holidays are Easter, Chinese New Year, and school holidays. In this paper we are concentrating on the Easter moving holiday. Each economic series is affected in different ways by Easter. GenHol allows us to specify three time periods of variable length in which an effect occurs. These are the before, during and after time intervals. For each interval the effect is estimated, which may also vary in direction and magnitude. The coefficients are estimated as a part of the usual seasonal adjustment process, in a similar fashion to trading day coefficients. Our interest in this tool has arisen partly because the built in Easter effect available with X-12-ARIMA is based on the U.S and Canada models which are not strictly applicable to the New Zealand situation.

The expected gain from a better specification of the holiday is a reduction in the magnitude of the irregular and hence better estimates of trend and seasonal components. We investigated series for retail trade, building consents and accommodation guest nights. Overall, the results indicated an improvement in the adjustment of the series for regular effects, allowing greater confidence in the interpretation of our published series. The current state of our analysis is presented.

Key words: X-12-ARIMA; Seasonal Adjustment; Official Statistics; GenHol; Easter; Moving Holidays.

1. Introduction

Statistics New Zealand publishes a large number of series that provide information on the New Zealand economy and society. Many of these time series have regular effects within them, such as those related to seasons or the number of trading days in the period. The process of seasonal adjustment estimates and removes these effects from a time series to enable valid comparisons between observations. The need for this process can be illustrated by a monthly series that has a distinct seasonal pattern, such as accommodation. If the series had a peak in the month of January but a trough in June and we acknowledge these as regular patterns, then it is best to allow for these when comparing observations for those months. Otherwise, we are at risk of misinterpreting the normal behaviour of a series and making poor decisions, either thinking that the economy is in a better state than it is, or like Chicken Little, that the sky is falling when only acorns are involved.

Seasonal adjustment is used by Statistics New Zealand to allow for the regular and discernable effects in a series, leading to a published seasonally adjusted and trend series. The models used may be classed as hidden component models because the trend and seasonality of a series are estimated but unobserved. The current method of seasonal adjustment employed at Statistics New Zealand is the X-11 Variant of the Census Method II (Shiskin, Young and Musgrave 1967), embodied in X-12-ARIMA (Findley at al, 1998). This Method is widely used amongst official statisticians and is one of the two approaches approved by Eurostat (eg Hussain et al., 2007).

The remainder of the paper commences with an introduction to the process of seasonal adjustment and the peculiarities of determining and estimating Easter effects. We discuss the current situation and methods employed and the motivation for considering an alternative tool. The alternative under consideration here, GenHol, is described and applied to a sample of series. The gains from using GenHol in the quality of the resulting seasonal adjustments are described and their implications for analysis discussed. The paper concludes with a summary of the research and future directions.

2. Seasonal adjustment

Generally, seasonal adjustment does not only include adjustment for regular seasonal effects; it also includes the process for removing from a series quantifiable and identifiable features which are not in a strict sense seasonal (for example, trading day effects and outliers). If we assume a multiplicative model for the series then we can describe a number of components, following Ladiray and Quenneville (2001):

$$X(t) = C(t) \times S(t) \times D(t) \times E(t) \times I(t)$$

where

X(t) is the observation of the series at time t

C(t) is the trend and cycle component. These are combined as the long-term cycles within the series may have a frequency too low to detect adequately over the short length of many economic series. In this sense, short means the length of time a series has not been subject to major shocks or structural changes.

S(t) the seasonal component, representing within year regular variations

D(t) the trading day component, reflecting the impact of variations in the number of trading days in the month or quarter

E(t) the Easter holiday effect

I(t) the irregular component, comprising the fluctuations not elsewhere described.

The process of seasonal adjustment is closely tied to the calendar. For a monthly series we can easily imagine separate adjustment of individual months, that is, each month is a separate 'season'. This is often the case even when there may be little difference between some of the months.

The cycle of trading days within a month is well-behaved and an adjustment for it can be made, where necessary, in the seasonal adjustment process. However, the number of trading days in each month varies during the year and also varies for the same month in different years. For example, August may always have the same number of days but the number of Mondays, Tuesdays, and so on, will depend on what day of the week the month starts. This will be the same for all months, except for the effects of moving holidays, such as Waitangi Day, ANZAC Day and Easter. The complete trading day cycle takes 28 years to complete.

Compared with many other countries, series in New Zealand tend to be more volatile or noisy. This is largely due to the small size of New Zealand's economy. In a larger economy there are enough contributors to a series so that fluctuations introduced by one may be offset by another. In New Zealand we tend to see more variability in time series because there are fewer contributors to help smooth out this variation. Compared with larger economies, such as the U.S., the top 10 contributors to a time series constitute a larger proportion of the total. This means that it is more difficult to detect the signal in our time series because of a greater proportion of noise. In this context a signal means anything from a seasonal factor to moving holiday effects. For this reason, the difficulty of modelling smaller effects, such as moving holiday effects, which by themselves are more difficult to discern and estimate, is compounded by the greater proportion of noise observed in series of a small economy.

However, we still want to estimate these effects where possible. First, because interest in interpreting time series to a certain level and quality is the same irrespective of the size of the economy. Second, when we can estimate these smaller effects well we generally improve the estimates of the other factors. This is because the estimates of the other factors are confounded by these other smaller effects. Such confounding tends to lead to less precise seasonal factors and a greater proportion of noise being attributed to the series. Third is the interest in the effect of these smaller components from an economic point of view. An advantage with New Zealand series is its longer Easter holiday compared with North America. This may lead to a larger effect than in North America and also increases the importance of the before and after effects. For this reason an Easter occurring in early April may have an effect in March as well.

We now discuss Easter in the context of seasonal adjustment.

3. Easter

Estimating an Easter effect, where present, is complicated by many factors. Many of these are related to the difficulties of incorporating a lunar festival into a solar calendar. The various effects on the calendar could be described in more detail (eg Duncan 1998, Tøndering 2008) but for our purposes it is sufficient to note that Easter Sunday may occur from 22 March to 25 of April and takes an extended period of 5,700,000 years to make a complete cycle through the dates in the Gregorian calendar (Ladiray and Quenneville, 2001). In the discussion which follows Easter refers to Easter Sunday and the Easter holiday is the four days from Good Friday to Easter Monday.

The movement of Easter between March and April reduces the utility of the observations made each year. Easter is not evenly distributed between March and April; Easter occurs in April approximately three-quarters of the time. However, given the length of the cycle of Easter dates, for a given number of years covered, a series may contain roughly equal numbers of March and April Easter observations, or almost no observations of a March Easter. This problem is compounded when the Easter holiday straddles March and April as it is less clear what the effect will be on either month. One might almost say that we have neither an observation for Easter in March nor April in this circumstance. In any estimation exercise it is therefore necessary to estimate at least two parameters: one for March Easter and one for April Easter. The above comments apply equally to months or to quarters as Easter can move between both March and April months and March and June quarters.

Having briefly considered the timing of Easter we now look at how it is observed. In New Zealand, Easter is observed for four days with a public holiday on the Friday and Monday, either side of the weekend in which Easter occurs. The behaviour associated with the holiday can be influenced by its proximity to ANZAC Day (25 April). Where these are close, people may take additional holidays. Depending on the series this may amplify or attenuate the effect. Easter also usually falls within the school holidays. Whether this occurs or not is also likely to affect what we observe the effect of Easter to be. In North America the Easter holiday may be confined to Good Friday only but a holiday on Monday is not observed.

What is the effect of Easter? The effects on a series may be quite varied. Traditionally the Easter holiday led to increased sales before the Easter weekend, especially of food items. However, in recent times shops have changed their opening hours over the Easter weekend. This altered the trading pattern by reducing activity before the holiday and increasing it during Easter. If we consider the number of building consents issued per month and the number of guest nights in commercial accommodation then we might expect to see different effects. There are no building consents issued over Easter weekend because all local authorities are closed from Friday to Monday, inclusive. There may be an effect of increased numbers of consents issued before and/or after Easter to ‘get them out’ or ‘catch up’. The length and magnitude of such effects also need to be considered.

For our accommodation series, the total number of guest nights is the sum of nights stayed per guest. We would expect this to increase in commercial accommodation over the Easter holiday as people take advantage of the longer weekend to travel. Again questions of interest are ‘What is the length of the effect and is it constant throughout?’. Ideally we would like to have three separate parameters in a model of Easter: before, during and after, all of which may vary in length and direction. However, first we would also prefer a theoretical explanation for the supposed effect. Even if such an effect exists it may not be possible to estimate given its poor definition or poor signal-to-noise ratio. This is particularly the case where one consumer may extrapolate their behaviour to the rest of the economy and be surprised to find that there is not an estimable effect as a result. Of course this does not mean that the effect is not there, merely that it is not sufficiently strong.

Before discussing the estimation of Easter effects, it is necessary to explain one difference between the method for estimating a holiday effect and the method for estimating the seasonal factors. X-12-ARIMA uses a filter of a given length to derive its seasonal factors which is usually much shorter than the length of the series. Since this filter is relatively short it only uses a limited amount of information for any given estimate of a seasonal factor. The length of the filter can be varied to some degree to take account of the signal-to-noise ratio, allowing a longer filter to pick up weaker signals. The fact that the filter is relatively short compared with the whole series allows the seasonality to evolve over the length of the series, so that in any given year one always has the best estimate of the seasonality derived from surrounding observations.

As discussed above, there are certain limitations in estimating moving holiday parameters, especially for Easter. Due to the quality and quantity of information available, moving holidays are estimated over the whole length of the series and the parameter applied over the whole length. The disadvantage is that the estimates of the parameters will not reflect the evolution of behaviour over the whole series. The quality of the parameters will thus be dependent on the extent of the evolution of the behaviour over the series. The advantage of this method is that for behaviour which is relatively consistent over the whole series we are more likely to get a good estimate, and for behaviour which is not so consistent we will obtain a parameter which takes the whole series into account and may indicate that the behaviour is simply too poorly defined in the series to be adequately adjusted for. This links to the hypotheses we have about the effect: what is the effect and how stable is it over the series?

X-12-ARIMA has an interative approach to estimating the trend, seasonal and irregular components. Calendar effects may be estimated either before the iterations begin or after a preliminary estimate of the irregular has been made. Where it is possible to fit an ARIMA model to the series a prior adjustment may be made to the series before passing it to the Census Method II for estimation of the trend, seasonal and irregular components. Where a series is not amenable to modelling using ARIMA then the adjustment may be made at the later stage.

In the past, estimates of the Easter effect have been applied sparingly to New Zealand series. Normally these estimates have been made at the later stage of the X-12-ARIMA cycle, once a preliminary estimate of the irregular component has been made. This is done in an x11regression specification using the Bateman-Mayes model as specified in US Census Bureau (2002) and Ladiray and Quenneville (2001). This method is simply a switch that includes parameters for an effect during the Easter holiday. Two other similar methods are built into X-12-ARIMA. These allow the specification of the length of change in daily activity before Easter Sunday or the Saturday as one prefers. Both of these options make use of preliminary estimates of the irregular component to derive an Easter effect. Unfortunately all of these methods ignore the Easter Monday holiday which we have in New Zealand and lack the flexibility to easily specify a before, during and after effect. For this reason Statistics New Zealand is investigating the potential of a new tool, GenHol, also available from the US Census Bureau.

GenHol is a package that creates regressors for the use in X-12-ARIMA from user-specified holiday dates. These dates enable the specification of time intervals during which the before, during and after effects occur of the event of interest. These intervals have associated regression variables which are then estimated as part of the seasonal adjustment process.

The preferred method is to use a regARIMA model defined within the X-12-ARIMA package. Such a model allows the generalisation of a regression model to allow the error terms to follow the ARIMA model (US Census Bureau, 2002). In practice this means that the calendar effects are removed from the series before the iterations to estimate the trend, seasonal and irregular components. However, many series in New Zealand are too noisy to fit a reasonable ARIMA model, especially when the series is shortened to a suitable length to exclude major structural changes. If an ARIMA model is not fitted to the series then the generalised holiday regressors may still be used but after the preliminary estimates of the irregular component. Unfortunately the test statistics calculated in this situation are optimistic as the regression errors are neither independent nor have constant variance (US Census Bureau, 2002).

4. Methodology

The three series were selected to give a variety of types broadly representative of those published. They differ from the very seasonal to quite seasonal, monthly and quarterly, and have a variety of magnitude, duration and direction of Easter effects.

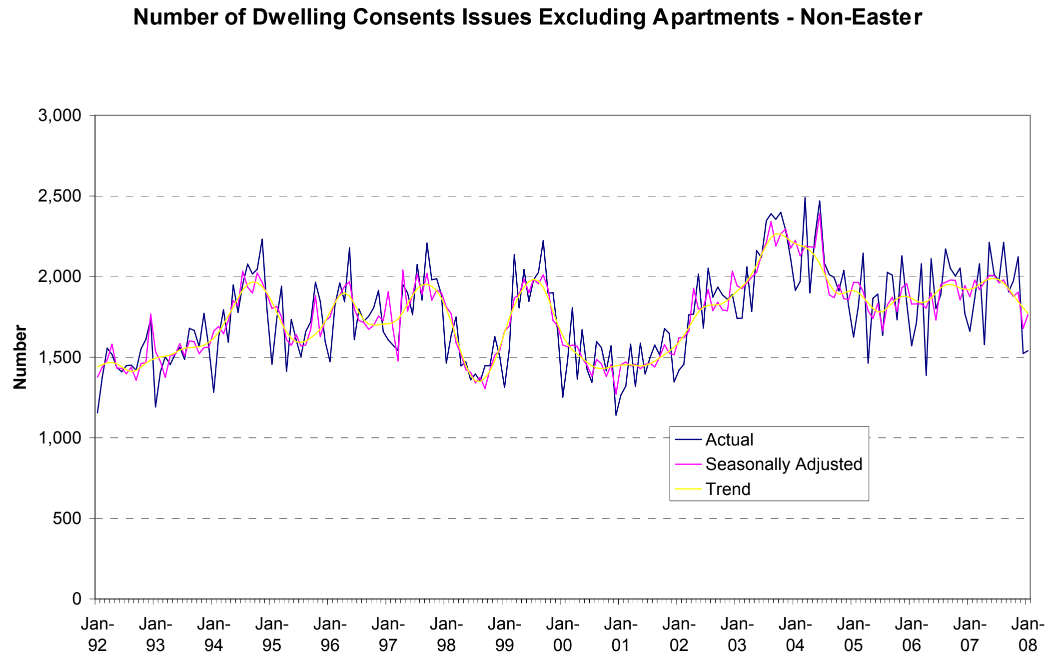
The first series is the number of dwelling consents issued per month, excluding apartments. This series is derived from administrative data provided by territorial authorities. It has exhibited several changes in the direction of the trend. The second series is total guest nights, the sum of nights stayed per guest each month. The data for this series comes from a monthly census of all accommodation providers. Third is a series from retail sales, furnishings and floor coverings. This series is from a sample survey conducted monthly but the data here have been aggregated to quarterly. For each series we made an initial assessment of the suitability for an Easter adjustment. We considered if there was likely to be an Easter effect, what it was likely to be and how it would manifest itself before, during and after the Easter period. We then considered if it was likely that these effects would be preserved given the methodology used to obtain the data. If the series still looked promising then we investigated if it was possible to estimate an Easter effect.

The preferred method for modelling Easter with GenHol-derived regressors is as a prior adjustment. However, first it is necessary to have an adequate ARIMA model. Where it was not possible to fit an ARIMA model to a suitable standard we modelled the Easter effects on the irregular component which is still an acceptable method. We now turn to the series themselves.

4.1 Dwelling consents

A graph of the number of dwelling consents issued each month, excluding apartments, is shown in figure 1. The current seasonally adjusted and trend series are plotted with the actual series. An adjustment for the trading day composition of the months is made as part of the seasonal adjustment. The series excludes apartment consents to better reflect the activity of the smaller scale dwellings, as well as give a smoother series for analysis.

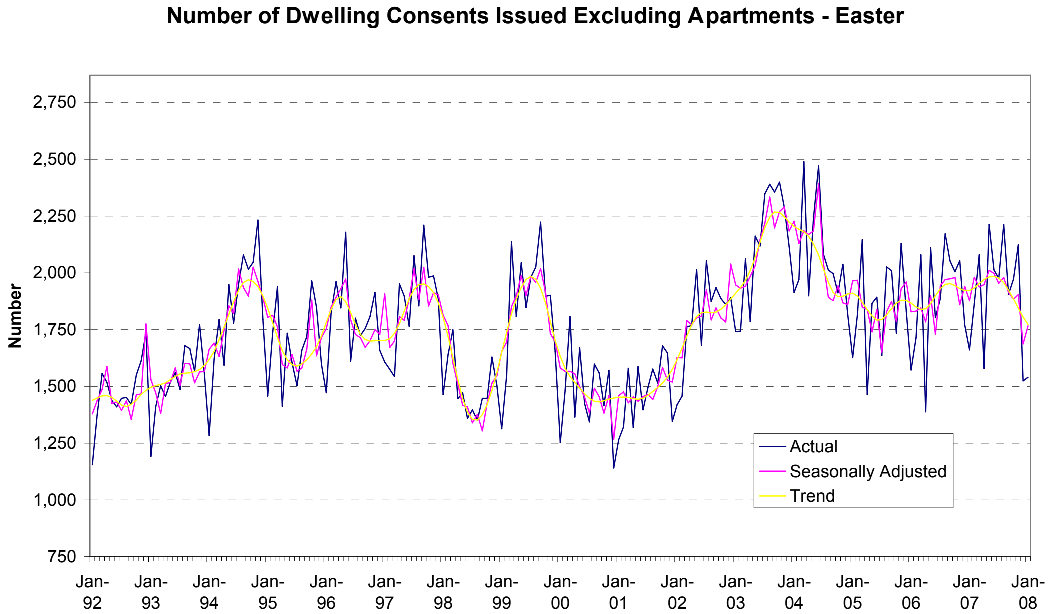
Figure 1



The series of dwelling consents appears to be a good candidate for seasonal adjustment because of its distinct seasonality. However, this is difficult to discern at first glance. A trend line would also assist to detect the turning points, of which there have been several in the series.

It was considered that the Easter effects observable were threefold. Firstly, there may be an effect before the Easter holiday – due to a 'get them out before Easter' attitude in the week before Easter, from Monday to Thursday. Secondly, no consents would be issued over the Easter holiday as the territorial authorities close for the period. Finally, there might be an effect after the holiday as staff attempt to make up for lost time during the week from Tuesday to Friday. The series spanned from January 1992 to January 2008 but was not amenable to ARIMA modelling, so the effects were estimated from the irregular component. The series with an Easter adjustment is shown in figure 2.

Figure 2



There are a number of summary statistics and diagnostic graphs available to assess the state and quality of an adjustment but we will concentrate on only a few here. A selection is shown in table 1.

Table 1

	AICC	MCD	Seasonal 1	Calendar 1	Irregular 1	Irregular 12
Non-Easter	-730.7	3	74.66	15.19	8.05	6.18
Easter	-762.3	3	72.11	17.73	8.09	6.04

The AICC is the Akaike information criterion corrected for the length of the series (US Census Bureau, 2002). An improved model produces a negative number of greater magnitude. There is some improvement from the model with the GenHol regressors. There is only little evidence for the before effect, a small positive t-statistic (0.97), but good evidence for the during and after effects with t-statistics of -5.82 and 6.43 respectively. The latter effect may be due to a requirement that processing should take no more than a certain number of working days. The MCD represents the months for cyclical dominance, and is an overall statistic giving a general indication of the number of months before the trend cycle dominates the irregular, or the signal of the trend dominates the noise. Although it is an integral value it is calculated as a ratio of two real numbers. For this reason there may be a change in the ratio without a change in the resulting MCD. It is unchanged for the two models.

The last four columns show summary statistics for the whole series giving an indication of the percentage of the typical n-step movement that is made up of a given component. For example, seasonal 1 shows that, typically, the month to month movement is comprised of about 75 percent of the seasonal component for the standard series. The calendar component includes the effects of trading day composition and holidays, and the irregular estimates the degree of noise in a series. Irregular 12 is the typical percentage of noise in a 12-step movement, or a year for a monthly series.

From table 1, we can see that the overall effect of adding an Easter adjustment is to move some of the month to month seasonal component to the calendar component. This suggests that some of the effect of Easter has been confounded with the estimates of the seasonal parameters in the standard seasonal adjustment. Since Easter usually occurs in April, it is expected that the Easter effect should reside in that seasonal factor if the effect is not explicitly modelled. This is likely to have had consequences for the estimates of the movements. In some series, estimating parameters for Easter may also reduce the irregular component. For the dwelling series we observe a small reduction in the irregular component at the twelfth step.

It is possible to detect an improvement in the seasonally adjusted series by plotting the new series with the Easter adjustment but the effect is easier to see if we look only at March and April. Despite the small difference in the overall irregular it is still possible to see some effect if we look at two graphs of the irregular component (figures 3 and 4).

Figure 3

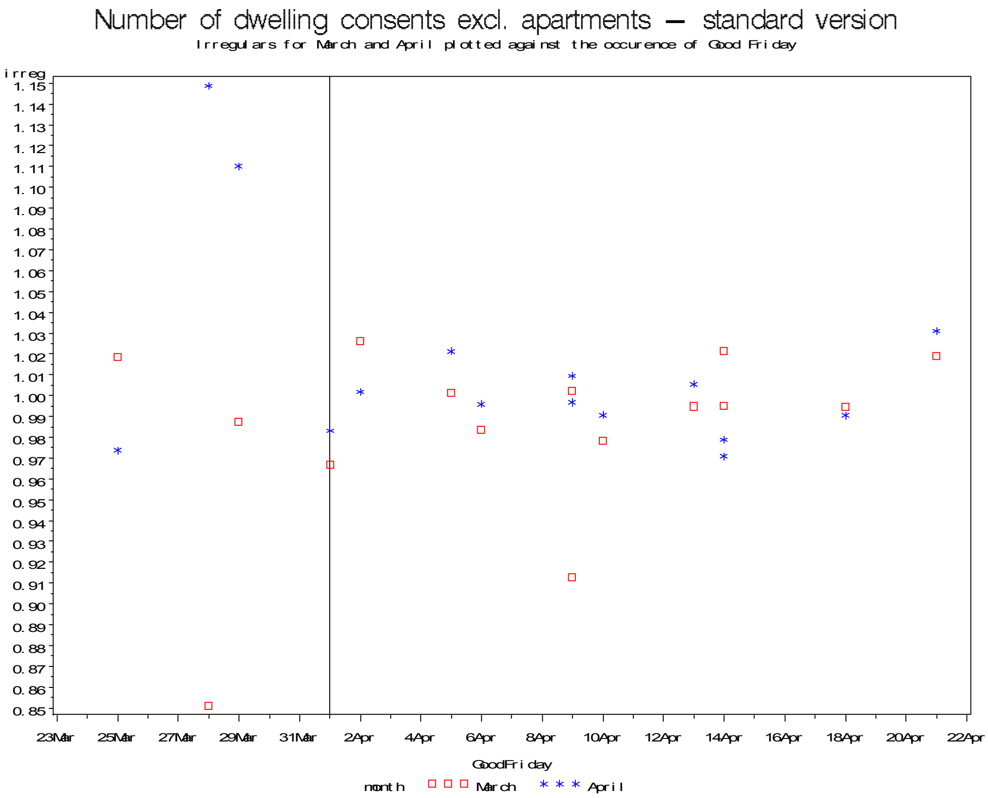
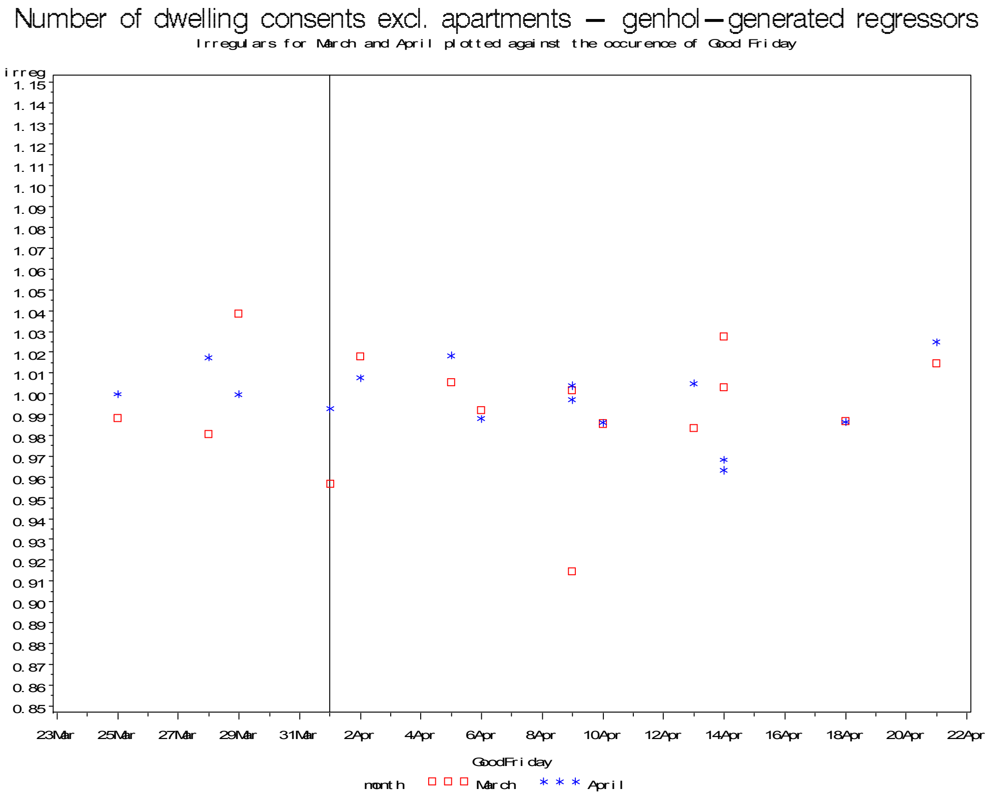


Figure 4



The irregular component is centred around 1 for a multiplicative model; most economic series are multiplicative. The dates of Good Friday are plotted across the x-axis with the irregular components from March and April for each Good Friday date plotted above. We have used Good Friday as the reference point because this is the start of the Easter holiday period. Of interest are the years where there is a large gap between the March and April irregular components, which might indicate that Easter is being treated as a strictly seasonal component. This will be especially noticeable where a March Easter occurs after an April Easter has been common.

It is immediately obvious in the standard version of the adjustment that there are two instances when Easter was in March where the irregular components for March and April were quite different. Further, the April irregular was high and the March low, indicating a higher than typical April figure and a lower than typical March. When we compare the two graphs it is clear that adjusting for Easter removes that wide variation and improves the overall appearance of the irregular.

However, an important question is what effect adjusting for Easter will have on the seasonally adjusted movements. If we graph the seasonally adjusted movements similar to the irregular then we see a similar pattern; again the effect is most noticeable where Easter occurs in March (figures 5 and 6). For example, when Good Friday was on 25 March in the standard series, we observed a movement of approximately -3 percent in March and -6 percent in April. When an Easter effect is estimated the March movement decreases to -6 percent and April is close to -0.5 percent. This suggests that the February to March movement was lower than normal, even allowing for Easter and that the March to April movement was close to the overall trend. That is, the data now tell a different story.

Figure 5

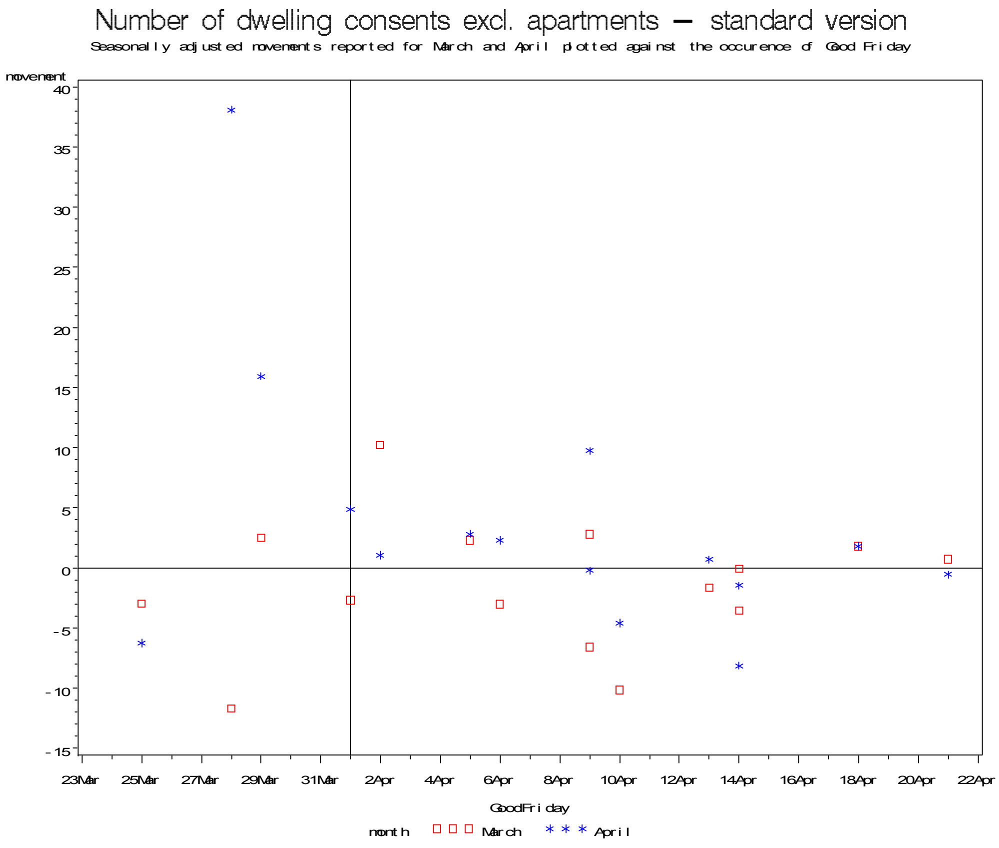
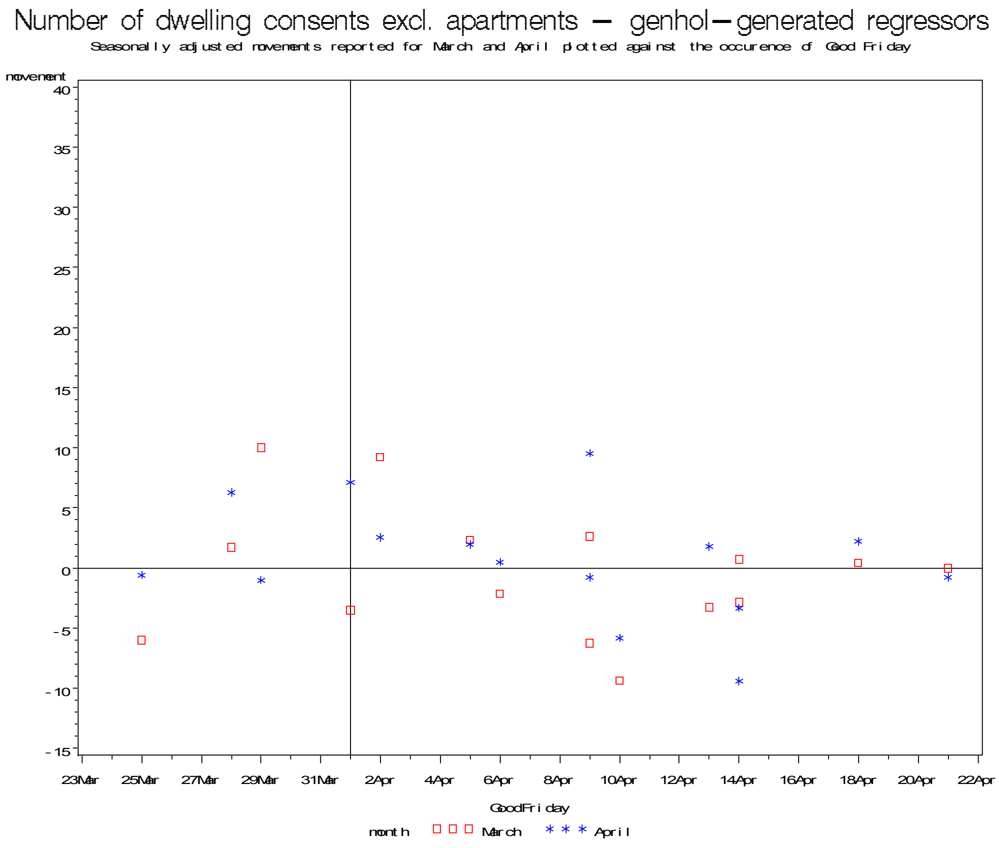


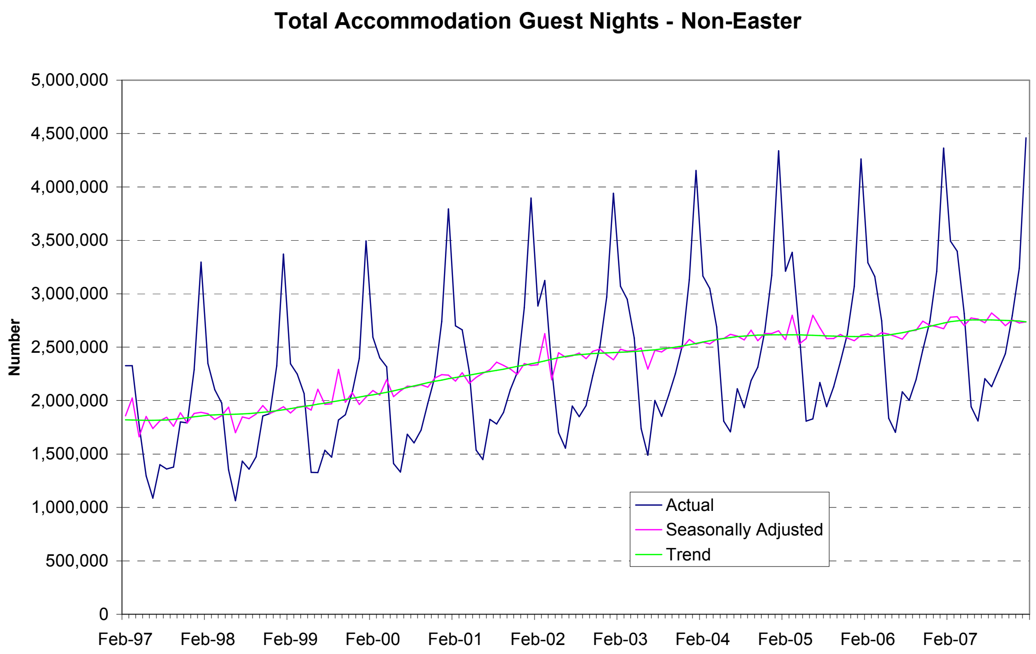
Figure 6



4.2 Accommodation

The second series is total accommodation guest nights, which is shown in figure 7, with the standard seasonally adjusted and trend series. It is clearly a seasonal series with a slight but persistent trend. At first the trend might appear to be monotonically increasing but on closer inspection it does have inflections. Given the high seasonal component already evident it might not seem to be worth improving the adjustment further. However, a relatively small absolute improvement in the definition of the components might be important given the small percentages of some of the components.

Figure 7



For this series we were successful in fitting an acceptable ARIMA model, which allows prior estimation and removal of the Easter effects. It was expected that there would be a noticeable increase in accommodation during Easter and a corresponding decrease after. The before effect was considered to be small. Both effects either side of the holiday were limited to two days: the before effect was estimated for Wednesday and Thursday, while the after effect was estimated for Tuesday and Wednesday. We used data from February 1997 to January 2008, inclusive.

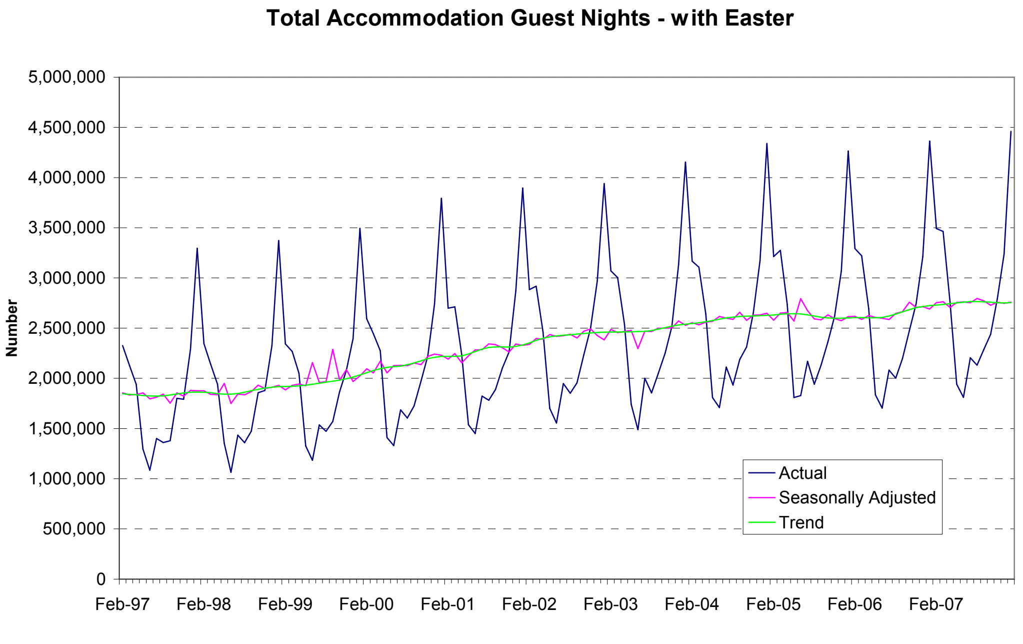
Table 2

	AICC	MCD	Seasonal 1	Calendar 1	Irregular 1	Irregular 12
Non-Easter	-593.5	9	98.41	0.0	1.55	17.34
Easter	3056.7*	5	98.8	0.34	0.76	9.52

*Note that the AICC is not directly comparable here as the standard adjustment does not currently incorporate an ARIMA model. For comparative purposes the AICC for seasonal adjustment with the ARIMA model only is 3079.3.

The results in table 2 allow illustration of the point above on more clearly being able to estimate the components. The MCD was reduced from 9 months to 5, a considerable reduction in the number of months before the trend cycle dominates the irregular. This is a result of almost halving the irregular component as well as a better definition of the seasonal and trend components, allowing better detection of a turning point in 2005. The series are shown in figure 8.

Figure 8



We estimated all three components for the Easter model. As expected there was minimal effect before Easter in the accommodation series, although the t-statistic was positive (0.67). The during and after effects both had reasonable t-statistics of 2.41 and -2.48, respectively.

The series has clearly been improved at the macro level. At the micro level we can compare the graphs of the irregular component for March and April, as shown in figures 9 and 10.

Figure 9

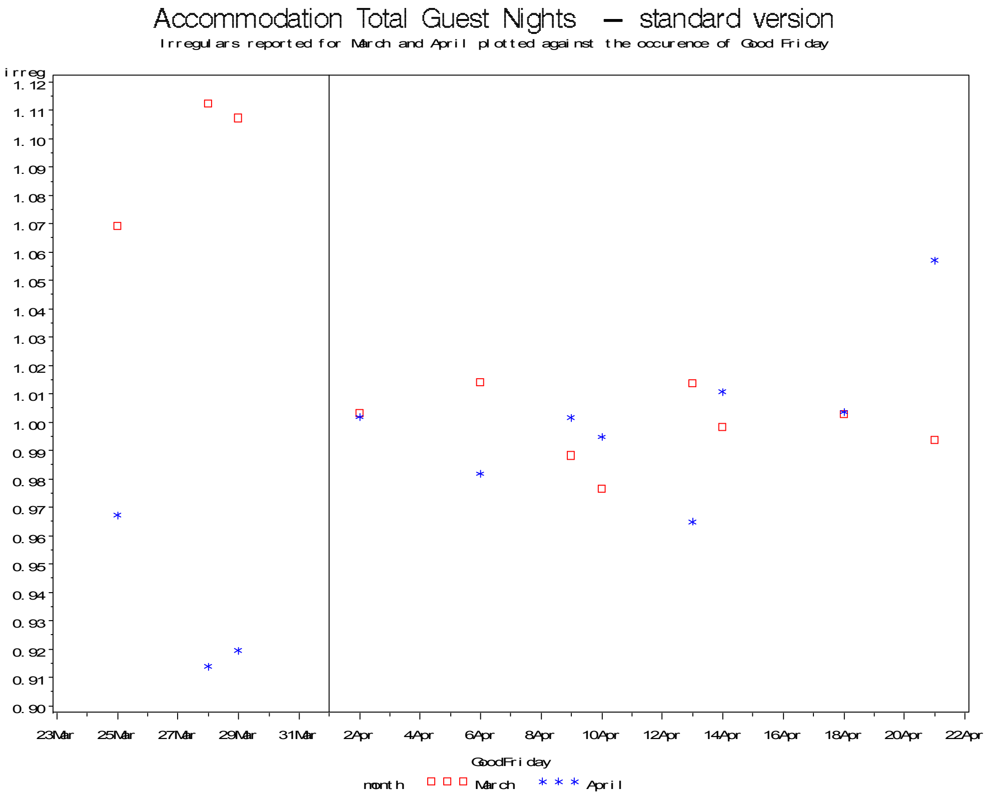
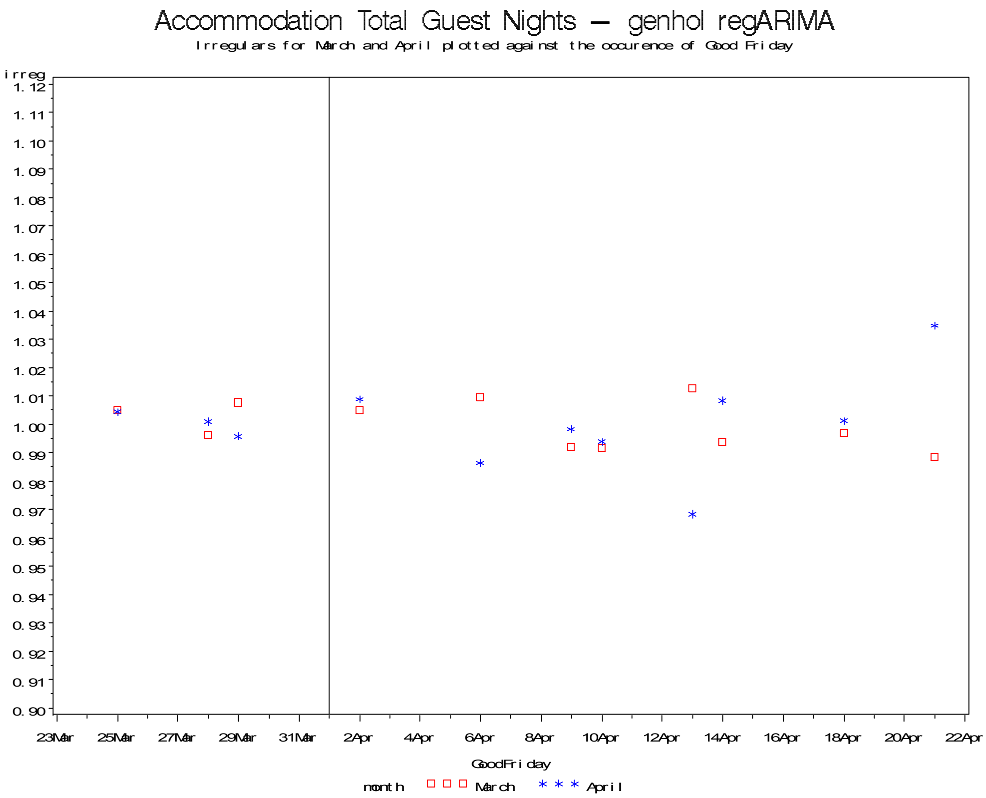


Figure 10



The series shows evidence of having trouble with the March Easters, given the wide gaps between the March and April irregulars for March Easters. After estimating parameters for Easter the irregular has been improved for Easters in both March and April. This increases our confidence that the model is producing better estimates of the seasonal components and not confounding them with Easter.

A similar effect can be observed from the graphs of the non-Easter and Easter-adjusted seasonally adjusted movements in figures 11 and 12. It is noticeable that some of the seasonally adjusted movements are quite large. For March there are indications that the model encountered unexpected increases followed by unexpected decreases in April. Generally for this series no major changes are evident for the years with Easters in April, except for 1998, when Good Friday was 10 April. This indicates that the standard model has incorporated the effect of Easter into its estimate of the seasonality in April. Once an Easter effect has been explicitly modelled for the series we are left with a much smaller set of monthly movements for March and April, providing a better indication of the small departures from the trend in this series.

Figure 11

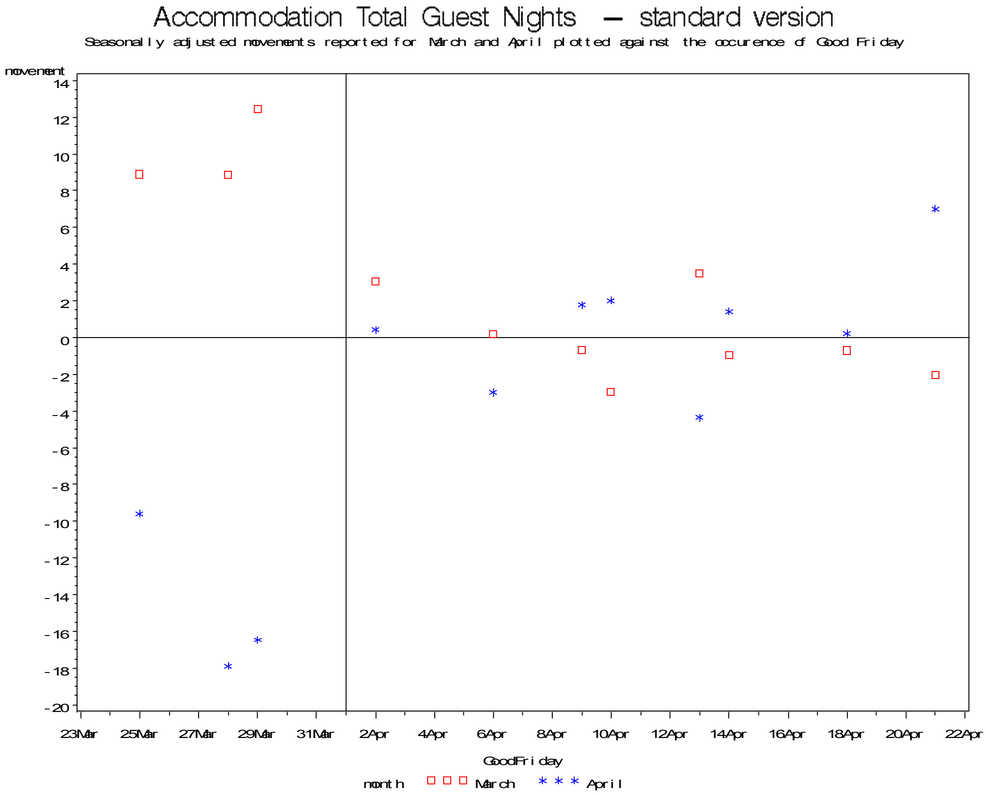
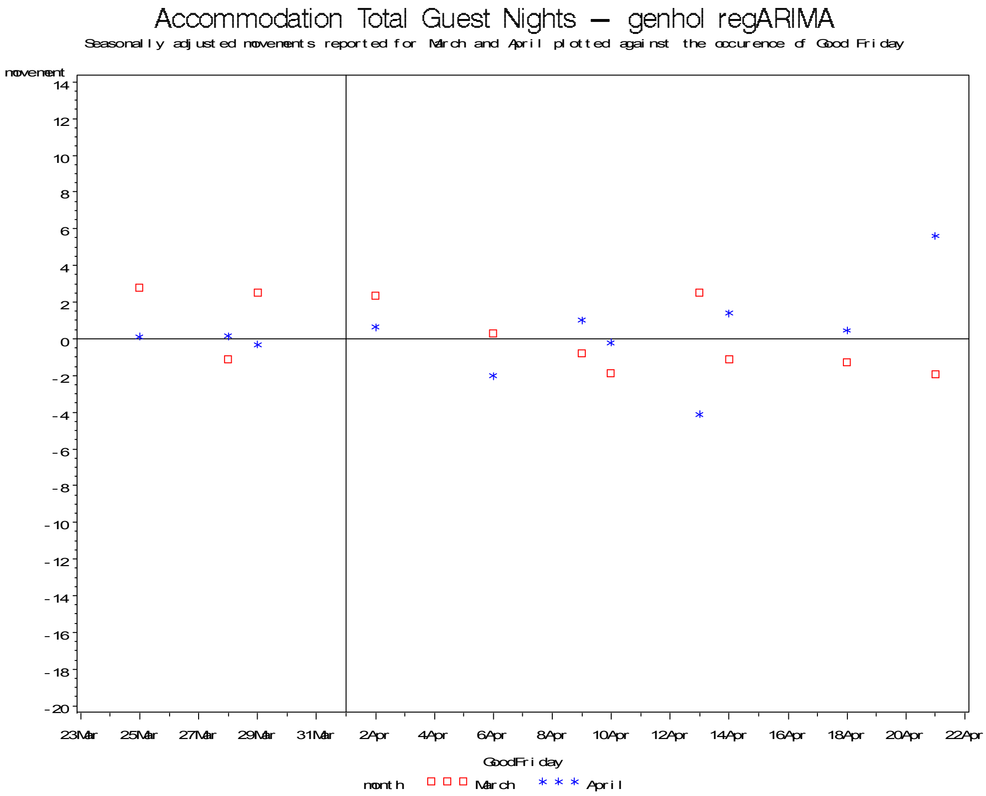


Figure 12



4.3 Furnishings and floor coverings

Finally we assessed a quarterly series, sales of furnishings and floor coverings, from the retail sector. The effect of Easter on a quarterly series is likely to be muted in comparison with that of a monthly series. The same issue of a holiday moving from one period to another applies, whether the series is sampled monthly or quarterly, but the number of days affected as a proportion of the total decreases. Instead of estimating an effect which occurs over four or more days in 30 or 31 days we are now considering an effect which occurs within a period of 90 or 91 days. However, leap year adjustments are often required for quarterly series, and a series sampled quarterly may exhibit a stronger signal than one sampled monthly.

It was expected that the series would exhibit an increase in activity before Easter as people made purchases to install over the Easter holiday. During Easter a fall in activity would be expected. On balance a fall after Easter would also be expected, due in part to prior purchasing, that is, a displacement of purchases that would have happened later to before the holiday. The series, which runs from the September quarter 1995 to the December quarter 2007, was not amenable to ARIMA modelling.

The observed series and the standard seasonally adjusted and trend series are in the graph, figure 13. The series exhibits some seasonality, tending to peak in the fourth quarter and have a trough in the first quarter. Interestingly the series was relatively flat until 2001 when it began to increase steadily.

Figure 13

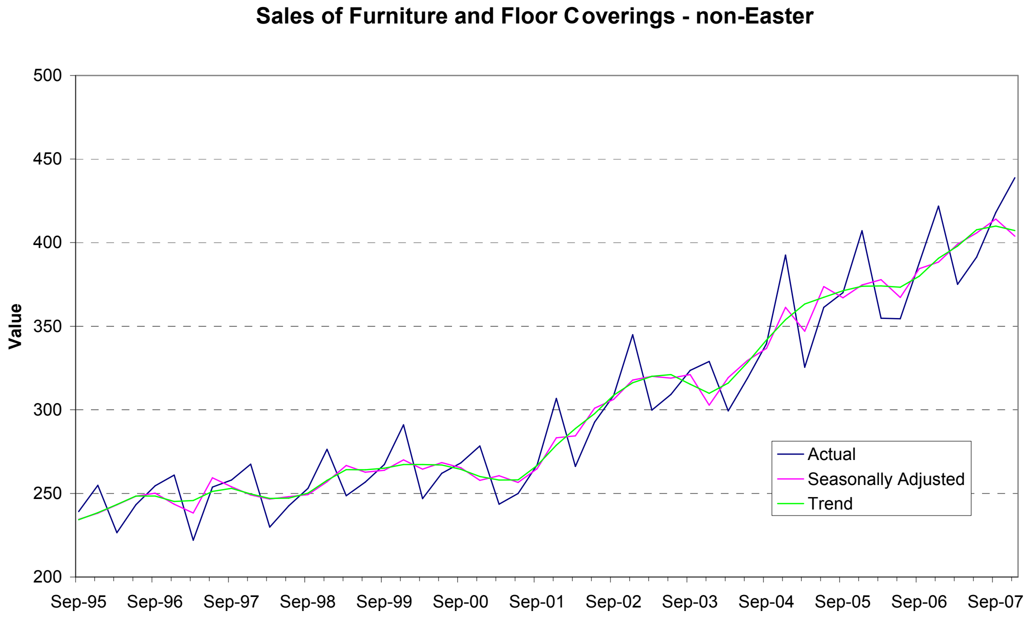
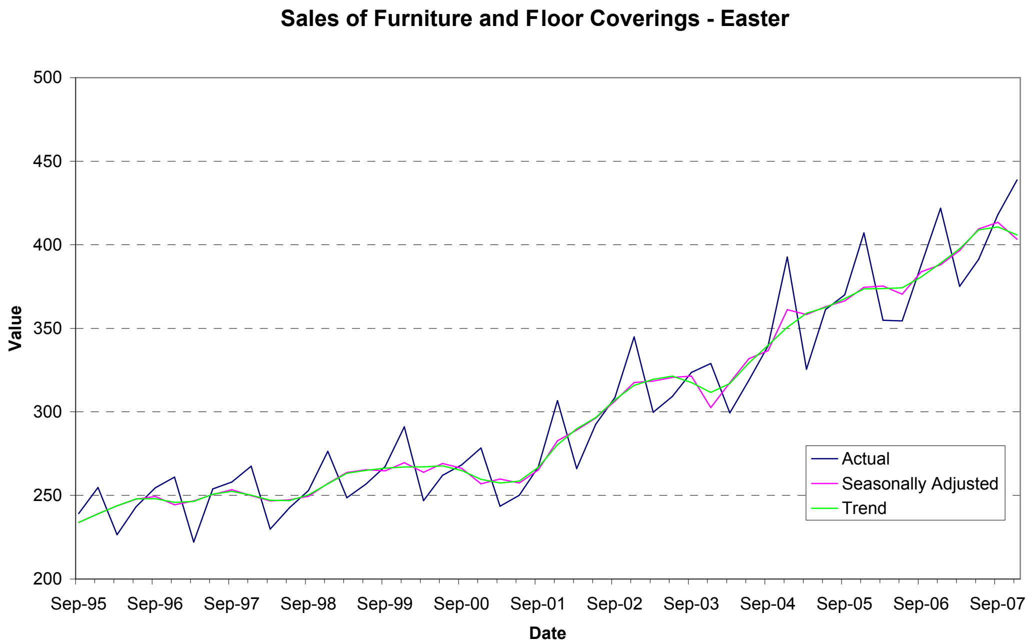


Figure 14 shows the series with the Easter adjustment included.

Figure 14



The summary statistics are in table 3 below.

Table 3

	AICC	QCD	Seasonal 1	Calendar 1	Irregular 1	Irregular 4
Non-Easter	-297.7	2	90.68	0.0	4.45	6.58
Easter	-330.8	1	91.52	2.25	1.65	2.87

The estimation of Easter effects had a reasonable effect on the AICC. The months for cyclical dominance now become the quarters for cyclical dominance, and have improved from two quarters to one. The introduced holiday effect accounts for around 2.25 percent of the movement from quarter to quarter, over the whole series, and the one-step seasonal component has also increased. The most noticeable effect has been the reduction in the irregular component, both at the one- and four-quarter span. This is directly responsible for halving the QCD. If we use the QCD as a guide for when we can state that the trend has changed direction, then we can now discern that change more promptly.

Looking at the irregulars for the March and June quarters in figures 15 and 16 we can see the expected pattern of wide variation between the March and April irregular component for those years with Easter in March. However, there is also a reduction in the disparity of the irregular components for the years with Easter in April as would be expected with the overall reduction in the irregular described above.

Figure 15

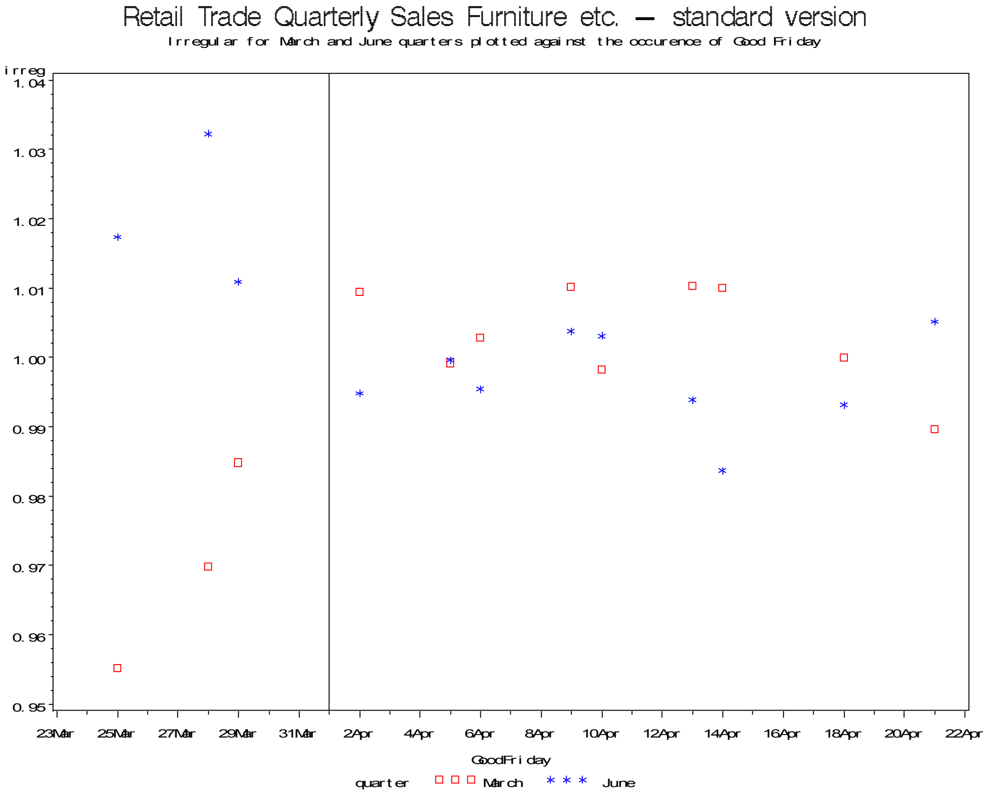
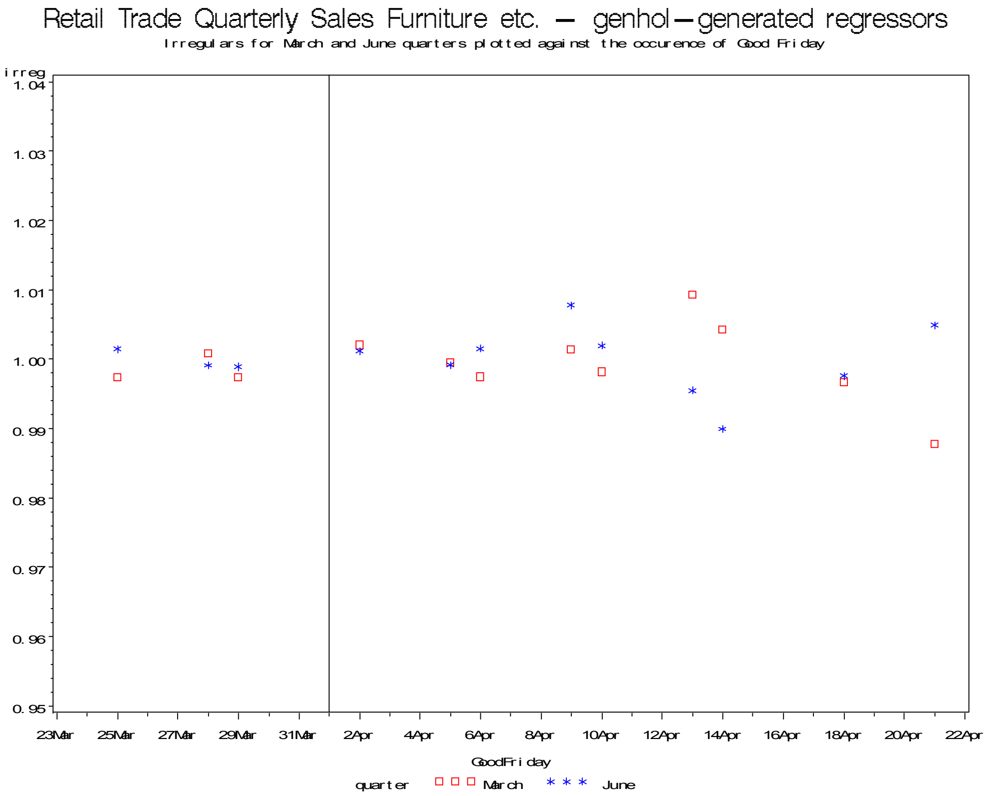


Figure 16



The model with the Easter effect had several different seasonally adjusted movements (figures 17 and 18). It is interesting to note that there were no significant changes for the many years with April Easters, while for those with March Easters, there were two years where negative movements have changed to positive.

Figure 17

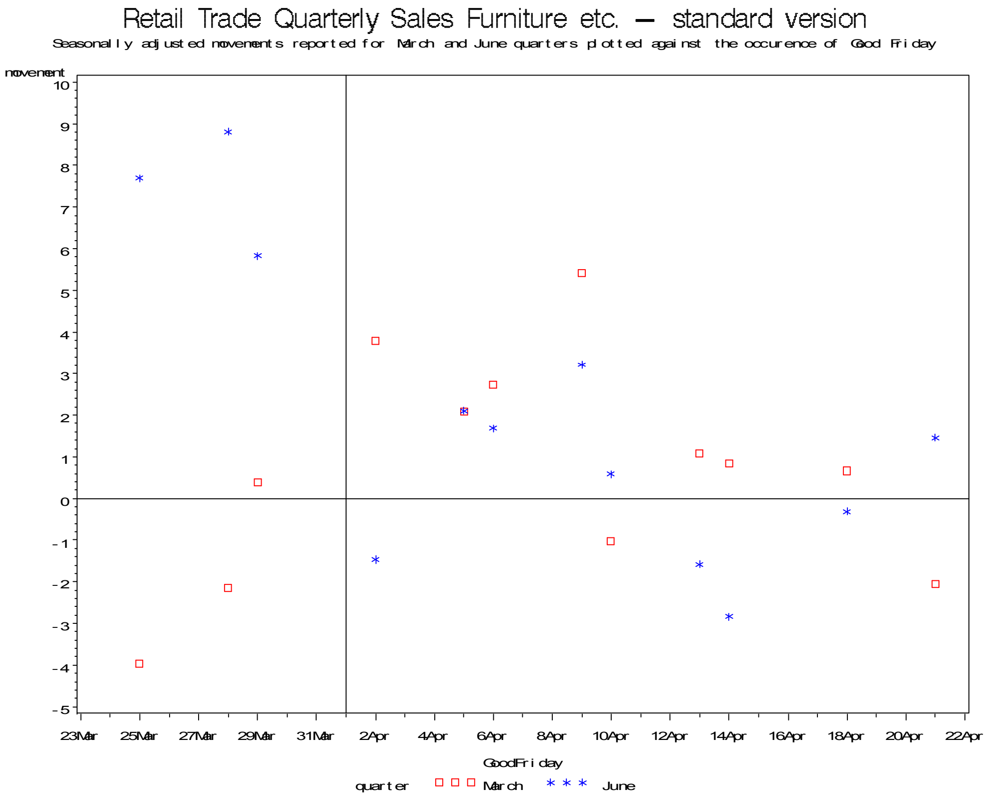
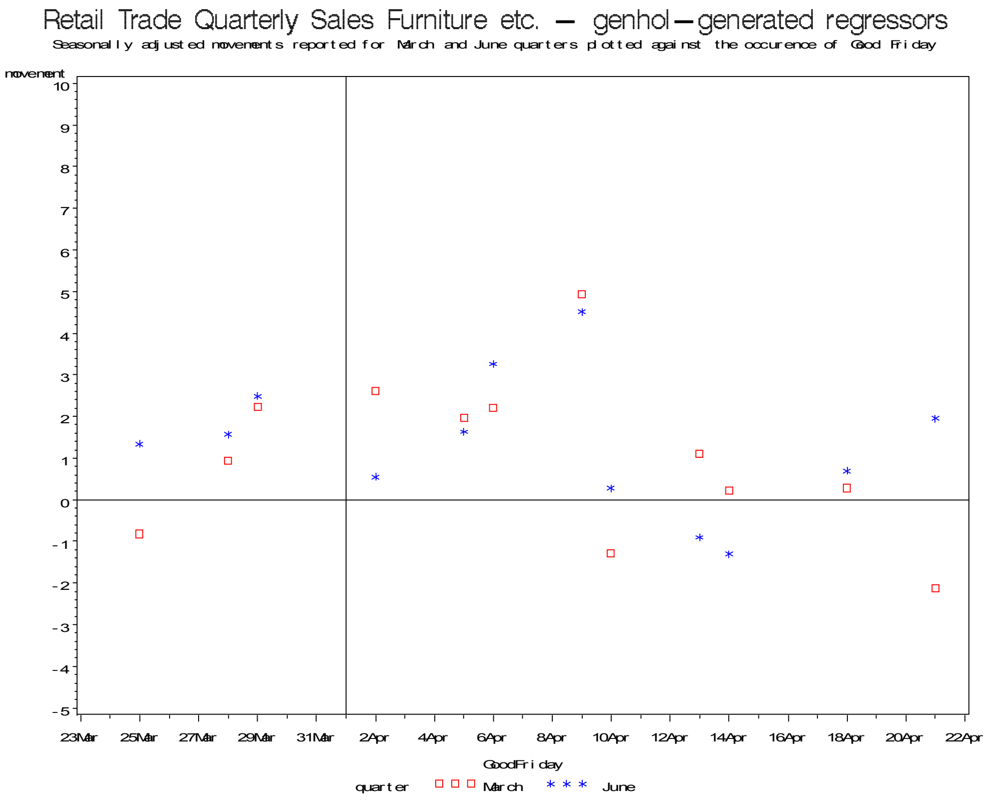


Figure 18



5. Discussion

We have illustrated the use of GenHol using three series, each with different features. In each case we hypothesised how an Easter effect would appear. The estimation was successful and it was also possible to see significant improvements in the seasonal adjustment of each series after estimating for an Easter effect. Of interest is that the effects on the series, while similar in the sense of improving the seasonal adjustment, tended to have different specific effects.

If a series is affected in some way by Easter but no adjustment is made for it then X-12-ARIMA will tend to include the effect as a part of the seasonal component. That is, the estimates of the seasonal components are confounded by the Easter effect. This in itself would not be a problem if Easter always occurred in the same month. Even where Easter occurred in March and April with equal frequency there would still be less of a problem. However, where Easter is predominantly in April there can be unwelcome effects upon the seasonally adjusted results. We observed this especially in the differences in the graphs of the seasonally adjusted movements for March and April, or quarter one and two.

We also observed that even relatively small improvements in the summary statistics were sufficient to improve the estimates of the components. For example, the improvement in the dwellings series was not large, judging by the figures in the table. However, it was clear that the series had improved considerably by inspection of the graphs of the irregular components and the seasonally adjusted movements for March and April.

Estimating the effect of Easter led to a considerable improvement in detecting the trend signal for accommodation and to a lesser extent, furnishings and flooring. However, little difference was made to the dwellings series in this respect. The seasonal component was hardly affected at all for accommodation and only a small amount for furnishings. In the case of dwellings, most of the change in the seasonal component was moved to the holiday component.

The irregular component was reduced for both accommodation and furnishings, which led to the improvement in detection of the trend signal. This was illustrated by the reduction in the MCD for accommodation and QCD for furnishings. The fact that there was not such a reduction in the irregular for dwellings is the reason for the lack of improvement in its MCD.

The three series thus illustrate that the effect of an Easter adjustment depends on the effect of the lack of adjustment, or the nature of the mis-specification of the model. Where the majority of the Easter holiday effect was confounded with seasonal components then the effect on other components, such as trend and irregular, may be minimal. The dwellings series illustrates this. Where the effect of Easter was confounded with the irregular then the result of correctly specifying the Easter effect is more likely to lead to improved trend component estimates, through the reduction of the irregular. This was illustrated by both the accommodation and furnishings series.

Estimating the Easter effect did not seem to be dependent on the method used to model the effect.

Finally, with respect to the estimation of the effects, although only accommodation was able to be modelled in the preferred manner, we were still able to obtain useful estimates of Easter by removing the effect from the irregular. It was noteworthy that the direction of the effects as expected was matched by the estimates.

6. Summary and conclusion

The flexibility of the GenHol tool was ably demonstrated. It is relatively easy to derive regressor variables for any specification of the timing of the before, during and after effects. This is particularly valuable in New Zealand where the Easter holiday does not match the standard Easter adjustment variables within X-12-ARIMA.

Three published series hypothesised to have an Easter effect were modelled with Easter effects as part of their seasonal adjustment. In all cases, the result of a better estimate of the Easter effect has been a reduction in unusual seasonally adjusted movements. In two cases the existing models appeared to confound the Easter effect with the irregular component. In these instances an improvement in the trend signal was obtained when Easter was estimated.

The exercise detailed in this paper was part of Statistics New Zealand's evaluation of the GenHol tool. It shows considerable promise, not only for estimating the effect of Easter, but also the effects of school holidays and other moving holidays such as Chinese New Year.

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