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## **METHODOLOGICAL NOTE:**

Seasonal adjustment of wholesale trade sales

**July 2015 to June 2016**

## **Methodological note on the seasonal adjustment of wholesale trade sales**

This document provides a brief explanation of the seasonal adjustment of wholesale trade sales, at both current and constant prices.

Monthly and quarterly time series are often characterised by considerable seasonal variations, which might complicate their interpretation. Such time series are therefore subjected to a process of seasonal adjustment in order to remove the effects of these seasonal fluctuations.

**Statistics South Africa (Stats SA) uses X-12-ARIMA to estimate trend, seasonal and irregular components as well as length of the month (LOM), trading day (TD) and Easter effects.**

The time series for wholesale trade sales show both TD and Easter effects; and therefore adjustments were done for LOM, TD and Easter effects as shown in Table 1. As can be seen in Table 1, some components were adjusted for TD without a leap year effect (TDNOLPYEAR) while others were adjusted for TD with a leap year effect.

X-12-ARIMA is a seasonal adjustment program developed at the United States Bureau of Census. The program is based on the Bureau's X11 algorithm. It incorporates regression techniques and also ARIMA modelling to improve estimation of the different time series components. The span of the wholesale trade sales time series at current prices used to identify the parameters was split into two intervals:

- January 1998 to August 2004 (direct seasonal adjustment was applied to the total only),
- September 2004 to May 2015 (indirect seasonal adjustment was applied by seasonally adjusting the subcomponents and then aggregating them to the total).

The span of the wholesale trade sales time series at constant prices used to identify the parameters was also split into two intervals and direct seasonal adjustment was applied for both intervals:

- January 1998 to August 2004,
- September 2004 to May 2015.

The identified parameters will be fixed for a period of one year and revised on an annual basis.

Table 1 shows metadata for wholesale trade sales at constant prices and subcomponents at current prices. For each component the following is given in the table below: decomposition scheme, ARIMA model, presence of seasonality, Henderson and seasonal moving average filters; outliers and presence of TD, LOM and Easter effects.

**Table 1: Metadata for wholesale trade sales (September 2004 to May 2015)**

Description	Decomposition scheme	ARIMA model	Outliers (AO, LS, TC)*	Presence Of Seasonality	Presence Of Easter Effect	Presence of TD or LOM effect	Seasonal Movement Average Filter	Henders on Filter
Wholesale trade sale at constant prices	Multiplicative	(0 1 1) (0 1 1)	LSMAY2004	Present	Easter(1)	TD with no LEAP YEAR	3x5	13
Wholesale trade on a fee or contract basis	Additive	(1 0 1) (1 0 0)	None	Present	None	Not Significant	3x5	13
Wholesale trade in agricultural raw materials and livestock	Multiplicative	(2 1 1) (0 1 1)	None	Present	Easter(15)	LOM	3x5	13
Wholesale trade in food, beverages and tobacco	Multiplicative	(0 1 1) (0 1 1)	None	Present	None	Not Significant	3x5	13
Wholesale trade in textiles, clothing and footwear	Multiplicative	(1 0 0) (0 1 1)	None	Present	Easter(15)	TD with no LEAP YEAR	3x5	13
Wholesale trade in other household goods except precious stones	Additive	(0 1 1) (0 1 1)	None	Present	Easter(1)	TD	3x5	13
Wholesale trade in solid, liquid and gaseous fuels and related products	Multiplicative	(1 1 0) (0 1 1)	TCJAN2005 LSFEB2009	Present	None	LOM	3x5	13
Wholesale trade in metal and metals ores	Multiplicative	(1 1 0) (0 1 1)	AOJUL2011 AOMAY2014 AOJUL2014 AODEC2014	Present	Easter(8)	TD with no LEAP YEAR	3x5	13
Wholesale trade in construction and building materials	Multiplicative	(0 1 1) (0 1 1)	AODEC2007	Present	Easter(8)	TD with no LEAP YEAR	3x5	13
Wholesale trade in other intermediate products, waste and scrap	Multiplicative	(0 1 1) (0 1 1)	None	Present	Easter(1)	TD with no LEAP YEAR	3x5	13
Wholesale trade in machinery, equipment and supplies	Multiplicative	(0 1 1) (0 1 1)	AONOV2008	Present	Easter(1)	TD with no LEAP YEAR	3x5	13
Wholesale trade in other goods	Additive	(0 1 1) (0 1 1)	AOJAN2012 TCJAN2015	Present	Easter(1)	TD	3x5	13
Wholesale trade in precious stones, jewellery and silverware	Additive	(0 0 1) (0 1 1)	LSAUG2008 LSJUL2013	Present	None	Not Significant	3x5	23

\* Note: Various economic reasons were provided for the existence of all outliers listed in the table above and hence no adjustment was done for them.

## Definitions:

**Additive decomposition** – An additive decomposition is appropriate if the magnitude of the seasonal fluctuations does not vary with the level of the series. Under the additive decomposition scheme, the original series (Y) is expressed as  $Y = T + (TD + S) + I$ , where T = trend, TD = trading day effect, S = seasonal component and I = irregular component.

**Multiplicative decomposition** – A multiplicative decomposition is usually appropriate for series of positive values where the size of the seasonal oscillations increases with the level of the series. The original series (Y) is expressed as  $Y = T * (TD * S) * I$ .

**Additive Outlier (AO)** – This refers to unusually high or low singular values in the time series.

**Level Shift (LS)** – This refers to an abrupt but sustained change in the level of the time series.

**Transitory Changes (TC)** – This refers to a series of outliers with transitory effects on the level of the series.

**Easter effect** – The Easter holidays may regularly affect economic activity before, during or after the holiday period. Unlike other public holidays which occur on the same date each year, the dates for Easter are not fixed and may occur in March or April. Such an effect, if it is present, is known as the Easter effect.

**Trading day effect (TD)** – An effect associated with the composition of the calendar. For example, different months have different numbers of working days and also the number of specific days of the week can occur in differing frequency in the same month over different years. Days of the week can have different levels of activity.

**Length of month effect (LOM)** – An effect arising from the fact that some months are longer than others e.g. 28, 29, 30 or 31 days.

**Seasonal adjustment approaches** – In seasonal adjustment, the direct approach refers to the adjustment of a total (aggregate of unadjusted components), and the indirect approach is the aggregation of seasonally adjusted components to obtain a total.

**Trend component** – An estimate of the local level of the series derived from the surrounding recent (a year or two) observations. The trend is generally fairly smooth and includes movements and cycles longer than a year.

**Seasonal component** – An estimate of effects that are reasonably stable in terms of annual timing, direction and magnitude. Possible causes include natural factors (the weather), administrative measures (starting and ending dates of the school year), and social/cultural/religious traditions (fixed holidays such as Christmas).

**Irregular component** – An estimate of any effect not included in the trend-cycle or the seasonal effects (or in estimated trading day or holiday effects). Its values are unpredictable with regard to timing, impact and duration. It can arise from sampling error, non-sampling error, unseasonal weather patterns, natural disasters, strikes, etc.

**Parameters** – This refers to the decomposition scheme, ARIMA model, seasonal moving average and Henderson filters, outliers and trading day, Easter and length of month regressors.