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Department:  
Statistics South Africa  
**REPUBLIC OF SOUTH AFRICA**

## **METHODOLOGICAL NOTE:**

Seasonal adjustment of wholesale trade sales



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

This document provides a brief explanation of the seasonal adjustment of wholesale trade sales.

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-month or length-of-quarter, trading day, leap year and Easter effects.**

X-12-ARIMA is a seasonal adjustment program developed at the United States Census Bureau. It incorporates regression techniques and also ARIMA modelling to improve estimation of the different time series. Further information is available at the following link:

<https://www.census.gov/topics/research/seasonal-adjustment.html>.

The following periods were used to identify the parameters for wholesale trade sales at current prices:

- January 1998 to August 2004 (direct seasonal adjustment was applied to the total only); and
- September 2004 to March 2021 (indirect seasonal adjustment was applied by adjusting the subcomponents and then aggregating them to the total).

The following periods were used to identify the parameters for wholesale trade sales at constant prices:

- January 1998 to December 2011 (direct seasonal adjustment was applied to the total only); and
- January 2012 to March 2021 (indirect seasonal adjustment was applied by adjusting the subcomponents and then aggregating them to the total).

The parameters will be revised every one year to two years, or as necessary.

Table 1, on page 2, shows metadata for the individual components for wholesale trade sales. For each component the following are given in the table below: decomposition scheme, ARIMA model, presence of seasonality, Easter, length-of-month and trading effects, Henderson and seasonal moving average filters, and outliers.

**Table 1: Metadata for wholesale trade sales time series at current and constant prices for the period January 1998 to March 2021**

Component	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of length-of-month and trading day effects	Henderson filter	Seasonal moving average filter	Outliers (AO, TC, LS)
<b>Total wholesale trade sales at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Present	Easter(1) TDNOLPYEAR LPYEAR	13	3x5	TC MAY2004 TC APR2020
<b>Fee or contract basis at current prices</b>	Multiplicative	(1,0,1)(1,0,1)	Present	Not present	Not present	23	3x5	AO APR2006 AO JAN2021 TC APR2020
<b>Agricultural raw materials and livestock at current prices</b>	Multiplicative	(2,1,1)(0,1,1)	Present	Present	Easter(1)	13	3x5	TC APR2020
<b>Food, beverages and tobacco at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	Not present	13	3x5	TC APR2020
<b>Textiles, clothing and footwear at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	Not present	13	3x5	LS JUL2020 TC APR2020
<b>Other household goods except precious stones at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Present	Easter(1) TDNOLPYEAR	13	3x5	LS JAN2005 AO APR2008 TC APR2020 AO JAN2021
<b>Precious stones, jewellery and silverware at current prices</b>	Additive	(0,1,1)(0,1,1)	Present	Not present	Not present	23	3x5	LS AUG2008 LS MAR2020 TC APR2020 TC DEC2020
<b>Solid, liquid and gaseous fuels and related products at current prices</b>	Multiplicative	(1,1,0)(0,1,1)	Present	Not present	LOM	13	3x5	LS FEB2009 LS MAR2020 TC APR2020
<b>Metals and metal ores at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Present	Easter(8) TDNOLPYEAR	13	3x5	AO JUL2014 TC APR2020
<b>Construction and building materials at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Present	Easter(1) TDNOLPYEAR	13	3x5	TC APR2020 LS DEC2020

Component	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of length-of-month and trading day effects	Henderson filter	Seasonal moving average filter	Outliers (AO, TC, LS)
<b>Other intermediate products, waste and scrap at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Present	Easter(1) TDNOLPYEAR	13	3x5	TC APR2020
<b>Machinery, equipment and supplies at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Present	Easter(8) TDNOLPYEAR	13	3x5	TC JAN2016 TC APR2020
<b>Other goods at current prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	TDNOLPYEAR	13	3x5	TC APR2020
<b>Total wholesale trade sales at constant prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Present	Easter(1) TDNOLPYEAR LPYEAR	13	3x5	LS MAY2004 TC APR2020
<b>Agricultural raw materials and livestock at constant prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Present	Easter(1) TDNOLPYEAR	13	3x5	TC APR2020
<b>Food, beverages and tobacco at constant prices</b>	Multiplicative	(1,0,0)(1,1,0)	Present	Not present	TDNOLPYEAR	13	3x5	TC APR2020
<b>Textiles, clothing and footwear at constant prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	Not present	23	3x5	TC APR2020 LS APR2020 LS JUL2020
<b>Solid, liquid and gaseous fuels and related products at constant prices</b>	Multiplicative	(1,0,0)(0,1,1)	Present	Present	Easter(8) LOM	23	3x5	TC APR2020
<b>Machinery, equipment and supplies at constant prices</b>	Multiplicative	(0,1,2)(0,1,1)	Present	Present	Easter(8) TDNOLPYEAR	13	3x5	TC APR2020
<b>Other goods at constant prices</b>	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	TDNOLPYEAR	23	3x5	TC APR2020

## 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..