METHODOLOGICAL NOTE:

Seasonal adjustment of motor trade sales

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This document provides a brief explanation of the seasonal adjustment of motor 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 span used to identify the parameters for motor trade sales at constant prices was January 2017 to October 2022.

The following spans were used to identify the parameters for motor trade sales at current prices:
- January 1998 to May 2005 (direct seasonal adjustment was applied to the total only); and
- June 2005 to October 2022 (indirect seasonal adjustment was applied by adjusting the components and then aggregating them to the total).

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

Table 1 shows the metadata for the individual components for motor 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 motor trade sales time series at constant and current prices for the period January 1998 to October 2022

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)
Total motor trade sales (at constant prices)	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	TDNOLPYEAR LOM	23	3x5	
New vehicle sales (at constant prices)	Multiplicative	(1,0,1)(0,1,0)	Present	Easter(15)	TDNOLPYEAR LOM	13	3x5	AO JUN2020
Used vehicle sales (at constant prices)	Multiplicative	(1,1,0)(0,1,1)	Present	Not present	TDNOLPYEAR	13	3x5	TC MAR2020 TC JUN2020 AO JUL2021
Workshop income (at constant prices)	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	TDNOLPYEAR LOM	13	3x5	AO MAY2020
Sales of accessories (at constant prices)	Multiplicative	(1,0,1)(1,0,0)	Present	Not present	Not present	13	3x5	
Fuel sales (at constant prices)	Multiplicative	(0,1,0)(1,1,0)	Present	Not present	LOM	13	3x5	AO JAN2021 TC JUL2021
Convenience store sales (at constant prices)	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	LOM	13	3x5	LS FEB2020

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)
Total motor trade sales (at current prices)	Multiplicative	(2,1,0)(0,1,1)	Present	Present	TDNOLPYEAR	13	3x5	LS JAN2009 AO APR2018 TC MAR2020 TC APR2020 TC JUN2020 AO JUL2021
New vehicle sales (at current prices)	Multiplicative	(2,1,0)(0,1,1)	Present	Not present	TDNOLPYEAR	13	3x5	AO MAR2018 AO MAR2020 TC APR2020 AO JUN2020 AO JUL2021
Used vehicle sales (at current prices)	Multiplicative	(2,1,0)(0,1,1)	Present	Present	TDNOLPYEAR	13	3x5	AO MAR2020 TC APR2020 TC JUN2020 AO JUL2021
Workshop income (at current prices)	Multiplicative	(0,1,1)(0,1,1)	Present	Present	TDNOLPYEAR	13	3x5	TC MAR2020 TC APR2020 AO MAY2020
Sales of accessories (at current prices)	Multiplicative	(2,1,0)(0,1,1)	Present	Present	TDNOLPYEAR	13	3x5	AO APR2018 AO MAR2020 TC MAR2020 TC APR2020
Fuel sales (at current prices)	Multiplicative	(0,1,0)(0,1,1)	Present	Not present	Not present	13	3x5	LS MAR2020 TC APR2020 AO JUL2021
Convenience store sales (at current prices)	Multiplicative	(0,1,1)(0,1,1)	Present	Not present	Not present	13	3x5	TC AUG2005 TC OCT2005 TC NOV2006 AO JAN2008 LS APR2008 LS JAN2009 LS MAR2015 LS MAR2020 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.