

## **METHODOLOGICAL NOTE**

Seasonal adjustment of manufacturing production and sales

**June 2017 to May 2018**

## Methodological note for the seasonal adjustment of manufacturing production and sales

This document provides a brief explanation of the seasonal adjustment of manufacturing production and 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 (LOM), trading day (TD) and Easter effects.**

The time series for manufacturing production and sales show LOM, TD and Easter effects. Adjustment was done for these effects as shown in Tables 1 and 2. As can be seen in Tables 1 and 2, 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. To improve the quality of the seasonal adjustment process, the span used in identifying the parameters for **manufacturing production** was split into two intervals:

- January 1996 to December 2004; and
- January 2005 to May 2017.

For **manufacturing production**, from January 1996 to December 2014, direct seasonal adjustment was applied for the manufacturing components, divisions and total manufacturing. For January 2015 to May 2017, indirect seasonal adjustment was applied for the manufacturing divisions and total manufacturing, while the direct approach was adopted for the components.

The span used in identifying the parameters for **manufacturing sales** was also split into two intervals:

- January 1998 to December 2004; and
- January 2005 to May 2017.

For **manufacturing sales**, indirect seasonal adjustment was applied for the manufacturing divisions and total manufacturing, while the direct approach was adopted for the components for the entire span (January 1998 to May 2017).

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

Tables 1 and 2 show metadata for manufacturing production and sales, respectively. For each component the following is given in the tables below: decomposition scheme, ARIMA model, presence of seasonality, Easter, trading day and length of month effects, Henderson and seasonal moving average filters and outliers.

**Table 1: Metadata for manufacturing production (January 2005 to May 2017)**

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of TD or LOM effect	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)*
MPI30000 <sup>+</sup>	Total manufacturing	Multiplicative	(2,1,1)(0,1,1)	Present	Easter(8)	LOM	23	3x5	LS NOV2008
MPI30100	Meat, fish, fruit etc.	Additive	(2,0,1)(0,1,1)	Present	Easter(1)	TD	13	3x3	
MPI30200 <sup>+</sup>	Dairy products	Multiplicative	(3,0,0)(0,1,1)	Present	N	LOM	23	3x5	
MPI30300	Grain mill products	Additive	(1,1,1)(0,1,1)	Present	Easter(1)	TD	13	3x5	
MPI30400	Other food products	Multiplicative	(1,0,1)(0,1,1)	Present	N	TDNOLPYEAR	23	3x5	
MPI30500 <sup>++</sup>	Beverages	Multiplicative	(3,0,1)(0,1,1)	Present	N	LOM	23	3x5	
MPI30600	Tobacco	Additive	(1,0,0)(0,1,1)	Present	Easter(8)	N	13	3x5	
MPI30999 <sup>+</sup>	Food and beverages	Multiplicative	(3,0,0)(0,1,1)	Present	N	LOM	23	3x5	
MPI31100	Textiles	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR	23	3x9	
MPI31200	Other textile products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(15)	TDNOLPYEAR	13	3x5	AO SEP2013
MPI31300	Knitted, crocheted articles	Multiplicative	(2,1,1)(0,1,1)	Present	N	LOM	13	3x5	
MPI31400	Wearing apparel	Additive	(0,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	
MPI31600 <sup>**</sup>	Leather and leather products	Additive	(0,1,1)(0,1,1)	Present	N	N	13	3x5	
MPI31700	Footwear	Multiplicative	(2,0,2)(0,1,1)	Present	N	TDNOLPYEAR	23	3x5	TC JUL2014
MPI31999 <sup>**</sup>	Textiles, clothing, leather and footwear	Multiplicative	(2,1,1)(0,1,1)	Present	Easter(8)	LOM	13	3x5	
MPI32100	Sawmilling and planing of wood	Additive	(0,1,1)(0,1,1)	Present	Easter(1)	TD	13	3x5	
MPI32200	Products of wood	Multiplicative	(0,1,1)(1,1,1)	Present	N	TDNOLPYEAR	13	3x5	
MPI32300	Paper and paper products	Multiplicative	(0,1,1)(1,1,1)	Present	Easter(1)	N	13	3x5	
MPI32400	Publishing	Multiplicative	(0,1,0)(1,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC NOV2011 TC DEC2011 AO JUL2012 TC OCT2012 AO DEC2012
MPI32500	Printing , recorded media	Multiplicative	(3,1,0)(0,1,1)	Present	Easter(8)	N	23	3x5	AO JUL2010 LS MAR2013
MPI32999 <sup>+</sup>	Wood and wood products, paper, publishing and printing	Multiplicative	(3,1,0)(0,1,1)	Present	Easter(1)	N	13	3x5	TC NOV2011
MPI33209	Coke, petroleum products and nuclear fuel	Additive	(1,0,0)(0,1,1)	Not Present	N	N	13	3x5	TC MAY2001 AO NOV2004
MPI33400	Basic chemicals	Additive	(0,0,1)(0,1,1)	Present	N	TDNOLPYEAR	23	3x5	LS NOV2006 TC FEB2008 TC MAY2009 LS DEC2013
MPI33500	Other chemical products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR	13	3x5	
MPI33700	Rubber products	Additive	(1,1,0)(0,1,1)	Present	Easter(15)	TD	13	3x5	AO AUG2007 AO SEP2010
MPI33800 <sup>+</sup>	Plastic products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	LOM	13	3x5	

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of TD or LOM effect	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)*
MPI33999	Petroleum, chemical products, rubber and plastic products	Additive	(1,0,0)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	TC OCT2005
MPI34100	Glass and glass products	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	AO DEC2011
MPI34200	Non-metallic mineral products	Additive	(0,1,1)(0,1,1)	Present	Easter(15)	TD	13	3x5	
MPI34999	Glass and non-metallic mineral products	Additive	(0,1,1)(0,1,1)	Present	Easter(15)	TD	13	3x5	
MPI35100	Basic iron and steel products	Additive	(0,1,0)(0,1,1)	Present	N	N	13	3x5	
MPI35200	Non-ferrous metal products	Additive	(0,1,1)(0,1,1)	Present	N	TD	13	3x5	AO JUL2014
MPI35400	Structural metal products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(15)	TDNOLPYEAR	13	3x5	AO JUL2014
MPI35500	Other fabricated metal products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	LS DEC2008 AO JUL2011 AO JUL2014
MPI35600	General purpose machinery	Multiplicative	(0,1,1)(1,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	AO JUL2011 AO JUL2014
MPI35700	Special purpose machinery	Additive	(1,1,2)(0,1,1)	Present	Easter(1)	N	23	3x5	
MPI35800	Household appliances	Multiplicative	(3,1,1)(0,1,1)	Present	Easter(1)	N	13	3x9	AO JUL2014
MPI35999	Basic iron and steel, non-ferrous metal products, metal products and machinery	Additive	(0,1,1)(0,1,1)	Present	Easter(1)	TD	13	3x5	AO JUL2011 AO JUL2014
MPI36100	Electric motors, generators, transformers	Multiplicative	(1,1,1)(0,1,1)	Present	Easter(15)	N	13	3x5	TC DEC2014 AO DEC2016
MPI36200 <sup>+</sup>	Electricity distribution and control apparatus	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	AO JUL2014
MPI36300	Insulated wire and cables	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	AO JUL2014
MPI36400	Accumulators, primary cells and primary batteries	Additive	(1,1,0)(0,1,1)	Present	Easter(8)	TD	13	3x5	
MPI36500	Electric lamps and lighting equipment	Additive	(0,1,1)(0,1,1)	Present	N	N	13	3x5	AO JUL2014
MPI36600	Other electrical equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	
MPI36999	Electrical machinery	Multiplicative	(1,0,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	AO JUL2014
MPI37200	Radio, television and communication apparatus	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC JAN2015
MPI37400	Professional equipment	Additive	(0,1,1)(0,1,1)	Present	N	N	23	3x5	
MPI37999	Radio, television and communication apparatus and professional equipment	Multiplicative	(0,1,1)(1,1,1)	Present	N	N	23	3x5	TC JAN2015

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of TD or LOM effect	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)*
MPI38100	Motor vehicles	Additive	(0,1,1)(0,1,1)	Present	Easter(8)	TD	13	3x5	AO SEP2007 LS DEC2009 TC AUG2010 TC OCT2010 TC OCT2012 TC AUG2013 AO SEP2013 AO JUL2014
MPI38200	Bodies for motor vehicles, trailers and semi-trailers	Additive	(1,1,0)(0,1,1)	Present	Easter(1)	TD	13	3x5	
MPI38300	Parts and accessories	Additive	(3,1,1)(0,1,1)	Present	Easter(15)	TD	13	3x5	AO SEP2007 AO SEP2010 AO SEP2013
MPI38400	Other transport equipment	Multiplicative	(1,0,0)(0,1,1)	Present	Easter(15)	N	23	3x5	
MPI38999	Motor vehicles, parts and accessories and other transport equipment	Additive	(0,1,1)(0,1,1)	Present	Easter(15)	TD	13	3x5	AO SEP2007 LS AUG2010 LS OCT2010 TC AUG2013 AO SEP2013 AO JUL2014
MPI39100	Furniture	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(15)	N	13	3x5	AO JAN2011
MPI39200	Other manufacturing groups	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	LS DEC2008 AO MAY2016
MPI39991	Furniture and other manufacturing division	Additive	(2,1,0)(1,1,1)	Present	Easter(8)	N	23	3x5	
MPI390th	Other manufacturing groups	Additive	(2,1,0)(0,1,1)	Present	Easter(8)	N	13	3x5	

\* 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.

\* These variables were further adjusted for residual TD

\*\*This variable was further adjusted for residual Easter(15) and TD

\*\*These variables were further adjusted for residual TDNOLPYEAR

**Table 2: Metadata for manufacturing sales (January 2005 to May 2017)**

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of TD or LOM effect	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)*
MSV30100*	Meat , fish, fruit etc.	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	LSJAN2007 LSJAN2008
MSV30200**	Dairy products	Multiplicative	(3,1,1)(0,1,1)	Present	N	LOM	13	3x5	
MSV30300	Grain mill products	Multiplicative	(0,1,0)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	
MSV30400	Other food products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	
MSV30500	Beverages	Multiplicative	(1,0,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR	13	3x5	
MSV30600	Tobacco	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	23	3x5	LSFEB2009 AOJAN2011
MSV31100+	Textiles	Multiplicative	(2,1,0)(0,1,1)	Present	Easter(1)	LOM	13	3x5	
MSV31200	Other textile products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	LSJAN2009 AOSEP2013
MSV31300	Knitted, crocheted articles	Multiplicative	(1,0,1)(1,1,1)	Present	Easter(1)	TDNOLPYEAR	23	3x5	LSAPR2012
MSV31400	Wearing apparel	Multiplicative	(0,1,2)(1,1,1)	Present	Easter(8)	LOM	13	3x5	
MSV31600+	Leather and leather products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	
MSV31700	Footwear	Multiplicative	(1,0,0)(0,1,0)	Present	Easter(1)	TDNOLPYEAR	13	3x5	AOJUN2014
MSV32100	Sawmilling and planing of wood	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	23	3x5	LSDEC2008
MSV32200	Products of wood	Multiplicative	(0,1,1)(1,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	LSFEB2009

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of TD or LOM effect	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)*
MSV32300	Paper and paper products	Multiplicative	(3,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	
MSV32400	Publishing	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	AONOV2011 TCDEC2011 LSAUG2012
MSV32500 <sup>+</sup>	Printing , recorded media	Multiplicative	(1,0,1)(0,1,1)	Present	Easter(8)	N	23	3x5	AOJUL2010
MSV33209	Coke, petroleum products and nuclear fuel	Multiplicative	(0,1,0)(0,1,1)	Present	N	N	13	3x5	AONOV2005
MSV33400	Basic chemicals	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	LSDEC2008
MSV33500 <sup>++</sup>	Other chemical products	Multiplicative	(2,1,1)(0,1,1)	Present	N	N	13	3x5	LSDEC2001
MSV33700	Rubber products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	AOAUG2007 AOSEP2010 TCAUG2013
MSV33800	Plastic products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	
MSV34100 <sup>+</sup>	Glass and glass products	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	
MSV34200 <sup>+++</sup>	Non-metallic mineral products	Multiplicative	(1,1,1)(0,1,1)	Present	Easter(1)	LOM	13	3x5	
MSV35100	Basic iron and steel products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	LSNOV2008 AOJUL2014
MSV35200 <sup>***</sup>	Non-ferrous metal products	Additive	(0,1,1)(0,1,1)	Present	N	LOM	13	3x5	
MSV35400	Structural metal products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(15)	TDNOLPYEAR	13	3x5	AOJUL2014
MSV35500	Other fabricated metal products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	AOJUL2011 AOJUL2014
MSV35600	General purpose machinery	Additive	(0,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	AOJUL2011

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of TD or LOM effect	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)*
MSV35700	Special purpose machinery	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	
MSV35800	Household appliances	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	AOJUL2014
MSV36100	Electric motors, generators, transformers	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	AOFEB2014 TCDEC2014 LSFEB2016
MSV36200	Electricity distribution and control apparatus	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TCAPR2009 AOJUL2014
MSV36300	Insulated wire and cables	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	AOJUL2014
MSV36400	Accumulators, primary cells and primary batteries	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	AOAUG2013
MSV36500	Electric lamps and lighting equipment	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	AOJUL2014
MSV36600	Other electrical equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	LSJUN2015
MSV37200	Radio, television and communication apparatus	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TCJAN2015
MSV37400	Professional equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TCAPR2006
MSV38100	Motor vehicles	Additive	(0,1,1)(0,1,1)	Present	Easter(8)	TD	13	3x5	AOSEP2013
MSV38200	Bodies for motor vehicles, trailers and semi-trailers	Multiplicative	(1,1,0)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	



Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of TD or LOM effect	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)*
MSV38300	Parts and accessories	Multiplicative	(1,1,0)(0,1,1)	Present	Easter(15)	TDNOLPYEAR	13	3x5	LSNOV2008 LSOC2010 AOSEP2013
MSV38400	Other transport equipment	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	
MSV39100	Furniture	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR	13	3x5	AOJAN2008 AOJAN2011
MSV39200	Other manufacturing groups	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	LSDEC2008 AOMAY2016

\* 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.

\*This variable was further adjusted for residual Easter(15)

\*\*This variable was further adjusted for residual LOM

\*\*\*This variable was further adjusted for residual Easter(8)

+These variables were further adjusted for residual TDNOLPYEAR

++This variable was further adjusted for residual Easter(1) and TDNOLPYEAR

+++This variable was further adjusted for residual TD

## 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** – The 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** – 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** – 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 or 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.