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METHODOLOGICAL NOTE:

Seasonal adjustment of manufacturing production and sales

Methodological note on 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 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 components. Further information is available at the following link: <https://www.census.gov/topics/research/seasonal-adjustment.html>.

The period from January 2005 to March 2021 was used to identify the parameters.

For **manufacturing production**, from January 2005 to December 2014, direct seasonal adjustment was applied for the manufacturing components, divisions and total manufacturing. For January 2015 to March 2021, indirect seasonal adjustment was applied for the manufacturing divisions and total manufacturing, while the direct approach was adopted for the components.

For **manufacturing sales**, indirect seasonal adjustment was applied for the manufacturing divisions and total manufacturing, while the direct approach was adopted for the components.

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

Tables 1 and 2 below show metadata for the individual components for manufacturing production and sales, respectively. 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 manufacturing production for the period January 2005 to March 2021

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of length-of-month and trading day effects	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)
MPI30000	Total manufacturing	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI30100	Meat, fish, fruit etc.	Multiplicative	(1,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI30200	Dairy products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI30300	Grain mill products	Multiplicative	(0,1,2)(0,1,1)	Present	Easter(1)	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI30400	Other food products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	23	3x5	TC01APR2020 AO01APR2020
MPI30500	Beverages	Multiplicative	(2,0,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI30600	Tobacco	Multiplicative	(1,0,1)(0,1,1)	Present	Easter(8)	N	23	3x5	TC01APR2020 AO01APR2020
MPI30999	Food and beverages	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR LPYEAR	23	3x5	TC01APR2020 AO01APR2020
MPI31100	Textiles	Multiplicative	(2,1,0)(0,1,1)	Present	Easter(1)	N	13	3x5	TC01APR2020 AO01APR2020
MPI31200	Other textile products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI31300	Knitted, crocheted articles	Multiplicative	(0,1,1)(1,1,1)	Present	Easter(8)	LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI31400	Wearing apparel	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	TC01APR2020 AO01APR2020
MPI31600	Leather and leather products	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI31700	Footwear	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MPI31999	Textiles, clothing, leather and footwear	Multiplicative	(2,1,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI32100	Sawmilling and planing of wood	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI32200	Products of wood	Multiplicative	(0,1,1)(1,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI32300	Paper and paper products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	TC01APR2020 AO01APR2020
MPI32400	Publishing	Multiplicative	(1,1,1)(1,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of length-of-month and trading day effects	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)
MPI32500	Printing , recorded media	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI32999	Wood and wood products, paper, publishing and printing	Multiplicative	(3,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MPI33209	Coke, petroleum products and nuclear fuel	Multiplicative	(1,0,0)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI33400	Basic chemicals	Multiplicative	(0,0,1)(0,1,1)	Present	N	TDNOLPYEAR	23	3x5	TC01APR2020 AO01APR2020
MPI33500	Other chemical products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI33700	Rubber products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MPI33800	Plastic products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI33999	Petroleum, chemical products, rubber and plastic products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	TC01APR2020 AO01APR2020
MPI34100	Glass and glass products	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI34200	Non-metallic mineral products	Multiplicative	(2,1,0)(1,1,1)	Present	Easter(8)	N	23	3x5	TC01APR2020 AO01APR2020
MPI34999	Glass and non-metallic mineral products	Multiplicative	(0,1,1)(1,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MPI35100	Basic iron and steel products	Multiplicative	(1,0,0)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI35200	Non-ferrous metal products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI35400	Structural metal products	Multiplicative	(2,1,0)(1,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI35500	Other fabricated metal products	Multiplicative	(2,1,0)(0,1,1)	Present	N	LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI35600	General purpose machinery	Multiplicative	(1,1,0)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI35700	Special purpose machinery	Multiplicative	(2,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	TC01APR2020 AO01APR2020
MPI35800	Household appliances	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MPI35999	Basic iron and steel, non-ferrous metal products, metal products and machinery	Multiplicative	(2,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI36100	Electric motors, generators, transformers	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of length-of-month and trading day effects	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)
MPI36200	Electricity distribution and control apparatus	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	23	3x5	TC01APR2020 AO01APR2020
MPI36300	Insulated wire and cables	Multiplicative	(1,0,0)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI36400	Accumulators, primary cells and primary batteries	Multiplicative	(2,1,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR	23	3x5	TC01APR2020 AO01APR2020
MPI36500	Electric lamps and lighting equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MPI36600	Other electrical equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI36999	Electrical machinery	Multiplicative	(1,0,0)(0,1,1)	Present	N	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI37200	Radio, television and communication apparatus	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MPI37400	Professional equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MPI37999	Radio, television and communication apparatus and professional equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI38100	Motor vehicles	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MPI38200	Bodies for motor vehicles, trailers and semi-trailers	Multiplicative	(2,1,0)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MPI38300	Parts and accessories	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MPI38400	Other transport equipment	Multiplicative	(3,1,0)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MPI38999	Motor vehicles, parts and accessories and other transport equipment	Multiplicative	(3,0,0)(0,1,1)	Present	Easter(8)	N	23	3x5	TC01APR2020 AO01APR2020
MPI39100	Furniture	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(15)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MPI39200	Other manufacturing groups	Multiplicative	(0,1,1)(1,1,1)	Present	Easter(1)	N	13	3x5	TC01APR2020 AO01APR2020
MPI39991	Furniture and other manufacturing division	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	23	3x5	TC01APR2020 AO01APR2020
MPI39Oth	Other manufacturing groups	Multiplicative	(0,1,1)(1,1,1)	Present	Easter(8)	N	23	3x5	TC01APR2020 AO01APR2020

Table 2: Metadata for manufacturing sales for the period January 2005 to March 2021

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of length-of-month and trading day effects	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	TC01APR2020 AO01APR2020
MSV30200**	Dairy products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV30300	Grain mill products	Multiplicative	(2,1,2)(0,1,1)	Present	Easter(1)	TDNOLPYEAR LOM	13	3x5	TC01APR2020 AO01APR2020
MSV30400	Other food products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV30500	Beverages	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(15)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV30600	Tobacco	Multiplicative	(2,1,0)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MSV31100	Textiles	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV31200	Other textile products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV31300	Knitted, crocheted articles	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	LOM	13	3x5	TC01APR2020 AO01APR2020
MSV31400	Wearing apparel	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MSV31600	Leather and leather products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	LOM	13	3x5	TC01APR2020 AO01APR2020
MSV31700	Footwear	Multiplicative	(0,1,1)(0,1,0)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV32100	Sawmilling and planing of wood	Multiplicative	(3,1,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR	23	3x5	TC01APR2020 AO01APR2020
MSV32200	Products of wood	Multiplicative	(0,1,1)(1,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV32300	Paper and paper products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	N	13	3x5	TC01APR2020 AO01APR2020
MSV32400	Publishing	Multiplicative	(3,1,1)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MSV32500	Printing , recorded media	Multiplicative	(1,0,1)(0,1,1)	Present	Easter(8)	N	23	3x5	TC01APR2020 AO01APR2020
MSV33209	Coke, petroleum products and nuclear fuel	Multiplicative	(0,1,0)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MSV33400	Basic chemicals	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV33500	Other chemical products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV33700	Rubber products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MSV33800	Plastic products	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020

Variable	Description	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of length-of-month and trading day effects	Henderson filter	Seasonal movement average filter	Outliers (AO,LS,TC)
MSV34100	Glass and glass products	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MSV34200	Non-metallic mineral products	Multiplicative	(2,1,0)(1,1,1)	Present	Easter(1)	TDNOLPYEAR LPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV35100	Basic iron and steel products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	LOM	13	3x5	TC01APR2020 AO01APR2020
MSV35200	Non-ferrous metal products	Multiplicative	(0,1,1)(0,1,1)	Present	N	LOM	13	3x5	TC01APR2020 AO01APR2020
MSV35400	Structural metal products	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MSV35500	Other fabricated metal products	Multiplicative	(2,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR LOM	13	3x5	TC01APR2020 AO01APR2020
MSV35600	General purpose machinery	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MSV35700	Special purpose machinery	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV35800	Household appliances	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	N	23	3x5	TC01APR2020 AO01APR2020
MSV36100	Electric motors, generators, transformers	Multiplicative	(1,0,0)(1,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MSV36200	Electricity distribution and control apparatus	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MSV36300	Insulated wire and cables	Multiplicative	(3,1,1)(0,1,1)	Present	N	LOM	13	3x5	TC01APR2020 AO01APR2020
MSV36400	Accumulators, primary cells and primary batteries	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV36500	Electric lamps and lighting equipment	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV36600	Other electrical equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV37200	Radio, television and communication apparatus	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MSV37400	Professional equipment	Multiplicative	(0,1,1)(0,1,1)	Present	N	N	13	3x5	TC01APR2020 AO01APR2020
MSV38100	Motor vehicles	Multiplicative	(2,0,0)(0,1,1)	Present	N	TDNOLPYEAR	13	3x5	TC01APR2020 AO01APR2020
MSV38200	Bodies for motor vehicles, trailers and semi-trailers	Multiplicative	(2,1,0)(0,1,1)	Present	Easter(8)	N	23	3x5	TC01APR2020 AO01APR2020
MSV38300	Parts and accessories	Multiplicative	(2,1,0)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MSV38400	Other transport equipment	Multiplicative	(2,1,0)(0,1,1)	Present	N	N	23	3x5	TC01APR2020 AO01APR2020
MSV39100	Furniture	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020
MSV39200	Other manufacturing groups	Multiplicative	(0,1,1)(1,1,1)	Present	Easter(8)	N	13	3x5	TC01APR2020 AO01APR2020

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.