STATS SA
STATISTICS SOUTH AFRICA

METHODOLOGICAL NOTE:

Seasonal adjustment of mining production and sales

October 2016 to September 2017

Methodological note for the seasonal adjustment of mining production and sales

This document provides a brief explanation of the seasonal adjustment of mining production and sales.

Monthly and quarterly time series are often characterised by considerable seasonal variation, which may 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 mining production and sales show LOM, TD and Easter effects. Adjustments were 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. Indirect seasonal adjustment was applied for the total while the direct approach was adopted for the components. To improve the quality of the seasonal adjustment process, the span used in identifying the parameters for **mining production** was split into two intervals:
- January 1980 to December 2002; and
- January 2003 to September 2016.

The span used in identifying the parameters for **mining sales** was also split into two intervals:
- January 1980 to December 2002; and
- January 2003 to August 2016.

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

Tables 1 to 2 show metadata for the production and sales for the second span. For each component the following is given in the tables below: decomposition scheme, ARIMA model, presence of seasonality, Easter, LOM and TD effects, Henderson and seasonal moving average filters and outliers.

Table 1: Metadata for mining production (January 2003 to September 2016)

Component	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of LOM and TD effects	Henderson Filter	Seasonal Moving Average filter	Outliers (AO, TC, LS)[1]
Coal[2]	Additive	(1,0,1)(0,1,1)	Present	Not significant	LOM	23	3x5	
Iron ore	Multiplicative	(0,1,1)(0,1,1)	Present	Not significant	TDNOLPYEAR	13	3x5	AOJAN2011 AOOCT2012 AODEC2013
Chromium	Additive	(0,1,1)(0,1,1)	Present	Not significant	LOM	13	3x5	AOJUN2005 LSDEC2008 LSMAR2009 LSNOV2012 LSDEC2015
Copper	Additive	(0,1,2)(0,0,0)	Not Present	Not significant	LOM	13	3x5	
Manganese ore	Multiplicative	(3,1,1)(0,1,1)	Not Present	Not significant	Not significant	13	3x9	
PGMs[3]	Additive	(0,1,1)(0,1,1)	Present	Not significant	LOM	13	3x5	
Nickel	Additive	(0,1,1)(0,1,1)	Not Present	Not significant[4]	Not significant	23	3x9	AOOCT1998 AOOCT1999
Other metallic minerals	Additive	(0,1,1)(0,0,0)	Not Present	Not significant	LOM	13	3x5	
Gold	Additive	(0,1,1)(0,1,1)	Present	Not significant	Not significant	13	3x5	TCOCT2012
Diamonds	Multiplicative	(0,1,1)(0,1,1)	Not Present	Not significant	Not significant	23	3x5	AOJAN2000 LSSEP2001
Building materials	Multiplicative	(0,1,1)(0,1,1)	Present	Easter(1)	TDNOLPYEAR	13	3x5	
Other non-metallic minerals	Multiplicative	(0,1,1)(0,1,1)	Not Present	Not significant	TDNOLPYEAR	13	3x5	

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[1] Various economic reasons were provided for the existence of all outliers listed on the table above and hence no adjustment was done for them.

[2] This component was further adjusted for residual Easter (1) and TD.

[3] This component was further adjusted for residual TD.

[4] The X-12 procedure detects the presence of Easter effect in nickel. However, with the advice from Stats SA's economists and subject matter specialists, it was concluded that there is no economic justification for this effect; hence the decision was taken not to adjust for it.

Table 2: Metadata for mining sales (January 2003 to August 2016)

Commodity	Decomposition scheme	ARIMA model	Presence of seasonality	Presence of Easter effect	Presence of LOM and TD effects	Henderson Filter	Seasonal Moving Average filter	Outliers (AO, TC, LS) [5]
Total, gold included	Multiplicative	(0,1,1)(0,1,1)	Present	Not significant	TDNOLPYEAR	13	3x9	
Total, gold excluded	Multiplicative	(0,1,1)(0,1,1)	Present	Not significant	TDNOLPYEAR	13	3x5	LSDEC2008

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[5] Various economic reasons were provided for the existence of all outliers listed on the table above and hence no adjustment was done for them.

Definitions:

Calendar effects – These are effects due to calendar variations. Such calendar effects include working/trading day or the incidence of moving holidays (such as Easter) or length of a month.

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 – Effects from holidays that are not always on the same day of a month. The most important moving holiday in South Africa is Easter since it can occur in March or April and at different periods of a month. These factors may consequently result in an increased level of production in weeks prior to or following Easter. Furthermore, this effect can give rise to monthly variations that may not reflect a true growth or fall in economic activity, but instead indicate a shift.

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 aggregated (totals) raw 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 regards 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.