

## **METHODOLOGICAL NOTE:**

Seasonal adjustment of mining: production and sales

**February 2014 to January 2015**

## Methodological note for the seasonal adjustment of mining: production and sales

The purpose of this document is to provide a summary on seasonal adjustment implemented for mining: 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 the X-12-ARIMA to estimate the trend, seasonal and irregular components as well as trading day (TD) and length-of-month (LOM) and Easter effects. Seasonal adjustments are made as set out in Tables 1 – 4.

The 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 ARIMA modelling to improve estimation of the different time series components. The spans used in identifying the parameters for production and sales are January 1980 to December 2013 and January 1980 to November 2013, respectively. The **production** span was split into two intervals:

- January 1980 to December 2002 (direct seasonal adjustment method was applied),
- January 2003 to December 2013. The direct and indirect seasonal adjustment methods were applied from January 2003 to December 2009 and January 2010 to December 2013, respectively.

Similarly, the span for the **sales** was also split into two intervals:

- January 1980 to December 2002 (direct seasonal adjustment method was applied); and
- January 2003 to November 2013 (direct seasonal adjustment method was applied).

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

Tables 1 to 4 show metadata for the production and sales for the two spans. For each component the following is given in the tables below: decomposition scheme, ARIMA model, presence of seasonality, Henderson and seasonal moving average filters, outliers, presence of LOM and Easter effects.

**Table 1: Metadata for mining production (January 1980 to December 2002)**

<b>Component</b>	<b>Decomposition scheme</b>	<b>ARIMA model</b>	<b>Presence of seasonality</b>	<b>Henderson Filter</b>	<b>Seasonal Moving Average filter</b>	<b>Outliers (AO, TC, LS)</b>	<b>Presence of LOM effect</b>	<b>Presence of Easter effect</b>
<b>Gold</b>	Additive	(311)(011)	Significant	13	3x5	TC Dec. 1984 TC Aug. 1987	Significant	Not significant
<b>Iron ore</b>	Additive	(111)(100)	Not significant	13	3x5	AO Sep. 1991	Not significant	Not significant
<b>Chromium ore</b>	Multiplicative	(011)(011)	Significant	13	3x5	AO Aug. 1991 AO Jun. 1999	Not significant	Not significant
<b>Copper</b>	Additive	(000)(011)	Not significant	23	3x9	AO Mar. 1982 LS Jun. 1985 LS Jul. 1992 LS Jan. 1999 AO May 1999	Not significant	Not significant
<b>Manganese ore</b>	Additive	(011)(011)	Not significant	13	3x9	TC Jan. 1981 LS Mar. 1983	Not significant	Not significant
<b>PGMs</b>	Multiplicative	(011)(011)	Not significant	13	3x5	LS Jun. 1982	Not significant	Not significant
<b>Nickel</b>	Multiplicative	(011)(011)	Significant	9	3x5	AO Oct. 1998 AO Oct. 1999	Not significant	Not significant
<b>Other metallic minerals</b>	Additive	(012)(101)	Not significant	13	3x5	LS Aug. 1987 AO Dec. 1995	Significant	Not significant
<b>Coal</b>	Multiplicative	(311)(011)	Significant	13	3x5	AO Aug. 1987	Not significant	Easter[1]
<b>Diamonds</b>	Additive	(011)(011)	Significant	13	3x5	AO Jan. 2000  LS Sep. 2001	Not significant	Not significant
<b>Building material</b>	Multiplicative	(111)(011)	Significant	23	3x5	TC Nov. 1994 TC Dec. 1996 TC Jan. 1997 TC Jul. 1997 TC Sep. 1997 TC Apr. 1998 TC Feb. 2000 AO Nov. 2000	Not significant	Easter[1]

						AO Aug. 2001		
<b>Other non-metallic</b>	Additive	(011)(011)	Significant	13	3x5	AO Aug. 1997 AO Mar. 2002	Not significant	Not significant
<b>Total including gold</b>	Additive	(011)(011)	Significant	13	3x5	TC Aug. 1987 AO Aug. 2001	Not significant	Easter[1]
<b>Total excluding gold</b>	Multiplicative	(011)(011)	Significant	13	3x5	LS Sep. 1982 AO Aug. 1987 AO Oct. 1998 TC Jul. 2001 AO Aug. 2001 TC Jan. 2002	Not significant	Easter[1]

\* Note: Various economic reasons were provided for the existence of all outliers listed on the table above and hence no adjustment was done for them.

**Table 2: Metadata for mining production (January 2003 to December 2013)**

Component	Decomposition scheme	ARIMA model	Presence of seasonality	Henderson Filter	Seasonal Moving Average filter	Outliers (AO, TC, LS)	Presence of LOM effect	Presence of Easter effect
<b>Gold</b>	Additive	(011)(011)	Significant	13	3x5	TC Oct. 2012	Significant	Not significant
<b>Iron ore</b>	Multiplicative	(011)(011)	Significant	13	3x5	AO Jan. 2011 AO Oct. 2012	Not significant	Not significant
<b>Chromium ore</b>	Additive	(010)(011)	Significant	13	3x5	AO Jun. 2005 LS Dec. 2008 LS Mar. 2009	Not significant	Easter[8]
<b>Copper</b>	Additive	(100)(011)	Not significant	13	3x5	AO Sep. 2005	Not significant	Not significant
<b>Manganese ore</b>	Multiplicative	(011)(011)	Not significant	13	3x5	LS Jan. 2009	Not significant	Not significant
<b>PGMs</b>	Additive	(011)(011)	Significant	13	3x5	None	Not significant	Not significant
<b>Nickel</b>	Additive	(011)(000)	Not significant	23	3x9	AO Oct. 2011	Not significant	Not significant <sup>1</sup>
<b>Other metallic minerals</b>	Additive	(011)(011)	Not significant	13	3x5	AO Dec. 2009	Not significant	Not significant
<b>Coal</b>	Additive	(101)(011)	Significant	23	3x5	AO Jan. 2007	Significant	Easter[1]
<b>Diamonds</b>	Multiplicative	(011)(011)	Not significant	23	3x5	LS Dec. 2008 TC Dec. 2013	Not significant	Not significant
<b>Building material</b>	Multiplicative	(210)(011)	Significant	23	3x5	AO Dec. 2013	Not significant	Easter[1]
<b>Other non-metallic minerals</b>	Multiplicative	(011)(100)	Not significant	13	3x5	LS Jul. 2004 TC Oct. 2009 AO Oct. 2011	Not significant	Not significant

<sup>1</sup> The X-12 ARIMA procedure detects the presence of the 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 3: Metadata for mining sales (January 1980 to December 2002)**

Component	Decomposition scheme	ARIMA model	Presence of seasonality	Henderson Filter	Seasonal Moving Average filter	Outliers	Presence of LOM effect	Presence of Easter effect
<b>Total including gold</b>	Multiplicative	(311)(011)	Significant	13	3x5	TC Jan. 1982	Not significant	Easter[1]
<b>Total excluding gold</b>	Multiplicative	(011)(011)	Not significant	13	3x5	AO Nov. 1986	Not significant	Not significant

**Table 4: Metadata for mining sales (January 2003 to November 2013)**

Commodity	Decomposition scheme	ARIMA model	Presence of seasonality	Henderson Filter	Seasonal Moving Average filter	Outliers	Presence of LOM effect	Presence of Easter effect
<b>Total including gold</b>	Multiplicative	(011)(011)	Significant	13	3x5	None	Not significant	Not significant
<b>Total excluding gold</b>	Multiplicative	(011)(011)	Significant	13	3x5	LS Dec. 2008	Not significant	Not significant

## 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 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 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.