

## Appendix 5 Details of seasonal adjustment with X-12-ARIMA

### 1 Specification file

The specification file (from the release of the December 2018 result for Japan (Note 1)), set in X-12-ARIMA for calculating the seasonally adjusted indices of the 2015-base CPI, is shown below.

series{ start=2010.01	Start of data: January 2010
span=(2010.1,2018.12)	Period of data: January 2010 to December 2018(Note 1)
period=12	Type of data: Monthly data
}	
transform{ function=log }	Log transformation of data
regression{ variables=(LS2014.4)}	Prior adjustment of outliers (see the next page for details)
x11{	(X-11 part)
sigmalim=(2 3)	Singular term management limit : $2\sigma$ to $3\sigma$
seasonalma=X11default	X-11 default used for moving average
appendfcst=yes	Output of prediction period of Reg-ARIMA model
save=(d10 d11)}	Storage of seasonal and seasonally adjusted indices in the file(Note 2)
arima{ model=(p d q)(P D Q)}	ARIMA model setting (see the next page for details)
estimate{ }	Default estimation of Reg-ARIMA model

(Note 1) The seasonally adjusted indices are revised every year when the December result for Japan is compiled. For example, when the December 2018 result for Japan is created, the seasonal indices from January 2010 to December 2018 will be calculated with “span = (2010.1, 2018.12)”, as well as the estimated seasonal indices from January to December 2019. Based on the seasonal indices calculated here, the seasonally adjusted indices from January 2010 to December 2018 will be recalculated. The seasonally adjusted indices from January to November 2019 (to preliminary figure in December for the Ku-area of Tokyo) given by the estimated seasonal indices calculated here are the first published figures.

(Note 2) The “original series before rounding off the fraction” is divided by the “(estimated) seasonal index before rounding the fraction” to calculate the seasonally adjusted indices for the 2015-base CPIs.

## 2 ARIMA model setting and prior adjustment of outliers

The table below shows the ARIMA model and prior adjustment of outliers for each grouping\*.

### (1) Japan

Group	After the release of the December 2018 result for Japan		(Reference) Before the release of the November 2018 result for Japan	
	ARIMA model (p d q)(P D Q)	Outlier setting	ARIMA model (p d q)(P D Q)	Outlier setting
All items	(0 1 1)(0 1 1)	LS2014.4	(0 1 1)(0 1 1)	LS2014.4
All items, less fresh food	(1 1 0)(0 1 1)	LS2014.4	(1 1 0)(0 1 1)	LS2014.4
All items, less imputed rent	(0 1 1)(0 1 1)	LS2014.4	(0 1 1)(0 1 1)	LS2014.4
All items, less imputed rent and fresh food	(1 1 0)(0 1 1)	LS2014.4	(1 1 0)(0 1 1)	LS2014.4
All items, less food (less alcoholic beverages) and energy	<u>(2 1 2)(1 1 0)</u>	LS2014.4	<u>(1 1 0)(1 1 0)</u>	LS2014.4
All items, less fresh food and energy	(1 1 1)(0 1 2)	LS2014.4	(1 1 1)(0 1 2)	LS2014.4
Goods	<u>(2 1 1)(0 1 1)</u>	LS2014.4	<u>(0 1 1)(0 1 2)</u>	LS2014.4
Semi-durable goods	(0 1 0)(1 1 0)	LS2014.4	(0 1 0)(1 1 0)	LS2014.4
Goods, less fresh food	<u>(0 1 1)(1 1 1)</u>	LS2014.4	<u>(1 1 0)(1 1 1)</u>	LS2014.4

### (2) Ku-area of Tokyo

Group	After the release of the December 2018 (final) result for the Ku-area of Tokyo		(Reference) Before the release of the December 2018 (preliminary) result for the Ku-area of Tokyo	
	ARIMA model (p d q)(P D Q)	Outlier setting	ARIMA model (p d q)(P D Q)	Outlier setting
All items	<u>(0 1 1)(0 1 1)</u>	LS2014.4	<u>(0 1 0)(0 1 1)</u>	LS2014.4
All items, less fresh food	(2 1 2)(0 1 1)	LS2014.4	(2 1 2)(0 1 1)	LS2014.4
All items, less imputed rent	<u>(0 1 1)(0 1 1)</u>	LS2014.4	<u>(0 1 0)(0 1 1)</u>	LS2014.4
All items, less imputed rent and fresh food	(2 1 2)(0 1 1)	LS2014.4	(2 1 2)(0 1 1)	LS2014.4
All items, less food (less alcoholic beverages) and energy	(2 1 2)(1 1 0)	LS2014.4	(2 1 2)(1 1 0)	LS2014.4
All items, less fresh food and energy	<u>(1 1 1)(1 1 2)</u>	LS2014.4	<u>(1 1 1)(1 1 1)</u>	LS2014.4
Goods	<u>(2 1 2)(0 1 1)</u>	LS2014.4	<u>(0 1 0)(0 1 1)</u>	LS2014.4
Semi-durable goods	(0 1 2)(0 1 1)	LS2014.4	(0 1 2)(0 1 1)	LS2014.4
Goods, less fresh food	(2 1 2)(0 1 1)	LS2014.4	(2 1 2)(0 1 1)	LS2014.4

(3) CPI calculated by Laspeyres' Chain Index method (Reference indices)

Group	After the release of the December 2018 result for Japan		(Reference) Before the release of the November 2018 result for Japan	
	ARIMA model (p d q)(P D Q)	Outlier setting	ARIMA model (p d q)(P D Q)	Outlier setting
All items	(0 1 1)(0 1 1)	LS2014.4	(0 1 1)(0 1 1)	LS2014.4
All items, less fresh food	<u>(0 1 1)(0 1 2)</u>	LS2014.4	<u>(0 1 1)(2 1 0)</u>	LS2014.4
All items, less imputed rent	(0 1 1)(0 1 1)	LS2014.4	(0 1 1)(0 1 1)	LS2014.4
All items, less imputed rent and fresh food	<u>(0 1 1)(0 1 2)</u>	LS2014.4	<u>(0 1 1)(2 1 0)</u>	LS2014.4
All items, less food (less alcoholic beverages) and energy	(1 1 0)(0 1 1)	LS2014.4	(1 1 0)(0 1 1)	LS2014.4
All items, less fresh food and energy	(1 1 0)(0 1 1)	LS2014.4	(1 1 0)(0 1 1)	LS2014.4

\* On the release of the December 2018 result for Japan, ARIMA model is reselected by following steps with the data from January 2010 to November 2018.

ARIMA models which combine (0 to 2 1 0 to 2)(0 to 2 1 0 to 2) were compared with using AIC to select the ARIMA model which has smallest AIC. In addition to that, nonseasonal-AR, MA and seasonal-AR, MA were verified by statistical significance.

In terms of the impact of changes in the index level due to the consumption tax rate revised in April 2014 and the effects such as linking both old and new indices whose weights are different because of the 2015-Base Revision of the Consumer Price Index in January 2015, LS2014.4 and LS2015.1, etc. were also verified by statistical significance before we selected one of outliers combinations, which is considered most appropriate.