

Appendix 3 Sampling Method, Estimation Method, and Sampling Errors of Estimates

1. Sampling method

The sampling method is a stratified two-stage sampling using the EDs (enumeration districts) of the Population Census as the first-stage sampling units and the dwelling units* as the second-stage sampling units.

* A dwelling unit is a structure or a part of a structure intended for habitation of a household, such as a detached house, an apartment, living quarter in a dormitory, hotels, hospitals, construction camps.

(1) Sampling of EDs (First-stage sampling)

For each region*, all EDs are classified into strata according to their characteristics** and in each stratum, the sample EDs are selected with the probability proportion by the *weight* (roughly the number of households in the ED divided by 15). The number of the sample EDs is about 2,900 every month.

The following EDs are excluded from the sampling.

- (a) Reformatory institutions
- (b) Areas resided exclusively by the personnel of the Self-Defense Forces
- (c) Areas resided exclusively by the personnel of foreign armed forces
- (d) Water districts

The data for the inmates of reformatory institutions and the personnel of the Self-Defense Forces are reported by the authorities in charge, and are added to the tabulation. In the “Detailed Tabulation”, these are excluded from the tabulation.

* Hokkaido, Tohoku, Southern-Kanto, “Northern-Kanto, Koshin”, Hokuriku, Tokai, Kinki, Chugoku, Shikoku, Kyushu, Okinawa

** Stratification is applied by the industrial and status composition of employed persons and other characteristics in each ED, based on the Population Census. The design of the sampling frame is revised every five years through several phases. The 2010 Census-based design was introduced from May 2013, and completed on August 2014.

(2) Sampling of dwelling units (Second-stage sampling)

For each sample ED, about 15 dwelling units

are selected from all dwelling units in the ED by systematic sampling with a constant sampling interval.

All households living in the selected dwelling units, which are approximately 40,000 households in total, are surveyed.

(3) Sample rotation and structure of sub-samples

In order to improve accuracy of the estimation on both monthly and annual figures and their changes, the following sample rotation system is applied.

- (a) A sample ED remains in a sample for four consecutive months, leaves the sample for the following eight months, and joins the sample again for the same four months in the following year.
- (b) For each ED, two sets of dwelling units are selected. In the first year of enumeration for the sample ED, the households in the sample dwelling units in the first set are surveyed for the first two consecutive months, and then replaced by the households in the dwelling units of the other set. In the second year, the dwelling units of the first set enter the sample again, and are replaced by those of the other set in the same way as in the first year.
- (c) Under this system, one fourth of the sample EDs and half of the sample households are replaced every month. Three fourths of sample EDs are common from month to month and a half from year to year.

In this system, the whole sample is divided into the following eight sub-samples, each of which forms an independent random sample of the universe. These sub-samples are used in calculation of sampling errors.

The eight sub-samples are represented by A1, A2, B1, B2, C1, C2, D1 and D2.

- A $i \cdots \cdots$ EDs beginning in January, May and September
 - B $i \cdots \cdots$ EDs beginning in February, June and October
 - C $i \cdots \cdots$ EDs beginning in March, July and November
 - D $i \cdots \cdots$ EDs beginning in April, August and December
- $i = 1 \cdots \cdots$ EDs of the first year
 $i = 2 \cdots \cdots$ EDs of the second year

Two sets of dwelling units (set of A2 and C2 or set of B2 and D2, corresponding to the second month in second year) are surveyed of the Special Questionnaire.

2. Estimation Method

(1) Outline of the estimation (Basic Tabulation)

The estimation method for the monthly figures of whole Japan is the ratio estimation with benchmarks of the population by age (15 age groups*), sex and area (11 regions,) estimated from the Population Estimates based Population Census (refer to (3)).

* The change in the method of estimation by 15 age groups (15-19, ..., 80-84, 85-) used in the Labour Force Survey was applied in 2007.

The basic formula of the estimation is as follows.

[Ex. the case for employed person]

Ratio estimate of employed person

= Benchmark population

× $\frac{\text{Linear estimate of employed person}}{\text{Linear estimate of total population}}$

(note) A linear estimation is to estimate the total population by multiplying the enumerated samples by the reciprocal of the sampling ratio.

The quarterly and annual averages are the arithmetic mean of the monthly figures.

(2) Procedure of the estimation (Basic Tabulation)

The estimate X of a population having certain characteristics is obtained by summing the ratio estimates \tilde{X} s for the sets of sex, age and area concerned.

\tilde{X} for a set of sex, age and area is obtained as follows:

$$\begin{aligned} \tilde{X} &= \sum_{l=1}^L \frac{1}{m_l} \sum_{i=1}^{m_l} \frac{w_l}{w_{li}} \cdot f_{li} \cdot x_{li} \frac{P}{\sum_{l=1}^L \frac{1}{m_l} \sum_{i=1}^{m_l} \frac{w_l}{w_{li}} \cdot f_{li} \cdot P_{li}} \\ &= \sum_{l=1}^L \sum_{i=1}^{m_l} x_{li} F_l \frac{P}{\sum_{l=1}^L \sum_{i=1}^{m_l} P_{li} \cdot F_l} \end{aligned}$$

l (=1, 2, ..., L) : each section by region and stratum

i (=1, 2, ..., m_l) : each sample ED in each section

x_{li} : Enumerated population (for the sex and age concerned) with certain characteristics in i -th ED in l -th section

w_{li} : Weight for i -th ED in l -th section

f_{li} : Reciprocal of the sampling ratio of dwelling units within i -th ED in l -th section (= w_{li})

w_l : Total of the weights for all the EDs in l -th section

m_l : Number of the EDs in l -th section

F_l (= w_l / m_l) : Multiplier for linear estimation for l -th section

P : Benchmark population (for the set of sex, age and area concerned)

P_{li} : Enumerated population (for the sex and age concerned) in i -th sample ED in l -th section

$\frac{P}{\sum_{l=1}^L \sum_{i=1}^{m_l} P_{li} \cdot F_l}$: Multiplier for ratio estimation (for the set of sex, age and area concerned)

The estimation method for the 11 regions is a parallel to that for the whole Japan.

(3) Benchmark population and its revision

“Population Estimates” released by the Statistics Bureau are used as the benchmark population for calculating the survey results.

These population estimates are calculated using the Population Census counts as the base, and adding other monthly data of population changes after the Census*.

Using the latest results of the Population Census as the base, the Population Estimates are revised every five years according to the release of new results of the Census conducted every five years. Therefore, the benchmark population for calculating the results of the Labour Force Survey is revised every five years.

* A change in the method of computing the Japanese number of emigrants and immigrants using “the number beyond overseas length-of-stay 91 day” since January 2007.

The benchmark population used at the time of the release of 2016 annual average results was based on 2010 Census-based population estimates. The revision to 2010 Census-based population estimates was held in January 2012 for Basic Tabulation, and in Jan.-Mar. 2012 for Detailed Tabulation.

Reference Tab. 1
Difference in level of the benchmark revisions
(Basic Tabulation)

	(10 thousand persons, point)				
	Population aged 15 years old and over	Employed person	Unemployed person	Not in labour force	Unemployment rate
1982 (1981 Yearly Average Results) (benchmark: 1980 Census)	-4	-3	0	-1	0.0
1987 (1986 Yearly Average Results) (benchmark: 1985 Census)	+7	+4	0	+3	0.0
1992 (1991 Yearly Average Results) (benchmark: 1990 Census)	-11	-7	0	-4	0.0
1997 (1996 Yearly Average Results) (benchmark: 1995 Census)	+28	+17	+1	+10	0.0
2002 (2001 Yearly Average Results) (benchmark: 2000 Census)	-6	-4	0	-2	0.0
2007 (2006 Yearly Average Results) (benchmark: 2005 Census)	+6	-6	-1	+13	0.0
2012 (Monthly Results -December 2011-) (benchmark: 2010 Census)	+69	+44	+1	+24	0.0

(4) Estimation method for “Detailed Tabulation”

The quarterly and annual averages are the arithmetic mean of the monthly figures.

The estimation method of the monthly figures for whole Japan is by the ratio estimation with the benchmark of population by age (6 groups), sex, labour force status (Employed person, Unemployed person and Not in labour force), status in employment and type of employment which estimated in Basic Tabulation.

The basic formula of the estimation is as follows.

[Ex. the case for employed person on column A in the Special Questionnaire]

Estimate of column A in the Special Questionnaire

= Linear estimate of column A in the Special Questionnaire

× $\frac{\text{Employed person which estimated in Basic Tabulation}}{\text{Employed person which estimated in Detailed Tabulation}}$

Multiplier for linear estimation in Detailed Tabulation is same as Basic Tabulation.

3. Sampling error for “Basic Tabulation”

The magnitude of sampling error varies by the size of estimates, the kind of item and the reference period. Standard errors for estimates which are calculated by using the sub-samples are shown in the following tables.

(1) Standard error for the whole Japan by size of estimates (Basic Tabulation)

Tab. 1 Standard error for annual average for the 2016 whole Japan

Estimates (10 thousand persons)	Standard error (10 thousand persons)	Relative standard error (%)
5000	15.5	0.3
2000	9.4	0.5
1000	6.4	0.6
500	4.4	0.9
200	2.7	1.3
100	1.8	1.8
50	1.2	2.5
20	0.8	3.8
10	0.5	5.1

The formula used in calculating the relative standard error for annual average of estimates is as follows:

$$\frac{\sqrt{\frac{1}{8(8-1)} \sum_{i=1}^8 (\bar{X}_i - \bar{X})^2}}{\bar{X}}$$

\bar{X}_i and \bar{X} respectively refer to the annual average of estimates with characteristic X in the i -th sub-sample ($i=1, 2, \dots, 8$) and whole sample.

Tab. 2 Standard error for monthly results for the 2016 whole Japan

Estimates (10 thousand persons)	Standard error (10 thousand persons)	Relative standard error (%)
5000	27.0	0.5
2000	17.3	0.9
1000	12.3	1.2
500	8.8	1.8
200	5.6	2.8
100	4.0	4.0
50	2.8	5.7
20	1.8	9.1
10	1.3	12.9

The formula used in calculating the relative standard error for monthly estimate is as follows:

$$\frac{\sqrt{\frac{1}{8(8-1)} \sum_{i=1}^8 (\tilde{X}_i - \tilde{X})^2}}{\tilde{X}}$$

\tilde{X}_i and \tilde{X} respectively refer to the estimates with characteristic X in the i -th sub-sample ($i=1, 2, \dots, 8$) and whole sample.

(2) Standard error for the whole Japan (Basic Tabulation)

Tab. 3 Standard error for major items for annual average (2016 annual average)

Item	Estimates	Standard error	Relative standard error (%)
	(10 thousand persons)		
Labour force	6648	27	0.4
Employed person	6440	27	0.4
Self-employed worker	527	6	1.1
Family worker	153	4	2.7
Employee	5729	20	0.4
Unemployed person	208	3	1.4
Not in labour force	4423	61	1.4
(Employed person by industry)			
Agriculture and forestry	202	4	1.9
Construction	492	4	0.9
Manufacturing	1041	11	1.0
Information and communications	207	4	1.9
Transport and postal activities	337	3	0.9
Wholesale and retail trade	1059	7	0.6
Finance and insurance	162	2	1.3
Real estate and goods rental and leasing	124	2	1.8
Scientific research, professional and technical services	220	3	1.5
Accommodations, eating and drinking services	389	4	1.0
Living-related and personal services and amusement services	234	3	1.4
Education, learning support	307	3	0.9
Medical, health care and welfare	808	4	0.4
Services, N.E.C.	413	4	1.0

Note) Figures on the Tab.3 do not include the inmates of reformatory institutions and the personnel of the Self-Defense Forces.

Reference Tab. 2 Unknown and Unclassifiable for major items (Basic Tabulation)

	[10 thousand persons]					
	Labour force status	Weekly hours of work	Status in employment	Number of persons engaged in enterprise	Industry	Occupation
2016 annual average	6	54	31	70	101	91

4. Sampling error for “Detailed Tabulation”

The magnitude of sampling error varies by the size of estimates, the kind of item and the reference period. Standard errors for estimates are shown in the following tables.

Tab. 4 Standard error for annual average for the 2016 whole Japan (Detailed Tabulation)

Estimates (10 thousand persons)	Standard error (10 thousand persons)	Relative standard error (%)
5000	18.9	0.4
2000	11.5	0.6
1000	7.9	0.8
500	5.4	1.1
200	3.3	1.7
100	2.3	2.3
50	1.6	3.1
20	1.0	4.8
10	0.7	6.6

Tab. 5 Standard error for quarter average for the 2016 whole Japan (Detailed Tabulation)

Estimates (10 thousand persons)	Standard error (10 thousand persons)	Relative standard error (%)
5000	38.0	0.8
2000	23.1	1.2
1000	15.8	1.6
500	10.8	2.2
200	6.6	3.3
100	4.5	4.5
50	3.1	6.2
20	1.9	9.4
10	1.3	12.9

5. Seasonal adjustment methods

(1) The seasonal adjustment procedure for main series is X-12-ARIMA program produced by the U.S. Census Bureau. The other series are seasonally adjusted by X-12-ARIMA (X-11 Default). All series are seasonally adjusted with the control limit for extremes set at $9.8\sigma \sim 9.9\sigma$, and using standard options for others. For further information on X-12-ARIMA, refer to following website.

URL:<http://www.stat.go.jp/english/data/roudou/sa/index.htm>

(2) The seasonal adjustment are calculated on each series independently.

(3) The seasonally adjusted figures released monthly are calculated by using the predicted seasonal factors, which are estimated through seasonal adjustments of the data up to December of the previous year. On the release of January results, the seasonal adjustments are computed retroactively by adding new data for twelve months of the previous year.* Due to the revisions of benchmark population in 2017,

the input data used for seasonal adjustment are a comparable time-series data, rather than initially released data, in order to remove the gaps (excluding the rates).

Due to the Great East Japan Earthquake, results for whole Japan are supplementary-estimated figures from March through August 2011.

* Retroactive calculation was conducted using the original data for the most recent 29 years to produce remodeled seasonally adjusted estimates, and the figures of the most recent 10 years are revised.