

Population Projections for Provinces (2020~2050)

In 2050, the population is projected to decrease in 13 provinces including Seoul and Busan.

□ (Total population)

In 2050, the population is projected to increase in 4 provinces of Gyeonggi, Sejong, Jeju and Chungnam from 2020. Whereas, the population is projected to decrease in the other 13 provinces.



(Population growth rate)

In 2020, 12 provinces including Seoul, Busan, Ulsan, Daejeon and Gwangju are projected to show negative population growth. After 2040, 16 provinces (excluding Sejong) are projected to record negative population growth.



☐ (Natural increase)

In 2020, 12 provinces including Jeonnam, Gangwon, Jeonbuk and Gyeongbuk are expected to show negative natural increase (more deaths than live births). After 2045, all provinces are expected to record natural decrease.



As for the median age, 7 provinces including Jeonnam, Gyeongbuk, Gangwon and Jeonbuk are projected to exceed 60 in 2050.

☐ (Median age)

In 2020, Jeonnam is projected to record the highest median age at 48.5. In 2020, Seiong is projected to record the lowest median age at 37.8.

O In 2050, Jeonnam is projected to record the highest median age at 64.7, which was followed by Gyeongbuk (64.2 years) and Gangwon (63.1 years). In the meantime, in 2050, Sejong is projected to record the lowest median age at 50.9, which was followed by Seoul (55.4 years) and Gyeonggi (55.8 years).



In 2050 the working age population is projected to decrease in 16 provinces (excluding Sejong) compared to 2020.

□ (Working age population)

In 2050, Ulsan (-50.6%) is projected to record the highest decrease in the working age population from 2020, which was followed by Daegu (-49.0%). Whereas, Gyeonggi (-22.2%) is projected to record the lowest decrease in the working age population, which was followed by Jeju (-23.6%).

O In 2050, the working age population of Sejong is projected to increase by 48.1% (120 thousand persons) compared to 2020.

□ (Elderly population)

In 2050, Jeonnam (49.5%) is projected to record the highest share of the elderly population aged 65 or more, which is followed by Gyeongbuk (48.9%) and Gangwon (47.2%). In the meantime, Sejong (28.8%) is projected to record the lowest share of the elderly population aged 65 or more, which is followed by Gyeonggi (36.4%) and Seoul (37.0%).

□ (Child population)

In 2050, the child population of Sejong is projected to increase by 20.0% compared to 2020. Whereas, the child population is projected to decrease in 16 provinces.

O The child population is projected to decrease by 30% or more in 14 provinces excluding Gyeonggi (-21.8%) and Jeju (-26.5%).

□ (Total dependency ratio)

In 2050, Jeonnam is projected to record the highest dependency ratio of 130 persons, which was followed by Gyeongbuk (127 persons) and Gangwon (121 persons). Whereas, Sejong is projected to record the lowest dependency ratio of 72 persons, which was followed by Seoul (83 persons) and Gyeonggi (86 persons).



□ (Population pyramid)

In 2020, the population pyramid is pot shaped due to a large share of people 30~59. In the meantime, in 2050, it is projected to change into an inverted triangle shape due to a small share of young population and a large share of old population.

O In particular, Gangwon, Jeonbuk, Jeonnam and Gyeongbuk with a large elderly population are projected to show an inverted triangle population pyramid in 2050, which is similar to population structure of the nation in 2070.













Methodology of Population Projections for Provinces

1. Methodology of population projections

- On the basis of the results of the 2020 Population Census, which is a register-based census, statistics of live births, deaths, internal migration and international migration are used for Population Projections for Provinces in 2022. According to the Cohort component method, the population size by province and the population structure by sex and age are projected from 2020 to 2050.
- □ According to the Cohort component method (birth, death and migration), the population is projected by applying the demographic balancing equation. Births and migrations are added to the base population, while deaths are subtracted for population projections.

Demographic Balancing Equation

 $P_t = P_{t-1} + B_{t-1} - D_{t-1} + NM_{t-1}$

 P_t : Population in t year, B_{t-1} : Number of live births in t-1 year, D_{t-1} : Number of deaths in t-1 year, NM_{t-1} : Number of net internal and international migrations in t-1 year

□ The sum of the population of all provinces of [¬]Population Projections for Provinces (2020~2050)_J is consistent with the total population of [¬]Population Projections (2020~2070)_J.

2. Base population (2020) and Retrospective population (2018~2019)

- □ The base population, which is a starting point for population projections, refers to the population as of July 1st, 2020. (The retrospective population refers to the population as of July 1st every year.)
- □ The base population in 2020 (retrospective population for 2018 and 2019) is calculated by reflecting the components of demographic variations during the July-October period on the basis of the population by province according to the Population Census (Register-based Census) as of November 1st 2020.
- □ The population by province is projected by adding the population of Koreans and the population of foreigners after separate calculation.
- O (Koreans)

The population of Koreans is projected by reflecting the components of demographic variations (live birth, death and migration) and the change in nationality (acquisition and loss of nationality) between July and October 2020, on the basis of the population according to the Population Census as of November 1st 2020.

O (Foreigners)

The population of foreigners by province is calculated by applying the share of foreigners by province according to the Population Census to the base population of foreigners of the nation.

3. Projection method of components of demographic variations and results

- □ Birth projection method and results
- (Projection model)

Applied the linear regression model when calculating the cumulative fertility rates (transformed data: Gompit model) of the nation and provinces by age

○ (Basic data)

Fertility rates of the nation and provinces by age for the recent decade (2012~2021p) and projections of the fertility rates of the nation for the 2020-2050 period

\bigcirc (High and low growth assumptions)

Applied the projections of fertility rates by age according to high and low growth assumptions in the birth projection of the nation to the linear regression model when calculating the cumulative fertility rates (transformed data: Gompit model)

○ (Sex ratio at birth)

After 2010, the sex ratios at birth of provinces remained the normal level. Just like the birth projections of the nation, the sex ratios at birth of provinces are assumed to remain as the average sex ratio for the recent 3 years.

O (Projection results)

The total fertility rate of the nation is projected to drop from 0.84 in 2020 to 0.70 in 2024. This figure is projected to rise again to 1.00 in 2031 and 1.21 in 2046.

- As for the total fertility rate by province in 2020, Seoul is projected to record the lowest figure of 0.64. Sejong is projected to record the highest figure of 1.28.
- As for the total fertility rate by province in 2050, Seoul is projected to record the lowest figure of 0.98. Sejong is projected to record the highest figure of 1.62.

(Unit: per woman aged 15-4										15-49)
	Year	The nation	Seoul	Busan	Daegu	Incheon	Gwangju	Deajeon	Ulsan	Sejong
Modium	2020	0.84	0.64	0.75	0.81	0.83	0.81	0.81	0.98	1.28
arowth	2035	1.18	0.94	1.07	1.16	1.17	1.18	1.18	1.36	1.60
growin	2050	1.21	0.98	1.10	1.20	1.20	1.21	1.22	1.40	1.62
High	2020	0.84	0.64	0.75	0.81	0.83	0.81	0.81	0.98	1.28
arowth	2035	1.36	1.14	1.26	1.35	1.36	1.36	1.37	1.54	1.73
growin	2050	1.40	1.18	1.30	1.39	1.39	1.40	1.41	1.57	1.75
Low	2020	0.84	0.64	0.75	0.81	0.83	0.81	0.81	0.98	1.28
growth	2035	0.94	0.71	0.83	0.92	0.93	0.94	0.95	1.13	1.39
	2050	1.02	0.79	0.91	1.00	1.01	1.02	1.03	1.21	1.46
	Year	Gyeonggi	Gangwon	Chungbuk	Chungnam	Jeonbuk	Jeonnam	Gyeongbuk	Gyeongnam	Jeju
Medium	2020	0.88	1.04	0.98	1.03	0.91	1.15	1.00	0.95	5 1.02
arowth	2035	1.21	1.28	1.34	1.39	1.27	1.45	1.37	1.34	1.38
giowin	2050	1.24	1.31	1.38	1.42	1.30	1.48	1.40	1.37	<u> </u>
High	2020	0.88	1.04	0.98	1.03	0.91	1.15	1.00	0.95	5 1.02
arowth	2035	1.40	1.46	1.51	1.56	1.45	1.61	1.53	1.51	1.55
growin	2050	1.43	1.49	1.55	1.59	1.48	1.64	1.57	1.55	5 1.58
Low	2020	0.88	1.04	0.98	1.03	0.91	1.15	1.00	0.95	5 1.02
arowth	2035	0.97	1.05	1.11	1.17	1.04	1.23	1.13	1.10) 1.15
growth	2050	1.05	1.13	1.19	1.25	1.12	1.31	1.22	1.19	1.23

< Projections of the total fertility rate by province (2020~2050) >

< Projections of the total fertility rate by province (medium growth scenario) (2020~2050) > (per woman aged 15-49)



□ Mortality projection method and results

○ (Projection model)

Just like population projections of the nation, the death rate by sex and age is projected by applying the extended Li-Lee-Gerland model (2013).

 $\log m_{x,t,i} = a_{x,i} + B_{x,t} K_t + b_{x,i} k_{t,i} + \epsilon_{x,t,i}$

- $a_{x,i}$: Average of death rates by age of each group (males and females of provinces)
- $B_{x,t}K_t$: Change pattern $(B_{x,t})$ of death rates by age of the total group (the total males and females of the nation) at *t* time and time index (K_t)
- $b_{x,i}k_{t,i}$: Change pattern $(b_{x,i})$ of death rates by age of *i* group (males and females of provinces) and time index $(k_{t,i})$
- The change pattern $(B_{x,t})$ of death rates by age at t period is calculated with the weighted average of B_x of the Li-Lee(LL) model and the change pattern $(B_x(u))$ of death rates by final age.

$B_{x,t} =$	B_{x}	$, e_0(t) < 80$	$w_t = \frac{e_0(t) - 80}{(t) - 80}$,
	$(1-w_{t})B_{x}+w_{t}B_{x}\left(u\right)$, $80 \le e_0(t) < e_0(u)$	$e_0(u) = 80$ $e_0(u)$: Final life expectancy that continues the
	$B_{x(u)}$	$,e_{0}\left(u\right) \leq e_{0}\left(t\right)$	change pattern of death rates by age (103) $B_x\left(u ight)$: Change pattern of death rates by final age

O (Basic data)

Death rates of provinces by sex and age between 1983 and 2021p

- (Calibration of period) Used the moving average of 3 years to calibrate the variations of periods
- (Calibration of the elderly population) Calibrated the elderly population aged 85 or more by applying the Coale-Kisker model
- (Age-specific extension)

5-year death rates are extended to 1-year death rates by using the Spline interpolation.

O (High and low growth assumptions)

The high and low mortality scenarios apply the 99% confidence interval of the extended Li-Lee-Gerland (LLG) metod.

○ (Projection results)

The life expectancy at birth of the nation is projected to go up by 5.4 years from 83.5 years in 2020 to 88.9 years in 2050.

- As for life expectancy at birth by province in 2050, Seoul is projected to record the highest figure of 89.6 years. Whereas, Ulsan is projected to record the lowest figure of 87.6 years.
- · As for the life expectancy at birth of males by province, Seoul is projected to record the highest figure of 87.7 years. Whereas, Jeonnam is projected to record the lowest figure of 85.8 years.
- · As for the life expectancy at birth of females by province, Seoul is projected to record the highest figure of 91.5 years. Whereas, Jeonnam is projected to record the lowest figure of 89.3 years.
- The gender gap in life expectancy at birth is projected to narrow down from 6.0 years in 2020 to 4.1 years in 2050.

< Projections of life expectancy at birth (medium growth scenario) (2020, 2050) >

(Unit: age)

	Tot	tal	Ma		Fom	aloc	Gender gap		
	i otai		IVIA	65	Fem	ales	(Females - Males)		
	2020	2050	2020	2050	2020	2050	2020	2050	
The nation	83.5	88.9	80.5	86.8	86.5	90.9	6.0	4.1	
Seoul	84.8	89.6	82.0	87.7	87.6	91.5	5.6	3.8	
Busan	82.7	88.1	79.6	86.0	85.9	90.1	6.3	4.1	
Daegu	82.9	88.3	79.9	86.4	85.9	90.3	6.0	3.9	
Incheon	82.9	88.3	79.9	86.3	86.0	90.2	6.1	3.9	
Gwangju	83.0	88.3	80.2	86.4	85.9	90.2	5.7	3.8	
Daejeon	83.5	88.8	80.7	86.8	86.4	90.8	5.7	4.0	
Ulsan	82.7	87.6	80.4	85.9	85.1	89.3	4.7	3.4	
Sejong	84.4	88.9	82.3	87.1	86.6	90.8	4.3	3.7	
Gyeonggi	83.9	88.8	81.2	87.0	86.7	90.6	5.5	3.6	
Gangwon	82.8	88.3	79.6	86.0	86.0	90.5	6.4	4.5	
Chungbuk	82.6	88.1	79.5	85.9	85.7	90.3	6.2	4.4	
Chungnam	83.2	88.7	80.1	86.4	86.3	90.9	6.2	4.5	
Jeonbuk	83.3	88.5	80.1	86.3	86.5	90.7	6.4	4.4	
Jeonnam	82.8	88.1	79.1	85.8	86.4	90.4	7.3	4.6	
Gyeongbuk	82.6	88.1	79.3	86.0	85.9	90.3	6.6	4.3	
Gyeongnam	82.8	88.1	79.5	85.9	86.0	90.2	6.5	4.3	
Jeju	84.0	89.1	80.2	86.8	87.7	91.4	7.5	4.6	



□ Internal migration projection method and results

O (Projection model)

Net internal migration is projected by applying a transition probability model to inter-province transition probabilities (O-D matrix) and the estimates of non-transition probability by province (1-inter-province migration rate).

< Projection model of internal migration >

	5
Transition probability model	Non-transition probabilities by province
$p_{ij}^{t} = p_{ij}^{0} \frac{\sum\limits_{i \neq j} p_{ij}^{t}}{\sum\limits_{i \neq j} p_{ij}^{0}} = p_{ij}^{0} \frac{(1 - p_{ii}^{t})}{(1 - p_{ii}^{0})}$	$p_{ii}^{t} = (\frac{p_{ii}^{0} - p_{}^{0}}{s^{0}})s^{t} + p_{}^{t}$
• p_{ij}^t : Transition probability from i region to j	• p_{ii}^t, p_{ii}^0 : Non-transition probability of i region at t and the
region at t period	reference period
• p_{ii}^0 : Transition probability from <i>i</i> region to <i>j</i>	• $p_{}^{t}, p_{}^{0}$: Inter-province non-transition probability at t and
region at the reference period	the reference period (the nation)
• p_{ii}^0 : Non-transition probability of <i>i</i> region at	• s^t, s^0 : Standard error of inter-province non-transition
the reference period	probability at t and the reference period

- Non-transition probabilities by province are estimated by applying a time series regression model to inter-province non-transition probabilities for the recent decade (2012 ~ 2021).

O (Basic data)

Average inter-province transfer probability for the recent 5 years (2017~2021)

- (Addition of scenario)

The average internal migration of 10 years is added to the assumption by reflecting the average inter-province transition probabilities for the recent decade (2012~2021) to supplement the uncertainty of internal migration.

O (Reflecting estimated net migration of Sejong)

Net internal migration is estimated by multiplying the number of multi-family housing occupants and the average household members.

- Net internal migration is estimated by multiplying the number of multi-family housing occupants for the next 2 years (July 2022 ~ June 2024) and the average household members, which is also applied to the additional assumptions.
- Adjusted to be consistent with net internal migration of Sejong by applying weights to the probability of migration from other regions to Sejong for the projection period
 - * When applying weights, the sum of the probability of migration by projection unit (province, sex and 1-year age group) is finally adjusted to be 1.

By year	Application of internal migration assumptions
2020	Actual figures of transition probabilities (July 2020 ~ June 2021)
2021	Actual figures of transition probabilities (July 2021 ~ March 2022) + Estimates (April ~ June 2022: year-on-year)
2022	5-year average transition probabilities + Estimates of non-transition probabilities + Reflecting
2023	estimated net migration of Sejong
2024~	5-year average transition probabilities + Estimates of non-transition probabilities

< Internal migration assumptions by year >

O (Projection results)

The inter-province migration rate is projected to drop from 4.8% in 2020 to 3.6% in 2050.

- 6 regions of Seoul, Busan, Daegu, Gwangju, Daejeon and Ulsan are projected to continuously show a minus net migration. However, the size of a minus net migration is projected to decrease.
- Regions including Gyeonggi and Sejong are projected to continuously show a plus net migration. However, the size of a plus net migration is projected to decrease.



< Projections of net internal migration by province (medium growth scenario) (2000~2050) > (thousand persons)

< Projections of inter-province migration rate and net internal migration by province (medium growth scenario) (2020~2050) >

		2020	2025	2030	2035	2040	2045	2050
Inter-province migr	4.8%	4.5%	4.3%	4.1%	3.9%	3.7%	3.6%	
	Seoul	-107	-60	-51	-41	-38	-40	-35
	Busan	-19	-17	-12	-9	-8	-6	-4
	Daegu	-22	-16	-13	-10	-8	-7	-5
	Incheon	-6	2	3	3	3	3	3
	Gwangju	-10	-7	-7	-6	-5	-5	-4
	Daejeon	-13	-10	-7	-5	-4	-4	-3
	Ulsan	-15	-9	-7	-7	-5	-4	-4
Not migration	Sejong	16	13	8	6	5	4	4
(thousand parsons)	Gyeonggi	169	86	57	36	21	12	2
(linousanu persons)	Gangwon	6	6	9	10	10	10	10
	Chungbuk	6	5	6	6	6	6	6
	Chungnam	7	9	9	8	8	8	8
	Jeonbuk	-4	-5	-1	1	2	4	4
	Jeonnam	-1	0	3	5	6	8	7
	Gyeongbuk	1	1	4	5	6	7	8
	Gyeongnam	-13	-3	-3	-2	0	2	2
	Jeju	5	4	2	1	1	1	0

□ International migration projection method

O International migration is projected by proportionally allocating the number of net international migration of the nation for the 2020-2050 period with the average of the shares of foreigners by province, sex and age for 3 years (2018 ~ 2020) in the Population Census (Register-based Census).

4. Population projection scenario and assumption by province

□ By considering the components of demographic variations (birth, death and migration), a total of 7 scenarios including basic scenarios and special scenarios are produced to reflect future uncertainty of population growth.

O (Basic scenario)

In addition to the medium growth scenario, which is the basis for population projections, the high and low growth scenarios are derived to obtain a total of 3 scenarios.

○ (Special scenario)

A total of 4 scenarios are produced by considering the current fertility rate, 'low fertility and aging', zero migration and the average internal migration for the decade.

- The scenarios are supplemented by applying the average moving migration probabilities for the recent decade to overcome the uncertainty of internal migration.

		Basic scenar	io	Special scenario					
	Medium	High	Low growth	Current fertility	Low fertility	Zero	Average internal		
	growth	growth	Low growin	rate	and aging	migration	migration for the decade		
Total fertility	Medium	High	Low growth	Fertility rate by	Low growth	Medium	Modium growth		
rate	growth	growth	Low growin	province (2020)	Low growin	growth			
Life expectancy	Medium	High	Low growth	Modium growth	High growth	Medium	Modium growth		
at birth	growth	growth	Low growin	wedium growin	Fight growth	growth			
International	Medium	High	Low growth	Madium grouth	Medium	Zero	Madium grouth		
migration	growth	growth	Low growin	wedium growin	growth	migration	Medium growin		
Internal	Medium	Medium	Medium	Madium grouth	Medium	Zero	Average internal		
migration	growth	growth	growth	medium growin	growth	migration	migration for the decade		

< Population projection scenarios by province (2022) >

< Estimates by scenario (2020, 2050) >

(Unit: per woman aged 15~49, age, thousand persons)

	2020			2050								
		2020		N	ledium grov	wth		High growt	h		Low growth	h
	Total	Life	Net	Total	Life	Net	Total	Life	Net	Total	Life	Net
	fertility	expectancy	internal	fertility	expectancy	internal	fertility	expectancy	internal	fertility	expectancy	internal
	rate	at birth	migration	rate	at birth	migration	rate	at birth	migration	rate	at birth	migration
The nation	0.84	83.5	-	1.21	88.9	-	1.40	90.1	-	1.02	87.6	-
Seoul	0.64	84.8	-107	0.98	89.6	-35	1.18	90.3	-37	0.79	88.8	-33
Busan	0.75	82.7	-19	1.10	88.1	-4	1.30	88.8	-3	0.91	87.1	-4
Daegu	0.81	82.9	-22	1.20	88.3	-5	1.39	89.2	-5	1.00	87.3	-5
Incheon	0.83	82.9	-6	1.20	88.3	3	1.39	89.3	4	1.01	87.1	3
Gwangju	0.81	83.0	-10	1.21	88.3	-4	1.40	89.8	-4	1.02	86.6	-4
Daejeon	0.81	83.5	-13	1.22	88.8	-3	1.41	90.2	-3	1.03	87.1	-3
Ulsan	0.98	82.7	-15	1.40	87.6	-4	1.57	89.2	-4	1.21	85.9	-3
Sejong	1.28	84.4	16	1.62	88.9	4	1.75	90.2	4	1.46	87.3	3
Gyeonggi	0.88	83.9	169	1.24	88.8	2	1.43	89.7	3	1.05	87.8	1
Gangwon	1.04	82.8	6	1.31	88.3	10	1.49	89.5	11	1.13	86.8	9
Chungbuk	0.98	82.6	6	1.38	88.1	6	1.55	89.4	6	1.19	86.7	5
Chungnam	1.03	83.2	7	1.42	88.7	8	1.59	89.9	7	1.25	87.3	8
Jeonbuk	0.91	83.3	-4	1.30	88.5	4	1.48	89.7	5	1.12	87.2	4
Jeonnam	1.15	82.8	-1	1.48	88.1	7	1.64	89.6	7	1.31	86.4	7
Gyeongbuk	1.00	82.6	1	1.40	88.1	8	1.57	89.4	8	1.22	86.7	8
Gyeongnam	0.95	82.8	-13	1.37	88.1	2	1.55	89.0	2	1.19	87.0	3
Jeju	1.02	84.0	5	1.41	89.1	0	1.58	90.5	0	1.23	87.5	0
						20	50					

	Cu	irrent fertility ra	te	Low	fertility and a	ging	Average internal migration for the decade			
	Total fertility rate	Life expectancy at birth	Net internal migration	Total fertility rate	Life expectancy at birth	Net internal migration	Total fertility rate	Life expectancy at birth	Net internal migration	
The nation	0.84	88.9	-	1.02	90.1	-	1.21	88.9	-	
Seoul	0.64	89.6	-32	0.79	90.3	-35	0.98	89.6	-33	
Busan	0.75	88.1	-4	0.91	88.8	-3	1.10	88.1	-1	
Daegu	0.81	88.3	-5	1.00	89.2	-5	1.20	88.3	-4	
Incheon	0.83	88.3	4	1.01	89.3	3	1.20	88.3	3	
Gwangju	0.81	88.3	-4	1.02	89.8	-4	1.21	88.3	-3	
Daejeon	0.81	88.8	-3	1.03	90.2	-3	1.22	88.8	-2	
Ulsan	0.98	87.6	-3	1.21	89.2	-4	1.40	87.6	-3	
Sejong	1.28	88.9	3	1.46	90.2	3	1.62	88.9	5	
Gyeonggi	0.88	88.8	0	1.05	89.7	2	1.24	88.8	-11	
Gangwon	1.04	88.3	9	1.13	89.5	10	1.31	88.3	10	
Chungbuk	0.98	88.1	6	1.19	89.4	5	1.38	88.1	6	
Chungnam	1.03	88.7	8	1.25	89.9	8	1.42	88.7	8	
Jeonbuk	0.91	88.5	4	1.12	89.7	5	1.30	88.5	6	
Jeonnam	1.15	88.1	7	1.31	89.6	7	1.48	88.1	9	
Gyeongbuk	1.00	88.1	8	1.22	89.4	8	1.40	88.1	9	
Gyeongnam	0.95	88.1	3	1.19	89.0	3	1.37	88.1	3	
Jeju	1.02	89.1	0	1.23	90.5	0	1.41	89.1	1	