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2014/25

Statistics Norway

Statistisk sentralbyrå

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The Population Projections

Documentation of the BEFINN and BEFREG models

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Statistisk sentralbyrå • Statistics Norway
Oslo–Kongsvinger

Documents In this series, documentation, method descriptions, model descriptions and standards are published.

Published

ISBN 978-82-537-8952-1 (electronic)
ISSN 1891-5906
Subject: Population

Print: Statistics Norway

Symbols in tables	**Symbol**
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Data not yet available	…
Not for publication	:
Nil	-
Less than 0.5 of unit employed	0
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Preface

This documentation report provides an overview of how projections for the Norwegian population are produced using the BEFINN and BEFREG models. The models were restructured in 2013–2014. The contents of this report therefore refer to how the projections published in June 2014 were made. More information about the population projections is available at www.ssb.no/folkfram.

Statistics Norway, 20 May 2014

Hans Henrik Scheel

Abstract

This report documents how Statistics Norway (SSB) produces population projections using the BEFINN and BEFREG models. In BEFINN, the population is projected by age and sex at the national level up to and including the year 2100. Immigrants from three country groups of origin, Norwegian-born children with immigrant parents and the remaining general population are projected as separate groups. In BEFREG, the population is projected by age and sex in 108 projection regions up to and including the year 2040. The population is thereafter distributed to counties, municipalities and city districts in Oslo.

We use the cohort component method when projecting the population. This method requires two types of input:

- Updated figures for the population by sex and one-year age groups
- Assumptions about the future development of the demographic components
  - fertility
  - life expectancy
  - domestic migration
  - immigration

Most of the assumptions that are used in the cohort component method are stated as rates, probabilities or proportions by sex and one-year age groups.

The results of a population projection depend to a great extent on which assumptions are used about the components. The assumptions concerning future fertility, life expectancy, domestic migration and immigration are therefore produced in different alternatives:

- M – medium alternative
- H – high alternative
- L – low alternative
- K – constant alternative
- 0 – zero alternative

Altogether, SSB projects the population in 15 combinations of these M, L, H, K and 0 alternatives. Each alternative is described using four letters in the following order: fertility, life expectancy, domestic migration and immigration. The term 'main alternative' is used to designate the MMMM alternative, which indicates that the medium level has been used for all components.

Contents

1. Introduction[1]

1.1. What are population projections?

Every second year, Statistics Norway (SSB) projects the Norwegian population at the national and regional level. Two models are used for these population projections:

- BEFINN – projects the population by age and sex at the national level up to and including the year 2100. Immigrants from three country groups of origin, Norwegian-born children with immigrant parents and the remaining general population are projected as separate groups.
- BEFREG – projects the population by age and sex in 108 projection regions up to and including the year 2040. The population is then distributed by county/municipality/city district (only in Oslo).

The results from BEFREG are adjusted so that the national population total from BEFREG tallies with the national population from BEFINN.

1. Population projection or population forecast?
A population projection is a calculation of the size and composition of a future population, for example with respect to sex, age, place of residence, immigration category and country background. This is done by using assumptions about future fertility, mortality, domestic migration and immigration and emigration by sex and age. These assumptions can be more or less realistic.

A population forecast is a calculation of the most probable size and composition of the future population. The term projection is used about all calculations of the future population's size, including developments that are improbable. Other terms include *plan*, which is used about a desired development, and *scenario*, which is used to refer to a description of a possible future development or an action plan based on specific assumptions (de Beer 2011).

In this report, we will describe in detail how we project the population using the BEFINN and BEFREG models. We will also explain how we arrive at the assumptions concerning fertility, mortality, domestic migration and immigration and emigration.

1.2. The process

In order to project the population, we need to make assumptions about future fertility, mortality, domestic migration, and immigration and emigration. In addition, we need figures for the baseline population taken from SSB's population statistics (see Text Box 2). The projection work is therefore organized around five roles:

- Fertility
- Mortality
- Domestic migration

[1] Advisor Kjersti Norgård Aase, senior advisor Marianne Tønnessen and researcher Astri Syse of the Unit for Public Economics and Population Models in the Research Department have been responsible for the population projections from 2014. They have also written this report, although Statistics Norway's models for population projections are the result of a number of people's work. During the past decade, it has particularly been senior advisor Inger Texmon and researcher Helge Brunborg who have been responsible for projecting the population and further developing the models, while researcher Dinh Pham and Professor Nico Keilman have contributed to the mortality projections, and researchers Ådne Cappelen and Terje Skjerpen have played a key role in the work on the immigration projections. In addition, senior advisor Pål Knudsen has contributed to the work of restructuring and documenting the models.

- Immigration and emigration
- Aggregation

Old time series have to be updated with new cohorts in each of these fields, assumptions have to be calculated in the form of age and sex-specific rates/probabilities, and input data for the models have to be quality assured. The aggregation also includes updating the baseline population and running the BEFINN and BEFREG models to generate the actual projections. For a more technical description of the models and the different steps in the work on them, see Knudsen et al. (2014).

2. Who are included in the figures?
The population statistics on which the population projections are based comprise persons registered as resident in the National Population Register, i.e. persons who live here permanently or who intend to have their fixed place of residence in Norway for at least six months and who are legally residing in Norway. Nordic nationals have been granted residence permits automatically since 1956. The same now applies to nationals of EFTA/EEA countries. There are some people staying in Norway who are not included in the statistics, however, for example people working on short-term contracts or people staying in Norway without a permit.

1.3. Publication

SSB's population projections are published in June every second year. The main results are presented in a press release (*Dagens statistikk)* at www.ssb.no/folkfram. In SSB's StatBank Norway (www.ssb.no/statistikkbanken), large amounts of data are published about projected population figures and changes in the population at different geographical levels based on various demographic characteristics (see Table 1). Assumptions about fertility, mortality, domestic migration, immigration and emigration, as well as the results of the projections, are also presented in articles in SSB's journal *Økonomiske analyser*.

Table 1. Tables from the population projections in SSB's StatBank Norway.

Table no.	Table title	Population or components	Geographic level	Model
10212	Projected population size by sex, age, immigration category and country group of origin in 15 alternatives	Total population	National	BEFINN
10213	Projected population size by sex and age in 9 alternatives	Total population	National, county, municipality and city districts of Oslo	BEFREG
10214	Projected number of immigrants by country group of origin and time since first immigration in 5 alternatives	Total population	National	BEFINN
10215	Projected population changes by country group of origin in 9 alternatives	Births, deaths, immigration, emigration and net migration	National	BEFINN
10216	Projected fertility by country group of origin in 3 alternatives	Total fertility rate (TFR)	National	BEFINN
10217	Projected life expectancy for men, women and both sexes in 3 alternatives	Life expectancy at birth and ages 1-105	National	Lee-Carter/ARIMA-models
10218	Projected number of births and deaths in 9 alternatives	Births and deaths	National and county	BEFREG

1.4. Users

The most important users of SSB's population projections are public and private planning bodies at the municipal, county and central government levels, as well as journalists, researchers, politicians and the general public. Every year, there are more than 35 000 downloads of the population projections from SSB's StatBank Norway. The projections are also used internally in SSB, for example as input in macroeconomic models such as KVARTS, MODAG and MSG, and in the micro-simulation model MOSART.

1.5. History

SSB has produced population projections regularly since the 1950s. They were initially published in Statistics Yearbook, but, since 1969, various regional and national projections have been produced and published; see www.ssb.no/befolkning/statistikker/folkfram/aar?fane=arkiv. For previous documentation of the population projections, see, for example, Rideng et al. (1985), Hetland (1998), and Texmon and Brunborg (2013). For a description of previous assumptions and results, see, for example, Brunborg, Texmon and Tønnessen (2012), Brunborg and Texmon (2011) and Brunborg and Texmon (2010). The majority of the documentation is, however, only available in Norwegian.

2. The projection models BEFINN and BEFREG

- The cohort component method is used for the actual projection of the population. It calculates next year's population by starting with the population in the current year and adding births, deducting deaths and emigrations/domestic emigrations, and adding immigrations. This is done for both sexes by one-year age groups. When next year's population has been calculated, it is used as the basis for calculating the population the year after.
- The cohort component method is used in both BEFINN and BEFREG.
- The population in BEFINN and the total national population in BEFREG are coordinated by adjusting the results from BEFREG so that they are consistent with the results from BEFINN.
- The population is projected in several different alternatives. Each alternative is described using four letters in the following order: fertility, life expectancy, domestic migration and immigration. The alternative MMMM indicates that the medium level is used for all the four components. The components can also have the levels L = low, H = high, K = constant or 0 = zero.

2.1. The cohort component method

The cohort component method is a method for projecting populations that is used by most agencies that project populations at the national or international level.

2.1.1 The method

We use two types of input when projecting the population using the cohort component method:

- Updated figures for the population by sex and one-year age groups for the baseline year
- Assumptions about the future development of the demographic components
    - fertility
    - life expectancy
    - domestic migration
    - immigration
    - emigration

Table 2 shows an example of how we do this. When we have an overview of the number of men and women in each age group in the baseline year, and assumptions about the demographic components for each of these groups, we can work out how many persons there will be in each age group the year after. If, for example, we start with 14-year-old females in a given year and deduct those who are assumed to emigrate/move away or die during the course of a year, and add the number of 14-year-old females who are assumed to immigrate, we arrive at the number of 15-year-old females the year after. This figure is then used as the basis for calculating the number of 16-year-old females the year after that, and so on. A cohort (see Text Box 3) can thereby be followed through the projection period.

Table 2. Illustration of the cohort component method

	Number of women			
	2014	2015	2016	2017
0 year	30 466	31 029	31 621	32 238
1 year	29 947	30 896	31 451	32 034
2 year	30 145	30 316	31 253	31 798
3 year	31 266	30 421	30 591	31 515
4 year	31 583	31 504	30 663	30 828
5 year	30 999	31 828	31 748	30 907
6 year	30 374	31 237	32 053	31 968
7 year	30 550	30 602	31 459	32 262
8 year	29 860	30 764	30 813	31 663
9 year	29 932	30 078	30 976	31 020
10 year	29 857	30 174	30 311	31 201
11 year	29 304	30 087	30 403	30 531
12 year	29 848	29 532	30 307	30 621
13 year	30 939	30 063	29 744	30 510
14 year	30 968	31 145	30 269	29 946
15 year	30 741	31 147	31 320	30 442
16 year	31 508	30 985	31 388	31 555
17 year	32 200	31 788	31 265	31 665
18 year	31 879	32 488	32 076	31 554
19 year	32 117	32 456	33 051	32 638
20 year	32 439	32 731	33 044	33 630
21 year	32 682	33 086	33 342	33 643
22 year	33 665	33 433	33 818	34 063
23 year	34 639	34 554	34 315	34 689
24 year	34 379	35 572	35 507	35 264
25 year	34 390	35 364	36 552	36 495
26 year	33 869	35 365	36 351	37 527
27 year	33 346	34 749	36 253	37 235
28 year	33 166	34 125	35 531	37 023
29 year	33 211	33 854	34 819	36 210
30 year	32 963	33 812	34 465	35 417

This method cannot be used directly for one age group, namely 0-year-olds. In order to project the number of 0-year-olds, we start with the number of women in each age group between 15 and 49 years, and combine this with the assumptions about fertility for each age group. We then arrive at a figure for newborn boys and girls. In order to calculate the number of newborn boys, this figure is multiplied by 0.51369 (more boys are usually born than girls).

3. Cohort
A cohort is a group of people who have experienced something during the same period, such as being born, getting married or being a student. The term is most frequently used about birth cohorts, i.e. men and/or women born in the same year.

2.1.2. More about the assumptions

Most of the assumptions that are used in the cohort component method are stated as rates, probabilities or proportions by sex and one-year age groups. These are assumptions about future fertility, mortality, domestic migration and emigration. For immigration, the total assumed number is distributed by age and sex based on the age and sex distribution observed in previous immigrations.

2.1.3. Several events during the course of one year

In principle, our version of the cohort component method only calculates changes from the turn of one year to the turn of the next. This implies that there is limited possibility for the same person to experience more than one demographic event during the course of one year. A person cannot, for example, immigrate and then emigrate (or die or have a child) in one and the same year. One result of this is that projected figures for immigration and emigration do not include persons who have both immigrated and emigrated during the same year. This means that the immigration and emigration figures from the population projections are somewhat lower than the corresponding figures from SSB's population statistics. The figures will be comparable for net migration, however.

An exception from the rule of only one demographic event during a year concerns newborns: It is possible to be born and die in the same year, or to be born and emigrate/move away in the same year. This is because of the order in which the components are entered in the model: First, all the births are entered, and the age of all the age groups is increased by one year. This population (including the births) is used to calculate the number of deaths and the number of emigrations in each age group. Finally, both the number of deaths and the number of emigrations are deducted, and immigrations are added.

2.1.4. Age at the end of the year

In the population projections, age at the end of the year is used in the definition and calculation of the demographic events (births, deaths and migrations). In the general population statistics, on the other hand, it is usually age at the time of the event that is used. This means that the age-specific rates and the probabilities that are used in the projections apply to a population that, on average, is half a year younger than those published in the population statistics. The same applies to life expectancy at birth and remaining life expectancy.

2.2. The BEFINN model

The BEFINN model projects the population at the national level, and immigrants, Norwegian-born persons with immigrant parents and the remaining general population are projected as separate groups. Since immigrants and Norwegian-born children with immigrant parents are separate groups, separate assumptions can also be used about the demographic components for these groups. For fertility, separate birth rates are assumed for immigrant women from three country groups of origin and five period of residence groups, while the same rates as for other women are assumed for Norwegian-born daughters of immigrant parents. As regards mortality, the same age and sex-specific probabilities apply to all groups. For emigration, separate probabilities are used for immigrants, for Norwegian-born persons with immigrant parents and for the remaining general population. These probabilities differ, in turn, depending on which of the three country groups of origin the immigrants and their Norwegian-born children come from. For immigrants, the probability of emigration also varies with period of residence.

To be able to calculate the number of Norwegian-born persons with immigrant parents, assumptions must be entered about how large a proportion of the children who are born to immigrant women also have an immigrant father. These proportions vary between the three country groups of origin.

2.2.1. Results

BEFINN calculates the future population as of 1 January in Norway for each projection year up to and including 2100 based on the following characteristics:

- one-year age group
- sex
- immigration category
  - immigrant
  - Norwegian-born children with two immigrant parents
  - the remaining general population
- country group of origin (only for immigrants and their Norwegian-born children)
- period of residence (only for immigrants)

For each projection year, BEFINN also calculates the number of births, deaths, emigrations and immigrations based on the same characteristics as above.

2.3. The BEFREG model

In the BEFREG model, the population is projected at the regional level. Here, immigrants and Norwegian-born children of immigrant parents are not treated as separate categories, and they are thereby included in the general population. The projection regions play a central role in BEFREG, because the cohort component method projects the population by sex and one-year age groups in each of the 108 projection regions (see Text Box 4). Figure 1 shows the 108 projection regions in Norway. For an overview of which municipalities belong to the different projection regions, see Appendix A.

4. The projection regions

The projection regions are a regional level between the counties and municipalities. The projection regions are based on SSB's 89 economic regions (Statistics Norway 2000), with the following exceptions:

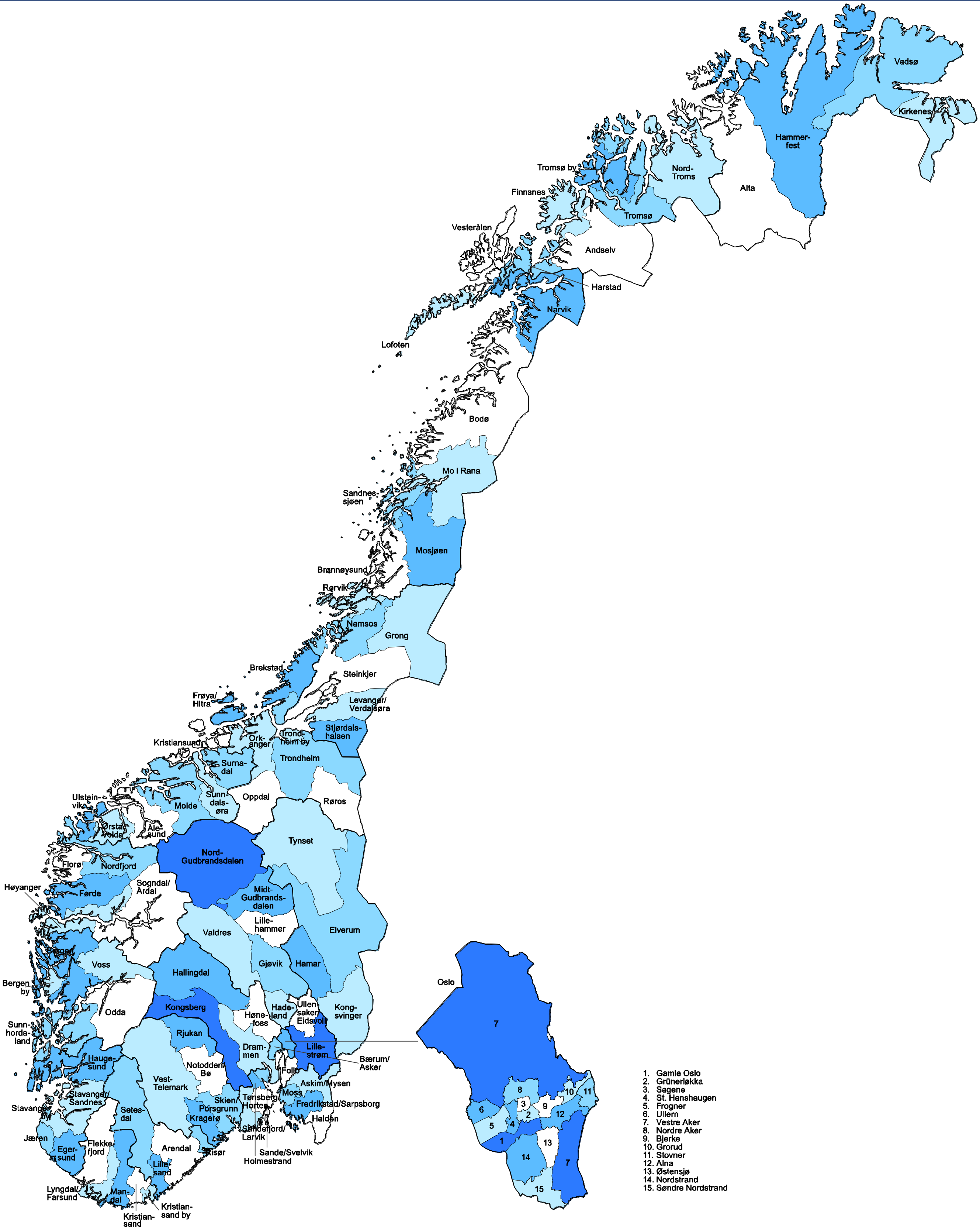
– The cities of Kristiansand, Stavanger, Bergen, Trondheim and Tromsø have been extracted from the economic regions with the same names and are treated as separate projection regions.

– Oslo has been sub-divided into 15 projection regions (the 15 largest city districts). The small city districts Marka and Sentrum have been merged with Vestre Aker and St. Hanshaugen, respectively.

The number of projection regions in BEFREG is therefore 89 + 5 + 15 – 1 = 108.

In order to project the population at the regional level, we need to have assumptions about future fertility, mortality and domestic migration in each of the projection regions. They are stated as sex and age-specific rates or probabilities. They are a combination of the national assumptions that were used in BEFINN and registered regional fertility, mortality and migration in the last five observation years prior to the projection. BEFREG projects both the population and the demographic components in each projection region during the entire projection period.

Figure 1. Projection regions in Norway.



Map source: the Norwegian Mapping Authority

2.3.1. Breakdown to the municipal level

In order to project the population by age and sex in each county, the populations from the projection regions in the county in question are added together. In order to project the population of each municipality, the population by age and sex in the projection region in question must be distributed between the municipalities in the projection region. This distribution is based on the following main principles:

- For those who are 50 years old or older, the proportion of the population in the projection region who belong to each municipality (by sex and one-year age groups) is equal to the proportion of persons who were one year younger and belonged to the same municipality one year earlier. For example, the proportion of 61-year-old women in a given municipality will be the same as the proportion of 60-year-old women in the same municipality the year before.
- For the age groups 1–49 years, we also take domestic migration into account. This is done using growth rates, which show the growth in the municipalities in the five years preceding the projection. More information about how domestic migration has been taken into account when breaking down the figures to the municipal level is provided in section 6.5.
- Girls and boys who are zero years old are distributed using different fertility profiles for the municipalities in the same projection region. See section 3.3.3 below for more information about this.

It is thus the population and not the components that is distributed from the projection regions to the municipalities. That is why we do not calculate figures for deaths, births and migrants at the municipal level. The few municipalities that are separate projection regions are the exceptions.

2.4. Calibration and rounding off

When we have projected the population using BEFINN and BEFREG, the results do not usually tally exact at the national level. In such case, the population figures in BEFREG are adjusted. This is done by calculating a factor for each age group and for each sex by which the national totals from BEFREG are multiplied in order to arrive at identical results as in BEFINN. The population in all the projection regions by sex and one-year age groups is then adjusted by the relevant factor. This is done for each projection year. If, for example, the total number of 90-year-old women in BEFINN in 2020 is 10 010 and the corresponding national total in BEFREG is 10 000, the adjustment factor will be 1.001 for this group for the year in question, and all the figures in BEFREG for 90-year-old women will be multiplied by 1.001. Corresponding adjustments are not made for the components (for example births and deaths), so that, for these, there may be some differences between the published results from BEFREG and BEFINN.

2.4.1. Rounding off

BEFINN and BEFREG use decimals throughout the projection. Before the results are published, the decimals are converted into whole numbers. In many cases, this involves a simple rounding off, but in cases where, for example, there are very many numbers that are closer to 0 than to 1, a simple rounding off will mean that the totals are incorrect. In some cases, therefore, and particularly when breaking down the figures to the municipal level, a method is used that is described in more detail in Rideng et al. (1985). The method is based on the principle that the percentage distribution of the population for municipalities in the same projection region should add up to 100. We first calculate and round off the smallest number. We then calculate the second smallest number as a percentage of the remaining total and round it off, and so on for increasingly large numbers. Even though we use this form of rounding off, there can nonetheless be some differences between the totals from the different models and the different geographical levels in the population projections.

2.5. Alternative projections

The results of a population projection depend to a great extent on which assumptions are used about the components. Different alternatives are therefore produced for fertility, life expectancy, domestic migration and immigration:

- M – medium alternative
- H – high alternative
- L – low alternative
- K – constant alternative
- 0 – zero alternative

SSB projects the population using a total of 15 combinations of these alternatives (Table 3). Each calculation alternative is described using four letters in the following order: fertility, life expectancy, domestic migration and immigration. The term 'main alternative' is used to designate the MMMM alternative, which indicates that the medium level has been used for all components, The main alternative is the one we assume to be most plausible and that can to the greatest extent be regarded as a population forecast (see Text Box 1).

Table 3. SSB's projection alternatives

Alternative	Description
MMMM	medium national growth
LLML	low national growth
HHMH	high national growth
HMMM	high fertility
LMMM	low fertility
MHMM	high life expectancy
MLMM	low life expectancy
MKMM	constant life expectancy*
MMMH	high immigration
MMML	low immigration
MMMK	constant immigration*
LHML	strong aging
HLMH	weak aging
MMM0	no net migration
MM00	no migration (domestic or international)

*The two alternatives with constant life expectancy and constant immigration are only modeled in BEFINN.

In the MMM0 alternative (no net migration), immigration and emigration take place, but the difference between them is 0. In other words, there are as many emigrations as immigrations. Domestic migration is the same as in the other alternatives. In the MM00 alternative, on the other hand, there is no net migration at all, neither domestically nor across national borders.

One reason why we project the population in so many alternatives is to illustrate the uncertainty associated with the projections. For example, the alternatives with constant life expectancy or immigration and the alternatives with zero migration and/or net migration are relatively unrealistic, but they can nonetheless yield interesting analytical results. The same applies to the alternatives high national growth (HHMH) and low national growth (LLML). It is not very probable that we will see a combination of high fertility, high life expectancy and high immigration, or of low fertility, low life expectancy and low immigration throughout the projection period.

3. Assumptions about fertility

- In BEFINN, which projects the population at the national level, we project fertility for different groups of women. In addition to projecting fertility for women with Norwegian backgrounds, we take into account the differences in fertility between immigrant women in 15 combinations of country background and period of residence in Norway.
- Based on observed fertility trends, SSB makes assumptions about how we believe fertility will develop in the future in these 16 groups.
- In the regional population model, BEFREG, we take differences in fertility between 68 geographical regions – referred to as fertility regions – in Norway as our point of departure.
- The assumptions about future fertility in the fertility regions are taken from the model results in BEFINN. The paths are then moved either up or down so that they are adjusted to the baseline level in each fertility region. The regions' birth rates are therefore constant in relation to the national rates throughout the projection period.
- Based on the regional fertility differences, we project the number of 0-year-olds in 108 projection regions. They are distributed between Norway's counties and municipalities, and Oslo's city districts.

5. Age-specific fertility rates (ASFR) are calculated by dividing the number of births to women of a given age by the mean population of women of the same age. The mean population is the average number of women of the age in question who are resident in the country in a calendar year. Women are divided into one-year age groups from 15 to 49 years. Moreover, immigrant women are divided by country background and period of residence in Norway, and all women are divided into groups by where in Norway they live.

The formula for age-specific fertility rates can be written as follows:

$ASFR(x, t) = f(x, t)/k(x, t)$

where $f(x, t)$ is the number of live births to women of age x in year t, and $k(x, t)$ is the mean population of women of age x in year t.

Total fertility rate (TFR) is the sum of the age-specific fertility rates for women aged 15–49 years in a given period, normally a calendar year. TFR can be interpreted as the number of children each woman will on average give birth to based on the assumption that the fertility pattern in the period will persist and that deaths do not occur before the age of 50.

3.1. Data

When we project the number of births, we use observed data in order to calculate the baseline level for fertility in the different subgroups, such as the different regions in Norway. We take the number of women aged 15–49 years from SSB's population statistics. The data source, which is SSB's version of the National Population Register, also contains information about the women's backgrounds, i.e. where they live, whether they are immigrants or not, and how long they have lived in Norway. Data about births are also taken from SSB's population statistics, which contain information about live-born children of women resident in Norway in a given calendar year.

3.2. Fertility for the country as a whole

BEFINN projects the population at the national level. To do this, we need estimates of future birth rates. This is done separately for immigrant women and for the remaining population. We first find the baseline level for the different groups and then make assumptions about how we believe fertility will develop for these groups in the future.

3.2.1. Fertility among immigrants

In order to calculate how many children will be born to immigrant women in future, we use the characteristics country group of origin and period of residence.

We use three country groups of origin:

1. Western Europe, North America, Australia and New Zealand
2. New Eastern European EU countries, i.e. from and including 2004
3. The rest of the world

Period of residence is calculated as the number of whole years since first-time immigration to Norway. We divide period of residence into five groups:

- 1 year or less
- 2–3 years
- 4–6 years
- 7–11 years
- 12 years or more

Together, this amounts to 3 x 5=15 combinations of country group of origin and period of residence. In order to find the baseline level for fertility in the 15 different groups of immigrant women, age-specific fertility rates are calculated for each group as an average of the last ten years. This a weighted average where the last year with available data counts most.

3.2.2. Fertility among the remaining population

Once we have calculated the baseline level for fertility among immigrant women, we are left with the rest. Norwegian-born women with immigrant parents are also part of this group. In order to find the baseline level for fertility among the remaining women, age-specific fertility rates are calculated for the last year. In order to remove irregularities in the age-specific fertility rates, the rates are smoothed using the Hadwiger function (Berge and Hoem, 1974). We smooth the rates for both immigrant women and the other women.

3.2.3. Fertility assumptions

Once we have calculated the baseline level for fertility for the 16 groups (15 groups of immigrant women and the remaining women), we have to arrive at assumptions about how fertility will develop in future. For each year in the projection period, we use a factor that adjusts the age-specific fertility rates up or down based on how we believe fertility will develop in future. The yearly factor is created in three alternatives: low, medium and high. The factor is set by SSB after discussions with an advisory reference group consisting of fertility researchers.

When we set the factor, we take fertility among the remaining population – i.e. those who are not immigrant women – as our point of departure. For example, we can envisage the overall fertility rate among the remaining women being 2 children per woman in 2020 – i.e. ten per cent higher than in 2012, when women gave birth to 1.82 children on average. The factor will then upwardly adjust all the age-specific fertility rates for those who are not immigrant women, so that they are ten per cent higher in the year 2020 than in 2012.

The same yearly factor is also used to adjust the fertility rates among immigrant women, either upwards or downwards. Since the same factor is used for everyone, it is conceivable that the differences in fertility between the immigrant women from each of the three country groups and the remaining women could be constant throughout the projection period. They are not, however. This is because immigrant women's fertility varies with their period of residence, and because the number of immigrant women varies over time. During the projection period, most immigrant women will switch period of residence groups several times, so that the composition of the 15 groups of immigrant women changes. This has consequences for how many women can potentially give birth in each period of residence group – and thereby for how fertility will develop among immigrant women overall. If, for example, we assume that the total fertility rate (TFR) among the remaining women will be constant until the year 2100, TFR among all women – a group consisting of both immigrants and the remaining women – will not be constant. As mentioned, the reason for this is that the distribution of period of residence among immigrants and the number of resident immigrant women will change over time.

3.3. Fertility at the regional level

3.3.1. Regional differences in fertility

In BEFREG, we need to make assumptions about fertility in different parts of Norway. This is done separately for women in 68 geographical areas, called fertility regions. This division into fertility regions involves merging some projection regions in the same area to form larger regions in order to arrive at more stable fertility figures (see Text Box 6). For an overview of which municipalities belong to the different fertility regions, see Appendix A. In order to find the baseline level for fertility in the 68 fertility regions, age-specific fertility rates are calculated as an average of the last five years in each region. This is a weighted average where the last year with available data counts most. The rates are smoothed.

3.3.2. Fertility assumptions

Once we have calculated the baseline level in each region, we enter assumptions about future fertility. The assumptions are based on what we believe the national fertility trends will be in future. The assumptions about the development of regional fertility are therefore taken from the model results from the national BEFINN model. The reason for this is that the sum of the number of births in the different parts of Norway should correspond to the number of births in the country as a whole.

The future development of regional fertility is set by adjusting the baseline level in the 68 fertility regions in proportion to the future development of national fertility. The regional fertility differences are thereby taken into account since the baseline level in each fertility region is different, but we assume that the absolute differences between the fertility regions will remain constant throughout the projection period.

In the actual population projection, we calculate the future population by sex and one-year age groups in 108 projection regions. The projection regions that belong to the same fertility region will therefore have the same age-specific fertility rates.

3.3.3. Breakdown of the figures to municipalities

Once we have projected the population in each projection region, we distribute the population between the municipalities in Norway and the city districts in Oslo. How large a proportion of 0-year-olds in each projection region will be allocated to each individual municipality/city district in the region depends on both the number of women in the municipality/city district and their fertility level. The local fertility level is calculated by classifying the municipalities/city districts according to 55 fertility profiles (see Text Box 6). The reason why we do not want to use the geographical fertility regions mentioned above is that municipalities/city districts within a fertility region can differ in terms of fertility. We know, for example, that fertility is often lower in cities than in the surrounding municipalities. For all municipalities with the same fertility profile, we calculate age-specific fertility rates as an average of the last five years. For an overview of which municipalities have which fertility profiles, see Appendix A.

For each projection region, we also calculate how large a proportion of women in each age group (15–49 years) belong to each municipality/city district in the region. If a municipality or city district is a separate projection region, the proportion in each age group will be 1.

In each municipality/city district, the proportion of women in each age group of childbearing age is multiplied by the age-specific fertility rates for the fertility profile to which the municipality/city district belongs (average of the last five years). By adding them together over all age groups, we can find out how large a percentage contribution the women in each municipality/city district make to the TFR in the projection region. If a projection region consists of two municipalities, one of the municipalities could, for example, contribute 0.005 children to the TFR in the region, while the other municipality contributes 1.8 children. Taken together, the TFR in the projection region will then be 1.85 children per woman. By dividing the TFR in the municipality or city district by the TFR in the projection region, we find out how large a proportion of 0-year-olds should be assigned to each municipality/city district in the projection region. This proportion is recalculated for every year in the projection period.

When breaking down the population, we thereby calculate the number of 0-year-olds in each municipality/city district for each year in the projection period. The number of 0-year-olds differs somewhat from the number of births since some of them may die or move to or from the municipality/city district during the first year of their lives. At the county level, however, we calculate both the number of births and the number of 0-year-olds for each year in the projection period.

6. Regional fertility classifications

When calculating regional differences in fertility, we use the classifications fertility region and fertility profile.

Fertility region refers to a classification where, in order to ensure more stable fertility figures, some of the 108 projection regions are merged to form larger geographical areas. The five projection regions in Telemark County, for example, have been merged to form two fertility regions. We have 68 fertility regions in the country as a whole. We use this classification when we calculate the baseline level for the regional fertility differences in BEFREG.

Fertility profile refers to a classification of the municipalities by fertility level (TFR) and average age on giving birth. The fertility profiles are a classification that is independent of geography, so that two municipalities in completely different parts of the country can have the same fertility profile. The municipalities and city districts are classified according to 55 fertility profiles, and we use this classification when we distribute the number of 0-year-olds at municipal and city district level.

Figures 2 and 3 illustrate the difference between fertility region and fertility profile. Figure 2 shows the five fertility regions in Oppland County: Lillehammer, Gjøvik, Nord-Gudbrandsdalen, Hadeland and Valdres. Figure 3 shows municipalities with the same fertility profile as Lillehammer municipality. Hvaler, Hamar, Våler, Kongsberg, Hol, Bø, Seljord, Tydal and Skånland have roughly the same TFR and age on giving birth as Lillehammer.

Figure 2. Fertility regions in Oppland County

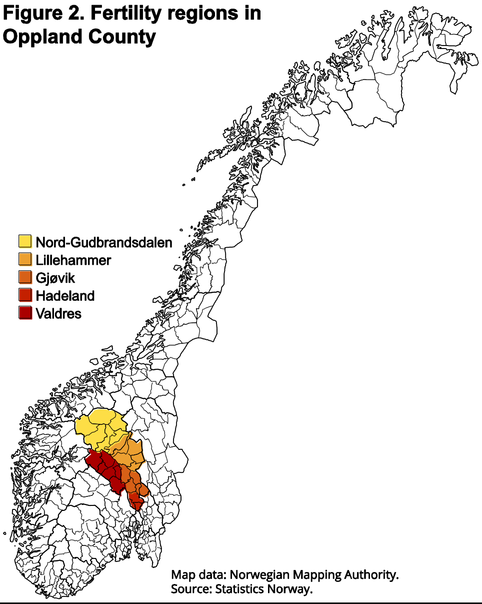
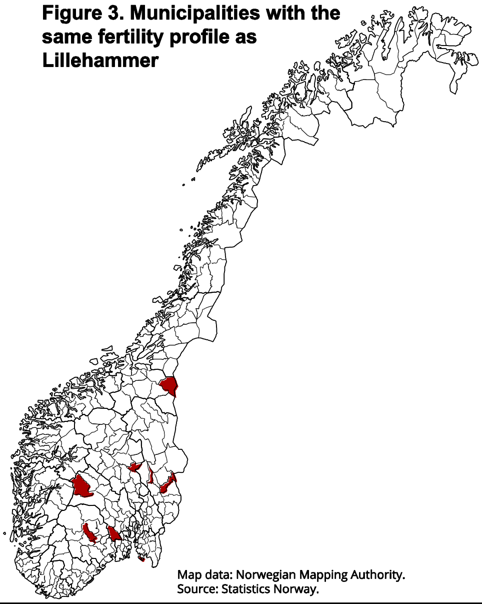


Figure 3. Municipalities with the same fertility profile as Lillehammer



4. Assumptions about mortality

- We make assumptions about future mortality by sex and age using different models.
- We use the 'product-ratio' variant of a Lee-Carter model in which the trend over time in the observed development in mortality, represented by two estimated time series, is continued using an ARIMA model.
- The Lee-Carter modeling is based on the development in observed mortality from and including 1968.
- We also make some discretionary assessments. Life expectancy has increased rapidly in both Norway and the rest of the word in recent decades. We have therefore chosen to increase the development in life expectancy somewhat more than the results of the models indicate.
- This method yields mortality rates by age and sex until and including the year 2100.
- The assumptions about future mortality are used to calculate the number of deaths in the whole country and in each county during the projection period, and to estimate the future population of the country as a whole and at county, municipal and city district level.
- The future mortality rates are also used when we calculate life expectancy at birth and remaining life expectancy for each age group up to and including 105 years. This is done separately for men and women, and for both sexes combined.
- In the national projection model, BEFINN, mortality is the same for everyone of the same age and sex in a calendar year. In other words, we do not take account of characteristics such as immigration category, country background or period of residence.
- In the regional model, BEFREG, regional differences in mortality are taken into account. Here, we take mortality during the last five years in each county, and in each of Oslo's city districts, as our point of departure.

4.1. How do we project mortality?

SSB uses recognized models to project mortality in Norway. In these models, future mortality is largely determined by the historical development in the mortality rate.

4.1.1. Data

The figures for the number of deaths and the size of the population are taken from SSB's population statistics. These figures are complete from and including 1967, but, because we use the population from the preceding year to calculate the mortality rates, we use the mortality rates from and including 1968 up to and including the last available cohort in the modeling work.

4.1.2. Mortality rates

Age-specific mortality rates can be calculated in several different ways, but, usually, the number of male and female deaths in one age group in one calendar year are divided by the population at risk of dying in the age group halfway through the year. In our calculations, however, we take into account that deaths do not occur linearly throughout the year.

We calculate age-specific mortality rates for men, women and combined for both sexes by one-year age groups from 0 to 107 years for each calendar year in the period from 1968 up to and including the last year for which data are available. Age at death is defined as age in whole years at the end of the year. Once the mortality rates have been calculated, they are corrected for extreme values. Mortality rates with the value 0 are set to the average of the rates for the age groups before and after for ages up to and including 100 years. This happens relatively rarely, but it is because deaths have not occurred in a certain year, sex and age

group. For example, deaths are rare among females aged between 10 and 15 years, and in individual years and in one-year age groups, deaths have therefore not occurred.
For the age group 101–107 years, extreme values are corrected using an extrapolated average, and the rates are smoothed. Once we have calculated the mortality rates in the period 1968 until and including the last year for which data are available, and corrections have been made, the actual modeling can begin.

4.1.3. The models

Initially, we use the 'product-ratio method' (Hyndman et al. 2013). The purpose of this method is to reduce the correlation between the mortality rates for men (M) and women (K). The method can be formally described as follows:

$$p(x,t) = \sqrt{(m_M(x,t) * m_K(x,t))}$$
$$r(x,t) = \sqrt{(m_M(x,t)/m_K(x,t))}$$

where $p(x,t)$ is defined as the square root of the product of the mortality rate ($m(x,t)$) of men and women, respectively, at age x in year t, and $r(x,t)$ corresponds to the square root of men's mortality rate divided by women's mortality rate. Even if $p(x,t)$ and $r(x,t)$ are not completely uncorrelated, the correlation is significantly reduced.

A model is then used that is based on the Lee-Carter model (Lee and Carter 1992, Li and Lee 2005, Lee 2000). This model was originally developed by Lee and Carter in 1992, but has subsequently been further developed. The method estimates parameters for changes in the mortality level over time and by sex and age. It can be expressed as follows:

$$\log m(x,t) = a(x) + \sum b_i(x)k_i(t) + u(x,t)$$

where $\log m(x,t)$ is the logarithm of the mortality rate in year t for age x, $a(x)$ is the general age pattern, $b_i(x)$ is the age-dependent correction in the time index, $k_i(t)$ is the time index and $u(x,t)$ is a stochastic error term that is assumed to be normally distributed.

Given that we have already reworked the mortality rates $m(x,t)$ for men and women using the product-ratio method, we use a Lee-Carter model in which the mortality rates $m(x,t)$ for men and women are replaced by $p(x,t)$ and $r(x,t)$, respectively. We thereby model mortality for men and women in the same process. The sum of the age-dependent correction in the time index $b_i(x)$ multiplied by the time index $k_i(t)$ can consist of one or more components. Our data prove to be well adapted using the following Lee-Carter model with two components (Keilman and Pham 2009).

$$\log p(x,t) = a_p(x) + b_{p1}(x)k_{p1}(t) + b_{p2}(x)k_{p2}(t) + u_p(x,t)$$
$$\log r(x,t) = a_r(x) + b_{r1}(x)k_{r1}(t) + b_{r2}(x)k_{r2}(t) + u_r(x,t)$$

So far, we have only modeled the observed mortality rates, i.e. mortality from and including 1968 until the last year for which data are available. In order to make assumptions about how mortality will develop in future, we use what is referred to as an ARIMA model (Wei, 2006).

ARIMA is an acronym for Auto-Regressive Integrated Moving Average. In this model, we include what is called a 'random walk with drift' (RWD), which means that we take account of a trend in mortality that we expect to continue into the future. The formula we use is as follows:

$$k_i(t) = \theta_i + k_i(t-1) + v_i(t), \ i=1,2$$

where θ_i is the trend (drift), $k_i(t)$ is the time index and $v_i(t)$ is a stochastic error term that is assumed to be normally distributed.

When we enter the predicted values for $k_1(t)$ and $k_2(t)$ in the Lee-Carter model, together with the estimated values for the age profiles $a(x)$, $b_1(x)$ and $b_2(x)$, we obtain predicted values for $p(x,t)$ and $r(x,t)$. These are transformed back into the projected mortality rates $m(x,t)$ for men and women.

Once we have calculated the age-specific mortality rates for the whole projection period using the models presented above, uncertainty from the Lee-Carter model is incorporated. Further uncertainty from the RWD model is estimated by simulating 2 000 alternatives by means of bootstrapping. This yields different paths for a possible development in future life expectancy.

SSB's population projections mainly use three alternative paths for the future development of life expectancy: medium (M), low (low life expectancy/high mortality) (L) and high (high life expectancy/low mortality) (H). The estimated projected alternative is called the medium alternative. We assign it an 80% confidence interval. We name the upper limit of the confidence interval for mortality rates the low alternative, while the lower limit is called the high alternative. In addition, we have a constant alternative (K), where the mortality rates in the medium alternative are held constant from the first projection year and throughout the projection period.

Before the age and sex-specific mortality rates in the four alternatives can be used in BEFINN and BEFREG, the mortality rates are converted into probabilities using the following formula:

$$q(x,t)=1-(exp(-m(x,t)))$$

where $q(x,t)$ corresponds to the probability of death at age x in year t and $m(x,t)$ corresponds to the mortality rate at age x in year t. Because of the low population and very few deaths among persons over the age of 108, the probability of death is set to a constant 0.50 for men and women aged 108–119 throughout the projection period.

4.1.3. Discretionary assessments

When we model the development in mortality using the models described above, we do not always get the development we expect. For that reason, we make some discretionary assessments following discussions with an advisory reference group consisting of demographers and mortality researchers from other research institutions in Norway and abroad.

Traditionally, the models used have overestimated the development of mortality somewhat, since life expectancy has increased more rapidly than indicated by the historical trend in both Norway and the rest of the world in recent decades (Oeppen and Vaupel 2002, Cohen and Oppenheim 2012, Department of Economic and Social Affairs, United Nations 2013). We have therefore chosen to add some parameters that, throughout the projection period, reduce the mortality rates and increase life expectancy somewhat more than the model estimates indicate, in line with the expectations of Eurostat and the UN, among others, as regards the development of life expectancy in Norway. The parameters we add increase life expectancy based on the model estimates by around one year for women and two years for men in 2100.

4.2. Life expectancy at birth and remaining life expectancy

Once we have estimated age-specific probabilities of death in the projection period, we calculate life expectancy at birth and remaining life expectancy for each age group in each projection year (see Text Box 7). We calculate this for the country as a whole in three alternatives; for men and women separately and for men and women combined. The latter is based on probabilities of death for both sexes together.

7. Life expectancy at birth and remaining life expectancy
Life expectancy at birth refers to the number of years a newborn will live if the current age-specific probabilities of death in a period, normally a calendar year, persist.

Remaining life expectancy is defined as the remaining number of years a person of a given age will live if the age-specific probabilities of death for remaining ages in the period (normally a calendar year) persist. SSB calculates remaining life expectancy for each age group up until the age of 105.

4.3. Mortality assumptions in BEFINN and BEFREG

It is the projected probabilities of death that are used as assumptions about mortality in BEFINN and BEFREG. In BEFINN, probabilities of death are used by sex, one-year age group and calendar year in four alternatives: high (H), medium (M), low (L) and constant (K) life expectancy. The same mortality level is assumed for immigrants and others.

In BEFREG, we take account of existing regional differences in mortality. We allow the mortality level to vary between the counties, and between the 15 biggest city districts in Oslo. This yields a total of 33 mortality regions. See Appendix A for an overview of the mortality regions. In order to find the baseline level for mortality in the 33 mortality regions, age-specific probabilities of death are calculated as an average of the last five years in each mortality region. This is a weighted average where the last year with available data counts most. The probabilities are smoothed.

Once we have calculated the baseline level in each region, we enter assumptions about future mortality at the national level. The national assumptions are the same in BEFINN and BEFREG. The future regional development in mortality is set by adjusting the baseline level in the 33 mortality regions in proportion to the future development of mortality at the national level. The regional differences in mortality are thereby taken into account since the baseline level by one-year age groups and sex is different in each mortality region. We thus assume that the absolute differences between the mortality regions will remain constant throughout the projection period.

In the actual population projection, we calculate the future population by sex and one-year age groups in 108 projection regions. The projection regions that belong to the same mortality region will therefore have the same age-specific probabilities of death. We do not calculate the number of deaths at the municipal level, only for counties and projection regions.

5. Assumptions about immigration and emigration

- In the population projections, immigration and emigration are calculated separately.
- A separate model is used to make assumptions about future immigration to Norway.
- In this model, immigration to Norway is affected by three factors in particular: differences in income level and in unemployment between Norway and other countries, and how many people from the immigrants' country group of origin already live in Norway.
- Emigration is determined by probabilities of emigration. These probabilities are based on observed figures for emigration and they vary by age and sex. They also vary depending on whether people are immigrants, Norwegian-born to immigrant parents or belong to the remaining general population. For immigrants and their children, we have different probabilities of emigration depending on country background and (for immigrants) period of residence.
- For both immigration and emigration, the world is divided into three country groups of origin:
    1. Western Europe, North America, Australia and New Zealand
    2. New Eastern European EU countries
    3. The rest of the world
- Individuals with Norwegian backgrounds comprise a fourth group.
- Net migration is calculated by deducting annual emigration from annual immigration.
- The projections of immigration and emigration are also used to estimate the number of immigrants and Norwegian-born children with immigrant parents who will live in Norway in future.

8. Immigrants, immigration and Norwegian-born children of immigrant parents
Immigrants are persons who are born abroad and have two foreign-born parents and four foreign-born grandparents, and who are registered as resident in Norway.

Immigration is defined as the number of migrations to Norway during a period, irrespective of the immigrants' country of birth and nationality. For example, immigration to Norway during a calendar year includes 8 000 to 10 000 Norwegian citizens, most of whom were born in Norway and do not have an immigrant background.

Norwegian-born children of immigrant parents are people who are born in Norway to two parents born abroad, and who also have four grandparents who were born abroad.

5.1. Immigration

SSB uses a separate model to calculate immigration to Norway in the years ahead (Cappelen et al. 2014). In this model, immigration is largely decided by the following factors:

- income in Norway compared with other parts of the world (purchasing power-adjusted gross domestic product (GDP) in nominal value per inhabitant)
- unemployment in Norway and in other parts of the world
- the number of immigrants (from the same country group of origin) who are already in Norway
- the population in the three country groups of origin

We model the immigration rate, i.e. gross immigration to Norway from each country group of origin divided by the total population of the country group in question.

5.1.1. The model

Slightly simplified, the model can be written as follows (the time lag can vary between country groups of origin):

$$ln(I_t) = c_o + c_1\, ln(I_{t-1}) + c_2\, ln(Y_{t-1}) + c_3\, U_{t-1} + c_4\, O_{t-1} + c_5\, ln(B_{t-1}) + c_6\, D_t + e_t$$

where
I_t is the emigration rate from a country group of origin to Norway in year t (the percentage of the population from the region in question that migrates to Norway)
I_{t-1} is the emigration rate to Norway from the area in question the year before (t-1)
Y_{t-1} is GDP per capita in Norway in year t-1 divided by the corresponding figure for the country group of origin in year t-1 in purchasing power-adjusted prices
U_{t-1} is the unemployment rate (percentage) in Norway in year t-1
O_{t-1} is the unemployment rate (percentage) in the area one migrates away from in year t-1
B_{t-1} is the number of immigrants from the area in question who already live in Norway in year t-1 (included in order to capture the bridgehead effect)
D_t is a vector with dummy variables that captures special events (wars, crises or major rule changes) in year t
e_t is a stochastic error term that is assumed to be normally distributed
c_i are unknown parameter vectors that must be estimated

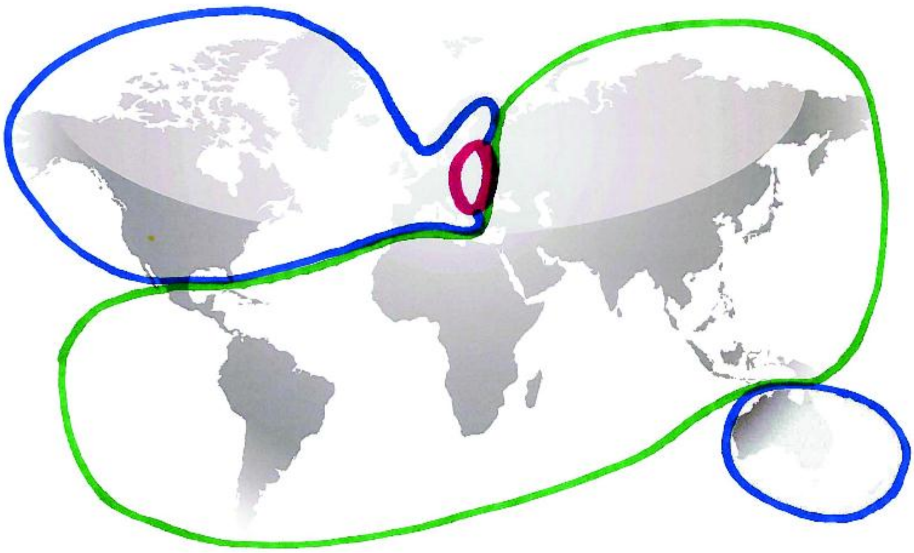
In the projections, we use three country groups of origin (see Text Box 9). For each of the country groups, we estimate a separate variant of the model. This means that we have taken ordinary significance criteria and other econometric considerations into account when we have specified the model for each country group of origin. All the parameters are therefore country group of origin-specific, for example that income differences can have different effects on immigration depending on which country group we examine. Some variables may also prove to be important in relation to immigration from one country group of origin, but not another. This applies, for example, to the bridgehead effect, which only has been significant for Country Group 3.

9. The country groups of origin
We have divided the countries of the world into three groups. Even though there are pronounced differences within each country group of origin, there are also certain similarities.

Country Group 1 comprises all the Western European countries, i.e. countries that were part of the 'old' EU (pre-2004) and/or the EEA and EFTA, as well as the US, Canada, Australia and New Zealand. On average, nationals from these countries display relatively similar demographic behavior as regards fertility and emigration. Moreover, few or no restrictions apply as regards their living and working in Norway.

Country Group 2 comprises the eleven new EU countries in Eastern Europe (became EU members in 2004 or later): Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Slovenia, Croatia, Bulgaria and Romania. We have merged them to form one group since it is from these countries that immigration to Norway has increased most in recent years. Moreover, of all the EU countries, it is these 11 countries where the income differences are greatest relative to Norway. The potential for migration to Norway is thereby great, at the same time as the restrictions on immigration have largely been abolished.

Country Group 3 comprises the rest of the world, e.g. the rest of Eastern Europe, Africa, Asia (including Turkey), Latin America and Oceania (excluding Australia and New Zealand). Nationals from these countries must apply for a permit to live and work in Norway. This group is very heterogeneous, and we have primarily merged these countries into one group for the sake of simplicity.



It is a person's country of origin that decides which group he or she belongs to. For persons born abroad, this is (with a few exceptions) their country of birth. For persons born in Norway, it is their parents' country of birth. If the parents are born in different countries, we use the mother's country of birth.

5.1.2. Data
In order to estimate the parameters in the model – i.e. to quantify the co-variation between the different factors and immigration – we use data that normally go back to 1970 (1990 for Country Group 2).

The figures for immigration to Norway are taken from SSB's population statistics. If someone moves both to and from Norway (or vice versa) during the same calendar year, this is neither registered as an immigration nor an emigration in this context, since the population projections are based on a change taking place from the turn of one year to the turn of the next. This does not affect the figures for net migration, but both the immigration and emigration figures will be a little lower than those that are usually published. This applies in particular to Country Group 1, i.e. primarily persons from Western Europe.

The population of the three country groups of origin, which is used as the denominator in the variable I_t, is the sum of the figures in the latest version of the UN's population statistics.[2]

The purchasing power-adjusted GDP per capita in Norway and in the three country groups of origin are taken from Penn World Tables, which include most countries in the world (Heston et al. 2011), and the OECD.

The unemployment rate for Norway is based on SSB's labor market surveys, which are available in the OECD's database dating back to 1970.[3] For the unemployment rate in Country Group 1, we use unemployment figures from the OECD. For the unemployment rate in Country Group 2 (the new Eastern European EU countries), we have used figures from both the OECD and Eurostat. They contain unemployment rates in each of the countries during the period from the end of the 1990s. We have calculated a weighted average of these figures, weighted by the countries' populations. For the period prior to this, the unemployment rate has been calculated retrospectively to 1988 by using the change in the unemployment rate for the OECD. For Country Group 3 (the rest of the world), there are no figures for the unemployment rate that give a satisfactory picture of the labour market situation. When the model is estimated for this group, this variable is therefore not included.

We have calculated the bridgehead effect using the number of immigrants from each country group of origin who are resident in Norway. These figures are taken from SSB's population statistics.

5.1.3. Forecasts for the variables

Once the parameters have been estimated, they are used to calculate how immigration will develop in future, based on forecasts of how the economic and demographic variables will develop. These forecasts are taken partly from international and partly from Norwegian sources.

The figures for the future development of the world’s population in the three country groups are taken from the UN's most recent population projections (the medium alternative).

The estimates of the future number of immigrants residing in Norway (which are used to calculate the bridgehead effect) are based on figures from the previous population projection. Once the number of immigrations has been calculated, the whole projection model is run using the updated figures. The model produces new estimates of the number of resident immigrants from each country group of origin. These figures are then used to estimate immigration again. Such rounds of iteration are repeated several times.

Rule changes and political decisions have also influenced immigration to Norway. When estimating the model, we have therefore included some important political changes that have taken place in this field in the last 40 years. We have not, however, included possible new political changes that could influence immigration in the years ahead, since they are very difficult to predict. The same applies to natural disasters or armed conflicts that can lead to new flows of refugees.

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[2] The UN's global demographic estimates and projections are updated every other year; see http://esa.un.org/unpd/wpp/index.htm

[3] http://www.oecd-ilibrary.org/economics/data/labour/labour-force-statistics_data-00046-en

Forecasts of the unemployment rate in Norway are taken from SSB's macroeconomic projections.[4] In the long term, the unemployment rate has been leveled off to a ‘normal’ level.

In the short term, the figures for future unemployment rates in Country Groups 1 and 2 (this variable is not used for Country Group 3) are based on OECD forecasts. In the long term, these levels are also expected to level off at historically ‘normal’ levels.

Three alternative paths have been made for future income development (low, medium and high alternatives). They reflect three different alternatives as regards future economic development, where the high alternative assumes the greatest income differences between Norway and the rest of the world in the years ahead.

5.1.4. Projected immigration

Based on these economic estimates, the immigration model yields three different paths (low, medium and high alternatives) for immigration from each of the three country groups of origin. Some unevenness generated by the econometric model at the start of the paths is smoothed based on a discretionary assessment. In addition, the estimated standard error in the econometric model is used to allow for model uncertainty in the calculations. This is done by adding the standard deviation of the prediction error to the forecast for immigration in the high alternative and correspondingly deducting the standard deviation from the low alternative. This is done for each of the three country groups of origin.

Every year, there are also some persons from Norwegian backgrounds who (re-)immigrate to Norway. We have projected this immigration by taking registered immigration for the last year as our point of departure and adding a weakly increasing trend in the period up until 2100. Separate low and high alternatives are not made for this group.

Immigration from the three country groups of origin (projected in three alternatives), as well as immigration by persons from Norwegian backgrounds, is entered in the national projection model BEFINN.

5.1.5. Distribution by age, sex etc.

In BEFINN, the assumed number of immigrations from each of the three country groups of origin is distributed by sex, one-year age groups (0–69 years) and one-year residence period (0–30 years). This distribution is based on the breakdown of previous immigration: how many have been women and men, and what age and what period of residence they have had. Some may have lived in Norway before, and this has been taken into account. People from a Norwegian background who move back to Norway are distributed by sex, one-year age groups (0–69 years) and whether they are Norwegian-born to immigrant parents (who have lived abroad for a period) or belong to the remaining general population. If they are Norwegian-born to immigrant parents, they are also distributed by country group of origin. We use figures for immigration back to 1990 in order to arrive at the rates for this distribution.

5.2. Emigration

Emigration is calculated using emigration probabilities. These probabilities are based on observed emigration during the last five years.

The probability of emigrating is significantly higher for immigrants than for their children born in Norway. Persons who belong to the remaining general population have the lowest tendency to emigrate. For the three country groups of origin, the

[4] http://www.ssb.no/nasjonalregnskap-og-konjunkturer

probability of emigrating is greatest for persons with a background from Country Group 1 and lowest for Country Group 3. Emigration is greatest in the first years after immigration to Norway, and it decreases as the period of residence increases.

In the population projections, separate emigration probabilities are used for immigrants, Norwegian-born children of immigrant parents and the remaining general population. The probabilities are calculated by sex, one-year age groups (0–69 years), country group of origin and period of residence (for immigrants), with a few exceptions:

- For persons under the age of 15, the same probability of emigration is used for boys and girls.
- For persons aged 55–69, the probabilities are calculated for five-year age groups for each sex.

Five period of residence groups are used:

- 0 years
- 1 year
- 2–4 years
- 5–9 years
- 10 years' residence or more

One group – immigrants from Country Group 2 with the longest period of residence – consists of too few persons for the observed figures to be used to produce good emigration probabilities. An average of the emigration probabilities for persons with the longest period of residence
in Country Groups 1 and 3 is used instead. For persons who are 70 years old or more, the population projections do not assume any immigration or emigration.

Since high immigration one year will entail higher emigration in the ensuing years, the estimates of the number of emigrations are largely dependent on the figures for immigration. Separate high, low and medium alternatives of emigration probabilities are not produced.

5.3. Net migration

10. Net migration
Net migration corresponds to the difference between the number of immigrations to and emigrants from the country during a period. It is net migration that constitutes the contribution of immigration and emigration to population growth in Norway.

Net migration is calculated by deducting annual emigration from annual immigration. Previously, assumptions were made about future net migration, but this is now just the result of the assumptions about gross immigration (which are made in three alternatives) and emigration.

5.4. The number of persons with immigrant backgrounds

Once we have made assumptions about immigration, emigration and mortality, BEFINN can calculate how many immigrants will live in Norway in future. In BEFINN, we also calculate how many of the future inhabitants will be Norwegian-born children of immigrant parents. For this, in addition to assumptions about future fertility among immigrant women, we need assumptions about how large a proportion of immigrant women's children will have a father who is also an immigrant. These latter assumptions are based on projections of observed trends for each of the country groups of origin.

In BEFREG, we do not take into account whether or not people are immigrants.

6. Assumptions about domestic migration

- Domestic migration is calculated in three rounds: First migration from each projection region is calculated. The emigrants are then distributed between projection regions using emigration areas and a domestic migration matrix. Finally, the model takes account of domestic migration when the population is broken down to the municipal level.
- The country is divided into 108 projection regions and 33 domestic emigration areas (+ abroad). Both these subdivisions are used when calculating the assumptions about domestic migration.
- Domestic emigration from the projection regions is calculated using emigration probabilities. They are based on observed emigration by age and sex in the last five years, and they differ between projection regions.
- Once the number of domestic emigrants has been calculated, they must be distributed to new places of residence. This is done by adding together all the domestic emigrants from all the projection regions in the same emigration area. They are then distributed to new projection regions using a domestic migration matrix. In the domestic migration matrix, there are separate probabilities for migration from each emigration area to each projection region. The probabilities are based on observed domestic migration figures for the last five years.
- Once BEFREG has projected the population in the 108 projection regions, the population is distributed between the municipalities within the regions. In this breakdown, account is taken of the fact that the municipalities have different migration patterns.
- In addition to migrations between different places in Norway, BEFREG also calculates migration between the projection regions and abroad. These figures are adjusted so that they tally with the national figures for immigration and emigration.
- Assumptions about future domestic migration are produced for persons aged 0–69 years. Migration within the same municipality is not calculated, except for Oslo.
- The migration assumptions are largely based on the migration patterns during the last five years continuing. Low and high alternatives are not calculated for domestic migration, but a separate alternative is produced with zero migration (used in the MM00-alternative).

6.1. Migration in the population projections

In the regional projection model, BEFREG, we take account of domestic migration. Assumptions about domestic migration are produced for persons aged 0–69 years. It is this age group that moves most. Migration within the same municipality is not calculated, except for Oslo, where we take moves between city districts into account. In the projections, we only take account of place of residence at the beginning and end of a calendar year. In other words, we ignore so-called multiple migrants in the same way as for immigration and emigration (see Text Box 11).

11. Multiple migrations
In BEFREG, we project the size and composition of the population from the turn of one year to the turn of the next. This means that people who migrate several times during one year only contribute one migration, or no migration if the person in question lives in the same municipality at the beginning and end of the year. Migration between more than two municipalities in the same year is therefore treated as if only one migration took place between the first and the last municipality. For that reason, migration back and forth between two different municipalities, or city districts in Oslo, is not captured by the model either. This also applies to migration between Norway and other countries. This means that people who migrate both to and from Norway during one calendar year do not contribute to the immigration and emigration figures used in the model. Thus, there are slightly fewer domestic migrations, immigrations and emigrations in this model than are usually published in the population statistics.

The migration assumptions are largely based on the observed migration patterns in the last five years continuing, but some adjustments are made so that the number of emigrations from each region to abroad tallies with the national emigration figures.

There are few observed migrations to and from the least populated regions, particularly when broken down to one-year age groups. Certain steps are taken to avoid the migration probabilities being overly influenced by random variations, such as smoothing the probabilities and merging geographical areas and age groups that appear to have fairly similar migration patterns.

Only one medium alternative is calculated for domestic migration flows, and not high and low alternatives as in the case of fertility, life expectancy and immigration. In order to be able to analyse the effects of fertility and mortality alone at the regional level, however, an alternative with zero migration is produced (neither within the country nor across national borders) – the MM00 alternative. This alternative is not very realistic, of course, but it can be useful for analytical purposes.

6.2. Calculating emigration

When we produce assumptions about future migration, emigration is first calculated for each projection region using emigration probabilities. These probabilities are calculated for each sex by one-year age groups (0–69 years), and they are based on observed migration from each projection region in the last five years. Since it is possible to migrate both abroad and to other parts of Norway, separate probabilities are calculated for emigration abroad and domestic emigration for each projection region. They are calculated slightly differently.

6.2.1. Emigration probabilities

The probabilities of moving abroad are first smoothed based on a relatively simple calculation in which the probabilities are a weighted total of probability in a certain age group and the probabilities in the age groups just above and just under the age in question. This is done separately for women and men. In order for the probabilities of emigration to produce results that tally with the national emigration figures from BEFINN, an index is calculated in accordance with which the smoothed emigration probabilities for each projection region are adjusted. National emigration varies over the projection period. The emigration probabilities in the migration calculations therefore also vary over the projection period. Since the emigration figures in BEFINN are dependent on the figures for immigration (high immigration leads to higher emigration in the ensuing years), different emigration probabilities are produced depending on which immigration alternative is to be used in the projection alternative in question. The probabilities of moving abroad are thus higher in the alternatives with high immigration to Norway than in the other alternatives.

6.2.2. Domestic migration probabilities

The probabilities of migrating to other parts of the country are smoothed in a more extensive process. It is based on splines functions and is documented in Sørensen (1980). In order to achieve a smooth transition from the domestic migration probabilities in the last observed year to the domestic migration probabilities that will apply in the long term (and which are based on observed figures for the last five years), the long-term probabilities are gradually phased in during the first four projection years.

6.3. Migration to and from abroad

As mentioned above, migration from the projection regions to abroad is calculated using emigration probabilities that are based on observed emigration, but that are adjusted in order to tally with projected national emigration figures.

With respect to moving *to* the projection regions *from* abroad, these figures are taken from the national figures for immigration to Norway. Immigrants to Norway are distributed between the projection regions based on how large a proportion of the immigration in the last five years has been to the different regions. This is done in the domestic migration matrix described in section 6.4.

We calculate how the immigrants break down by age and sex by taking the national figures for immigration to Norway as our point of departure, and then calculating how large a proportion belong to each sex and one-year age group. These proportions are also used when the immigrants are to be distributed between the projection regions. Different national assumptions about immigration result in a somewhat different national distribution of immigrants by age and sex. We therefore also produce different distributions depending on which immigration alternative is to be used in the projection alternative in question.

6.4. Distribution of domestic emigrants – the domestic migration matrix and the emigration areas

Once we have projected the number of persons who move from the projection regions and from abroad to Norway, they have to be distributed as migrants to the projection regions. We use what we call a domestic migration matrix when the migrants are to be distributed between the projection regions. In the domestic migration matrix, there are separate proportions for migrations from the different parts of the country and to each projection region. Since the number of migration flows between all the 108 projection regions is very high (108 x 108 = 11 664) and many of them are small, random variations in the migration flows can have large effects. We have therefore merged the projection regions into larger emigration areas. For an overview of which municipalities and projection regions belong to each emigration area, see Appendix A.

The emigration areas are based on the five regions (Eastern Norway, Agder and Rogaland, Western Norway north of Rogaland, Trøndelag and Northern Norway) and on how central the projection regions are. For example, the projection regions in Western Norway are merged to form four emigration areas: Bergen, the area around Bergen, central areas of Møre og Romsdal County, and the rest of Western Norway. A similar subdivision has been made for the other regions, whereby 18 emigration areas have been established. Abroad and Oslo's 15 largest city districts come in addition. This results in a total of 34 emigration areas in the matrix.

In the domestic migration matrix, proportions have been calculated for how large a part of the migration from each of the domestic emigration areas (and abroad) will be to each projection region. They are based on observed migration during the last five years, for 20 groups of migrants. The migrants are divided by age and sex as follows:

- For the two youngest age groups, 0–5 years and 6–16 years, boys and girls are merged.
- For the older age groups (17–21 years, 22–24 years, 25–26 years, 27–28 years, 29–31 years, 32–35 years, 36–42 years, 42–51 years and 52–69 years), women and men are in separate groups.

Since the tendency to move is high when people are in their 20s, there are more different age groups for this group, while there are few groups among the oldest, who move relatively rarely.

Since we use emigration areas and relatively large age groups in the matrix, there is less need to smooth the migration proportions that are used in the matrix calculations. In the same way as for the emigration probabilities, however, we take the migration proportions for the last observed year as our point of departure and gradually phase in the long-term migration proportions (which are based on observed migration in the last five years). The phasing-in takes place during the first five projection years.

We show an example of a domestic migration matrix in Table 4. The proportions are based on observed migration figures among women aged 17–21 years in the five-year period 2008–2012. In this example, we have selected emigration areas and immigration areas (i.e. projection regions) in Western Norway (north of Rogaland). The emigration areas are in the left-hand column, which show the four emigration areas in Western Norway. The horizontal rows show the proportion of migrants from each of the emigration areas that will be included in the different projection regions. In this example, the projection regions in Western Norway are highlighted.

Table 4. Excerpt from the domestic migration matrix for women aged 17–21 years in Western Norway

	(to projection regions in Eastern Norway)	(to projection regions in Agder and Rogaland)	City of Bergen	Municipalities surrounding Bergen	Odda	Voss	Sunnhordland	Florø	Høyanger	Sogndal/Årdal	Førde	Nordfjord	Molde	Kristiansund	Ålesund	Ulsteinvik	Ørsta/Volda	Sunndalsøra	Surnadal	(to projection regions in Trøndelag)	(to projection regions in Northern Norway)
City of Bergen	0.31	0.13	0	0.33	0.01	0.01	0.03	0	0	0.01	0.02	0	0.01	0	0.01	0	0	0	0	0.06	0.03
Municipalities surrounding Bergen	0.11	0.08	0.68	0	0.01	0.02	0.03	0	0.01	0.01	0	0	0	0	0.01	0	0	0	0	0.02	0.02
Remaining Western Norway	0.2	0.16	0.24	0.06	0.01	0.01	0.01	0.02	0.01	0.02	0.04	0.02	0.02	0.02	0.07	0.01	0.01	0	0	0.06	0.02
Central Møre and Romsdal	0.32	0.05	0.11	0.01	0	0	0	0	0	0	0	0.01	0.06	0.04	0.07	0.02	0.04	0.01	0.01	0.21	0.04

6.5. Breakdown from projection region to municipality

Once BEFREG has projected the population in each projection region, the population is distributed by sex and one-year age groups between the municipalities within the region. In this breakdown, account has been taken of migration between municipalities within the same projection region among persons aged 1–49 years. In order to find out how large a proportion of the persons in each age group are to be distributed to each municipality, we first deduct the calculated number of emigrations and deaths by one-year age group. That leaves only the sedentary population. The calculated number of immigrations is then added to the sedentary population, which makes up the new population of the municipality. The new population of the municipality is then divided by the projected population of the projection region, thereby giving us the proportion in each age group (1–49 years) that is to be distributed to the municipality in question.

The probabilities that are used to calculate the number of emigrations and deaths are constant over time and vary by sex and one-year age group. They are identical for all the municipalities in a projection region and are based on registered migration to other Norwegian municipalities and deaths in the last five years prior to the projection.

The number of domestic migrations to each of the municipalities is calculated using growth rates for the municipalities. In order to calculate the municipalities' growth rates, the population is divided into five groups:

- boys and girls 1–15 years
- women 16–24 years
- men 16–24 years
- women 25–49 years
- men 25–49 years

Separate growth rates are calculated for each of these groups. The growth rates tell us how large a proportion of those who belong to the group in question in a given year live in the municipality in question, compared with the corresponding proportion who lived in the municipality one year earlier (and who were one year younger). These growth rates are based on registered figures for the municipalities' growth in these groups in the last five years prior to the projection, and they therefore vary between municipalities in the same projection region.

In order to ensure that the growth rates result in a population of the municipalities that adds up to the projected population of the projection region, the growth rates are adjusted by a correction factor before being used further. In addition, a damping factor is entered in order to ensure a decreasing trend in the growth rates, so that the growth percentages for all the municipalities in a projection region approach the common growth percentage for the projection region as a whole.

Using the growth rates, which take account of domestic emigration and deaths, the (gross) migration to the municipalities can be calculated. This is done for each of the five groups defined above. We start with the adjusted growth rates for the group in question, deduct 1 and multiply by the number of persons in this group in the municipality – which isolates the net growth – and add emigrations and deaths. This leaves us with the estimated figure for the gross number of immigrants to each municipality in each group (because net growth = immigration minus deaths minus emigration). This figure is divided by the corresponding figure for the sum of immigrations in each group in the projection region. This is done in order to determine the proportion of immigrations in each group that is to be distributed from the projection region to each municipality within the region. The breakdown is also documented by Rideng et al. (1985).

7. Conclusion

This report documents how Statistics Norway (SSB) projects the population using the BEFINN and BEFREG models. We have described how assumptions about future fertility, life expectancy, domestic migration and immigration are determined, and how we project the population using the cohort component method.

For more information about the projected population and populations changes, see www.ssb.no/en/folkfram. The tab 'About the Statistics' on this web page also contains information about the background to and the production of the population projections, and about definitions etc. in that connection. In SSB's StatBank Norway www.ssb.no/en/statistikkbanken, detailed figures are available for the projected population and population changes.

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Appendix A: Regional classifications used in BEFREG

Projection region		Municipality		Fertility region	Fertility profile	Mortality region	Domestic out-migration area
0191	Halden	0101	Halden	1	35	1	12
		0118	Aremark	1	57	1	12
0192	Moss	0104	Moss	3	35	1	13
		0135	Råde	3	36	1	13
		0136	Rygge	3	46	1	13
		0137	Våler	3	37	1	13
0193	Fredrikstad/ Sarpsborg	0105	Sarpsborg	2	35	1	12
		0106	Fredrikstad	2	36	1	12
		0111	Hvaler	2	27	1	12
		0128	Rakkestad	4	46	1	12
0194	Askim/Mysen	0119	Marker	4	45	1	13
		0121	Rømskog	4	55	1	13
		0122	Trøgstad	4	35	1	13
		0123	Spydeberg	4	46	1	13
		0124	Askim	4	35	1	13
		0125	Eidsberg	4	45	1	13
		0127	Skiptvet	4	65	1	13
		0138	Hobøl	4	37	1	13
0291	Follo	0211	Vestby	47	38	2	13
		0213	Ski	47	48	2	13
		0214	Ås	47	58	2	13
		0215	Frogn	47	58	2	13
		0216	Nesodden	47	58	2	13
		0217	Oppegård	47	48	2	13
0292	Bærum/Asker	0219	Bærum	48	58	2	13
		0220	Asker	48	58	2	13
0293	Lillestrøm	0221	Aurskog-Høland	49	45	2	13
		0226	Sørum	49	37	2	13
		0227	Fet	49	38	2	13
		0228	Rælingen	49	46	2	13
		0229	Enebakk	49	36	2	13
		0230	Lørenskog	49	38	2	13
		0231	Skedsmo	49	47	2	13
		0233	Nittedal	49	48	2	13
		0234	Gjerdrum	49	36	2	13
		0236	Nes	49	36	2	13
0294	Ullensaker/Eidsvoll	0235	Ullensaker	49	36	2	13
		0237	Eidsvoll	49	36	2	13
		0238	Nannestad	49	35	2	13
		0239	Hurdal	49	46	2	13
0301	Gamle Oslo	0301	Gamle Oslo	5	10	3	14
0302	Grünerløkka	0302	Grünerløkka	50	11	13	15
0303	Sagene	0303	Sagene	51	12	21	16
0304	St. Hanshaugen	0304	St. Hanshaugen	52	13	22	17

		0316	Sentrum	52	13	22	17
		0318	Uoppgitt	52	13	22	17
0305	Frogner	0305	Frogner	53	14	23	18
0306	Ullern	0306	Ullern	54	15	24	19
0307	Vestre Aker	0307	Vestre Aker	55	16	25	25
		0317	Marka	55	16	25	25
0308	Nordre Aker	0308	Nordre Aker	56	17	26	26
0309	Bjerke	0309	Bjerke	57	18	27	27
0310	Grorud	0310	Grorud	58	19	28	28
0311	Stovner	0311	Stovner	59	20	29	29
0312	Alna	0312	Alna	60	21	30	35
0313	Østensjø	0313	Østensjø	61	22	31	36
0314	Nordstrand	0314	Nordstrand	62	23	32	37
0315	Søndre Nordstrand	0315	Søndre Nordstrand	63	28	33	38
0491	Kongsvinger	0402	Kongsvinger	7	26	4	11
		0418	Nord-Odal	7	36	4	11
		0419	Sør-Odal	7	36	4	11
		0420	Eidskog	7	55	4	11
		0423	Grue	7	26	4	11
		0425	Åsnes	7	26	4	11
0492	Hamar	0403	Hamar	6	27	4	12
		0412	Ringsaker	6	55	4	12
		0415	Løten	6	37	4	12
		0417	Stange	6	36	4	12
0493	Elverum	0426	Våler	8	27	4	11
		0427	Elverum	8	36	4	11
		0428	Trysil	8	35	4	11
		0429	Åmot	8	26	4	11
		0430	Stor-Elvdal	8	26	4	11
		0434	Engerdal	8	66	4	11
0494	Tynset	0432	Rendalen	8	48	4	11
		0436	Tolga	8	98	4	11
		0437	Tynset	8	68	4	11
		0438	Alvdal	8	48	4	11
		0439	Folldal	8	68	4	11
		0441	Os	8	77	4	11
0591	Lillehammer	0501	Lillehammer	9	27	5	12
		0521	Øyer	9	47	5	12
		0522	Gausdal	9	36	5	12
0592	Gjøvik	0502	Gjøvik	10	36	5	12
		0528	Østre Toten	10	36	5	12
		0529	Vestre Toten	10	35	5	12
		0536	Søndre Land	10	36	5	12
		0538	Nordre Land	10	24	5	12
0593	Midt-Gudbrandsdalen	0516	Nord-Fron	9	35	5	11
		0519	Sør-Fron	9	45	5	11
		0520	Ringebu	9	36	5	11
0594	Nord-Gudbrandsdalen	0511	Dovre	8	45	5	11

		0512	Lesja	8	67	5	11
		0513	Skjåk	8	36	5	11
		0514	Lom	8	47	5	11
		0515	Vågå	8	46	5	11
		0517	Sel	8	54	5	11
0595	Hadeland	0532	Jevnaker	11	45	5	13
		0533	Lunner	11	36	5	13
		0534	Gran	11	36	5	13
0596	Valdres	0540	Sør-Aurdal	12	86	5	11
		0541	Etnedal	12	45	5	11
		0542	Nord-Aurdal	12	26	5	11
		0543	Vestre Slidre	12	46	5	11
		0544	Øystre Slidre	12	47	5	11
		0545	Vang	12	67	5	11
0691	Drammen	0602	Drammen	13	36	6	13
		0621	Sigdal	13	36	6	13
		0623	Modum	13	25	6	13
		0624	Øvre Eiker	13	36	6	13
		0625	Nedre Eiker	13	45	6	13
		0626	Lier	13	48	6	13
		0627	Røyken	13	58	6	13
		0628	Hurum	13	46	6	13
0692	Kongsberg	0604	Kongsberg	12	27	6	13
		0631	Flesberg	12	66	6	13
		0632	Rollag	12	48	6	13
		0633	Nore og Uvdal	12	45	6	13
0693	Hønefoss	0605	Ringerike	11	36	6	13
		0612	Hole	11	48	6	13
		0622	Krødsherad	11	25	6	13
0694	Hallingdal	0615	Flå	12	36	6	11
		0616	Nes	12	56	6	11
		0617	Gol	12	36	6	11
		0618	Hemsedal	12	57	6	11
		0619	Ål	12	68	6	11
		0620	Hol	12	27	6	11
0791	Tønsberg/Horten	0701	Horten	15	46	7	12
		0704	Tønsberg	15	37	7	12
		0716	Re	15	56	7	12
		0719	Andebu	15	45	7	12
		0720	Stokke	15	57	7	12
		0722	Nøtterøy	15	37	7	12
		0723	Tjøme	15	38	7	12
0792	Holmestrand	0702	Holmestrand	14	35	7	13
		0714	Hof	14	46	7	13
0793	Sandefjord/Larvik	0706	Sandefjord	16	46	7	12
		0709	Larvik	16	46	7	12

		0728	Lardal	16	35	7	12
0794	Sande/Svelvik	0711	Svelvik	14	46	7	13
		0713	Sande	14	56	7	13
0891	Skien/Porsgrunn	0805	Porsgrunn	17	45	8	12
		0806	Skien	17	35	8	12
		0811	Siljan	17	37	8	12
		0814	Bamble	17	45	8	12
		0819	Nome	17	35	8	12
0892	Notodden/Bø	0807	Notodden	18	36	8	11
		0821	Bø	18	27	8	11
		0822	Sauherad	18	37	8	11
		0827	Hjartdal	18	55	8	11
0893	Kragerø	0815	Kragerø	18	44	8	12
		0817	Drangedal	18	44	8	12
0894	Rjukan	0826	Tinn	18	25	8	11
0895	Vest-Telemark	0828	Seljord	18	27	8	11
		0829	Kviteseid	18	26	8	11
		0830	Nissedal	18	56	8	11
		0831	Fyresdal	18	76	8	11
		0833	Tokke	18	58	8	11
		0834	Vinje	18	55	8	11
0991	Risør	0901	Risør	19	45	9	22
		0911	Gjerstad	19	44	9	22
		0904	Grimstad	20	65	9	22
0992	Arendal	0906	Arendal	20	46	9	22
		0912	Vegårshei	20	66	9	22
		0914	Tvedestrand	20	55	9	22
		0919	Froland	20	55	9	22
		0929	Åmli	20	74	9	22
0993	Lillesand	0926	Lillesand	19	56	9	23
		0928	Birkenes	19	86	9	23
0994	Setesdal	0935	Iveland	19	74	9	22
		0937	Evje og Hornnes	19	85	9	22
		0938	Bygland	19	78	9	22
		0940	Valle	19	57	9	22
		0941	Bykle	19	67	9	22
1001	Kristiansand by	1001	Kristiansand	64	56	10	24
1091	Kristiansand	1014	Vennesla	21	84	10	23
		1017	Songdalen	21	75	10	23
		1018	Søgne	21	66	10	23
1092	Mandal	1002	Mandal	19	66	10	23
		1021	Marnardal	19	86	10	23
		1026	Åseral	19	97	10	23
		1027	Audnedal	19	96	10	23
		1029	Lindesnes	19	75	10	23
1093	Lyngdal/Farsund	1003	Farsund	22	74	10	21

		1032	Lyngdal	22	74	10	21
		1034	Hægebostad	22	84	10	21
1094	Flekkefjord	1004	Flekkefjord	22	55	10	21
		1037	Kvinesdal	22	63	10	21
		1046	Sirdal	22	76	10	21
1103	Stavanger by	1103	Stavanger	65	57	11	24
1191	Egersund	1101	Eigersund	22	85	11	21
		1111	Sokndal	22	94	11	21
		1112	Lund	22	95	11	21
		1114	Bjerkreim	22	96	11	21
1192	Stavanger/Sandnes	1102	Sandnes	23	76	11	23
		1122	Gjesdal	23	95	11	23
		1124	Sola	23	77	11	23
		1127	Randaberg	23	76	11	23
		1129	Forsand	23	85	11	23
		1130	Strand	23	83	11	23
		1133	Hjelmeland	23	86	11	23
		1141	Finnøy	23	97	11	23
		1142	Rennesøy	23	86	11	23
		1144	Kvitsøy	23	96	11	23
1193	Haugesund	1106	Haugesund	25	75	11	22
		1134	Suldal	25	75	11	22
		1135	Sauda	25	75	11	22
		1145	Bokn	25	63	11	22
		1146	Tysvær	25	95	11	22
		1149	Karmøy	25	74	11	22
		1151	Utsira	25	94	11	22
		1160	Vindafjord	25	95	11	22
1194	Jæren	1119	Hå	23	94	11	23
		1120	Klepp	23	95	11	23
		1121	Time	23	85	11	23
1201	Bergen by	1201	Bergen	66	57	12	34
1291	Bergen	1238	Kvam	27	66	12	33
		1241	Fusa	27	86	12	33
		1242	Samnanger	27	67	12	33
		1243	Os	27	65	12	33
		1244	Austevoll	27	94	12	33
		1245	Sund	27	45	12	33
		1246	Fjell	27	85	12	33
		1247	Askøy	27	75	12	33
		1251	Vaksdal	27	75	12	33
		1252	Modalen	27	65	12	33
		1253	Osterøy	27	94	12	33
		1256	Meland	27	75	12	33
		1259	Øygarden	27	84	12	33
		1260	Radøy	27	54	12	33

		1263	Lindås	27	74	12	33
		1264	Austrheim	27	75	12	33
		1265	Fedje	27	25	12	33
		1266	Masfjorden	27	96	12	33
1294	Odda	1227	Jondal	24	97	12	31
		1228	Odda	24	65	12	31
		1231	Ullensvang	24	57	12	31
		1232	Eidfjord	24	66	12	31
1295	Voss	1233	Ulvik	24	67	12	31
		1234	Granvin	24	47	12	31
		1235	Voss	24	67	12	31
1296	Sunnhordaland	1211	Etne	26	65	12	31
		1216	Sveio	26	85	12	31
		1219	Bømlo	26	93	12	31
		1221	Stord	26	84	12	31
		1222	Fitjar	26	93	12	31
		1223	Tysnes	26	86	12	31
		1224	Kvinnherad	26	64	12	31
1491	Florø	1401	Flora	29	86	14	31
		1438	Bremanger	29	76	14	31
1492	Høyanger	1411	Gulen	28	86	14	31
		1412	Solund	28	76	14	31
		1416	Høyanger	28	66	14	31
		1418	Balestrand	28	76	14	31
1493	Sogndal/Årdal	1417	Vik	28	78	14	31
		1419	Leikanger	28	48	14	31
		1420	Sogndal	28	67	14	31
		1421	Aurland	28	38	14	31
		1422	Lærdal	28	77	14	31
		1424	Årdal	28	56	14	31
		1426	Luster	28	98	14	31
1494	Førde	1413	Hyllestad	29	95	14	31
		1428	Askvoll	29	77	14	31
		1429	Fjaler	29	66	14	31
		1430	Gaular	29	98	14	31
		1431	Jølster	29	86	14	31
		1432	Førde	29	78	14	31
		1433	Naustdal	29	77	14	31
1495	Nordfjord	1439	Vågsøy	29	76	14	31
		1441	Selje	29	95	14	31
		1443	Eid	29	97	14	31
		1444	Hornindal	29	98	14	31
		1445	Gloppen	29	78	14	31
		1449	Stryn	29	78	14	31
1591	Molde	1502	Molde	32	57	15	32
		1535	Vestnes	32	75	15	32

		1539	Rauma	32	55	15	32
		1543	Nesset	32	76	15	32
		1545	Midsund	32	74	15	32
		1547	Aukra	32	65	15	32
		1548	Fræna	32	65	15	32
		1551	Eide	32	84	15	32
		1557	Gjemnes	32	36	15	32
1592	Kristiansund	1505	Kristiansund	33	35	15	32
		1554	Averøy	33	55	15	32
		1573	Smøla	33	54	15	32
		1576	Aure	33	66	15	32
1593	Ålesund	1504	Ålesund	31	67	15	32
		1523	Ørskog	31	68	15	32
		1524	Norddal	31	76	15	32
		1525	Stranda	31	76	15	32
		1526	Stordal	31	67	15	32
		1528	Sykkylven	31	66	15	32
		1529	Skodje	31	86	15	32
		1531	Sula	31	86	15	32
		1532	Giske	31	86	15	32
		1534	Haram	31	66	15	32
		1546	Sandøy	32	64	15	32
1594	Ulsteinvik	1511	Vanylven	30	84	15	31
		1514	Sande	30	66	15	31
		1515	Herøy	30	65	15	31
		1516	Ulstein	30	86	15	31
		1517	Hareid	30	75	15	31
1595	Ørsta/Volda	1519	Volda	30	67	15	31
		1520	Ørsta	30	65	15	31
1596	Sunndalsøra	1560	Tingvoll	33	56	15	31
		1563	Sunndal	33	45	15	31
1597	Surnadal	1566	Surnadal	33	75	15	31
		1567	Rindal	33	75	15	31
		1571	Halsa	33	46	15	31
1601	Trondheim by	1601	Trondheim	67	46	16	44
1691	Trondheim	1624	Rissa	36	84	16	43
		1648	Midtre Gauldal	36	64	16	43
		1653	Melhus	36	55	16	43
		1657	Skaun	36	65	16	43
		1662	Klæbu	36	56	16	43
		1663	Malvik	36	56	16	43
		1664	Selbu	36	46	16	43
		1665	Tydal	36	27	16	43
1692	Frøya/Hitra	1617	Hitra	35	63	16	41
		1620	Frøya	35	83	16	41
1693	Brekstad	1621	Ørland	35	75	16	41

		1627	Bjugn	35	55	16	41
		1630	Åfjord	35	74	16	41
		1632	Roan	35	54	16	41
		1633	Osen	35	85	16	41
1694	Oppdal	1634	Oppdal	34	65	16	41
		1635	Rennebu	34	64	16	41
1695	Orkanger	1612	Hemne	34	83	16	42
		1613	Snillfjord	34	96	16	42
		1622	Agdenes	34	55	16	42
		1636	Meldal	34	44	16	42
		1638	Orkdal	34	45	16	42
1696	Røros	1640	Røros	34	77	16	41
		1644	Holtålen	34	57	16	41
1791	Steinkjer	1702	Steinkjer	38	55	17	41
		1718	Leksvik	38	63	17	41
		1724	Verran	38	64	17	41
		1725	Namdalseid	38	75	17	41
		1736	Snåsa	38	76	17	41
		1756	Inderøy	38	66	17	41
1792	Namsos	1703	Namsos	35	54	17	41
		1743	Høylandet	35	65	17	41
		1744	Overhalla	35	64	17	41
		1748	Fosnes	35	56	17	41
		1749	Flatanger	35	97	17	41
1793	Stjørdalshalsen	1711	Meråker	37	54	17	43
		1714	Stjørdal	37	65	17	43
1794	Levanger/Verdalsør a	1717	Frosta	37	75	17	42
		1719	Levanger	37	75	17	42
		1721	Verdal	37	74	17	42
1795	Grong	1738	Lierne	38	84	17	41
		1739	Røyrvik	38	76	17	41
		1740	Namsskogan	38	85	17	41
		1742	Grong	38	75	17	41
1796	Rørvik	1750	Vikna	35	83	17	41
		1751	Nærøy	35	94	17	41
		1755	Leka	35	54	17	41
1891	Bodø	1804	Bodø	41	56	18	51
		1836	Rødøy	41	94	18	51
		1837	Meløy	41	73	18	51
		1838	Gildeskål	41	65	18	51
		1839	Beiarn	41	63	18	51
		1840	Saltdal	41	26	18	51
		1841	Fauske	41	54	18	51
		1845	Sørfold	41	54	18	51
		1848	Steigen	41	76	18	51
		1849	Hamarøy	41	67	18	51

1892	Narvik	1805	Narvik	42	55	18	51
		1850	Tysfjord	42	64	18	51
		1851	Lødingen	42	65	18	51
		1852	Tjeldsund	42	45	18	51
		1853	Evenes	42	84	18	51
		1854	Ballangen	42	65	18	51
1893	Brønnøysund	1811	Bindal	39	97	18	51
		1812	Sømna	39	65	18	51
		1813	Brønnøy	39	55	18	51
		1815	Vega	39	76	18	51
		1816	Vevelstad	39	54	18	51
1894	Sandnessjøen	1818	Herøy	39	55	18	51
		1820	Alstahaug	39	55	18	51
		1822	Leirfjord	39	64	18	51
		1827	Dønna	39	65	18	51
		1834	Lurøy	39	83	18	51
		1835	Træna	39	94	18	51
1895	Mosjøen	1824	Vefsn	39	55	18	51
		1825	Grane	39	65	18	51
		1826	Hattfjelldal	39	66	18	51
1896	Mo i Rana	1828	Nesna	40	75	18	52
		1832	Hemnes	40	74	18	52
		1833	Rana	40	55	18	52
1897	Lofoten	1856	Røst	43	94	18	51
		1857	Værøy	43	94	18	51
		1859	Flakstad	43	96	18	51
		1860	Vestvågøy	43	76	18	51
		1865	Vågan	43	55	18	51
		1874	Moskenes	43	93	18	51
1898	Vesterålen	1866	Hadsel	43	55	18	51
		1867	Bø	43	54	18	51
		1868	Øksnes	43	84	18	51
		1870	Sortland	43	76	18	51
		1871	Andøy	43	65	18	51
1902	Tromsø by	1902	Tromsø	68	57	19	54
1991	Harstad	1903	Harstad	42	55	19	52
		1911	Kvæfjord	42	76	19	52
		1913	Skånland	42	27	19	52
		1917	Ibestad	42	56	19	52
1992	Tromsø	1933	Balsfjord	45	75	19	51
		1936	Karlsøy	45	54	19	51
		1938	Lyngen	45	84	19	51
		1939	Storfjord	45	66	19	51
1993	Andselv	1919	Gratangen	44	66	19	51
		1920	Lavangen	44	54	19	51
		1922	Bardu	44	66	19	51

		1923	Salangen	44	56	19	51
		1924	Målselv	44	76	19	51
		1925	Sørreisa	44	76	19	51
1994	Finnsnes	1926	Dyrøy	44	24	19	51
		1927	Tranøy	44	84	19	51
		1928	Torsken	44	83	19	51
		1929	Berg	44	73	19	51
		1931	Lenvik	44	64	19	51
1995	Nord-Troms	1940	Kåfjord	44	65	19	51
		1941	Skjervøy	44	74	19	51
		1942	Nordreisa	44	75	19	51
		1943	Kvænangen	44	75	19	51
2091	Vadsø	2002	Vardø	46	75	20	51
		2003	Vadsø	46	66	20	51
		2024	Berlevåg	46	73	20	51
		2025	Tana	46	55	20	51
		2027	Nesseby	46	68	20	51
		2028	Båtsfjord	46	63	20	51
2092	Hammerfest	2004	Hammerfest	46	45	20	51
		2017	Kvalsund	46	63	20	51
		2018	Måsøy	46	64	20	51
		2019	Nordkapp	46	84	20	51
		2020	Porsanger	46	55	20	51
		2021	Karasjok	46	86	20	51
		2022	Lebesby	46	65	20	51
		2023	Gamvik	46	63	20	51
2093	Alta	2011	Kautokeino	46	76	20	51
		2012	Alta	46	85	20	51
		2014	Loppa	46	84	20	51
		2015	Hasvik	46	64	20	51
2094	Kirkenes	2030	Sør-Varanger	46	65	20	51

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ISBN 978-82-537-8952-1 (electronic)

Statistisk sentralbyrå
Statistics Norway

Design: Siri Boquist