Demographic projections from Statistics New Zealand: Aims, methods, and results

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1. Purpose and background

Purpose of paper

This paper explains the demographic projections produced by Statistics New Zealand, with a focus on the national population projections.

- Section 2 backgrounds the nature of these projections, their purpose, and the methods.
- Section 3 outlines how the necessary assumptions underlying the projections are derived, and what they are.
- Section 4 gives an overview of the accuracy of the projections, within the context of the aim of such projections.
- Section 5 presents a summary of the latest projection results.

Introduction to population projections

Population projections are a common demographic tool, used to indicate likely and possible changes in the future size and structure of the population. Projections are also used to analyse the determinants of population change, to present alternative scenarios, and to provide a base for other projections (eg of labour force, families, households). These varied uses make them a valuable tool for planning and decision-making.

Statistics NZ has a long history of producing demographic projections. In the 1950s it began projecting the population of New Zealand; a role previously undertaken by the Treasury. In the mid-1970s it began projecting the population of subnational areas; a role that was previously undertaken by the Ministry of Works.

Statistics NZ's suite of demographic projections now includes national and subnational ethnic populations, labour force, and families and households.

Projections can be viewed as complementary to other population statistics:

- Census counts: a periodic but comprehensive survey providing a wealth of data for small geographic areas, variables (eg occupation, country of birth), families, households and dwellings.
- Population estimates: an indication of change since the last census for a limited range of demographic variables (eg age, sex, geographic area[1]). Estimates are typically for dates in the past.
- Population projections: an indication of future change for a limited range of demographic variables (eg age, sex, geographic area). Projections are typically for dates in the future.

[1] Population estimates and projections are derived for geographic areas as small as area unit. As of 2012, there are about 2,000 area units (or 'suburbs') covering all of New Zealand, with a median population size of about 2,000.

2. Understanding projections

This section outlines the purpose and methods of projections produced by Statistics NZ.

Different types of forecasts

Statistics NZ produces demographic projections. These give an indication of the future size and structure of the population.

Traditionally, these projections have been deterministic. Essentially, they have been scenarios based on specific stated assumptions about the components of change (fertility, mortality, migration).

In 2012, for the first time, Statistics NZ produced stochastic (or probabilistic) projections of the New Zealand population. These give an estimate of uncertainty, although the estimates of uncertainty are themselves uncertain.

Importantly, Statistics NZ always produces multiple projections, whether they are deterministic or stochastic. This is simply because the future is inherently uncertain, and the projections need to convey that uncertainty. It is also because a single projection would never meet the varied needs of users. For some, the 'best indication' of the future is sufficient. For others, the relative risks of an under-projection or an over-projection are quite different, so alternative projections are needed, or some understanding of uncertainty. One way to assess uncertainty is to consider the accuracy of past projections (see section 4, Projection accuracy).

In contrast, a prediction is one statement of what the population will be at a given date.

Projections are not predictions

A number of organisations, including central and local government, often initiate strategies to avert the population trends implied by the projections. It is therefore illogical to criticise the projections if they do not match actuality, especially when projections have been used to inform those strategies. One of the roles of projections is to enable future changes to be understood and managed, if not averted.

The difference between projections and predictions is sometimes made in an analogy of someone seeing a large boulder on a train track (eg Productivity Commission, 2005). The **projection** is that there will be a rail disaster and many deaths if the boulder is not moved or if the train is not stopped. The **prediction** is that someone will move the boulder, averting the accident. It is likely that the projection is much more useful for policy formulation and planning.

This important difference can be illustrated further. Statistics NZ's labour force projections take no account of unknown policy changes, such as changes in the age of eligibility for national superannuation, or other policy changes, that could influence labour force participation rates (LFPRs) (or indeed migration or fertility). The labour force projections are therefore an indication, not a prediction, of the future supply of labour. The projections are based on the current known policy environment, even if one might consider future policy changes are likely. People use the projections to assess, among other uses, whether the future labour supply is sufficient to meet labour demand.

To anticipate policy changes would undermine the role of the projections, even if those anticipated changes were clearly stated. If the labour force projections were to, say, anticipate an increase in the age of eligibility for national superannuation, this would lead to higher LFPRs and higher projections of the labour force, if all other things were equal. The real value of the projections is as an indication of future changes based on the current policy environment (and demographic trends). This allows people to assess if and when policy changes might be necessary.

The projections can be supplemented by 'what if?' scenarios that illustrate what might happen, for example, if a specific policy change was made. But the 'what if?' scenarios need to be compared and contrasted with the baseline projections (that pertain to the current policy environment), to be understood.

Population concept

All demographic projections produced by Statistics NZ since the mid-1990s relate to the 'resident' population. This is the population that usually lives in New Zealand, or in an area of New Zealand, and:

- includes New Zealand residents who are temporarily overseas
- excludes visitors from overseas who are in New Zealand.

Population projections therefore give an indication of the future population, by age and sex, usually living in New Zealand. Labour force projections give an indication of the future labour force, by age and sex, usually living in New Zealand (ie they are an indication of the future supply of people available for work).

While other concepts exist (eg de facto and service population concepts), the resident population concept is most relevant for many agencies for electoral, education, health, and fiscal purposes. The resident population concept is also pragmatic, as it can be applied in practice to population estimates and projections.

Residents and visitors are essentially self-defined in the resident population. For example, in the Census of Population and Dwellings, they are defined according to their response to the question 'where do you usually live?'. Guide notes for the 2006 Census (Statistics NZ, 2006) included the following guidelines for usual address:

- If you are an overseas resident and will be staying in New Zealand for less than 12 months, give your address in your home country. Otherwise, give your New Zealand address.
- If you are a New Zealand resident, follow these guidelines to give the right address.
    - If you are a primary or secondary school student at boarding school, give your home address.
    - If you are a tertiary student, give the address where you live during term.

In international travel and migration statistics, a resident is someone who is mainly living in New Zealand for 12 months or more, as determined from arrivals and departures of the person and/or intentions as stated on arrival and departure cards.

In birth registration statistics, the residence of the child is based on the self-identified 'home address' of the mother. In death registration statistics, the residence of the deceased is based on their 'usual home address' as identified by the family and/or funeral director.

Population mobility

While the resident population concept is suitable for many purposes, it is important that users are aware that on any given day (based on data for 2011) there can be up to:

- 270,000 visitors from overseas in New Zealand
- 190,000 New Zealand residents temporarily overseas.

Moreover, these numbers vary markedly across the year and between geographic areas. In addition, we have:

- almost 1 million overseas-born living in New Zealand (2006 Census)
- at least 600,000 New Zealand-born living overseas
- over half of New Zealand's population changes address within 5 years
- seasonal and diurnal flows with work, study, leisure, and holidays.

We therefore have an increasingly mobile population, with this mobility increasingly extending beyond national boundaries. Users of population statistics need to be aware that their population(s) of interest may be different from what is measured.

Relationship with census

The periodic Census of Population and Dwellings is the basis for population estimates and projections produced by Statistics NZ. Population estimates use the latest census as a base with adjustments for people excluded from the census, and updated for recorded population change since that census. Population projections use the latest population estimates as a base, with assumptions applied about future fertility, mortality, and migration patterns.

In principle, population estimates and projections can be produced for an indefinite period after each census. Therefore, the postponement of the 2011 Census to 2013 had no immediate impact on the estimates or projections.

In practice, the accuracy of the population estimates and projections tends to diminish further out from the census, especially for population subgroups and smaller geographic areas. A periodic census is therefore an important re-calibration of population estimates and projections, even though alternative options to the traditional census model are being explored (Statistics NZ, 2012).

How certain are demographic projections?

All projections have uncertainty because the future is inherently uncertain. However, roughly three-quarters of New Zealand's population in 2030 is already alive, as is half of New Zealand's population in 2050, and everybody aged 65+ in 2070. Only death and migration can alter the numbers of people already alive. Hence, barring major epidemics, war, or catastrophes, New Zealand's population can be projected with some confidence.

A substantial shift in fertility or migration patterns could also alter our demographic future. But even with the inherent uncertainty, several trends are clear. We will have:

- an ageing population, with increasing numbers of people and proportions of the population in the older ages
- slowing population growth, with the gap between births and deaths narrowing as deaths increase, driven by more people reaching the older ages.

Labour force projections are less certain than population projections because they have the additional uncertainty of future labour force participation (of each age-sex group), on top of the uncertainty of future population (of each age-sex group).

Using projections

Users of the projections should always make their own judgement as to which projections are most suitable for their purposes.

At the time of releasing each set of projections, Statistics NZ considers the mid-range[2] projection to be a suitable indication of future population changes. However, the future will inevitably be lower or higher than the mid-range projection, which is why Statistics NZ consistently encourages users to consider the uncertainty.

Moreover, birth, death, and migration patterns change, as does the resulting population. Statistics NZ updates its projections every 2–3 years to incorporate these changes. The relevance and usefulness of the projections is also maintained by incorporating developments in methods.

Although there is no certainty that the projections will be realised, like all statistics produced and released by Statistics NZ, the projections are:

- produced with the integrity and independence of Statistics NZ as the national statistical organisation
- produced using best practice and internationally accepted methods

[2] The median stochastic projection, or historically the mid-range deterministic projection.

- updated if and when circumstances change. New national population and labour force projections, for example, are scheduled for release in late 2014 and early 2015, respectively, following the release of new census data and population estimates.

Projection methods

Population projections

The 'cohort component' method is used to derive the population projections, regardless of whether the projections are stochastic or deterministic. In this method:

- new birth cohorts are added to the population by applying the specified fertility assumptions to the female population of childbearing age
- the population at the start of each year is projected forward by calculating the effect of deaths and migration within each age-sex group (or cohort) according to the specified mortality and migration assumptions.

The method is international best practice, with its main features being:

- suitability for both short-term and long-term projections
- internal consistency of age-sex groups with totals
- changes in age structure inherently affect projected births and deaths.

The method also recognises that fundamentally only three factors can change the population: births (fertility), deaths (mortality), and migration. Although other social, economic, political, and environmental factors can influence those demographic factors, it is sufficient to model the demographic factors when projecting the population. The wider factors are implicitly accounted for inasmuch as they have influenced past trends in births, deaths, and migration.

Specific methods are used for formulating fertility, mortality, and migration assumptions, as discussed in section 3, Projection assumptions.

International comparability

The cohort component method is international best practice when it comes to projecting populations. Most countries, including New Zealand, project the population at a macro (aggregate) level. Some micro-simulation models are used elsewhere (eg Netherlands Interdisciplinary Demographic Institute) to project individual behaviours before aggregating to higher geographies.

Statistics NZ is at the forefront of work by statistical agencies to develop and apply new methods to its projections. This is most evident in the new mortality forecasting method and stochastic approach adopted in its 2011-base national population projections.

Specific methods for formulating projection assumptions vary from country to country and reflect a range of factors:

- There is no perfect method, with different methods having different strengths and weaknesses.
- Different countries have different data sources of different quality to draw on.
- Different countries have different projection requirements (eg age, ethnicity, geography, projection period).
- More complex methods, such as dynamic models, do not necessarily improve projection accuracy, although they may improve projection interpretability.
- Different trade-offs between the usefulness, costs, complexity, and transparency of different methods.

How to use and interpret stochastic projections

Statistics NZ's stochastic projections are produced by creating 2,000 simulations (different population projections). Each simulation path can be considered as likely, or unlikely, as any other. However, the simulations provide a probability distribution which can be summarised using percentiles.

Each percentile is not a projection, but an indication of the distribution of values, if those values were sorted by size. For example:

- The 50th percentile (median) indicates an estimated 50 percent chance that the actual result will be lower, and a 50 percent chance that the actual result will be higher, than this percentile.
- The 25th percentile indicates an estimated 25 percent chance that the actual result will be lower, and a 75 percent chance that the actual result will be higher, than this percentile.

Percentiles are non-additive except for the 50th percentile. For example, percentiles for the population aged 15–39 and 40–64 years cannot be added together to give the equivalent percentile for the population aged 15–64 years.

For each assumption, the median is equivalent to the 'medium' assumption used in previous Statistics NZ deterministic projections. Similarly, the median stochastic projection is equivalent to the deterministic projection that combined the medium fertility, medium mortality, and medium migration assumptions in earlier projections (ie series 5 in the 2009-base projections). More information about stochastic projections is available (Dunstan 2011) including illustrations of simulations for selected assumptions and projection results.

Stochastic projections can be illustrated graphically using fan charts. The shading in graphs indicates the chance that actual results will fall within a certain range. Different shading is used to distinguish different ranges. The typical fan shape indicates that uncertainty increases as the period from the base (starting-point) increases.

Users can still use the median (mid-range) projection if they choose. However, the stochastic projections convey two important aspects:

- The future is uncertain.
- The probabilities give an estimate of that uncertainty, which improves the interpretation and use of those projections.

Notwithstanding the nature of projections (eg that future policy changes may alter the outcomes), the probabilities indicate the likelihood of different outcomes. This helps decision-making compared with deterministic projections where no outcome was quantified.

Stochastic projections

In 2012, for the first time, Statistics NZ applied a stochastic (probabilistic) approach to producing the 2011-base national population projections. The stochastic approach involves creating multiple (ie 2,000) simulations for the base population, births, deaths, and net migration, and then combining these using the cohort component method.

The main advantage of stochastic projections is that they provide a means of quantifying demographic uncertainty, although it is important to note that the estimates of uncertainty are themselves uncertain. While it is possible to estimate uncertainty based on the historical variability of the demographic parameters, it is more difficult to estimate the uncertainty that arises from the choice of models, or from the choice of time period(s) that affect the model parameters.

Stochastic projections also produce projection trajectories that are more realistic, in that they are more variable than a deterministic projection.

Stochastic projections are much better at conveying uncertainty than the more conventional deterministic projections. This is particularly evident for characteristics of the population such as deaths, percentage age distribution, and dependency ratios. Stochastic projections are also better at conveying the large uncertainty that exists in long-range projections beyond 50 years, and the extent to which this uncertainty expands over time.

Stochastic projections also indicate that uncertainty is rarely symmetrical, unlike that typically conveyed by deterministic projections. Although the probability of outcomes below and above the median may be equal, the uncertainty is usually skewed. For population growth outcomes, for example, there is a greater range of outcomes above the median than below.

Other demographic projections

Labour force projections (Statistics NZ, nd, e) are derived from population projections by multiplying the projected population by assumed labour force participation rates (LFPRs), by single year of age and sex.

A stochastic approach was adopted for the new labour force projections released in August 2012. LFPR simulations were applied to the 2011-base national population projections to give 2,000 simulations of the labour force.

Family and household projections (Statistics NZ, nd, d) are derived from population projections by multiplying the projected population by assumed living arrangement type rates, by single year of age and sex. There are 11 different living arrangement types:

1. Partner in couple-without-children family: people usually living in a partner role, but not in a parent role.
2. Other person with couple-without-children family: people usually living with a couple-without-children family, but not in a partner, parent, or child role.
3. Partner/parent in two-parent family: people usually living in a partner and parent role.
4. Child in two-parent family: people usually living in a child role with two parents, but not in a partner or parent role.
5. Other person with two-parent family: people usually living with a two-parent family, but not in a partner, parent, or child role.
6. Parent in one-parent family: people usually living in a parent role, but not in a partner role.
7. Child in one-parent family: people usually living in a child role with one parent, but not in a partner or parent role.
8. Other person with one-parent family: people usually living with a one-parent family, but not in a partner, parent, or child role.
9. Person in other multi-person household: people usually living with one or more people not in partner, parent, or child roles.
10. Person in one-person household: people usually living alone.
11. Person in non-private dwelling. people not living in households, but in short-term or long-term communal or transitory type accommodation (eg hotels, motels, hospitals, retirement homes, prisons, hostels, motor camps, boarding houses, defence barracks).

Projections of the population in these different living arrangement types are aggregated to give projections of families (by broad family type) and households (by broad household type).

Ethnic population projections (Statistics NZ, nd, c) are produced using the same method as the total population projections, with two additions:

- For each ethnic group, births are projected for men where the mother is not of that ethnic group. For example, Māori births are projected for Māori men where the mother is non-Māori. This is in addition to the Māori births that are projected where the mother is Māori.
- The projections allow for population change due to inter-ethnic mobility (people changing their ethnic identification over time).

Ethnic population projections have a shorter projection period than projections of the total population because of their greater uncertainty:

- Ethnic identification can change over time. This may reflect a person's cultural affiliations changing over time. Or it may occur when different people respond to the ethnicity question. For example, the ethnicity of babies and young children is usually identified by their parents. However, in a later census when these children are old enough to complete their own forms, they will decide which ethnicity they identify with. This may differ from the ethnicity identified by their parents. Inter-ethnic mobility can also occur when different ethnicities are reported for a person in different collections (eg birth registrations, different censuses).
- There are greater difficulties in establishing past trends in fertility, mortality, and migration. Different ethnicities can be reported in different collections (eg birth registrations, death registrations, census), which makes the derivation of ethnic-specific fertility and mortality rates problematic. Furthermore, the measurement of ethnicity has changed over time in many collections, while it is not captured at all in some collections (eg international travel and migration data).
- Ethnic populations are not mutually exclusive because people can and do identify with more than one ethnicity. People are not asked to prioritise their ethnic responses. Statistics NZ includes people in each of their reported ethnic groups.
- There is the added complication of births to parents of different ethnicities. The parents may consider the child to belong to one or more of their ethnicities, or indeed to another ethnicity.
- There is greater future uncertainty about the components of population change. For example, it is uncertain whether the fertility and mortality of different ethnicities will converge, and if so, at what pace. Assumptions about future migration, notably for people of Asian and Pacific ethnicities, are particularly susceptible to changes in migration patterns (which partly reflect immigration policy).

3. Projection assumptions

This section discusses the assumptions that underpin the national population and labour force projections released in 2012.[3]

Statistics NZ's projection assumptions are formulated using a mix of extrapolative methods and expert judgement. Assumptions are not driven solely by extrapolative methods, as inevitably judgements have to be made about choice of those methods and historical data (eg which historical period is used).

That judgement comes from the department's demographic experts (Population Statistics unit) often in consultation with statistical experts (Statistical Methods unit) on, for example, modelling techniques. Consultation with the department's Labour Market unit typically occurs in the derivation of assumptions about labour force participation rates.

Unlike some national statistical organisations (eg in Europe), there is no explicit consultation process with experts or agencies beyond Statistics NZ on projection assumptions. However, feedback on projection methods and assumptions is implicitly incorporated to ensure the projections are meeting the needs of users. Moreover, Statistics NZ regularly participates in national and international forums where demographic trends (current and future) and methods are presented and discussed.

Main changes in assumptions in national population and labour force projections

Reflecting the new method for extrapolating death rates (see 'Mortality'), assumed survival rates and **life expectancies** are higher in the 2011-base projections. The median period life expectancy at birth reaches 88.1 and 90.5 years for males and females, respectively, in 2061. This compares with the corresponding figures of 85.6 and 88.7 years in the 2009-base projections (medium variant).

In the short term, the median **net migration** assumptions are -3,000 in 2012, zero in 2013, and 7,000 in 2014 (June years). In the long term, the median annual net migration assumption is 12,000, compared with 10,000 in the 2009-base projections (medium variant).

The short-term migration assumptions reflect the latest trends in sub-flows, notably net outflow of 39,500 New Zealand citizens in the year ended June 2012. This was partly offset by a net inflow of 36,300 non-New Zealand citizens over the same period.

The long-term migration assumptions reflect the observed migration trends and current immigration policy. Since the late 1980s, New Zealand has gained an average of 10,000 to 15,000 people a year from net migration. It is important to note, however, that the gains have fluctuated from over 40,000 in 2003, to periods of net loss (eg 1985–89, 1999–2001, 2012).

The median period **total fertility rate** remains 1.90 births per woman in the long term. This level is not attained until 2036, however, gradually declining from 2.05 births per woman in 2012. The previous 2009-base projections reached the long-term level in 2026.

In the labour force projections, higher male **LFPRs** at ages above 65 years and higher female LFPRs at ages above 50 years are assumed compared with the previous projections. In addition, there is a wider probability interval for future LFPRs at all ages, especially at ages above 50 years, reflecting the uncertainty of future LFPRs.

Base population

The projections generally have as a base (starting-point) the latest available estimate of the resident population. The estimated resident population (ERP) is the best available measure of the number of people usually living in New Zealand.

[3] National population projections, 2011(base)–2061, released on 19 July 2012. National labour force projections, 2006(base)–2061 (August 2012 update), released on 29 August 2012.

The base for the 2011-base national population projections is the ERP of New Zealand at 30 June 2011. This population (4.405 million) was derived from the ERP of New Zealand at 30 June 2006 (4.185 million), updated for births, deaths, and net migration between 30 June 2006 and 30 June 2011 (+221,000).

The ERP of New Zealand at 30 June 2006 was derived from the census usually resident population count at 7 March 2006 (4.028 million) with adjustments for:

- net census undercount (+80,000)
- residents temporarily overseas on census night (+64,000)
- births, deaths, and net migration between census night and 30 June 2006 (+9,000)
- reconciliation with demographic estimates[4] at ages 0–4 years (+3,000).

The ERP is the best available measure of the number of people usually living in New Zealand. However, for projection purposes, some uncertainty in the base population has been assumed. This uncertainty is assumed to vary by age and sex, and arise from two broad sources:

- Census enumeration and processing. Coverage errors may arise from non-enumeration and mis-enumeration (eg residents counted as visitors from overseas, and vice versa), either because of deliberate or inadvertent respondent or collector error. Errors may also arise during census processing (eg scanning, numeric and character recognition, imputation, coding, editing, creation of substitute forms).
- Adjustments in deriving population estimates. This includes the adjustments applied in deriving the ERP at 30 June of the census year (eg net census undercount). It also includes uncertainty associated with the post-censal components of population change (eg estimates of births occurring in each time period based on birth registrations; changes in classification of external migrants between 'permanent and long-term' and 'short-term').

The uncertainty is difficult to quantify, so the adopted approach is to use expert judgement to formulate an uncertainty distribution around the official ERP of 4.405 million at 30 June 2011. The assumed uncertainty is asymmetrical so the range given by the 5th and 95th percentiles is 4.400–4.457 million. Therefore, there is a 5 percent chance that the actual population is more than:

- 5,000, or 0.1 percent, lower than the official ERP
- 52,000, or 1.2 percent, higher than the official ERP.

Fertility

Projected births are derived by applying the assumed age-specific fertility rates to the female population of childbearing age in each year. The age-specific fertility rates are typically summarised by the total fertility rate (TFR). The period TFR is the number of live births that women would have during their life if they experienced the age-specific fertility rates of a given year.

The period TFR is a hypothetical construct, because in reality the age-specific fertility rates change throughout the lifetime of women. The cohort TFR takes these changes into account by measuring the average number of live births that women born in the same year have had during their life.

The period TFR and cohort TFR are both useful measures when formulating assumptions about future fertility rates:

- In the 35 years from 1977 to 2011, the period TFR was generally in the range 1.9–2.2 births per woman (see Figure 1).

[4] Estimates derived solely from births, deaths, and migration data, independent of census.

- However, the cohort TFR indicates a progressive decline in completed family size. Women born in the early 1970s averaged 2.2 births each, compared with 2.5 for those born in the early 1950s (see Figure 2).
- Census data (1981, 1996, 2006) also indicate progressive declines in completed family size and progressive increases in childlessness (for women of each major ethnic group).
    - Women aged 45–49 years had averaged 3.3, 2.5, and 2.3 births during their lifetime as at the 1981, 1996, and 2006 censuses, respectively.
    - The proportion of women aged 45–49 years who were childless[5] was 9, 10, and 13 percent at the 1981, 1996, and 2006 censuses, respectively.
- Internationally, TFRs are generally declining. New Zealand's period TFR is one of the highest among Organisation of Economic Co-operation and Development (OECD) countries, ranking in the top quartile in the 1990s and 2000s.

Figure 1

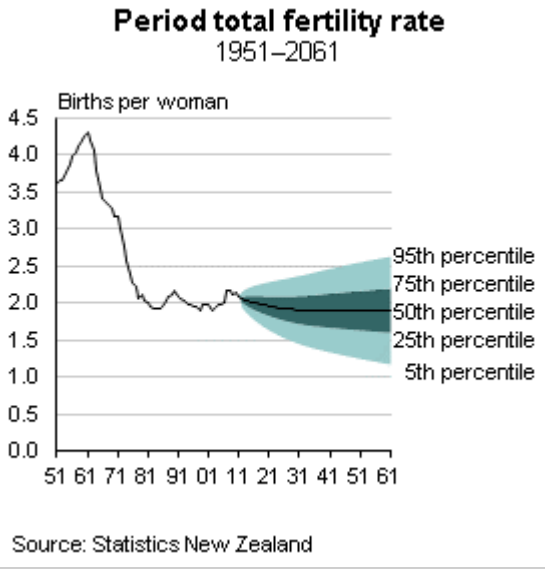
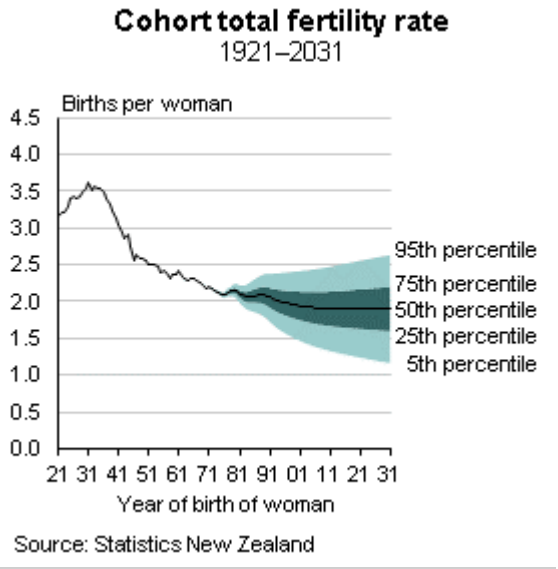


Figure 2



Given these sources and trends, the 2011-base projections assume future fertility is more likely to be lower than higher than current (2011–12) levels. However, fertility rates are assumed to vary throughout the projection period. The median period TFR declines gradually from 2.05 births per woman in 2012 to 1.96 in 2021, and to 1.90 in 2036 and beyond. The assumed standard deviation in annual period TFR of 0.0625 is derived by fitting an autoregressive integrated moving average or ARIMA (0,1,0) model to period TFR for December years 1977–2011.

There is no evidence of a sustained shift from current fertility levels to significantly lower or higher fertility levels. However, future fertility trends are uncertain and depend on a range of factors:

- changes in population composition and different trends in population subgroups (including ethnic groups)
- trends in ideal family size and the strength of individual desires for children
- trends in the patterns of education and work, including the timing, duration, and proportion of time dedicated to those activities
- changing macro-level conditions (eg government policies, childcare facilities, and housing) that influence the cost of children in a broad sense

[5] Had no live births during their lifetime.

- changing nature and stability of partnerships, including rates of partnership formation (including re-partnering) and dissolution
- changing biomedical conditions (eg female fecundity, new methods for assisted conception).

Mortality

Projected deaths are derived indirectly, by applying the assumed age-and-sex-specific survival rates to the population in each year. The age-and-sex-specific survival rates, or corresponding death rates, are typically summarised by life expectancy at each age. The period life expectancy is the average length of life remaining at a given age, assuming people experience the age-specific death rates of a given period from the given age onwards (see Figure 3 and Figure 4).

Just like period TFR, period life expectancy is a hypothetical construct, because in reality the age-specific death rates change throughout people's lifetime. The cohort life expectancy takes these changes into account by measuring the average length of life that people born in the same year have had (or are projected to have) (see Figure 5 and Figure 6).

Figure 3

Figure 4

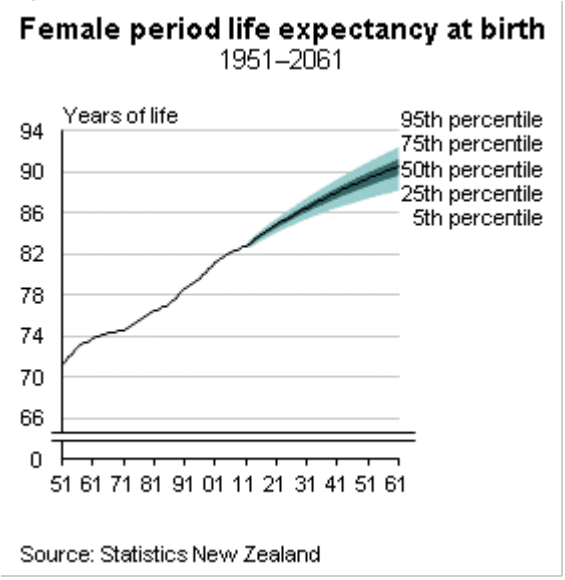


Figure 5

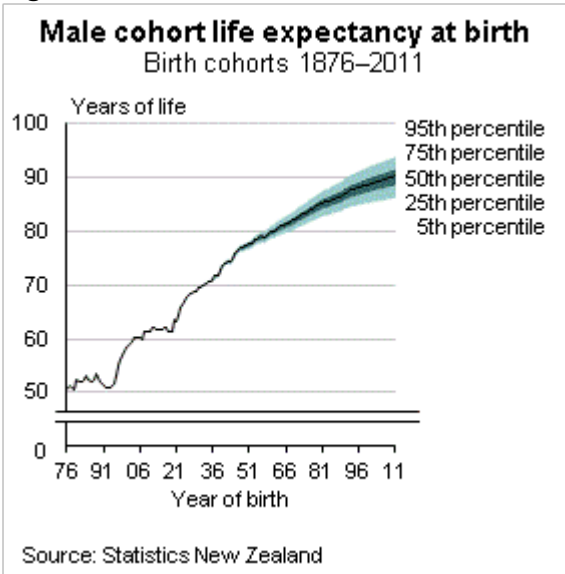


Figure 6

Period and cohort life expectancy are both useful measures when formulating and summarising assumptions about future death rates. However, the cohort life expectancy is generally the most intuitive and informative, as it indicates the actual average length of life experienced by people.

Moreover, it is actually the trends in the underlying age-and-sex-specific death rates that drive Statistics NZ's recent mortality assumptions (see Figure 7 and Figure 8), not trends in life expectancy.

Figure 7

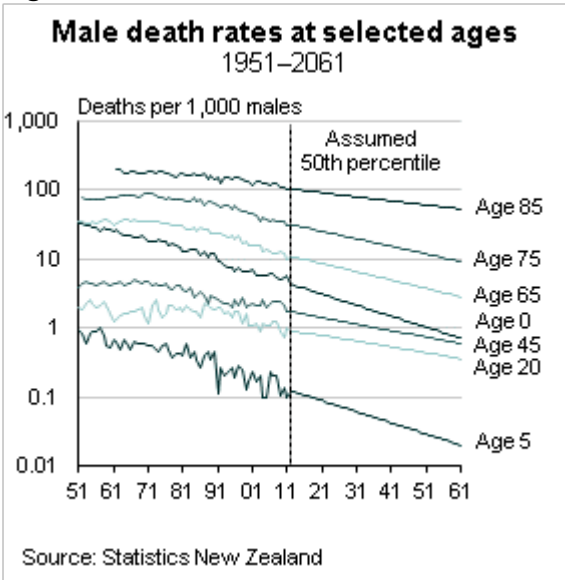
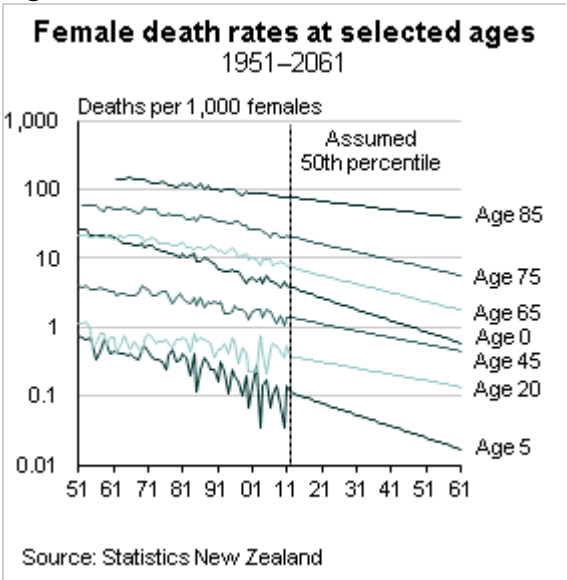


Figure 8



Relationship between death rates and life expectancy

There is a non-linear relationship between age-specific death rates and life expectancy. This means that as death rates decline, a 10 percent reduction in death rates does not produce the same increase in life expectancy as a 10 percent reduction when the death rates were higher.

In the 2011-base projections, future assumed reductions in death rates are based on those observed at each age during 1977–2011. Future reductions may, of course, be higher or lower than experienced during this period. Moreover, future reductions may occur at different paces at different ages than assumed.

Male and female age-specific death rate assumptions are formulated using a coherent functional data method (FDM) developed by Hyndman, Booth, and Yasmeen (2012). This method builds on the FDM of Hyndman and Ullah (2007), which is itself an extension of the Lee-Carter method widely used in mortality forecasting. The research of the authors and Booth, Hyndman, Tickle, and de Jong (2006) indicates that FDM forecasts are more accurate than the original Lee-Carter method and at least as accurate as several other Lee-Carter variants. The advantage of the coherent FDM is that it ensures male and female assumptions do not diverge over time.

Other features of the coherent FDM method include:

- The model is fitted to smoothed death rates for each age for June years 1977–2011, transposed from Statistics NZ's cohort mortality series (nd, a). Using historical data for the last 35 years gives a larger reduction in assumed future death rates, and a larger increase in life expectancy, than using a longer historical period. For example, period life expectancy at birth increased by an annual average of:
    - 0.9 months for males and 2.0 months for females between 1950–52 and 1975–77
    - 3.6 months for males and 2.7 months for females between 1975–77 and 2005–07 (Statistics NZ, 2009).

- The method uses autoregressive integrated moving average (ARIMA) and autoregressive fractionally integrated moving average (ARFIMA) time series models to give simulations of death rates.
- The simulated death rates are adjusted to give 'median' male and female deaths at the start of the projection period which are consistent with the latest death registrations.

Internationally, death rates are generally declining and life expectancy is generally increasing. New Zealand's period life expectancy is one of the highest among OECD countries, ranking in the top half in the 1990s and 2000s. In terms of future life expectancy, the New Zealand assumptions are broadly consistent with those in other countries.

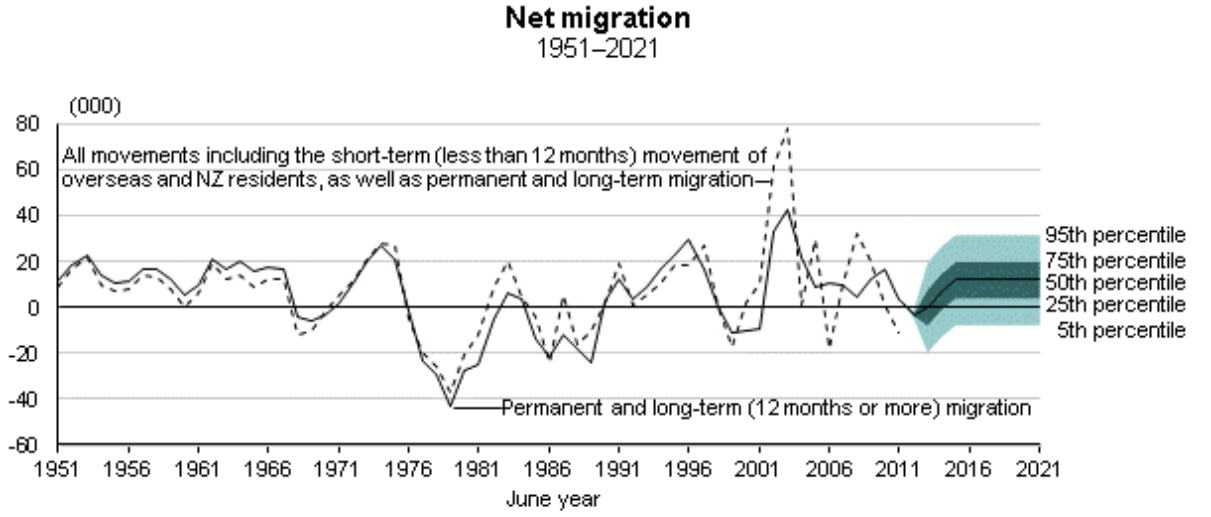
Mortality reductions are expected to continue in the future. However, the extent of the trends is uncertain and depends on a range of factors:

- changes in population composition and different trends in population subgroups (including ethnic groups)
- changes in biomedical technology, regenerative medicine, and preventative methods including monitoring, treatment, and early intervention
- changes in health care systems including effectiveness of public health
- changes in behaviour and lifestyle (eg smoking, exercise, diet)
- changes in infectious diseases and resistance to antibiotics
- environmental change, disasters, and wars.

Migration

Assumed net migration (arrivals minus departures), by age and sex, is applied directly to the population each year. Annual net migration is assumed to vary each year, although the median assumption increases from -3,000 in 2012 to zero in 2013, to 7,000 in 2014, and to 12,000 in 2015 and beyond (see Figure 9). The assumed long-run annual net migration of 12,000 reflects the average annual gain of 10,000–15,000 since the late 1980s and the influence of current immigration policy. The assumed standard deviation in annual net migration of about 11,900 is derived by fitting an ARIMA (1,0,1) model to 'permanent and long-term' migration for June years 1980–2011.

Figure 9



Source: Statistics New Zealand

The median assumed level conceals the volatile and uncertain nature of New Zealand's migration balance. The assumptions imply a 50 percent chance that net migration in the long term will be between about 4,000 and 20,000 in any given year. They also imply that roughly 1 year in 6 will have more departures than arrivals, while 1 year in 15 will have net migration exceeding 30,000.

Another perspective on the ability of the projections to reflect New Zealand's volatile migration balance is given by the 'cyclic migration scenario'. This assumes net migration fluctuates between -10,000 and +30,000 on a 10-year cycle, although the net migration gain between 2011 and 2061 is the same as the median projection. The population in 2061 is just 4,000 lower in the cyclic migration scenario than the median projection, although it varies in other years ranging 37,000 lower to 24,000 higher. Other characteristics of the population (eg age distribution, dependency ratios, births, deaths) are very similar between the two projections. A constant level of migration in the long term is therefore a sufficient assumption for most purposes.

Permanent and long-term migration

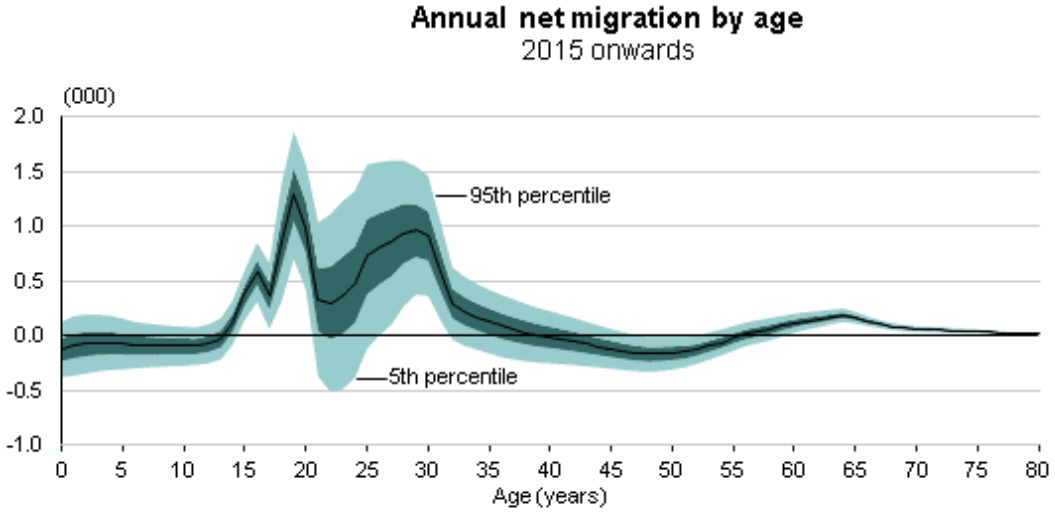
The international travel and migration data published by Statistics NZ (nd, b) are an excellent measure of movements in and out of New Zealand. And the 'permanent and long-term' (PLT) migration statistics are a good, though imperfect, measure of the net migration impact on the resident population.

At different times the PLT measure has under-estimated the contribution of migration to New Zealand's population change. For example, in the five-year period to June 2006, net PLT migration was 117,000, net all movements was 153,000, and the estimated net migration gain (a residual calculation from subtracting natural increase from estimated population change) was 161,000.

A real world perspective on recent migration patterns is that 'temporary' flows are a much more important aspect than they once were. For example, some international students and people on work permits move in and out of the resident population of New Zealand, and other countries. We also have increasing numbers of people spending significant amounts of time in multiple countries over the course of a year. These travellers may not necessarily be recorded as PLT arrivals or departures.

The assumptions about net migration by age and sex (see Figure 10) are based on analysis of trends in international travel and migration data (including arrivals and departures by country of citizenship and age), immigration applications and approvals, census data on people born overseas (including years since arrival in New Zealand), and consideration of immigration policies (in New Zealand and other countries).

Figure 10



Source: Statistics New Zealand

New Zealand's migration balance comprises the following main sub-flows:

- New Zealand citizen departures to Australia, which accounted for:
    - 56 percent of PLT departures in the year to June 2012.
    - 78 percent of New Zealand citizen PLT departures in the year to June 2012
- New Zealand citizen departures to countries excluding Australia, which accounted for:
    - 15 percent of PLT departures in the year to June 2012
    - 22 percent of New Zealand citizen PLT departures in the year to June 2012
- Non-New Zealand citizen departures, which accounted for:
    - 29 percent of PLT departures in the year to June 2012
- New Zealand citizen arrivals from Australia, which accounted for:
    - 11 percent of PLT arrivals in the year to June 2012
    - 40 percent of New Zealand citizen PLT arrivals in the year to June 2012
- New Zealand citizen arrivals from countries excluding Australia, which accounted for:
    - 16 percent of PLT arrivals in the year to June 2012
    - 60 percent of New Zealand citizen PLT arrivals in the year to June 2012
- Non-New Zealand citizen arrivals, which accounted for:
    - 73 percent of PLT arrivals in the year to June 2012.

Future migration trends are uncertain and depend on a range of factors in source and destination countries:

- changes in immigration policy (in New Zealand and other countries)
- changes in the main motives for migration (eg work, family reunification, education, asylum, retirement)
- changes in migration pressure in source countries (eg population growth, economic growth)
- changes in the attractiveness of New Zealand as a place to live (eg work opportunities, economic conditions, wages relative to costs and other countries, settlement and integration practices)
- costs of migration, including cost of travel and existence of networks and pathways that facilitate migration
- environmental change, disasters, and wars.

Labour force participation

Labour force participation rates (LFPRs) measure the proportion of the population in the labour force, either part-time or full-time. LFPRs differ significantly across age for both males and females.

Assumed LFPRs are formulated from analysis of trends in the Census of Population and Dwellings and the Household Labour Force Survey (HLFS). Although the same definition of labour force is used in the projections as in the census and HLFS, some important differences exist:

- The HLFS provides the official measure of the labour force using an interviewer-administered survey of about 15,000 households and 30,000 people each quarter. By comparison, the census provides a snapshot of the labour force (usually every five years).

- The HLFS measures labour force status over each quarter, while the census question refers to labour force status in the week before the census date.
- Unlike the HLFS, the census is not subject to sample error (although both data sources may contain non-sampling errors). As a result, the census can provide information at a more detailed demographic level (eg single year of age) than the HLFS.
- Non-response in the HLFS is minimised through the use of best survey practices. Because the census is self-administered, higher rates of item non-response occur.
- The HLFS generally excludes people in the armed forces and non-private dwellings (eg retirement homes, hospitals, prisons), while the census includes everyone who is in New Zealand on census night.

These differences explain why LFPRs, as well as numbers in the labour force, vary between census and HLFS. These differ again from the base for these labour force projections, which is the estimated resident population of New Zealand in the labour force at 30 June 2006.

Compared with the HLFS, the 2006 Census generally indicated higher LFPRs for males and females at ages 65+ years. The 2006 Census also indicated lower LFPRs for males at ages 25–54 years.

Base for the labour force projections

The base for the latest labour force projections remains 2006, even though 2011-base national population projections are used to produce them. This is because the labour force projections draw on LFPRs by single-year of age and sex from the Census of Population and Dwellings. Hence, 2006 is the latest census data available, and 2006 is the latest available 'estimate' of the labour force by single-year of age.

Labour force projections for 2006–10 are based on population estimates for that period. Labour force projections for 2011–61 are based on the national population projections (2011-base).

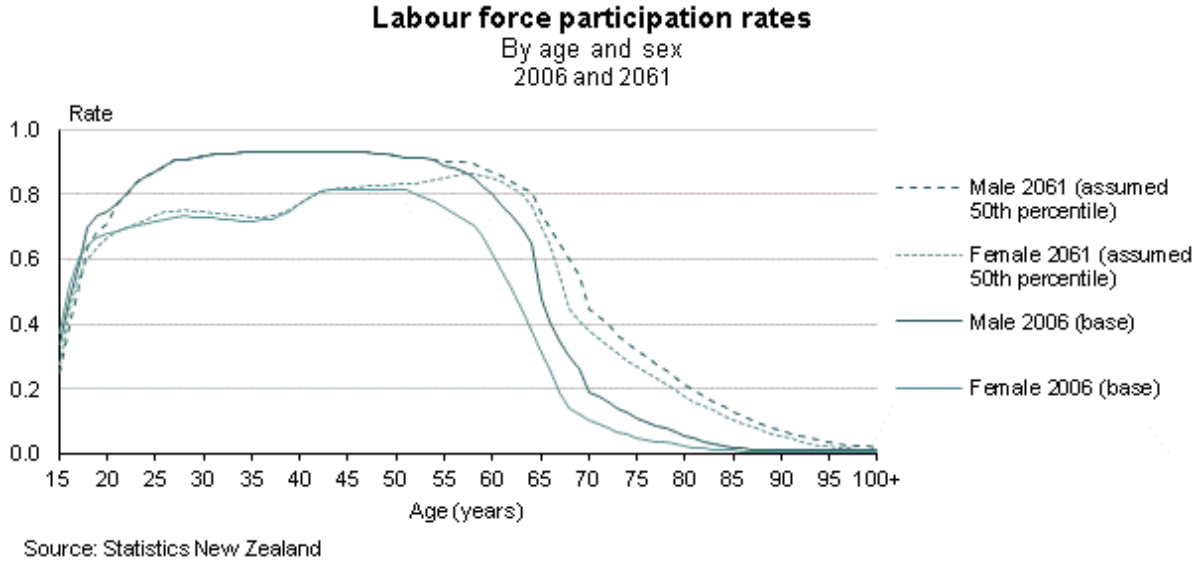
LFPR assumptions are formulated by single year of age and sex, and for each projection year including the base year. Important considerations in formulating LFPR assumptions are:

- comparability of LFPRs across age (eg consistency between adjacent ages)
- comparability of LFPRs across projection period (eg consistency between adjacent years)
- comparability of male and female LFPRs at each age and each projection year
- plausibility of LFPRs (eg $0 \leq \text{LFPRs} \leq 1$).

The main features of the median LFPR assumptions (Figure 11) are:

- significant increases in LFPRs for males aged 55+ years and females aged 50+ years. This reflects increased flexibility in the age of retirement (with no compulsory age of retirement), changing attitudes (of employees and employers) towards older workers and retirement, and increasing life expectancy and well-being in the older ages. Increased labour force participation is likely, especially among males and females aged 55 years and over
- small increases in LFPRs for females in main childbearing ages, 21–49 years. This partly reflects declines in completed family size and increases in childlessness
- small decreases in LFPRs for males and females aged 15–20 years. This reflects the impact of the global economic recession, as well as increasing rates of participation in tertiary education
- static LFPRs for males at ages 21–54 years.

Figure 11



Source: Statistics New Zealand

Future labour force participation trends are uncertain and depend on a range of factors:

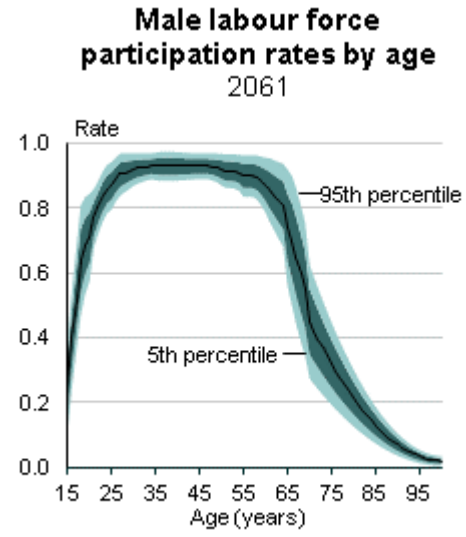
- changes in population composition and different trends in population subgroups (including ethnic groups).
- trends in fertility including the timing and number of births.
- trends in the patterns of education (especially tertiary education) and work, including the timing, duration, and proportion of time dedicated to those activities.
- trends in the balance between paid work, unpaid work, family, and leisure activities at different ages.
- changing macro-level conditions (eg global and national economic conditions, government policies) that affect the labour market and demand for labour.
- trends in health and mortality, affecting well-being and life expectancy, especially at ages above 50 years.
- changes in financial considerations, including eligibility for government superannuation, especially at ages above 60 years.

Simulations of LFPRs are produced using a simple random walk with drift model. Random errors are sampled from a normal distribution with mean of zero. For the base year (2006) of each simulation, a random number is multiplied by the assumed standard error for each age-sex, then added to the base LFPR.

For subsequent years of each simulation, a random number is multiplied by the assumed standard error for each age-sex, added to the standard error from the previous year, then added to the median LFPR. The assumed standard errors in each year are formulated by expert judgement. The drift function shifts the median of the LFPR simulations to follow the assumed median LFPRs.

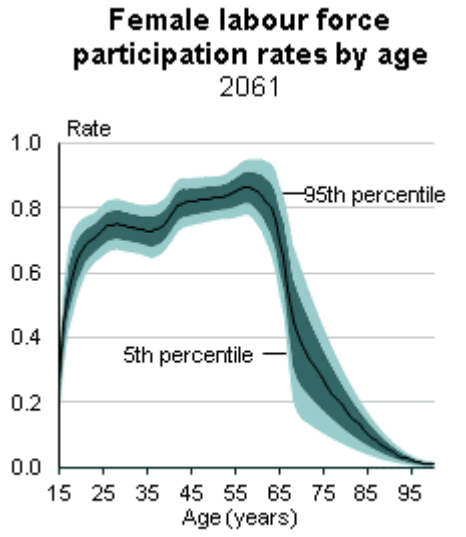
So LFPR simulations are correlated across age-sex (ie if LFPRs are high, they are high at all ages for both males and females), but vary randomly from year to year.

Figure 12



Source: Statistics New Zealand

Figure 13



Source: Statistics New Zealand

4. Projection accuracy

This section discusses the accuracy of projections, within the context of the aim of projections.

Quality context

Most national statistical organisations provide guidelines and discussion of the dimensions of quality as they relate to statistics (see Statistics NZ, 2007; Australian Bureau of Statistics, 2009; Office of National Statistics, 2007; Statistics Canada, 2002). These quality dimensions provide a framework for evaluating the usefulness of demographic projections:

- Relevance. Do the projections cover the necessary geographic areas, demographic characteristics (eg age, sex, ethnicity) and future time periods as required by different users? Are the projections produced to satisfy the expectations and aspirations of individuals or groups, or are they based on an objective assessment of demographic trends?
- Timeliness. Are the projections updated and available when they are needed?
- Coherence. Is the choice of methods, data, and assumptions consistent with accepted practices and do they account for the relevant factors? Are the projection results plausible given known constraints and limitations?
- Accessibility. Is the information readily available to everyone? Are there costs to access?
- Interpretability. Is the information about the projections (eg methods, assumptions, results) available, understandable, and even replicable? Do the projections provide measures of uncertainty?
- Accuracy. How do the projected trends compare with actuality? Do the projections adequately illustrate changing demographic patterns?

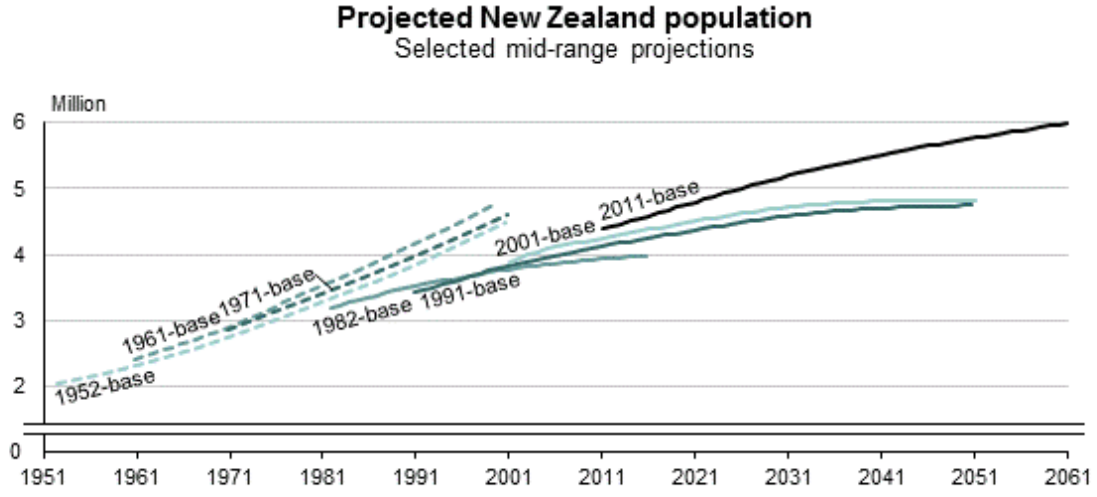
Such diverse evaluation criteria notwithstanding, it is often the accuracy of projections which is most questioned. To address those questions, Statistics NZ (2008) published an evaluation of its population projections. However, given the role of projections, the value of any set of population projections should be assessed on their relevance, timeliness, coherence, accessibility, interpretability, and accuracy – not one aspect in isolation.

Past accuracy

Historic population projections produced before the 1990s are not available in any detail. Only summary results are available from printed publications. Comparisons of historic subnational population projections are even more problematic because of myriad boundary changes.

To avoid conveying an overly precise future, multiple projections have always been produced. Nevertheless, mid-range projections of New Zealand's total population have varied considerably (see Figure 14). Generally, the historic projections illustrate the strong impact that fertility assumptions have. They also partly illustrate the prevailing fertility levels at the time the projections were produced. In addition, more recent projections have incorporated higher net migration assumptions and more sophisticated mortality assumptions.

Figure 14

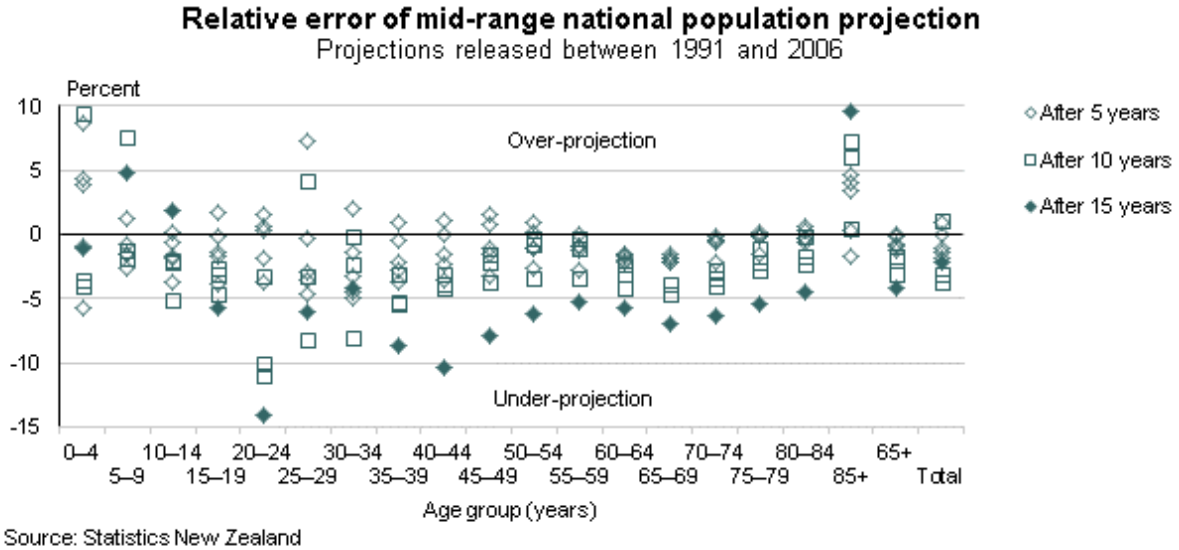


Source: Statistics New Zealand

Between 1991 and 2006, Statistics NZ released five sets of national population projections. As a measure of New Zealand's **total** population, the mid-range projection:

- after 5 years ranged from an under-projection of 1.8 percent to an over-projection of 1.0 percent (based on five sets of projections) (see Figure 15)
- after 10 years ranged from an under-projection of 3.8 percent to an over-projection of 1.0 percent (based on three sets of projections)
- after 15 years was an under-projection of 2.2 percent (based on one set of projections).

Figure 15



Source: Statistics New Zealand

For projections by age, the pattern of accuracy is more complex, but the following observations apply at the national level for the 1991–2006 period:

- Projection accuracy generally decreased as the period from the base (starting point) increases. That is, relative errors tended to be higher after 10 years than after 5 years, and after 15 years than after 10 years.

- Projection accuracy has generally been highest for ages 30+ years. Accuracy for the youngest ages (0–14 years) and young adult ages (15–29 years) has been lower, on average, reflecting fluctuations in births and migration at those ages, respectively.
- Projections of age group 65+ years have generally more accurate than younger age groups, but there was variation within this broad age group. Age group 85+ years was generally over-projected, while age group 65–84 years was generally under-projected. This reflects that mortality assumptions before 2006 assumed the same rate of decrease in death rates at all ages, compared with the observed actual pattern of higher decreases under 85 years than over 85 years. The more recent (2009-base and 2011-base) mortality assumptions incorporate different rates of change at different ages (see Figure 7 and Figure 8).
- The broad age group 65+ years was consistently under-projected, though by less than 5 percent even after 15 years. This reflects the various methods and assumptions previously applied around death rates and life expectancy. The most recent (2011-base) mortality assumptions are based on empirical trends in death rates over the recent past (1977–2011) rather than a longer historical period.

The accuracy of the projections over the longer term is, of course, unknown. For that reason it is difficult to deduce whether projection accuracy is increasing for more recent projections. Accuracy is also a function of the demographic conditions and variability of each period. For example, the periods 1991–96 and 2001–06 were relatively high population growth periods driven by high net migration; the period 1996–2001 was a relatively low population growth period driven by low net migration.

Moreover, although the mid-range national projection tended to under-project than over-project the population during 1991–2006, there is no inevitability about the future direction of inaccuracy.

What we do know, however, is that the most recent projections are the best available assessment of future trends, based on analysis of past and current trends, and the current policy environment. An analysis of past projections shows that the assumptions have evolved to reflect the changing trends. Distinguishing short-term fluctuations from long-term trends and level shifts remains a challenge for any producer of projections.

A history of under-estimating gains in life expectancy

Historically, statistical agencies have generally under-estimated future gains in life expectancy. This was often because it was assumed that the past gains could not continue indefinitely. Sometimes it was also because of limitations in methods. Sometimes it was because mortality assumptions were neglected relative to fertility and migration (which have bigger impacts on total population numbers).

It is possible Statistics NZ's latest life expectancy assumptions may also under-estimate future gains. Or they may over-estimate. There is consensus among demographers and epidemiologists that life expectancy will increase further, but there is no consensus about the pace and extent of those increases. There is uncertainty, which is why Statistics NZ always produces a range of assumptions about future mortality, and updates them every 2–3 years.

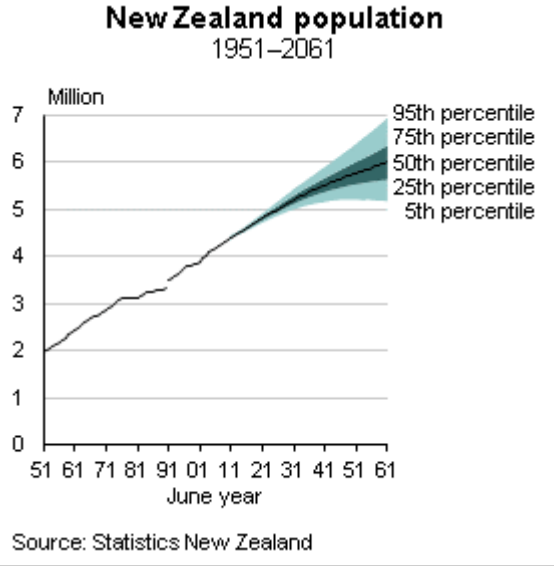
5. Projection results

This section discusses the latest population and labour force projection results.

Population size and growth

The projections indicate that New Zealand's population is likely to keep growing (see Figure 16), but at a decreasing rate (see Figure 17). From a population of 4.4 million in 2012, a population of 5 million in the mid-2020s is likely. By 2061, a population of about 6 million is projected.

Figure 16



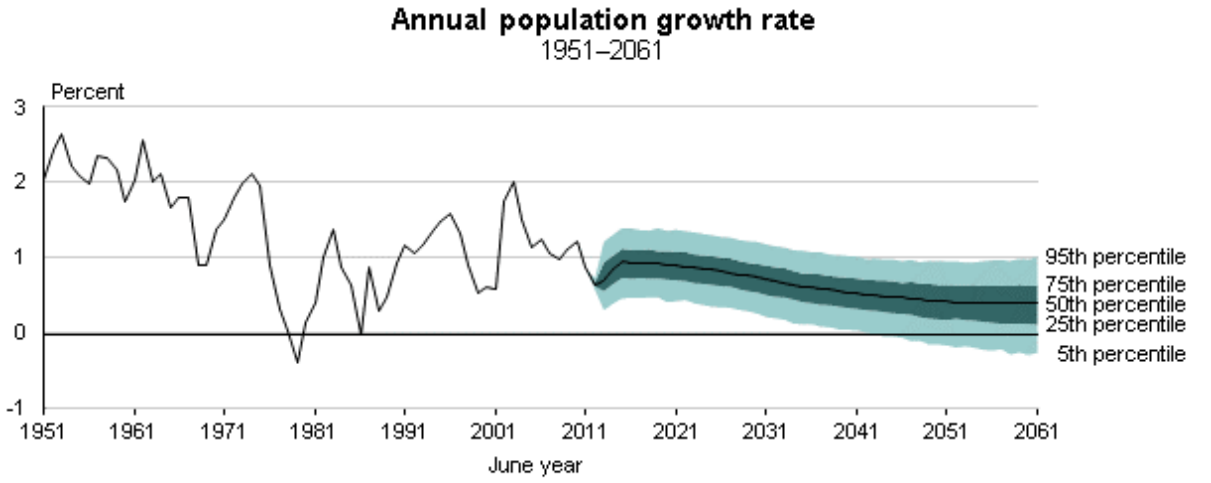
Note: In Figure 16, the break in data between 1990 and 1991 denotes a change from the de facto population concept to the resident population concept.

New Zealand's population grew at an average rate of 1.3 percent a year between 1951 and 2012. The growth rate has generally been slowing as fertility rates have fallen and the population age structure has changed. Population growth averaged 2.2 percent during the 1950s but only 0.7 percent during the 1980s. Growth averaged 1.2 percent in the decade ending 2012.

The median projection indicates that annual population growth will average about:

- 0.9 percent during the 2010s
- 0.8 percent during the 2020s
- 0.6 percent during the 2030s
- 0.5 percent during the 2040s
- 0.4 percent during the 2050s.

Figure 17

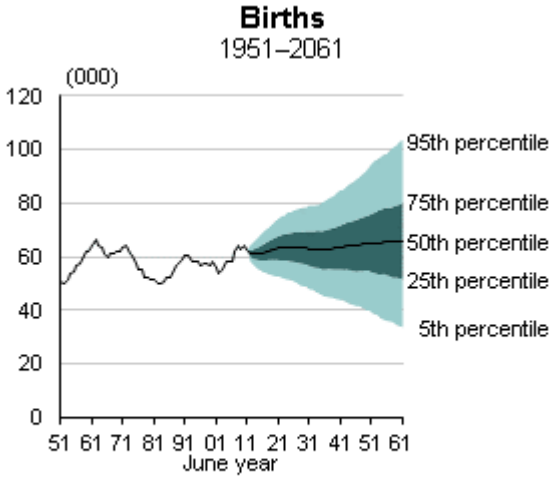


Source: Statistics New Zealand

Population ageing

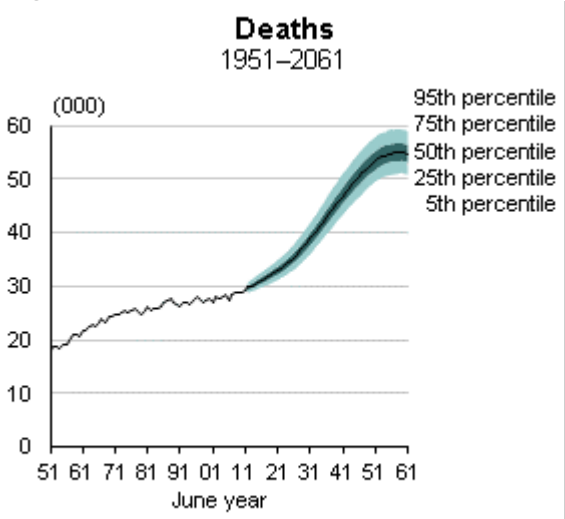
The projected slower population growth is intrinsically linked with the ageing of the population. Deaths are expected to increase steadily (see Figure 19), despite assumed lower death rates at all ages and increasing life expectancy. As a result, the narrowing gap between births and deaths (natural increase) (see Figure 20) will drive population growth downwards. The uncertainty in natural increase is a function of the uncertainty in both births and deaths.

Figure 18 Births, 1951–2061



Source: Statistics New Zealand

Figure 19 Deaths, 1951–2061



Source: Statistics New Zealand

Contribution of migration to population growth

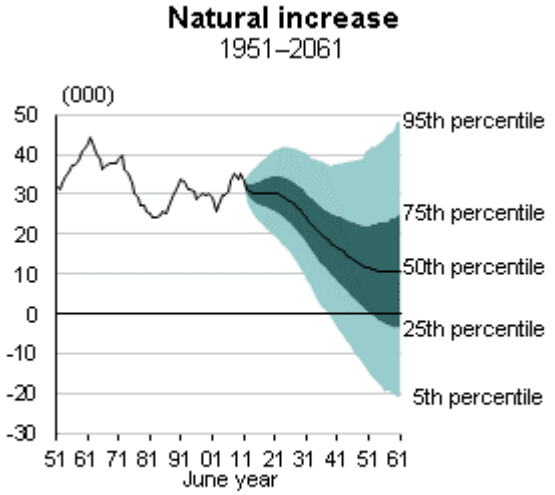
Net migration (arrivals less departures) contributed about one-fifth of New Zealand's population growth since 1970. Natural increase (births less deaths) has been the dominant contributor over the last 150 years.

Net migration did, however, contribute more at different times. For example, net migration contributed roughly half of New Zealand's population growth between 2001 and 2006. Net migration also had a significant impact on population composition, with departures exceeding arrivals at some ages, and arrivals exceeding departures at other ages.

Future population growth will continue to be dominated by natural increase, but decreasingly so. The median projection indicates that the contribution of net migration to New Zealand's population growth will average about:

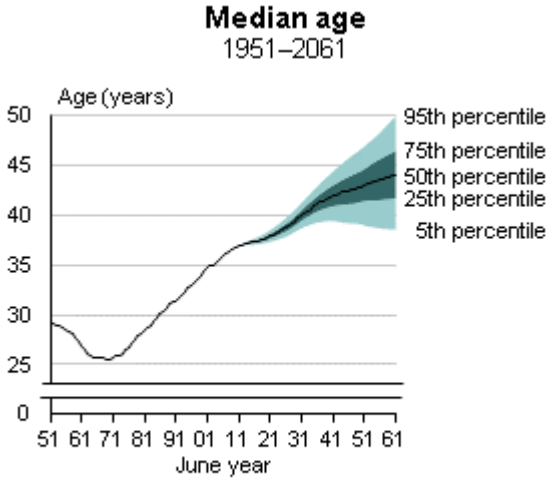
- 21 percent during the 2010s
- 30 percent during the 2020s
- 37 percent during the 2030s
- 46 percent during the 2040s
- 53 percent during the 2050s.

Figure 20



Source: Statistics New Zealand

Figure 21



Source: Statistics New Zealand

The median age of New Zealand's population increased from 26 years in 1971 to 37 years in 2012 (see Figure 21). As a summary indicator of population ageing, the median age is likely to exceed 41 years by the late 2030s. Half the population could be older than 44 years by 2061. The gradual ageing reflects the combined impact of people having fewer children (sub-replacement fertility), people living longer, and the large number of people born between 1950 and the early 1970s moving into the older ages (65+).

Baby boomers

Population ageing is often attributed, wrongly, to the post-war 'baby boom'. The changes in fertility rates, birth numbers, and the age structure that occurred during the baby boom have actually delayed the general ageing of New Zealand's population, although these changes will also make population growth among older age groups more pronounced after 2011.

Population ageing reflects the transition to lower birth rates and lower death rates. In New Zealand, this has involved a gradual transformation of the age structure, beginning in the 19th century and continuing into the 21st century. The main effects of ageing have, until now, been experienced among those under 65 years of age.

Fluctuations in the size of birth cohorts notwithstanding, the youngest age groups have reached a state of relative numerical stability (see Figure 22). The broad older working age group (40–64 years) grew rapidly during the 1990s and 2000s. As the transition continues to move through the population, future changes in age structure will be most dramatic at ages over 65 years.

The projections indicate that once the baby boomers have moved through the age structure, the New Zealand population will not revert to a younger age structure – barring major changes in childbearing patterns (fertility rates).

Figure 22

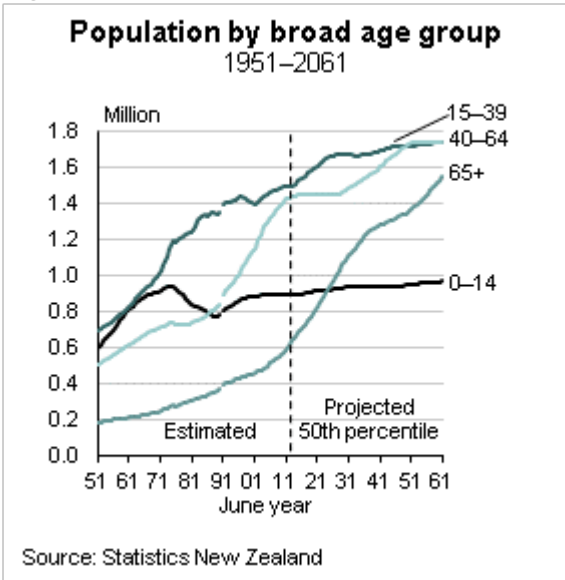
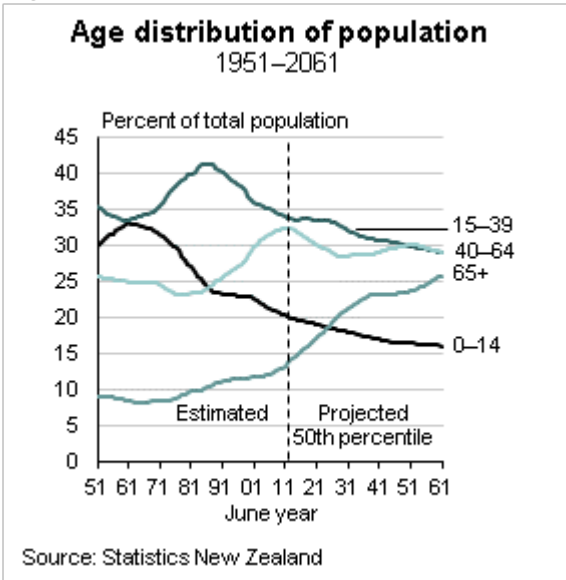


Figure 23



Note: In Figure 22, the break in data between 1990 and 1991 denotes a change from the de facto population concept to the resident population concept.

The number of people aged 65+ has doubled since 1980, eclipsing 600,000 in 2012. The number is likely to double again by 2036. It is 'highly likely'[6] that there will be 1.18–1.25 million people aged 65+ in 2036, and 1.44–1.66 million in 2061 (see Figure 24). The largest growth will occur between 2011 and 2036, as the baby boomers move into the 65+ age group (see Figure 25).

By 2036, it is expected that between 21 and 24 percent of New Zealanders will be aged 65+, compared with 14 percent in 2012. By 2061, it is expected that between 22 and 30 percent of the population will be aged 65+.

[6] The range indicated by the 5th and 95th percentiles. There is an estimated 90 percent chance that the actual population will be in this range.

Figure 24

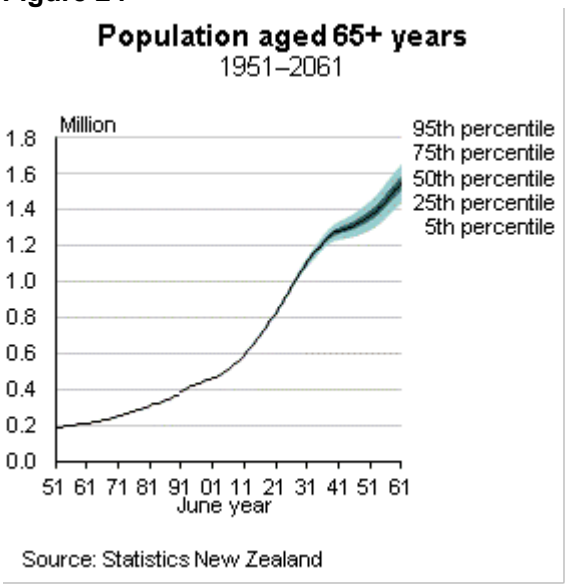
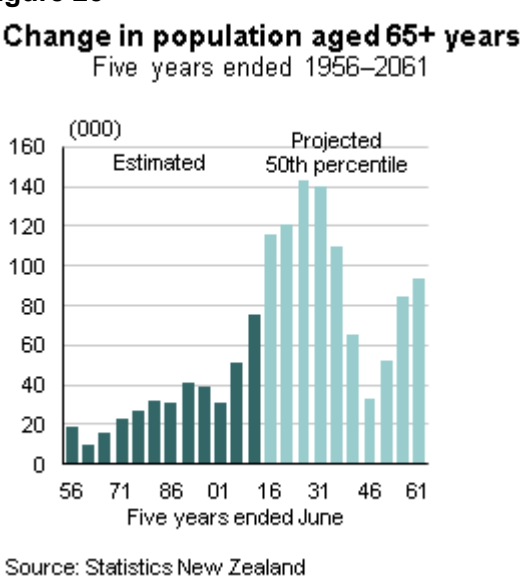


Figure 25



Note: In Figure 24, the break in data between 1990 and 1991 denotes a change from the de facto population concept to the resident population concept.

Within the 65+ age group, the number of people aged 85 and over (85+) is expected to increase significantly. From 76,000 in 2012, it is highly likely that there will be 180,000–210,000 people aged 85+ in 2036, and 290,000–430,000 in 2061 (see Figure 26). By 2061, about 1 in 4 people aged 65+ will be 85+, compared with 1 in 8 in 2012.

The age of the oldest 10 percent of the population is also projected to rise significantly (see Figure 27). In 2012, 10 percent of the population is aged 69+. The oldest 10 percent of the population will be 75+ in 2031 and 80+ in 2061.

Figure 26

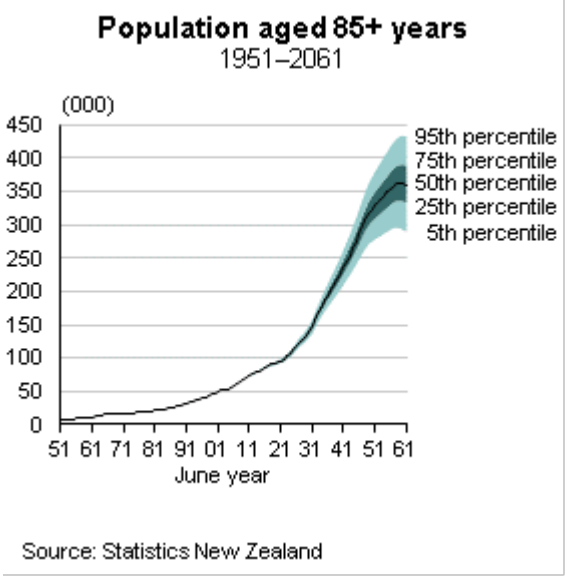
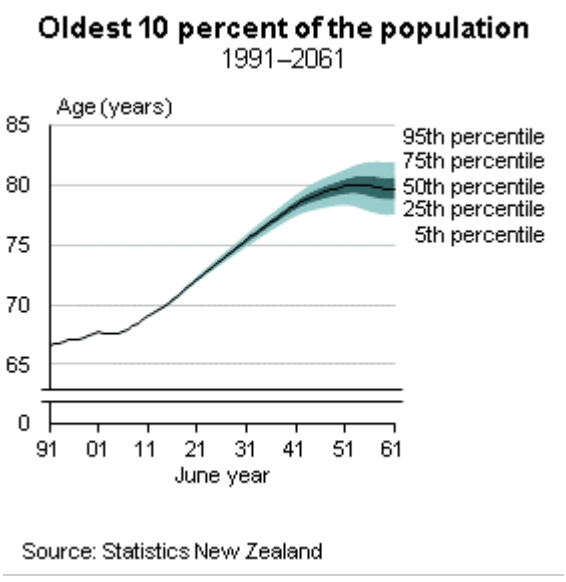


Figure 27



Uncertainty at the older ages

Everyone aged 65+ (see Figure 24) and 85+ (see Figure 26) in 2061 is already alive. Uncertainty comes from deaths and migration. Over the 50-year projection period, migration has a relatively small impact on the numbers at the older ages. Meanwhile, there has been a consistent long-term downward trend in death rates. This suggests that the population aged 65+ and 85+ can be projected with some confidence, although the uncertainty does increase the further out we project. These conclusions are consistent with an analysis of past accuracy of recent projections (see section 4, Projection accuracy, and Figure 15).

Dependency ratios

Dependency ratios relate the number of people in the 'dependent' age groups to the 'working-age' population. They are another indicator of changes in New Zealand's age structure. However, dependency ratios do not allow for the fact that some people in the working-age population may not be in the workforce, while some people aged 65+ may be in the workforce. In the case of those aged 65+, the term 'dependency' does not necessarily imply financial or economic dependency, as those aged 65+ are generally living and working longer.

The 65+ dependency ratio[7] (the number of people aged 65+ per 100 people aged 15–64 years) increased gradually from 14 per 100 in the mid-1960s to 20 per 100 in 2011. It is projected to increase significantly, with the ratio expected to be in the range 36–39 per 100 in 2036, and 39–51 per 100 in 2061 (see Figure 28). This means that for every person aged 65+, there will be about 2.6 people aged 15–64 years in 2036 and 2.3 in 2061, compared with 5.0 people in 2011 and 7.1 in the mid-1960s.

Figure 28

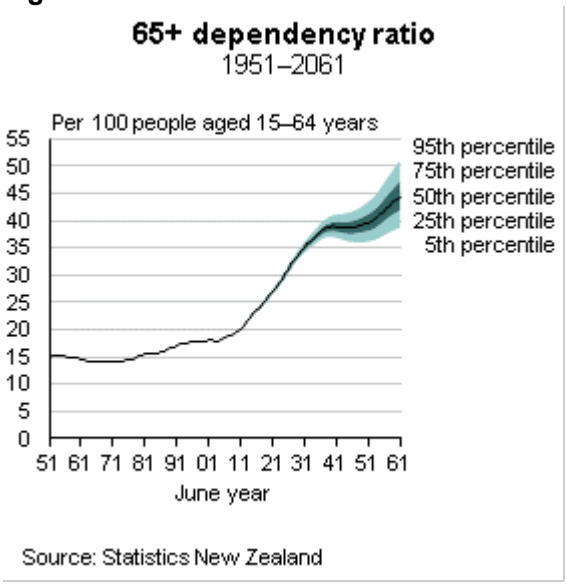
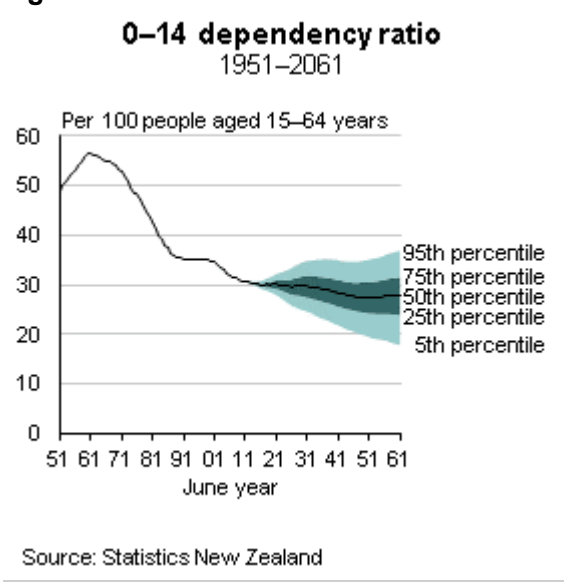


Figure 29



In contrast, the 0–14 dependency ratio[8] (the number of people aged 0–14 years per 100 people aged 15–64 years) decreased from a peak of 57 per 100 in 1961 to 31 per 100 in 2011 (see Figure 29). This downward trend will probably continue, with the ratio expected to be in the range 23–35 per 100 in 2036, and 18–37 per 100 in 2061.

[7] Sometimes referred to as the 'aged' or 'elderly' dependency ratio.
[8] Sometimes referred to as the 'child' or 'youth' dependency ratio.

The total dependency ratio (sum of the 0–14 and 65+ dependency ratios) reached its lowest level since the mid-1930s in 2008 (50 per 100). It is projected to increase from 51 per 100 in 2011, with the ratio expected to be in the range 61–73 per 100 in 2036, and 66–79 per 100 in 2061 (see Figure 30). The 65+ dependency ratio will then contribute three-fifths of the total dependency ratio compared with two-fifths in 2011. A total dependency ratio of over 70 per 100 was also experienced around 1960, but then the 65+ dependency ratio contributed about one-fifth of the total dependency ratio.

Figure 30

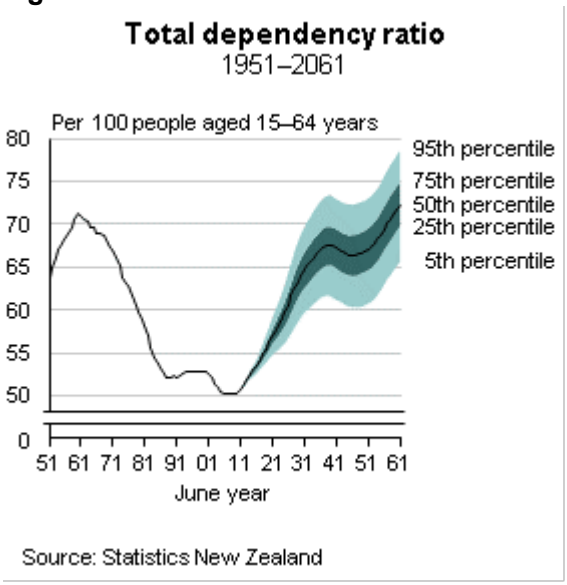
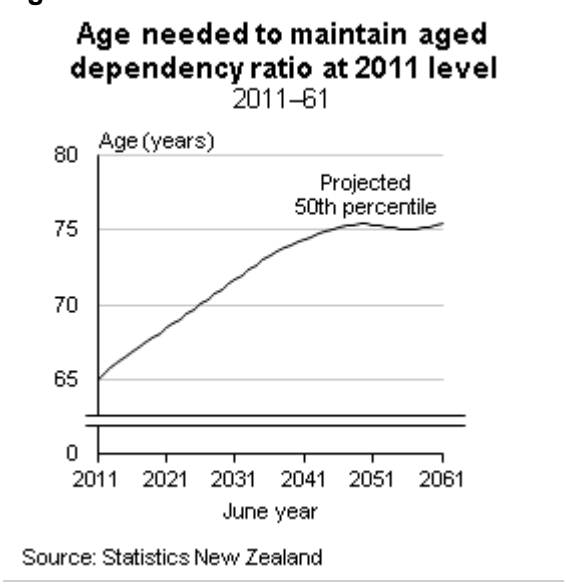


Figure 31



Given an aged (65+) dependency ratio of 20 per 100 in 2011, the age would need to rise progressively to about 75 years in 2051 and 2061 to maintain this ratio (see Figure 31). That is, the ratio of those aged 75+ to those aged 15–74 years in 2061 is projected to be about 20 per 100.

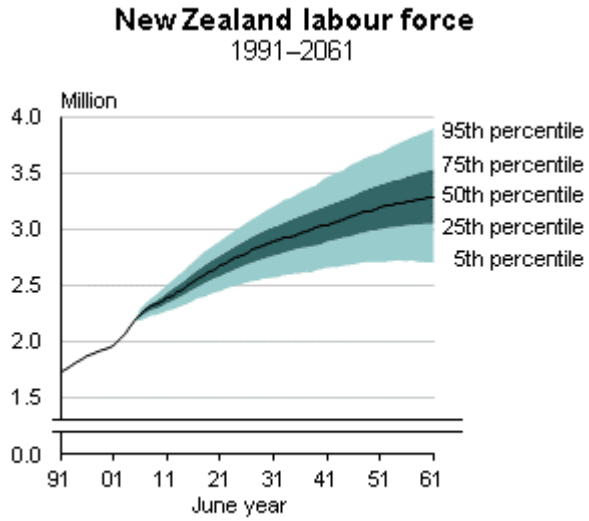
Labour force

The labour force projections (Statistics NZ, nd, e) reflect the trends in the underlying population projections (Statistics NZ, nd, f). That is, New Zealand's labour force will continue to grow, but at a slowing rate. And the labour force will age, reflected in a rising median age and an increasing proportion of the labour force in the older ages.

Lower growth

The total labour force is projected to rise from an estimated 2.41 million at 30 June 2012 to 2.96 million in 2036 and 3.29 million in 2061 under the median projection. There is uncertainty, however, in both the future population (size and structure) and future labour force participation rates. It is highly likely that the labour force will be in the range of 2.61–3.33 million in 2036, and 2.71–3.90 million in 2061 (Figure 32).

Figure 32



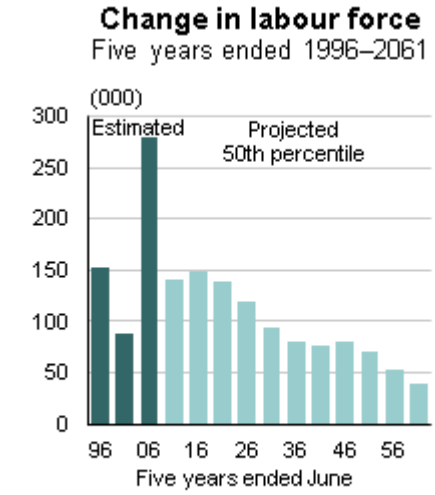
Source: Statistics New Zealand

The median projection indicates that annual labour force growth will average about:

- 1.2 percent during the 2010s
- 0.8 percent during the 2020s
- 0.5 percent during the 2030s and 2040s
- 0.3 percent during the 2050s.

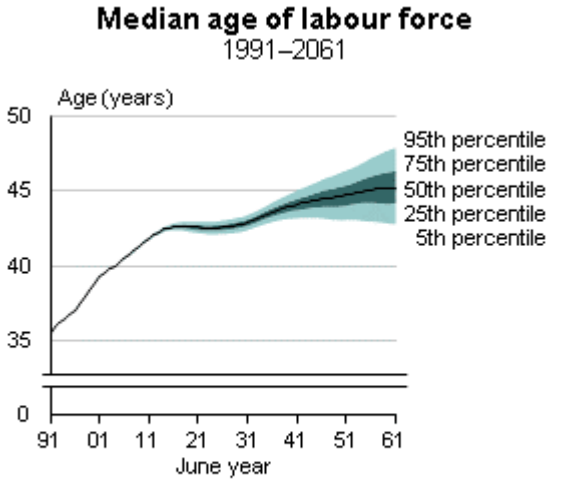
Future growth in the labour force is expected to be less than historically. The projections indicate increasing proportions of older people in the population, who are less likely to participate in the labour force than people at younger ages. From 2011, the baby boomers began to reach age 65 years and retire from the labour force in significant numbers. The youngest baby boomers will reach age 65 years in the year 2030. As a result, smaller increases in the labour force are expected, especially after 2020, as the number of people retiring from the labour force exceeds the number of new entrants by a narrowing margin (Figure 33).

Figure 33



Source: Statistics New Zealand

Figure 34



Source: Statistics New Zealand

An older labour force

The labour force is projected to continue ageing. The median age of New Zealand's labour force increased from 36 years in 1991 to an estimated 42 years in 2012 (Figure 34). It is likely the median age will exceed 43 years by the mid-2030s. Half the labour force could be older than 45 years by 2061. The gradual increase in the historical and projected median age reflects the general ageing of the population, the large number of people born between 1950 and the early 1970s moving into the older ages (65+), and increasing labour force participation among males and females aged 50 years and over.

The number of people aged 65+ in the labour force climbed from 25,000 in 1991 to about 130,000 in 2012. Further increases in labour force participation, coupled with more people at older ages, is likely to grow the older segment of the labour force further. It is highly likely that there will be 240,000–500,000 people aged 65+ in 2036, and 280,000–660,000 in 2061 (Figure 35). The largest growth will occur between 2011 and 2031, as the baby boomers move into the 65+ age group (Figure 36).

Figure 35

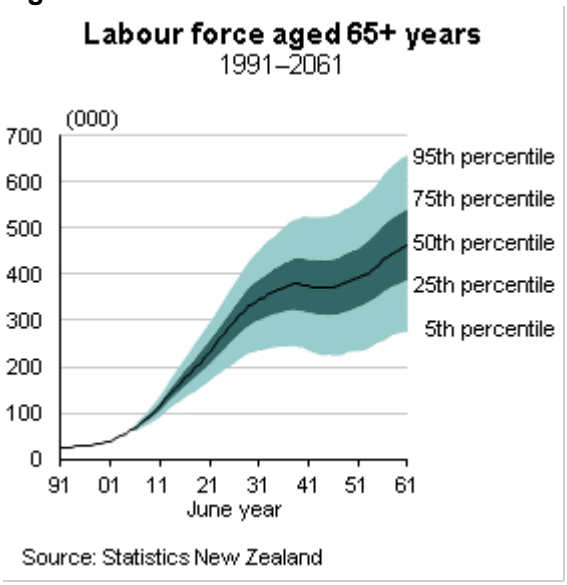
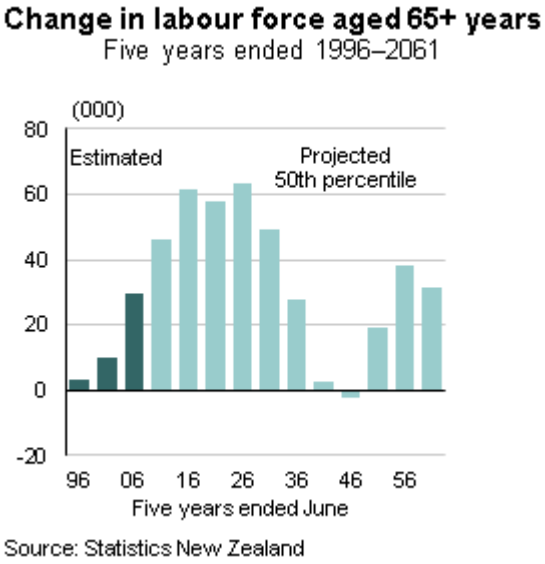


Figure 36



Among those aged 65+, 1 in 16 were in the labour force in 1991. It is 1 in 5 in 2012, and is projected to increase to 1 in 3 by the mid-2020s.

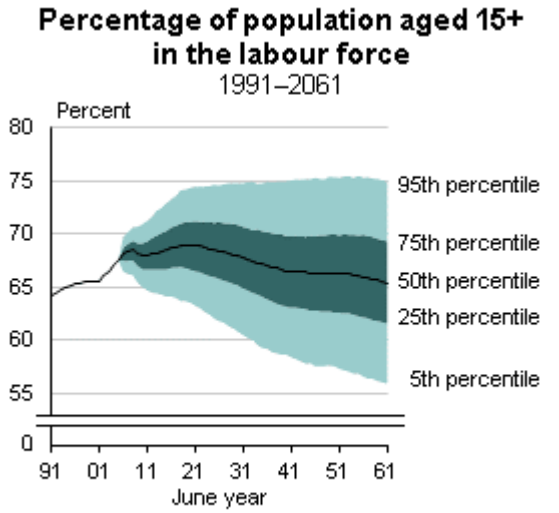
As a result, by 2036, it is expected that between 9 and 15 percent of the labour force will be aged 65+, compared with 3 percent in 2006. By 2061, it is expected that between 10 and 18 percent of the labour force will be aged 65+.

Within the labour force aged 65+, the number of people aged 80 and over (80+) is also expected to increase significantly. From 8,000 in 2012, it is highly likely that there will be 21,000–64,000 people aged 80+ in the labour force in 2036, and 27,000–96,000 in 2061.

Among those aged 80+, about 1 percent were in the labour force in 1991. It is 5 percent in 2012, and is projected to increase to 10 percent by the late 2020s.

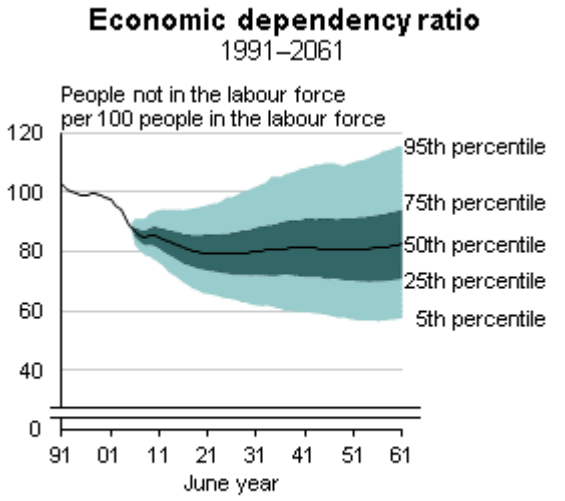
Overall, 68 percent of adults (aged 15 years and over) were in the labour force in 2012. The median projection indicates an increase to 69 percent around 2020, then a gradual drop to 67 percent in 2036, and to 65 percent in 2061 (Figure 37). This drop is despite the assumptions of static or increasing LFPRs at most ages. This apparent contradiction is caused by the changing age structure of the population, with more people at the oldest ages where LFPRs are at their lowest.

Figure 37



Source: Statistics New Zealand

Figure 38



Source: Statistics New Zealand

Over all ages, there are more people in the labour force than not. The ratio of those not in the labour force to those who are (the economic dependency ratio) stands at 84 per 100 in 2012. The projections indicate that the ratio may hover around 81 per 100, but with significant uncertainty. For example, it is highly likely that the ratio will be in the range 61–105 in 2036, and 58–116 in 2061 (Figure 38).

The uncertainty largely reflects the uncertainty in future LFPRs, although uncertainty in the age distribution of the population (from the interplay of fertility, mortality, and migration) increases over the projection period.

6. Glossary

Assumption: statement about a future course of behaviour (eg fertility, mortality, migration) from which projections of the population are derived.

Baby boomer: someone born in the years 1946–65, although the definition of the baby boom period varies between sources and between countries.

Base population: the starting population for the projections.

Cohort: a group of people sharing a common experience. For example, the 1900 birth cohort refers to people born in the year 1900.

De facto population concept: a statistical basis for a population in terms of those present in a given area at a given time. For example, the 'estimated de facto population' of New Zealand is an estimate of all people present in New Zealand at a given date, including visitors from overseas, but excluding New Zealand residents who are temporarily overseas.

Deterministic projection: a single projection from a given set of assumptions (eg about fertility, mortality, migration).

Estimated resident population: an estimate of all people who usually live in New Zealand at a given date. It includes:

- all residents present in New Zealand and counted by the census (census usually resident population count)
- residents who are temporarily overseas (who are not included in the census)
- an adjustment for residents missed or counted more than once by the census (net census undercount).

It excludes visitors from overseas.

Fertility: the demographic process relating to births, often summarised by birth rates and fertility rates. Fertility should not be confused with fecundity, which is the biological capacity of a population to bear children.

Labour force: comprises people aged 15 years and over who:

- regularly work for one or more hours per week for financial gain
- work without pay in a family business
- are unemployed and actively seeking part-time or full-time work.

People not in the labour force include:

- people under 15 years of age
- students who do not work for pay
- people who are unemployed and not actively seeking work
- some people with childrearing responsibilities
- people who work without pay (but not in a family business)
- people who have retired.

Labour force participation rate (LFPR): the proportion of the population in the labour force.

Life expectancy (cohort): the average length of life remaining at a given age, experienced by people born in the same year. For example, life expectancy at birth for people born in 1900 is based on death rates experienced by those people at each age throughout their life.

Life expectancy (period): the average length of life remaining at a given age, assuming people experience the age-specific death rates of a given period from the given age onwards. For example, life expectancy at birth for the period 2005–07 is based on death rates in that period, and takes no account of changes in death rates after that period.

Median age: half the population is younger, and half the population is older, than this age.

Median projection: the 50th percentile, which indicates an estimated 50 percent chance that the actual result will be lower, and a 50 percent chance that the actual result will be higher, than this percentile.

Mortality: the demographic process relating to deaths, often summarised by death rates, survival rates, and life expectancy.

Over-projection: a projected population that was higher than the observed population (eg population estimate) at the corresponding reference date.

Percentile: indicates the distribution of values (such as projection results or assumptions). For example, the 25th percentile indicates an estimated 25 percent chance that the actual result will be lower, and a 75 percent chance that the actual result will be higher, than this percentile.

Percentiles are non-additive except the 50th percentile (median). For example, percentiles for the population aged 15–39 and 40–64 years cannot be added together to give the equivalent percentile for the population aged 15–64 years.

Shading in graphs indicates the chance that actual results will fall within a certain range. Different shading is used to distinguish different ranges.

Permanent and long-term migration: permanent and long-term arrivals are people who have spent the last 12 months or more overseas, and who have arrived in New Zealand for an intended stay of 12 months or more (or permanently); permanent and long-term departures are people who have spent the last 12 months or more in New Zealand, and who have departed from New Zealand for an intended absence of 12 months or more (or permanently).

The classification of passengers to 'permanent and long-term' (or 'short-term') is primarily determined by individual passenger responses on the arrival and departure cards to the questions on intended or actual length of stay/absence. If a person's intention changes later, they may also change their migrant category (eg a person may come to New Zealand with the declared intention of settling permanently, but return overseas after a few months).

Projection: indication of the future characteristics of a population based on an assessment of past trends and assumptions about the future course of demographic behaviour (eg fertility, mortality, migration).

Relative error: percentage difference between the projected population and observed population in a given year relative to the observed population.

Replacement fertility: the average number of live births that women need to have for a population to replace itself in the long term, without migration. This equates to a total fertility rate of about 2.1 births per woman, which allows for the sex ratio at birth (roughly 105 males born for every 100 females) and for mortality of females between birth and before they have children of their own.

Resident population concept: a statistical basis for a population in terms of those who usually live in a given area at a given time. For example, the 'estimated resident population' of New Zealand is an estimate of all people who usually live in New Zealand at a given date, including New Zealand residents who are temporarily overseas, but excluding visitors from overseas.

Stochastic (probabilistic) projection: a projection which varies randomly according to the probability distributions of the assumptions (eg about fertility, mortality, migration).

Total fertility rate (cohort TFR): the average number of live births that women born in the same year have had during their life. For example, the TFR for women born in 1960 is based on fertility rates experienced by those women at each age throughout their life.

Total fertility rate (period TFR): the average number of live births that women would have during their life if they experienced the age-specific fertility rates of a given period. For example, the TFR for the year 2011 is based on fertility rates in that year, and takes no account of changes in fertility rates after that year.

Under-projection: a projected population that was lower than the observed population (eg population estimate) at the corresponding reference date.

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