

Nga Tangata  
Oho Mairangi



# Regional Stochastic Population Projections in New Zealand: Prospect and Challenges

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# Background

- New Zealand is experiencing significant population changes
- The demographic changes vary considerably by region
- There is considerable uncertainty regarding future regional populations
- It is therefore useful to explicitly model the uncertainty in population projections at the regional level for New Zealand

# The deterministic cohort component method

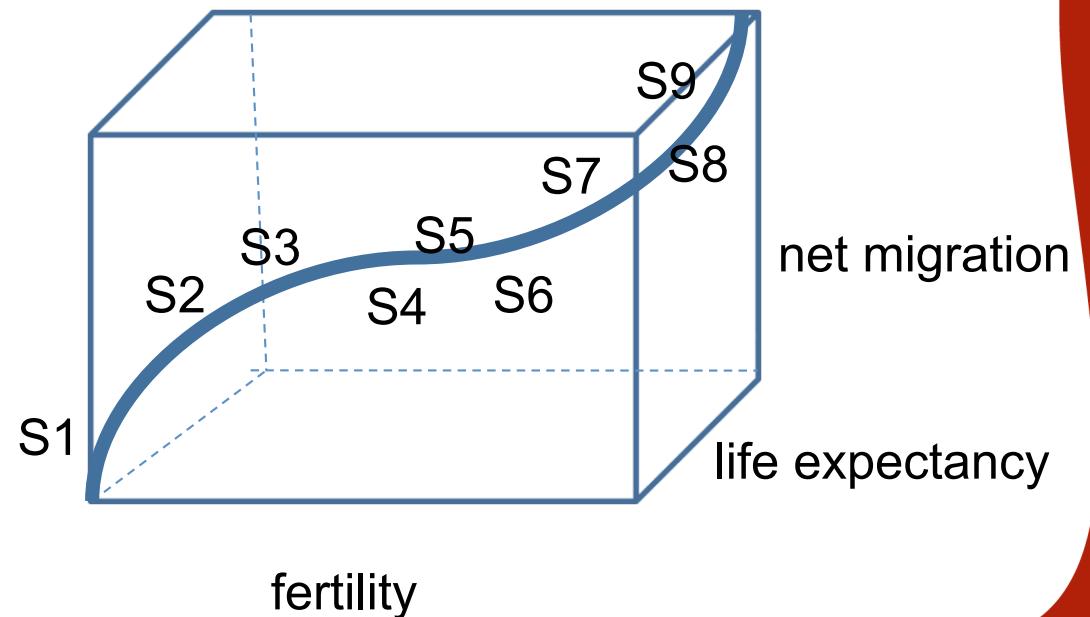
The population usually resident in area  $i$  at the **end** of year  $t$

- = The population usually resident in area  $i$  at the **beginning** of year  $t$
- + **births to mothers** residing in area  $i$  during year  $t$
- **deaths of residents** of area  $i$  during year  $t$
- + **inward migration from other regions** into region  $i$  during year  $t$
- + **inward migration from overseas** into region  $i$  during year  $t$
- **outward migration of residents** from area  $i$  to **other regions** during year  $t$
- **outward migration of residents** from area  $i$  to **overseas** during year  $t$

**Note:** All migration is conventionally combined into one **net** migration number (by region, age and sex)

# Parameters in deterministic projections

- Deterministic projections implicitly assume correlation between fertility, mortality and migration assumptions that may not be consistent with past trends



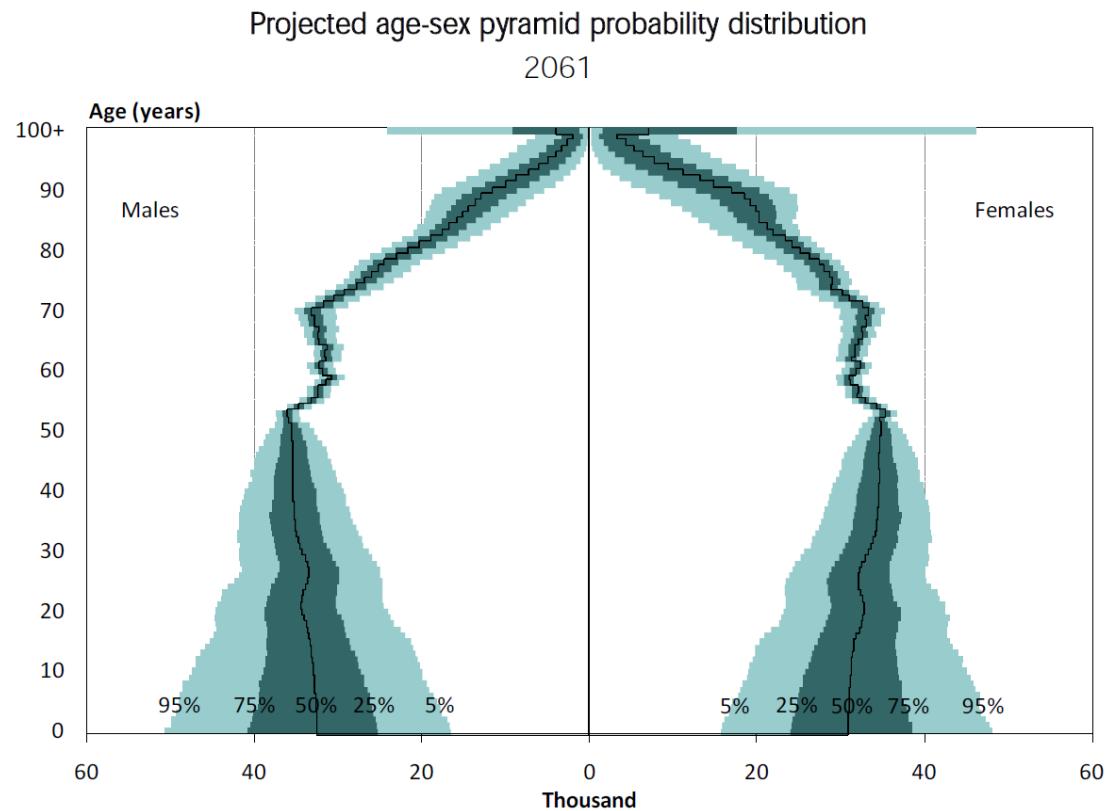
## Advantages of stochastic projections (e.g., Bryant 2005)

- Statements that the future population will be between x and y with z% probability are more informative than just quoting low, medium and high projections
- Probabilistic statements can also be made regarding other interesting demographic indicators, such as demographic dependency ratios (e.g., pop. 65+ / pop 15-64)
- Moreover, differences in regional uncertainty can be quantified in terms of differences in the underlying parameter distributions
- The consistency of fertility, mortality and migration assumptions can be assured through modelling

# Stochastic projections in New Zealand

- Wilson (2005) was the first to apply stochastic population projections methodology in NZ
- Cameron and Poot (2010; 2011) were the first to apply the method at the subnational level (for parts of the Waikato Region, at the TLA level)
- Statistics NZ began producing experimental stochastic projections at the national level in 2011 (Dunstan, 2011)
  - No subnational stochastic projections yet, though

# Output from stochastic projections

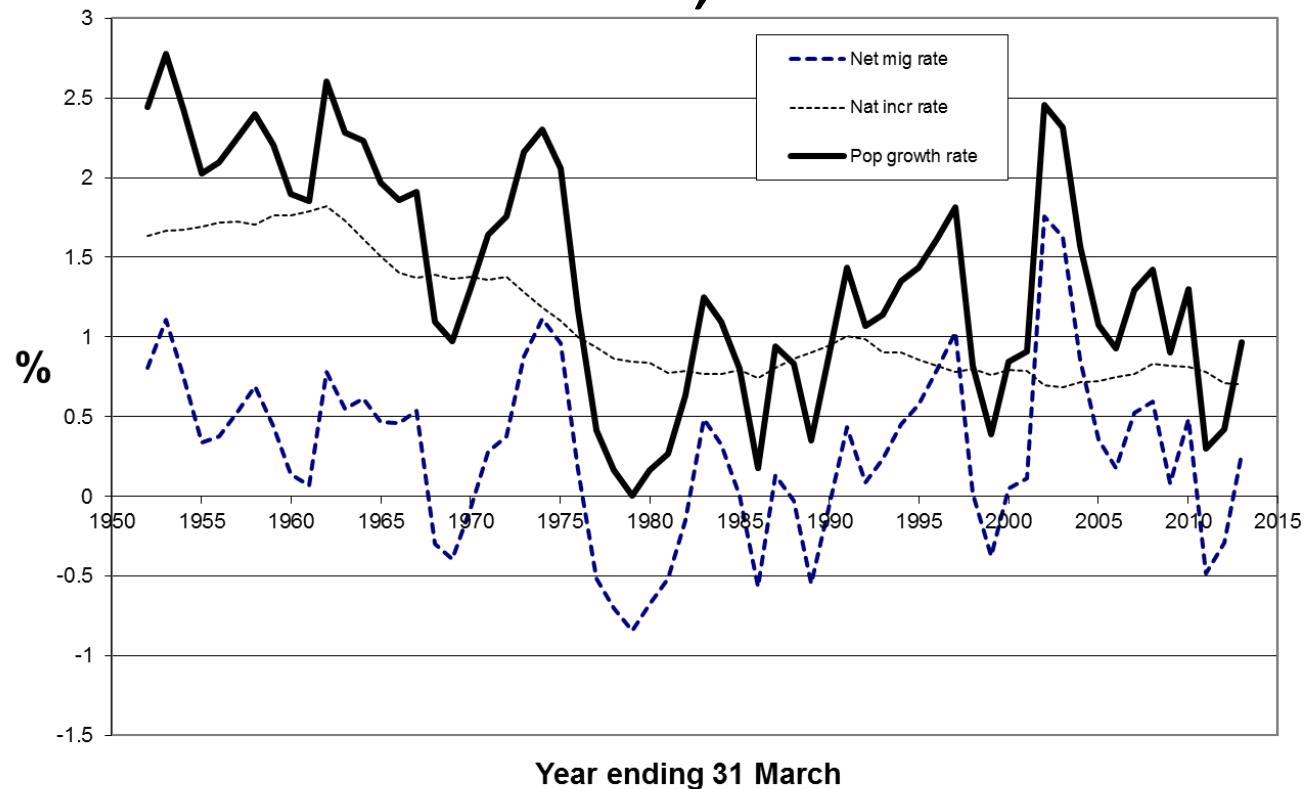


Source: Dunstan, 2011

# Modeling the uncertainty in projections

- Future mortality (survivorship)
  - Infant and child mortality
  - Life expectancy at age 5
  - Life expectancy at age 65
- Future fertility rates
  - Total fertility rate
  - Sex ratio at birth
- Future net migration rates
  - Internal migration
  - International migration

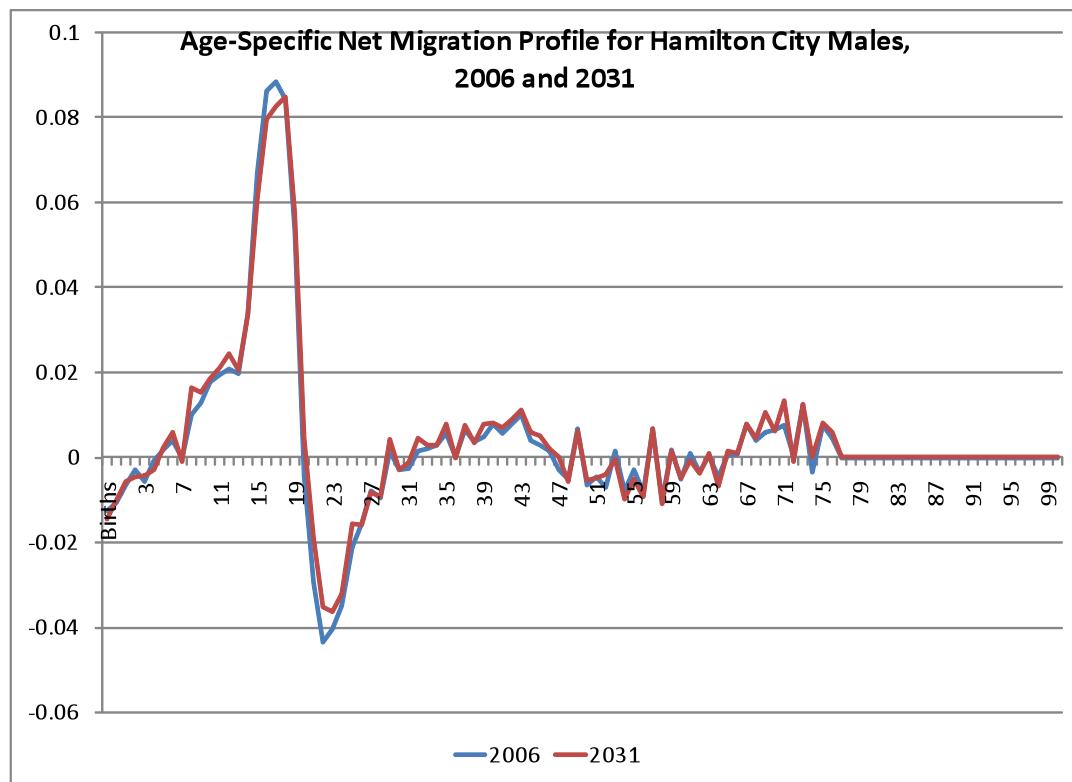
# Drivers of national population change in New Zealand, 1951-2013



# Stochastic projections in NTOM

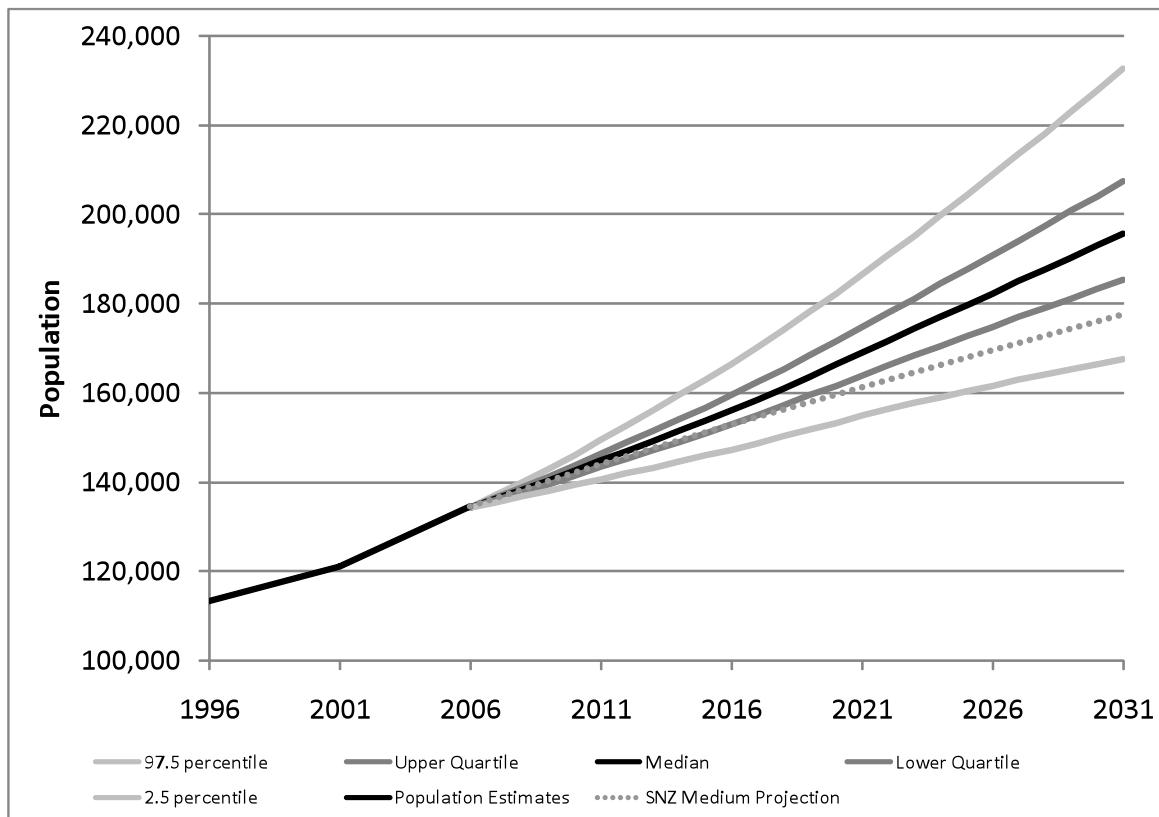
- We apply a bottom-up approach to subnational projections, as opposed to the top-down approach favoured by Stats NZ
- We use gross migration *rates* as opposed to absolute levels of net migration
- We extend the methodology in Cameron and Poot (2011) by:
  - Explicitly modelling the time series of mortality and fertility parameters by region (similar to Stats NZ's national methodology)
  - Using a gravity model to estimate and project gross internal migration; and calculate net migration as the difference
  - Modelling gross international migration separately from gross internal migration
  - Applying the methodology to all regions in NZ (14 – Nelson/Tasman/Marlborough as a single region)
  - Comparing the aggregate results for validation against national deterministic and stochastic projections

# Indicative net migration rates



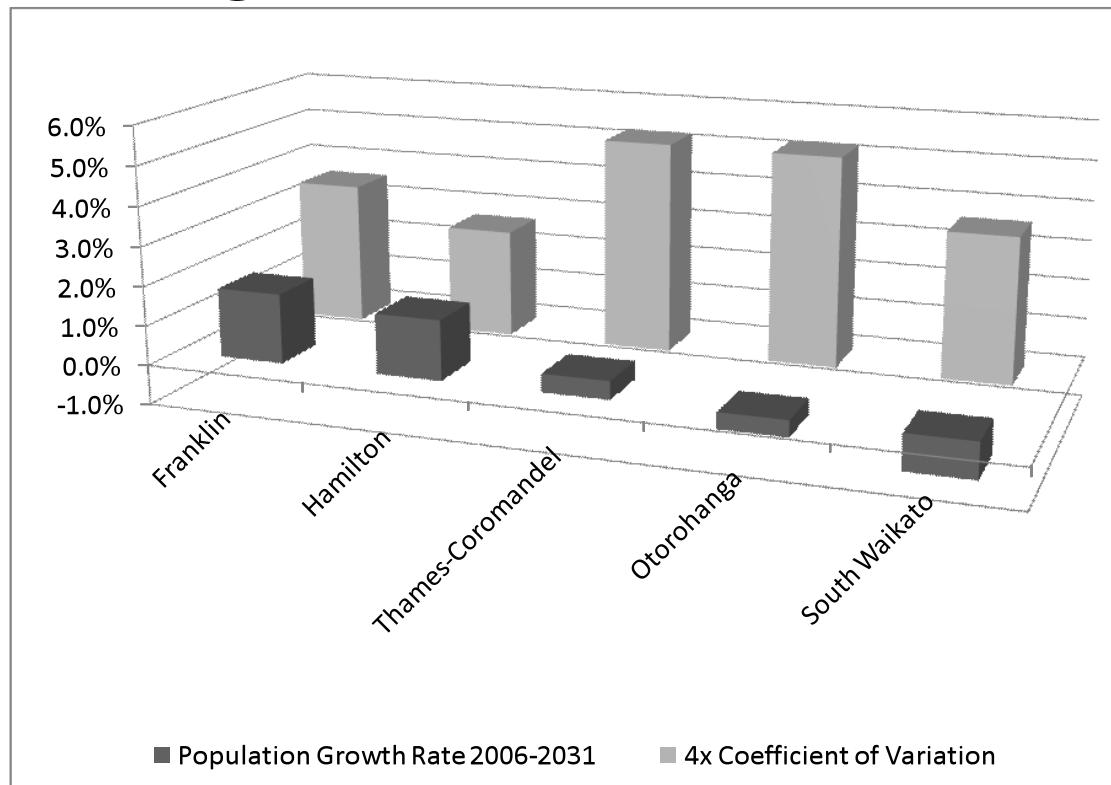
Source: Cameron and Poot, 2010

# Indicative results, Hamilton City



Source: Cameron and Poot, 2011

# Population growth rates and variability



Source: Cameron and Poot, 2011

# NTOM Projections: Prospects and Challenges

- Through the projections methodology, the NTOM project is linked to the MBIE-funded Climate Change: Impacts and Implications (CCII) project
  - The gravity modelling of internal migration rates will investigate the impact of differences in climate between the NZ regions
  - The potential impacts of climate change on future mortality is another consideration, but impacts on fertility rates are unlikely (Cameron, 2013)
  - Assumptions regarding future international migration *may* make use of CGE modelling of international economic conditions that are also affected by climate

# NTOM Projections: Prospects and Challenges

- A key challenge is how to try to project the regional population along additional dimensions, including:
  - Industry (broad groups, plus unemployment and not in the labour force)
  - Skills (low, medium, high)
  - Migrant status (NZ born, foreign born)
  - Ethnicity (Asian, European, Maori, Pasifika, Other)
- Additional transition parameters are required in order to model how people change between labour force status and industry; and to account for the impact of these characteristics on fertility, mortality and migration
  - For example, potential differences in fertility, mortality, migration between skill groups have not been explicitly considered in past projections, and have not been explored in a systematic and holistic way
  - Thus, projecting the population in a high dimensional space presents considerable challenges
  - Additionally there can be interaction effects, for example between skill and ethnicity on fertility

# NTOM Projections: Prospects and Challenges

- If sufficient data on all transitions would be available, dynamic microsimulation would be the appropriate technique
- Instead, our preferred solution at this point is to project shares across each dimension and then ‘attach’ attributes to the population accordingly
  - This is consistent with the approach used by SNZ to generate household, labour force and ethnic projections

# References

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- Cameron, M.P. (2013). The demographic implications of climate change for Aotearoa New Zealand: A review, *NIDEA Working Paper WP-4*. Hamilton: National Institute of Demographic and Economic Analysis, University of Waikato.
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