

Australia's population in the future.

- An application involving the use of algebraic models -

Introduction

It is obvious that a nation's future is affected by the size and composition of its population. Population issues vary from country to country. In the developing world a common issue is unsustainable population growth.

In the western world the issue is more often an aging and declining population. In countries like Germany population decline is already being experienced. Whilst Australia's population is currently growing, projections suggest a possible decline in the near future¹. It is in this context that vigorous debate has taken place about the growth and composition of Australia's future population (see left).

Sydney Morning Herald

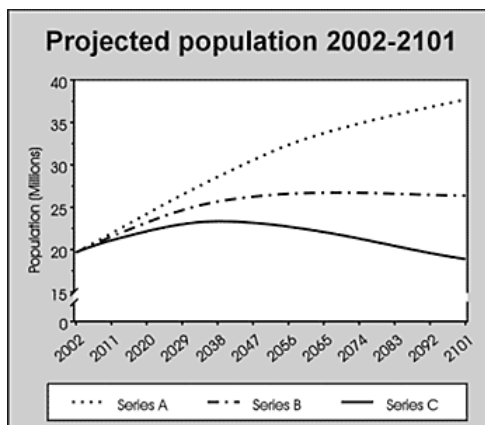
February 16, 2006

Danna Vale defends Muslim comments

A federal Liberal MP has defended her controversial comments on Australia becoming a Muslim nation as being about population figures. Sydney MP Danna Vale was criticised after saying this week that Australia was aborting itself out of existence and could become a Muslim nation.

Population projections for Australia.

The Commonwealth's *Department of Immigration and Multicultural Affairs* spends a lot of time and money developing projections about the future of Australia's population. These projections are based on mathematical models that combine



current trends with sets of assumptions about the future. Different projections are based on different assumptions. One projection might assume that current trends will continue, another might incorporate a fall in fertility levels and a third might include an increase in net migration. These projections present some 'what if...' scenarios that can help governments develop policies and plan for the future.

Aspects of population change.

The data that government departments use for population projections is supplied by the Australian Bureau of Statistics. Their data distinguishes between two aspects of population change. The first is *Natural Increase*, which is the amount by which births exceed deaths. The second is *Net Overseas Migration*, which is the amount by which immigration into Australia exceeds emigration out of Australia. Population models deal separately with these two aspects of population change, and then combine them to provide an overall picture of the future.

Australia's population in the future.



Activity 1: Modeling population change due to Natural Increase.

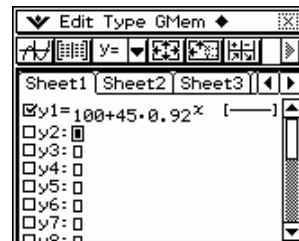
Based on Australian Bureau of Statistics data, a model for Australia's population change due to Natural Increase N (in thousands per year) is the function






$$N = 100 + 45 \times (0.92)^x \quad \text{where } x \text{ represents time, in years since 1990.}$$

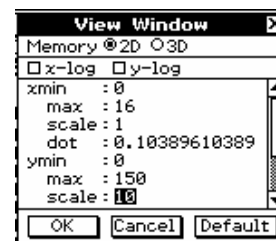
Working with this model.




- A. Enter the  mode of a CASIO *ClassPad 300*.
- B. Enter the function for N into the y_1 row.
- Use the  key to enter x as an exponent.







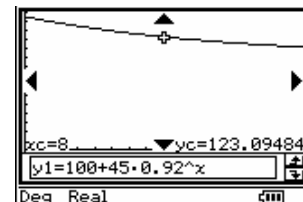
- C. Set an appropriate View Window.
- Tap  to see the view window settings.
 - Set the View Window so that the graph is drawn from 1990 ($x=0$) until to 2006.
 - The graph will need to incorporate population values of up to $N = 150$.
 - Your choice of *scale* will determine how often 'tick marks' are made on the axes. The *dot* value will be set automatically.
 - Tap or press  to enter each of your settings. You can also use  and  to move within elements of this window. Tap  to exit this window.



- D. Draw the function by tapping .



- E. To obtain function values from your graph by tracing tap  then  or tap Analysis : Trace.
- Use  and  to move from left to right.
 - If you cannot move to the exact x value you require just enter it on your keypad.



- Use this model for N to determine the change in Australia's population due to Natural Increase in the years
 - 1990
 - 2000
 - 2006
- Describe how, according to your model, Natural Increase has contributed to Australia's population in the years between 1990 and 2006.

Checkpoint



Australia's population in the future.

Activity 2: Modeling population change due to Net Overseas Migration.

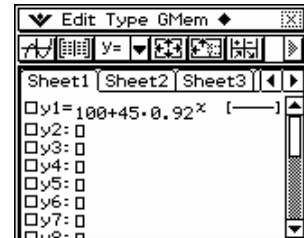
Based on Australian Bureau of Statistics data, a model for Australia's population change due to Net Overseas Migration M (in thousands per year) is the function

$$M = 8x + 30 \quad \text{where } x \text{ represents time, in years since 1990.}$$



Before you start work with this new model, *deselect* the previous model by tapping on the ticked box.

The tick will disappear, showing that the function is no longer selected. Repeating this process will *reselect* y_1 .



Working with Net Overseas Migration

1. Draw a graph of this model for M , Australia's population change due to Net Overseas Migration for the period 1990 until 2020. You will need to adjust your View Window.
2. Use this model to determine Australia's population change due to Net Overseas Migration in
 - a. 1990
 - b. 2000
 - c. 2006
 - d. 2020
3. Describe how, according to your model, Net Overseas Migration has contributed to Australia's population over this period.

Checkpoint



Activity 3: Representing total population change.

1. By *reselecting* your model for N (and leaving your model for M selected) draw a graph of *both* models for the years 1990 until 2020 on the same axes.
2. Find the year in which these two models intersect.
3. Interpret what this result means about Australia's population change, at and after that time.

Checkpoint



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Activity 4: Modeling total population change

1. Write down an algebraic model for T , Australia's *total population change* in the years since 1990.
2. Represent this algebraic model graphically.
3. Determine the year in which Australia's total population will first increase by more than 300 000 individuals, according to your model.
4. Of these 300 000 person increase in population, what percentage will come about by Net Overseas Migration, according to your models?



Checkpoint

ⁱ The information about, and graph of, long-term population projections comes from the *Australian Immigration Fact Sheet – Population Projections*. This is published by the Australian Government's *Department of Immigration and Multicultural Affairs* and can be found at <http://www.immi.gov.au/facts/15population.htm>