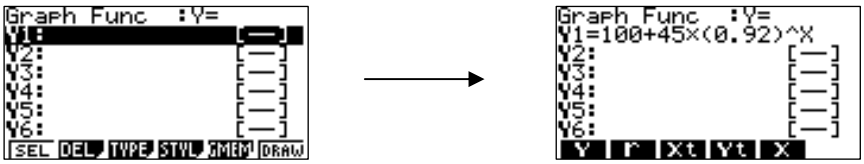
Australia's population in the future.

Checkpoints

Activity 1: Modeling population change due to Natural Increase.

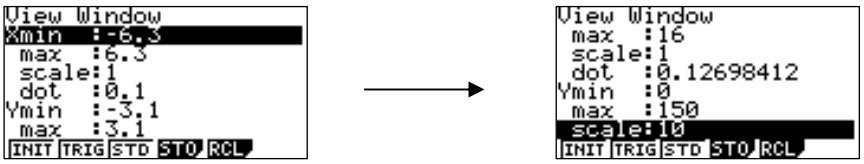
Part B – Entering a function.



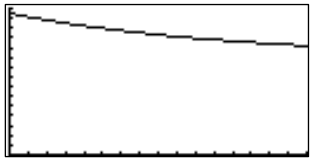
Part C – Setting a View Window.

Starting from the initial view window (shown left),

- Set the `xmin` as 0 [EXE], `xmax` as 16 [EXE] and a `scale` of 1 [EXE].
- Arrow up ▲ or down ▼ to move between rows.
- Set the `ymin` as 0, the `ymax` as 150 and a scale of 10.

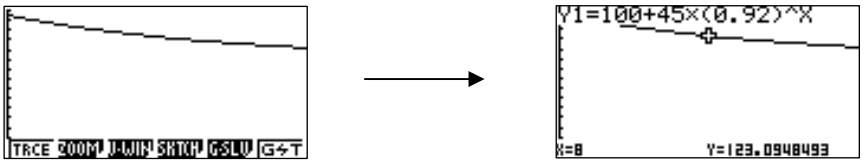


Part D – Drawing a graph



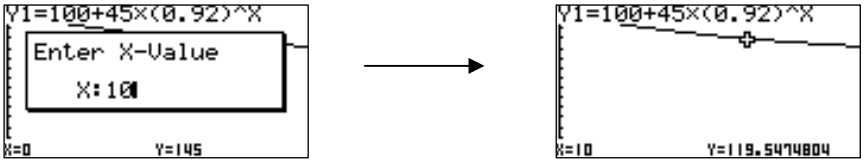
Part E – Tracing to obtain function values

Pressing [SHIFT] then `TRCE` [F1] starts the `TRACE`, which always starts in the middle of the graph (horizontally speaking).



Arrowing left ◀ and right ▶ will get you to `x=0` and `x=16`

To get to x=10 you just need to type 10 while in `TRACE`



Answers.

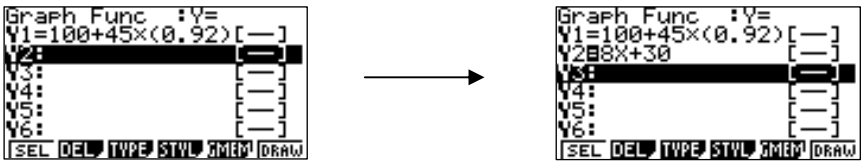
1. a. In 1990 Natural Increase caused Australia's population to grow by 145 000 according to the model for *N*.
   b. In 2000 Natural Increase caused Australia's population to grow by 119 550 according to the model for *N* (to 5 significant figures).
   c. In 2006 Natural Increase caused Australia's population to grow by 111 850 according to the model for *N* (to 5 significant figures).

2. Natural increase has caused Australia's population to grow in the years from 1990 to 2006 but in each successive year it has caused the population to grow by less than the growth of the previous year, according to our model.

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

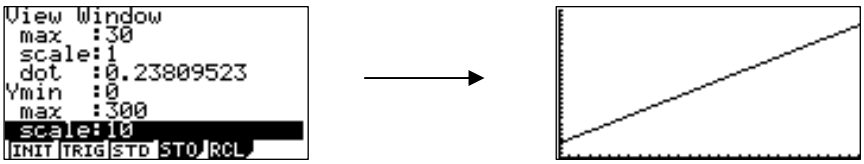
Deselecting a function.

By placing the input bar over a function and using the SEL F1 command, a function can be deselected and reselected. *Only selected functions are drawn*.

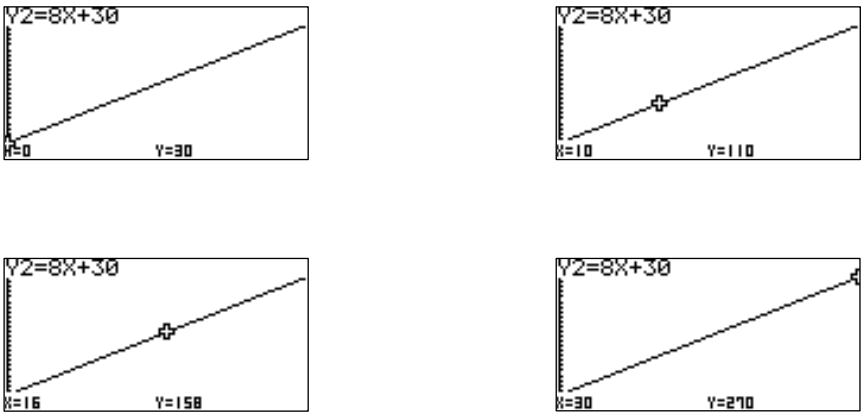


Answers.

1. The View Window will need to be changed to include the years up to 2020 (x=30) as well as *N* values of up to at least N=270. A set of View Window settings are shown below. Press EXE and DRAW F6 to draw the graph



2. Using TRACE, and entering the x values required, the following information can be obtained



From this we can see that,

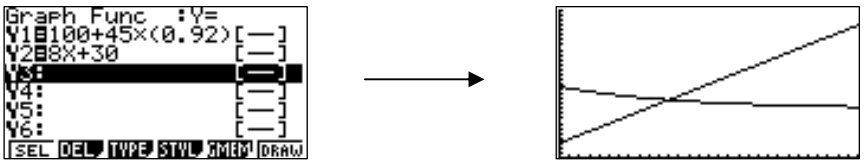
a. In 1990 Australia's population change due to Net Overseas Migration was 30 000 individuals, according to the model.
b. In 2000 Australia's population change due to Net Overseas Migration was 110 000 individuals, according to the model.
c. In 2006 Australia's population change due to Net Overseas Migration was 158 000 individuals, according to the model.
d. In 2020 Australia's population change due to Net Overseas Migration will be 270 000 individuals, according to the model.

3. Over this period Net Overseas Migration has made an ever-increasing contribution to Australia's population growth, according to the model.

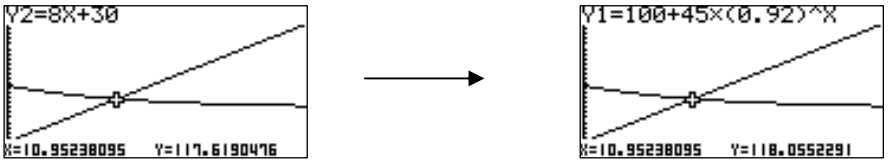
Activity 3: Representing total population change.

Answers.

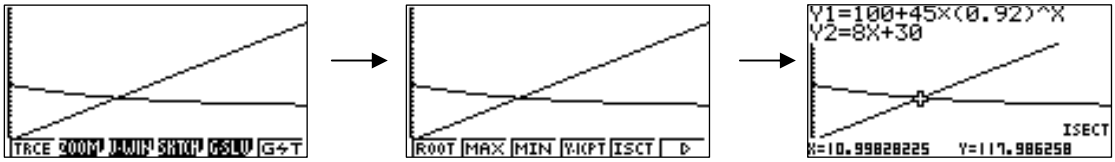
1. By reselecting and drawing we get



2. The year when *N* and *M* intersect can be found using TRACE. When using TRACE with two or more graphs drawn the ▲ and ▼ keys allow you to move from one function to another.



The time of intersection can also be found by using the INTERSECT command, part of the G-SOLVE men. This, and other useful commands, can be obtained by pressing SHIFT then G-SLV F5 then choosing ISCT F5



This confirms that the models predict that *N* and *M* will intersect at $x = 11$, corresponding to the year 2001.

3. This result means that, in 2001, Natural Increase and Net Overseas Migration made equal contributions to Australia's population increase. After that time Net Overseas Migration makes a greater contribution to Australia's population growth than Natural Increase, according to our model.

Activity 4: Modeling total population change

Answers.

1. Using the idea that

   Total Population Change = Natural Increase + Net Overseas Migration

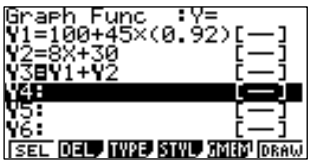
   we can define a model for Australia's Total Population Change *T* (in thousands per year) as the function

   T = N + M

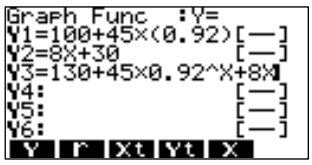
   which, in terms of x, can be written as

   $T = 100 + 45 \times (0.92)^x + 8x + 30$ where x represents time, in years since 1990.

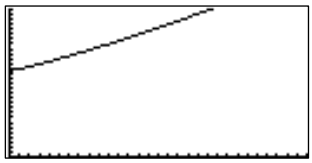
2. Either version of the model for Total Population Change can be graphed



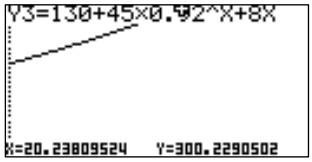
or



   To enter the left hand version, Y is obtained by pressing VARS then GRPH F4 then Y F1. Also notice, the right hand function has been slightly simplified. The graph of either version of *T* looks like



3. The year in which *T* will exceed 300, according to our model can be found, using TRACE, to be 2010



4. In 2010 Net Overseas Migration is predicted by our model to be 191 900, roughly 64% of Australia's Total Population Change.