

Investigating the maths inside:

Prawns for profit

Activity 3

Populations, people and prawns



How do populations increase and decline?

# Introduction

Predictions are often made about the future population of humans and various animal species. Such predictions are very important. We must plan ahead to ensure that there is enough food available for human consumption. It is also important that biodiversity is maintained.

In this activity, you will use a calculator and a spreadsheet to model situations in which populations are increasing or decreasing. These models will be used to make future predictions.

# Modelling populations

## The population of Australia: Milestones

This video shows some of the milestones of Australia’s population.

[www.abs.gov.au/videos/360-0216-002/360-0216-002\_player.html](http://www.abs.gov.au/videos/360-0216-002/360-0216-002_player.html)

While watching the video, complete the table.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **1918** | **1959** | **1981** | **2004** | **2007** | **2010** | **2013** | **2016** |
| ***Time*** | 0 | 41 | 63 | 86 |  |  |  |  |
| ***Population***  ***(millions)*** |  |  |  |  |  |  |  |  |

## Australia’s population clock

The following link will take you to the Australian population clock that is published by the Australian Bureau of Statistics (ABS).

[www.abs.gov.au/ausstats/abs%40.nsf/94713ad445ff1425ca25682000192af2/1647509ef7e25faaca2568a900154b63?OpenDocument](http://www.abs.gov.au/ausstats/abs%40.nsf/94713ad445ff1425ca25682000192af2/1647509ef7e25faaca2568a900154b63?OpenDocument)

When this document was written, the population of Australia was 24 194 693. This figure was increasing by one person every 1 minute and 30 seconds. By the time you read this document, these statistics will have changed.

* What is the current population of Australia?
* How many people are born in Australia every hour?
* How many people die in Australia every hour?
* How many people migrate to Australia every hour?
* By how many people does Australia’s population increase every hour?

## The growth rate of populations

Growth in population is usually expressed as a percentage.

If population increases by 2% per annum, by the end of each year it will be 102% of the previous year. The percentage 102% can be expressed as the decimal 1.02.

Population growth can be modelled on a calculator or in a spreadsheet. Your teacher will provide a sheet of instructions to show you how to do this.

|  |
| --- |
| Growth of a town **F**or a town of 5000 people with a growth rate of 2% |

* What is the population of the town after one year?
* What is the population at the end of the fifth year?
* How many years does it take for the population to double?
* What is the population at the end of the tenth year?
* Press . How does this compare to the answer for question 4? Explain. Calculate the population at the end of the 50th year.

Write a sentence to describe the change in the population as time progresses.

In reality, the growth rate varies from year to year.

In the second year of the colony of NSW (1789), the non-indigenous population fell by 25%. In the following year it increased by 219%.

Why did the percentages vary so much in these early years?

### Growth of Australia (early)

Complete the table.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **1788** | **1789** | **1790** | **1791** | **1792** | **1793** | **1794** | **1795** |
| ***Population*** | 859 | 645 | 2056 | 2873 | 3264 | 3514 | 3579 | 3466 |
| ***Population growth*** | na |  |  |  |  |  |  |  |
| ***Population growth (%, to 1 d.p.)*** | na |  |  |  |  |  |  |  |

Source: [www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3105.0.65.001](http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3105.0.65.001)

### Growth of Australia (recent)

In more recent times the percentage population growth has been more stable. Complete the table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year** | **2006** | **2007** | **2008** | **2009** | **2010** |
| ***Population*** | 20 627 547 | 21 016 121 | 21 475 625 | 21 865 623 | 22 172 469 |
| ***Population growth*** | na |  |  |  |  |
| ***Population growth (%, to 1 d.p.)*** | na |  |  |  |  |

Source: [www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3105.0.65.001](http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3105.0.65.001)

### Growth of Australia (from 1900)

The graph below shows Australia’s population every ten years from 1900 onwards. Write a sentence to describe how the population is growing.

|  |
| --- |
| Growth of Australia (future) Your teacher will provide you with a spreadsheet on percentage growth.  The blue graph shows the actual change in population every ten years. The other graph shows what the population would have been if it increased by 1% every year from 1900 onwards. |

* Using two or three decimal places, what percentage do you think is the most accurate predictor of past growth?
* According to your model, find the population of Australia in 2030, 2040, 2050, 2060, 2070, and 2080.

The statisticians at the Australian Bureau of Statistics (ABS) take the job of predicting Australia’s future population very seriously. They estimated in 2013 that Australia’s population in 2101 will be somewhere between 42.4 million and 70.1 million.

[www.abs.gov.au/ausstats/abs@.nsf/Lookup/3222.0main+features32012%20(base)%20to%202101](http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/3222.0main+features32012%20(base)%20to%202101)

Why is it important to have an understanding of the future population?

This interactive illustrates what is meant when it is said that Australia has an ageing population. Why is the age profile important?

[www.abs.gov.au/websitedbs/d3310114.nsf/home/population%20pyramid%20-%20australia](http://www.abs.gov.au/websitedbs/d3310114.nsf/home/population%20pyramid%20-%20australia)

The ABS statisticians include several assumptions in their projections, such as life expectancy.

[www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3222.0Main%20Features42012%20(base)%20to%202101?opendocument&tabname=Summary&prodno=3222.0&issue=2012%20(base)%20to%202101&num=&view=\](http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3222.0Main%20Features42012%20(base)%20to%202101?opendocument&tabname=Summary&prodno=3222.0&issue=2012%20(base)%20to%202101&num=&view=\)

What are two other assumptions they may have used in their projections.

## Declining populations

Some populations decline rather than grow. This is called exponential decay.

Model the decline in the population of a town of 5000 people with a 15% decrease.

How many years does it take for the population to decline by half and how long before the population is zero?

Earlier you created and saved a spreadsheet called *Population Growth*.

Make a new copy of that file and save it using the name *Population Decline*.

Change the formulas in Row 2 to show the population declining by 15% per annum.

Read this CSIRO article about prawn farming. Note the prediction of Australia’s population in 2075, compared to your prediction.

[www.csiro.au/en/Research/AF/Areas/Aquaculture/Premium-breeds/Black-tiger-prawn](http://www.csiro.au/en/Research/AF/Areas/Aquaculture/Premium-breeds/Black-tiger-prawn)

### The ‘wild’ population of fish, prawns and other species

In the wild, many marine species have a population that is declining rather than increasing.Search the internet for information about a marine animal from Australian waters (such as prawns, abalone or lobsters) that has a declining population due to human consumption.

* Find a piece of statistical evidence, such as a graph or a percentage that indicates the decline in their population
* Describe what is being done to protect this food resource and to ensure sustainability.

Suggested websites:

[www.choice.com.au/food-and-drink/meat-fish-and-eggs/fish/articles/sustainable-canned-tuna](http://www.choice.com.au/food-and-drink/meat-fish-and-eggs/fish/articles/sustainable-canned-tuna)

[www.abc.net.au/news/2014-09-02/pacific-tuna-stocks-on-brink-of-disaster-says-glenn-hurry/5704644](http://www.abc.net.au/news/2014-09-02/pacific-tuna-stocks-on-brink-of-disaster-says-glenn-hurry/5704644)

[www.sustainableseafood.org.au/fish.php?seafoodName=&classificationOption=3&typeOption=&state=#searchresult](http://www.sustainableseafood.org.au/fish.php?seafoodName=&classificationOption=3&typeOption=&state=#searchresult)

# Extension: The number called *e*

Your teacher will show you a video about using an Excel spreadsheet to draw an exponential curve. This can be used as a model for the Australian population data. It also explains how to display the equation of the curve, which reveals the number called *e*.

Your teacher will also provide you with a spreadsheet to assist you to find *e*.

Your calculator has a function with which you can calculate powers of *e*.

Use your calculator to complete the following table, correct to 4 decimal places:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Some interesting facts about Euler’s number: [www.mathsisfun.com/numbers/e-eulers-number.html](http://www.mathsisfun.com/numbers/e-eulers-number.html)