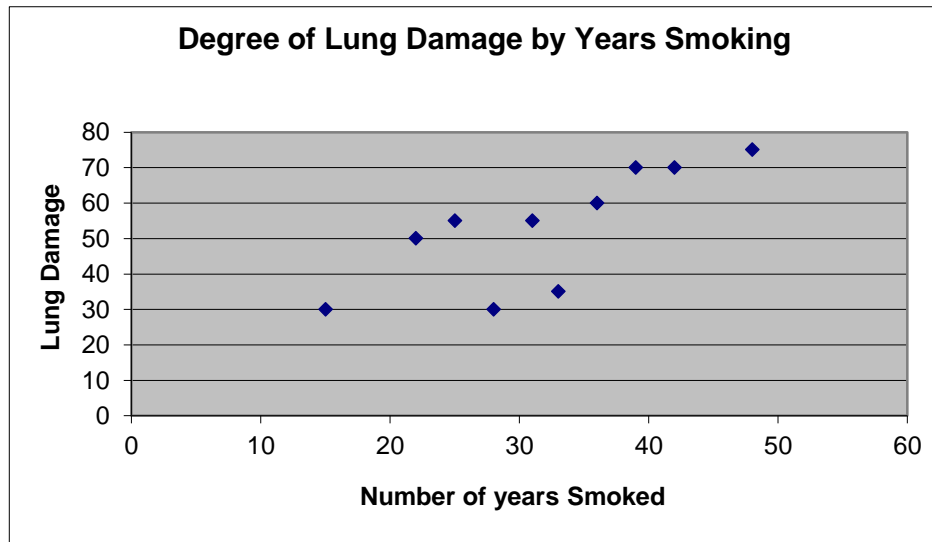
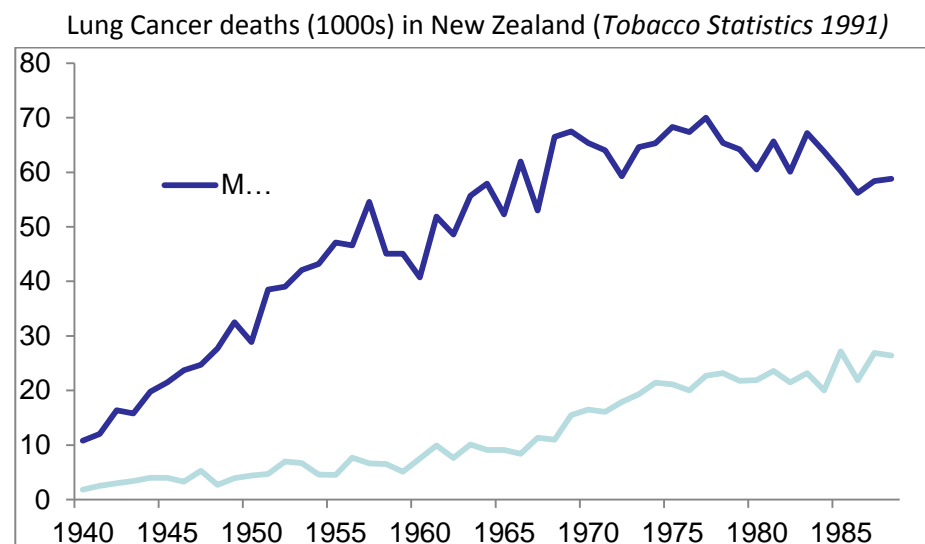


## Using graphs in decision making.

A policy example that demonstrates the use of simple graphs that can be created in Excel is New Zealand's smoking regulations and legislation. The first indication of an association between smoking and lung damage was demonstrated using simple scatter graphs such as the following that showed that lung damage increased linearly as the years of smoking increased.



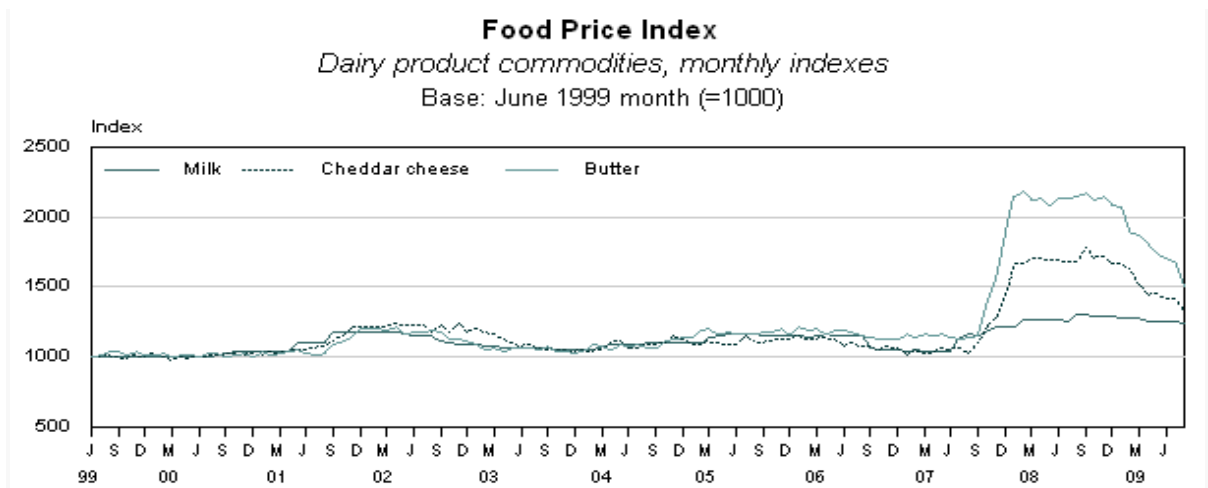
This was followed by time series showing the dramatic increase in lung cancer deaths following the Second World War.



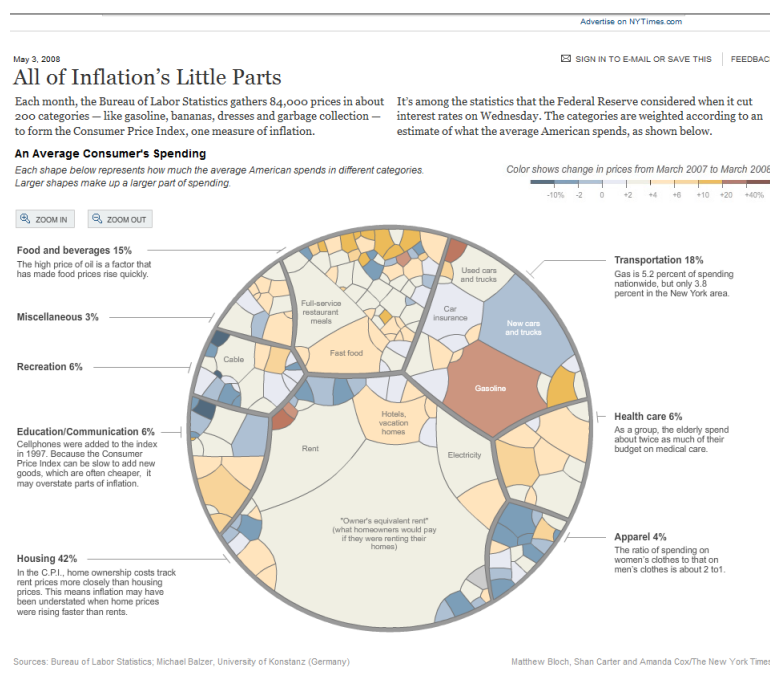
This type of data together with a report from the Surgeon General in 1964 resulted in a dramatic reversal in smoking policy in New Zealand (as in many other countries of the world) from its promotion and support through the provision of free tobacco to army services personnel and prisoners to the 1990 Smoke Free Environments Act.

Time series of smoking prevalence and tobacco consumption continue to be used to monitor the effectiveness of Government's incentives, disincentives and anti-smoking education campaigns.

Time series are a simple but powerful graph for looking at trends, for example in the following graph showing a dramatic rise in the price of New Zealand dairy products in the mid 1970s. This graph was displayed on television news and used in inform discussions on this controversial issue (see the video in the accompanying Web App on Measuring Price Change).



In New Zealand, as in many other countries, the Consumer Price Index (CPI), is used to inform Government and business decisions. The CPI is a measure of how the prices that households face change over time. Graphs that help explain how the CPI is constructed from the goods and services purchased by households include interactive tools such as the German statistics office's Price Kaleidoscope available at <https://www.destatis.de/Voronoi/PriceKaleidoscope.svg>.



In New Zealand the CPI is used by the media to inform the public of price (and standard of living) changes, by Government to adjust superannuation and other benefit payments, by the Reserve Bank to help set national monetary policy and by employers and employees in wage negotiations.

As it is hard to wrap your brain around big volumes of data graphs are used to **summarise** data and make **comparisons**, to **reduce** information and make huge data sets understandable, to **reveal** insight that may otherwise remain hidden, to give a **fast** overview and/ or to **convey** a memorable story by showing data visually.

The type of graph used depends on the type of data to be displayed (whether it is categorical, numeric discrete or numeric continuous) and what type of summary or feature is being displayed (frequency, association, change over time, etc.) Some graphs that can be created in Excel and are in common use by decision makers are pie and bar charts, histograms and population pyramids, scatter graphs, box plots and time series line graphs. A summary of these graphs and what they are used to show is given on the last page of this document.

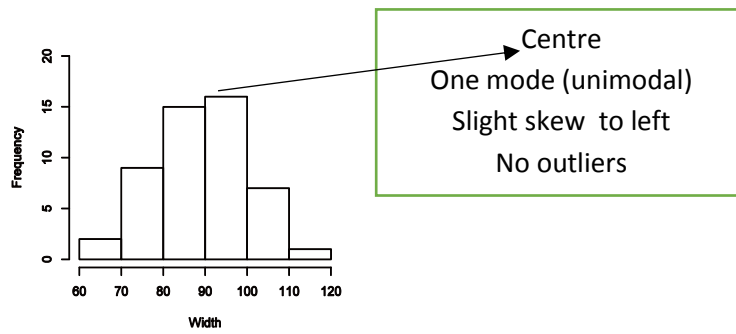
The following gives the type of graph(s) would best suit in each given situation:

- Total Population in each region of a country - **bar chart**
- Monthly visitors by country of origin - **bar chart**
- Responses to the question: what will your party vote be in an election - **bar or pie chart**
- Compare the number of hours boy and girls spend on computers - **clustered bar chart**
- Population by age and sex in an indigenous population - **population pyramid**
- Height of children in a school - **histogram or box plot**
- Number of visitors arriving in a country every month - **time series**
- Relationship between age and how many hours spent watching TV - **scatterplot**
- The number of cigarettes smoked by degree of lung damage for individuals in a health study - **scatterplot**

Using graphs in decision making requires interpretation of their main features. These include for graphs such as bar charts, histograms, boxplots and scatter graphs that display all the data:

- where the centre of the data is
- how much spread is in the data
- and how many peaks (modes) there are
- whether it is symmetric or skewed
- whether there are observations far from the rest of the values (outliers).

Example:



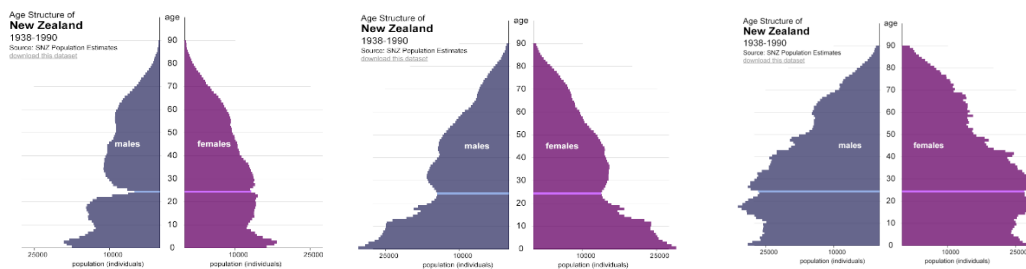
Features to look for in line graphs and time series include:

- trends over time (increasing or decreasing)
- repeated patterns in the data (such as seasonal changes)
- points of abrupt change.

The graph below shows that, in New Zealand, unemployment rates generally decrease as people are older, with a slight bump (increase) between ages 40-50 years.

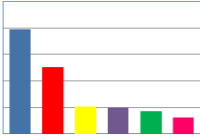
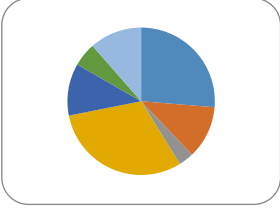

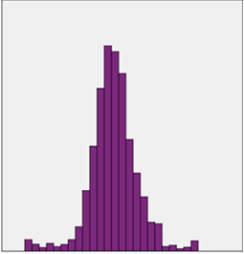
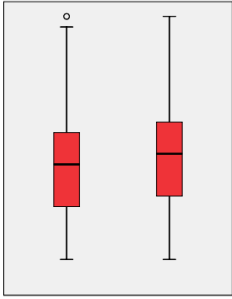



Good graphs tell a story that is based on the data without exaggerating any aspects of it. The three population pyramids below of the New Zealand population in 1945, 1960 and 1990 clearly show the impact of the second war world in the loss of young men, the baby boom that followed the war and its roll on impact in future generations.



Good and bad graphs are discussed in the next section.

**Summary - types of graphs that can be created in Excel and which to use when.**

Graph	Use to show	Name	Data
	Proportion	Bar Chart	Type of car owned
	Proportion	Pie Chart	"X Factor" Voting patterns
	Relationship between variables	Scatter Diagram	Height vs Foot length
	Distribution	Histogram	Foot length
	Compare groups	Box plot	Girls' and boys' heights
	Trend over time	Time series	Price change for different fruits