MAKING SENSE OF SEA ICE DATA

The Arctic Survey's measurements will allow us to better characterise the current state of the Arctic sea ice cover and predict its declining trend.

The Arctic ice cap is in trouble. Due to global warming, summer sea ice cover has been shrinking by an area the size of Scotland every year. But scientists believe that the thinning of the ice is even more important when it comes to the future of the ice caps – they believe that the Arctic ice cover will break up and disappear through thinning, rather than shrinkage. While it's easy to measure the sea ice extent from satellites, it's much more difficult to assess the thickness of the ice. This is the aim of the Catlin Arctic Survey: along their route through the Arctic, they will gather much-needed information on the ice thickness, as well as the type of ice to be found in the Arctic. All the data they gather will need to be organised and analysed, and the results will need to be presented accurately and in a way that's accessible to everyone – this means that statistics lie at the heart of the scientific part of the Arctic Survey.

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The ice team drill into the ice to measure its thickness.

Statistics are something we all come across every day when we read the papers or watch TV. It might be the risk of cancer, the changing crime rate, the rise and fall of house prices or the melting of the Arctic ice cap – all of these are described by numbers which summarise large sets of data.

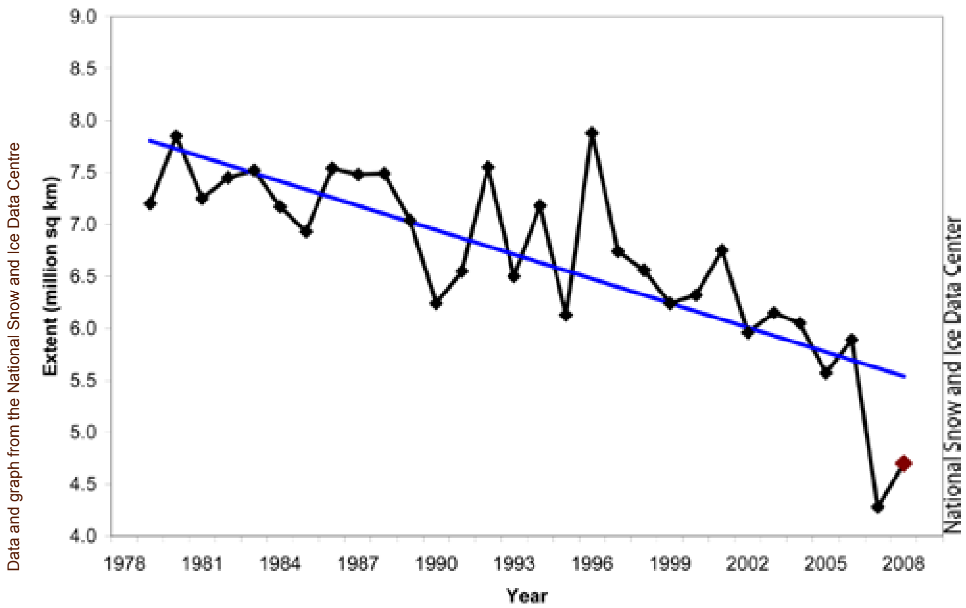
We couldn't imagine making important decisions without a solid base of evidence. You wouldn't want your doctor to guess what dose of medicine to prescribe – decisions on dosages and medical treatment are based on large sets of data from clinical trials to reduce the risks to patients. Scientists, like those working with the Catlin Arctic Survey, often base their theories on a large number of data from observations of the world around us. Governments collect large amounts of data which they will use to formulate policy that impacts on all of our lives. Even commercial companies design and launch new products after carefully collecting and interpreting consumer data.

Some people don't like the use of statistics. The saying "There are three kinds of lies: lies, damn lies and statistics" [1] illustrates that for centuries people have felt that statistics have been used to mislead rather than to reveal the truth. Even correct figures can be framed in such a way as to put a positive or negative spin on the data. But an understanding of statistics, and an awareness on how they should be presented, can help all of us identify when the numbers are being used to mislead, and when they accurately portray the data they summarise.

Trendsetters

One way of interpreting data is to look for trends – if we can mathematically describe the relationship between the variables in the data (the amount of sea ice over time, or the global mean temperature over time), we can understand the past and even make predictions about the future.

The simplest way to do this is to plot the data collected and try to fit a line to the points on the graph, a technique called *linear modelling*. Statisticians want the line that most closely matches the data, and have standard methods to calculate the line of best fit. One method, called the *least squares method*, involves examining the distances between each of the data points and the line, and choosing a line that minimises the sum of the squares of these distances.



This graph shows the sea ice extent measured in September each year from 1979 to 2008, together with a line of best fit.

The graph above shows the extent of Arctic sea ice as measured in September of each year since 1979, together with a line of best fit. The slope of the line of best fit can be interpreted as the annual decrease in sea ice extent each September. The year-by-year figures vary, but data covering a longer period gives us a bigger picture of what is happening. Not all data sets can be approximated by straight lines of course, and statisticians can also fit more complicated curves to real data.

1 Benjamin Disraeli, 19th century British Prime Minister'

But what happens if observations differ drastically from the curve of best fit, as is the case with the 2007 and 2008 figures in the graph above? When this happens statisticians use mathematical methods to establish whether the discrepancy is likely to be a statistical blip that occurred by chance, or whether it indicates a genuine change of trend. If the latter is the case, scientists go off to investigate the reasons for the drastic change, and statisticians fit new curves to the data to predict the future.

Reading between the headlines

Summarising a data set in a single number can give us a snapshot of the situation and can be a powerful way to communicate information. Single statistics are often used in the media, but also in other places such as briefing documents for politicians or decisions makers. But although the numbers used may well be correct, the person using that number (the reporter or the politician) has great power over the impression such a statement will create.

Does bacon cause cancer?

A recent media storm erupted over the dangers of the humble bacon sandwich. Many papers reported on figures released by the World Cancer Research Fund that eating 50g of processed meat a day (equivalent to a bacon sandwich) increased your chance of cancer by 20%. This sounded like a huge increase, but really it only represents an increase in your risk of cancer from 5% to 6%. That's just 1%, which no longer sounds quite so huge. The numbers in the sensational press coverage ("Careless pork costs lives" cried The Sun) were technically correct (1% is a fifth of 5%, so the 20% figure is fine), but they were presented in a way that gave a false impression of the data involved .

The important thing when faced with a single statistic is to ask yourself if it gives you the full picture. If it describes how your behaviour changes your exposure to risk, for example bacon sandwich eating causing a 20% increase in your risk of cancer, ask yourself what the risk was before, and what it would be after. If you're told you have a 10% chance of winning a lottery, remember you have a 90% chance of losing. The statistics might be correct, but they might be intentionally framed in a way to make you feel more positive or negative about the situation they describe.

To find out more about linear modelling and presenting statistical evidence, have a look at our worksheets *Making sense of ice data – predicting the trend* and *Arctic sea ice data – presenting the evidence.*

Further reading:

- From restaurants to climate change – linear modelling and trend analysis http://plus.maths.org/issue49/features/cook/index.html
- The tiger that isn't: numbers in the media – how to unravel misleading statistics in the media http://plus.maths.org/issue45/features/tiger/index.html
- 2845 ways of spinning risk – you can experiment online with different ways of framing evidence to give it a positive or negative spin http://plus.maths.org/issue50/risk/index.html
- Career interview, government statistician – discover how statistics can be used to provide aid to the developing world http://plus.maths.org/issue42/interview/index.html