Penguin Number

Learn how to estimate the number of penguins in a colony from piles of 'poo'.
(Adapted from Royal Statistical Society Web Site)

What you need

• Calculator • 'Poo' table • Satellite image of penguin colony

1. Look at this medium resolution Landsat image of an Emperor penguin colony in West Antarctica. Can you tell how many penguins there are? Look again, do you see a pink area? This is penguin 'poo' on the ice picked up on the satellite image. (Ariel Photography Digital Globe).
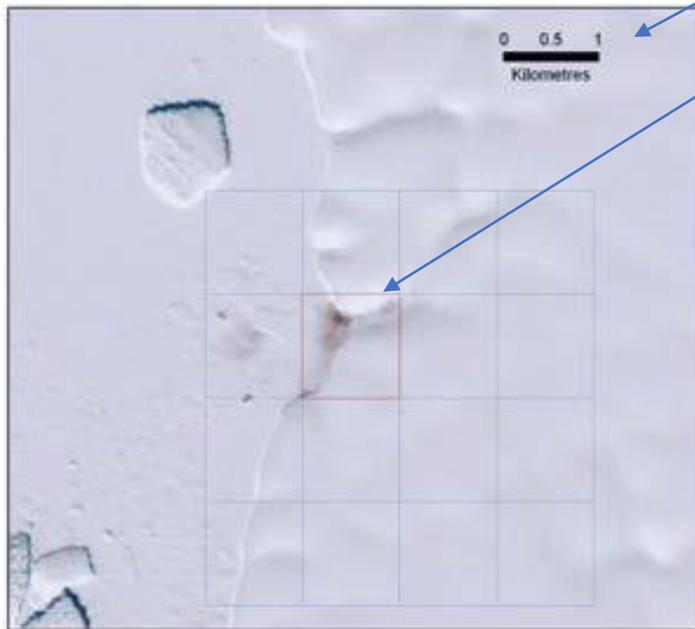
2. There is a scale at the top of the image. One square is 1Km by 1Km. The red square has about 20% of its area covered by penguin 'poo'. We can use this information to estimate how many penguins there are.

3. Researchers at Edinburgh Zoo have studied their penguin colony for a year and measured the area of guano ('poo') each penguin produces in a year.

A   B   C   D   E   F   G
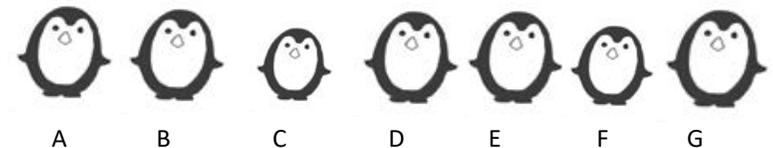
4. Look at the penguin population above. You want to 'sample' this population, that is take look at the guano produced by only a few members and get a mean. In this case select 3 penguins. Move to the next page and look at the penguin guano table, this shows how much guano each penguin produces in a year.

5. Look up your penguin ID letters on the table. Note down the area of guano that each of your penguin produces.

Penguin ID	Area of guano m2
A	15
B	15
C	7
D	19
E	9
F	17
G	21

C

B

G

The Calculation

1. Calculate the mean area of penguin guano produced by an average Edinburgh Zoo penguin. Use a calculator (or pencil and paper) to do this.

$$\text{Mean m2 of guano} = \frac{\text{m2 of guano penguin 1 + m2 guano penguin 2 + m2 guano penguin 3}}{\text{Number of penguins i.e. 3}}$$

2. Now we can use this figure for the Edinburgh Zoo penguins to estimate the number of penguins in the colony in the Antarctic. Look at the red square, the pink area is penguin 'poo''. The red square is 1km x 1km with about 20% of the area covered in penguin guano: 200 000 square metres.

3. Finally do this calculation: $\dfrac{\text{Surface area of guano in picture e.g. 200,000}}{\text{Mean m2 of guano (see 1)}}$

The Science

This activity is all about populations and sampling. Using information from a 'local' penguin population at Edinburgh Zoo we can suggest the number of penguins that are in the colony shown in the Land-sat image. What is a population? This is how we describe an entire group of individuals e.g. the entire group of Emperor penguins in the zoo's colony. By taking a random sample, an unplanned smaller selection of penguins, from a larger population we can estimate of the average amount of guano produced. If we have information about one population the statistician assumes that principle remains the same. If the zoo population produces a mean of 15 square metres of guano per penguin per year, then a penguin in Antarctica will produce the same amount of guano. Finally, if the area of guano can be measured from a Landsat image, then by using the calculation the statistician can 'estimate' the number of penguins.

Different random samples will lead to different estimates of the mean guano produce by the Zoo population. These 'means' will vary around the true mean of the population. The larger the sample the smaller the variation will be. By using a sample of a measurable population, we get an estimate which allows us to make an inference about a larger population.