# Problem of the Week
## Problem B and Solution
Destination: Estimation

Problem

(a) Charley wants to estimate the total number of birds in a picture. Her strategy is to divide the picture into eight smaller rectangles of equal area, count the number of birds in one of the smaller rectangles, and then multiply this number by 8. Using this strategy, estimate the number of birds in Picture 1.

Picture 1
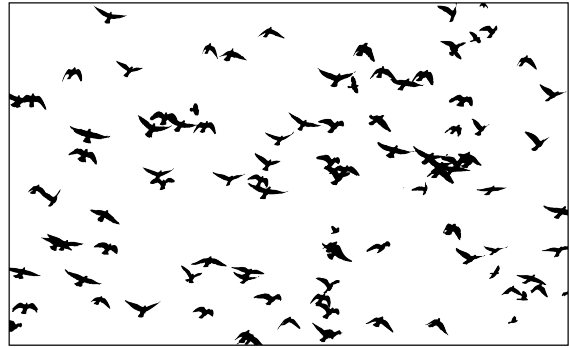
(b) Why might Charley's strategy not give a reliable estimate for the number of birds in Picture 2? Determine a strategy that will give a more reliable estimate, then use your strategy to estimate the number of birds in the picture.
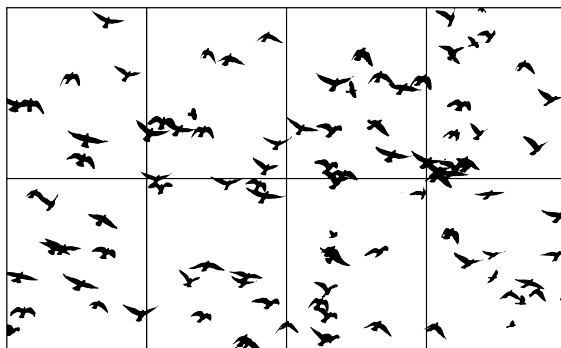
Picture 2
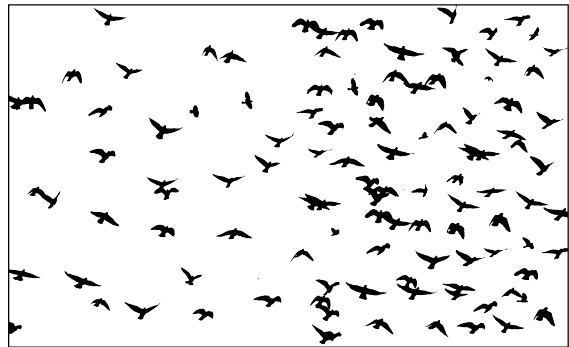
(c) Determine a strategy to estimate the total number of shipping containers on the boat in the picture, then use your strategy to get an estimate. How reliable do you think your estimate is? Explain.

Solution

(a) One way to divide the picture into eight smaller rectangles of equal area is by dividing it into two rows of equal height and four columns of equal width, as shown. We will choose the bottom-left rectangle and count the number of birds in it. Since there are 12 birds, our estimate for the total number of birds in the picture is $12 \times 8 = 96$. Note that estimates will vary depending on which rectangle is chosen and also on how the picture was divided into eight rectangles.

(b) In Picture 2, there are more birds on the right side than the left side. So Charley's strategy could give us an estimate that is considerably larger or smaller than the actual number of birds, depending on which rectangle is chosen.

One strategy is to divide the picture into 8 smaller rectangles like in part (a). The 4 rectangles on the left have few birds, while the 4 rectangles on the right have a lot of birds. We then choose two rectangles; one with few birds and one with a lot of birds, and count the number of birds in each. We then calculate the average (mean) of these and multiply it by the number of rectangles to get an estimate.
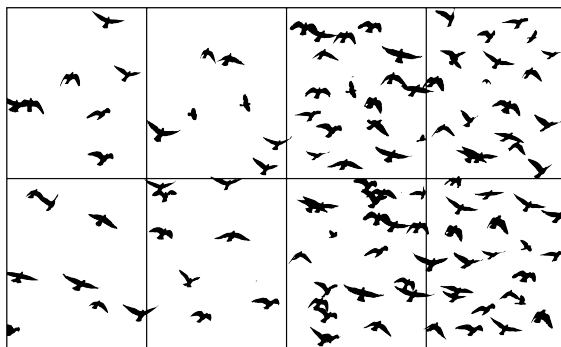
In our case, we will choose the top-left and bottom-right rectangles. We counted 7 birds in the top-left rectangle and 22 birds in the bottom-right rectangle. The sum of these is $7 + 22 = 29$ so the average is $29 \div 2 = 14.5$. Then our estimate is $14.5 \times 8 = 116$. Note that estimates will vary depending on the strategy used.

This is more reliable than Charley's strategy because it takes into account the fact that some rectangles have significantly more birds than others.

(c) It is very difficult to determine a reliable estimate for the number of shipping containers because we can't see them all. One strategy is to separate the shipping containers into rows, where each row is parallel to the back of the boat. The only row that we can see clearly is the closest row, where we counted 53 shipping containers. If we assume that the average number of shipping containers in all rows is 53, then we can multiply this by the number of rows to get an estimate. We counted 16 rows, so that means our estimate is $53 \times 16 = 848$. Answers will vary depending on the strategy used, but no strategy can give a very reliable estimate because we can't see so many of the shipping containers.