

For our discussion this week, we will explore the use of the maximum likelihood approach to estimation with a hypergeometric model, specifically for mark-recapture.

Data analysis

A study set out to estimate the size of a population of humpback whales. To do so, extensive aerial photographs were taken of whales in a breeding area in each of two consecutive years. After the first year, the photographs were closely compared, and unique whales identified (each was assigned an ID number). After the second year, then, the photographs were again closely compared, and unique whales identified; moreover, photos from the first and second years were closely compared, so that whales seen in both years could be identified.

We will assume that the whales that were seen were randomly sampled from the population in each year, and that the populations in the two years were the same.

Suppose that 10 unique whales were seen the first year, 20 were seen the second, and that 4 of these whales were seen again the second year (i.e. seen in both years). **$N=?$, $M=10$, $n=20$, $k=4$**

- (a) Plot the graph of the likelihood function given the results above.
- (b) Plot the log-likelihood function given the results above.
- (c) What is the maximum likelihood estimator of the population size on the basis of these results? Do the likelihood and log-likelihood in (a) and (b) yield different maximizers? Explain.