Assignment 3

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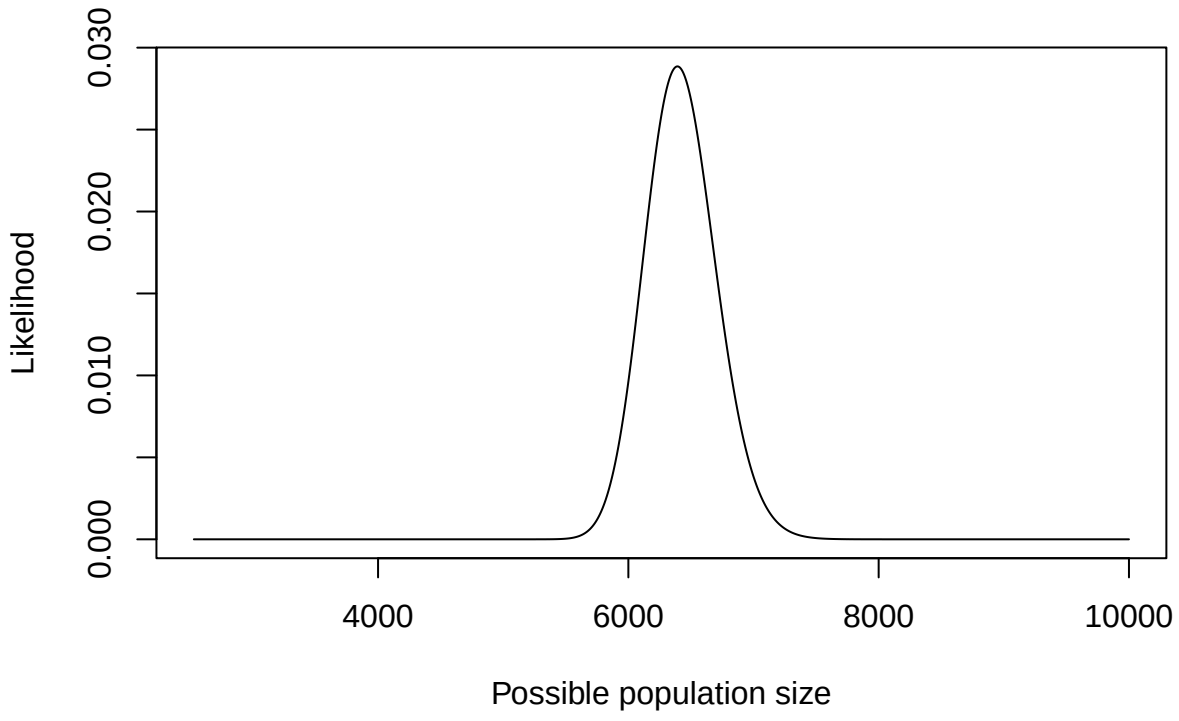
Study 1:

Using photos, researchers identified 1,377 and 1,467 individual whales in a breeding area during the first and second years of their study, respectively. Of those that they identified in the second year, 316 had been seen the previous year as well. Is the proportion of the whales seen in the first year that are seen again in the second large? What does this indicate about the size of the population relative to the size of the sample in the second year? Plot the likelihoods for possible values of the population size. What would you estimate the population size to be?

Parameters: M = 1,377, n = 1,467, m = 316

Smallest population possible: (M-m) + n = 2,528

In principle, any population size larger than 2,528 is possible. We can compute the likelihoods for possible values from 2,528 to 10,000.




```
## [1] 6392
```

Results: In this case 316 out of the 1,377 whales seen in the first year were seen again which is a small proportion, so it seems that the population size should be substantially larger than 1,467. Due to the small

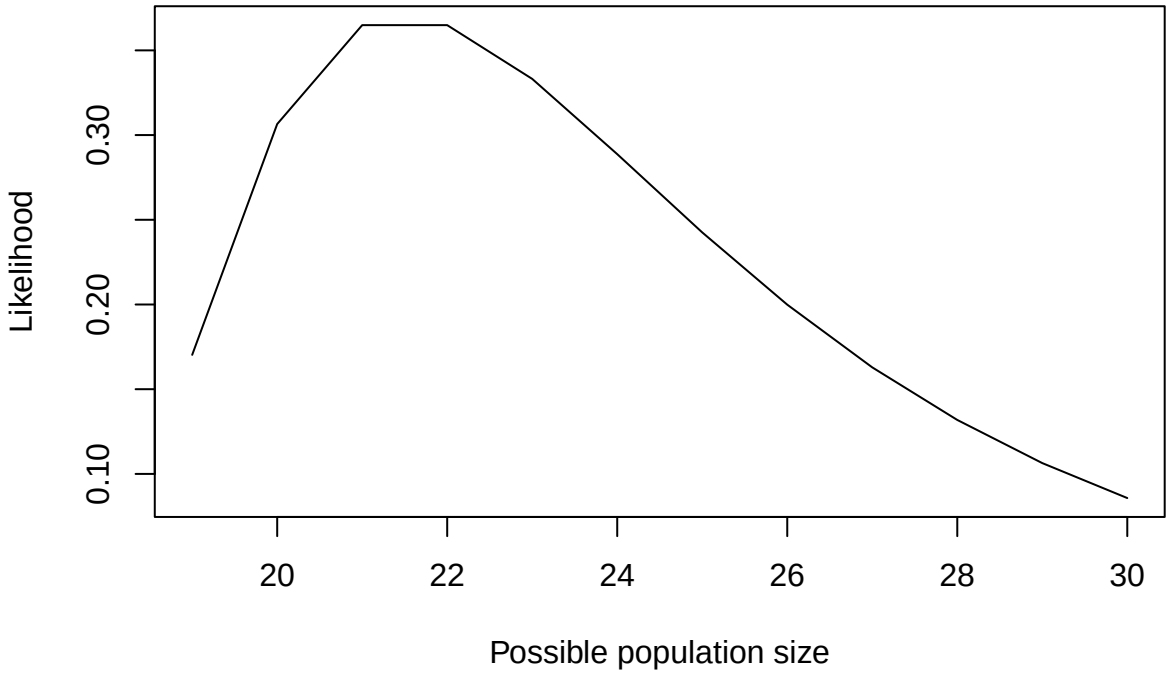
proportion of common whales seen in the second year the possible population range was taken to be from 2,528 to 10,000. With this we can see the possible values seem to be around 6,300. The exact value can then be calculated which turns out to be 6,392. This is the maximum likelihood estimate of the population of whales observed in the study.

Study 2:

In a separate study, researchers captured and tagged 16 grizzly bears. After the tagging, wildlife cameras in the area saw 11 different bears, of which 8 were tagged. Is the proportion of tagged bears that were seen by the cameras large? What does this indicate about the size of the population relative to the size of the sample seen by the cameras? Plot the likelihoods for possible values of the population size. What would you estimate the population size to be?

Parameters: M = 16, n = 11, m = 8

Smallest population possible: (M-m) + n = 19 In principle, any population size larger than 19 is possible.




```
## [1] 21
```

Results: In this case 8 out of the 16 tagged bears seen were seen again by the wildlife cameras which is half the initial population of the bears, so it seems that the population size should be greater than 11. Due to the proportion of bears seen by the cameras the possible population range was taken to be from 19 to 30. After plotting the graph using the likelihood approach we can see that the values seem to be around 20. The exact value can then be calculated which turns out to be 21. This is the maximum likelihood estimate of the population of bears observed in the study.

Appendix: R Script

```
knitr::opts_chunk$set(echo = FALSE, fig.align = 'center')
#define our function first
knitr::opts_chunk$set(echo = FALSE, fig.align = 'center')
hyperLik <- function(N,M,n,m){dhyper(m,M,N-M,n)}
knitr::opts_chunk$set(echo = FALSE, fig.align = 'center')
possibleN <- 2528:10000
likelihoods <- hyperLik(possibleN,1377,1467,316)
plot(possibleN,likelihoods,
type="l", # linear interpolation for a smooth curve
ylab="Likelihood",
xlab="Possible population size")
est <- possibleN[which.max(likelihoods)]
est
knitr::opts_chunk$set(echo = FALSE, fig.align = 'center')
possibleN <- 19:30
likelihoods <- hyperLik(possibleN,16,11,8)
plot(possibleN,likelihoods,
type="l", # linear interpolation for a smooth curve
ylab="Likelihood",
xlab="Possible population size")
est <- possibleN[which.max(likelihoods)]
est
```