

Reinforcing Likelihood concepts in L2.3-2.6 and developing R skills.

Problem 1: Sampling Distribution vs. Likelihood function

In an experiment, 10 seed are planted. 7 are observed to germinate and produce seedlings.

- i. What is an appropriate distribution to use to model this process? Why?
- ii. Plot the Sampling distribution: Calculate $P(x|p)$ for $x=0,1,2,3,4$ assuming $p=0.5$ and plot the Probability Mass Function.
- iii. Plot the Likelihood function given 7 of the 10 seeds germinated. Estimate the mle for p ?

Problem 2: Question. Is a coin fair? You sample 18 coin tosses and observe 10 heads.

Compare the likelihood function for p in the following two cases:

A Bernoulli process that results in $c(0,1,1,0,0,1,0,1,0,0,1,1,1,1,0,0,1,1)$

and a Binomial($k=10, n=18$).

- i. Compare the pmf for the Bernoulli and Binomial distributions. How are they similar and different?
- ii. Plot the likelihood functions in the same figure.
- iii. Are the likelihood functions the same? Why or why not?
- iv. Plot confidence limits on the likelihood plot using a likelihood set with $\alpha = 0.1$ (see L2.4.2). Is the coin fair?

Problem 3: Now instead of observing only ($k=10, n=18$) for a single coin, you are interested in testing the population of coins produced at a US mint. You sample 10 coins, 10 times each.

You observe the following number of heads:

6 3 7 3 6 4 4 5 3 8

Plot the likelihood function with the confidence limits as in Problem 2. iv. Is the mint producing fair coins?

Problem 4: Make a figure with 6 panels that show the likelihoods for the following samples (seedlings, seeds): (3,4), (6,8), (12,16), (24,32), (300,400), and (3000,4000).

Problem 5: Let's simulate seedling counts in forest quadrats. Let's imagine that we have a field experiment where we are measuring seedlings in forest gaps vs closed canopy.

- i. Simulate data that represent 20 quadrats sampled from a forest gap using a lambda (Poisson parameter) of 10 and 20 quadrats from beneath forest canopy with a lambda of 5.
- ii. Plot the likelihood function for the lambda parameters for the gap and forest plots. Estimate the mle for the gap and forest plots.