

# Likelihood and Population Size Estimation

# Likelihood vs Probability

- Probability
  - chance of observing specific data given an underlying statistical model
  - asks the question: how likely is this observation assuming that a certain model applies
  - How likely is it that you flip a coin 10 times and observe 10 'heads' and 0 'tails' assuming that probability is governed by a binary model (only 2 possible outcomes) with  $p = 0.5$ ?
- Likelihood
  - chance that a model explains a given set of observed data
  - asks the question: how likely is this model given the data I have observed
  - based on a number of trials of flipping a coin 10 times, what is the best model that describes those data and would allow future predictions?

# Capture-recapture studies

- All animals can be divided into 2 categories
  - those caught
  - those not caught
- Sum of those will equal population size—the parameter of interest
- Those that are caught can be further subdivided into those recaptured (e.g., Lincoln-Peterson, Schnabel), or for some estimators, those captured  $x$  times (frequency-of-capture estimator)

# Example of frequency-of-capture estimator

- Edwards and Eberhardt, 1967, JWM
- Estimating cottontail abundance in a fenced area
  - knew total population size
- Noted that some rabbits were trap-happy and some were trap-shy
- Violated assumption of equal catchability for Lincoln-Peterson and Schnabel estimators
- Would it have a large effect?
- Applied different estimators to determine which was best

# not captured  
Don't know this

# example data

	Observed data	Expected data			
Frequency of capture	# rabbits in each class	Schnabel MLE	Geometric Regression	Geometric MLE	Poisson MLE
0	59	20.6	59.7	87.5	24.2
1	43	33.2	33.3	40.7	34.3
2	16	25.2	18.6	18.9	24.4
3	8	11.8	10.3	8.8	11.5
4	6	5.2	5.8	7.6	5.8
5	0		8.0		
6	2				
7	1				
N	135	96.0	135.7	163.5	100.2

# captured x times

Want to estimate this