Practice problems for population estimation and population analysis

Capture-Mark-Recapture

You have been tasked to estimate the number of rattlesnakes using a series of hibernacula along a ridge in western Texas. To accomplish your assigned task, you capture 37 rattlesnakes and mark them with PIT tags. You return to the site one week later and resample the population by capturing 52 rattlesnakes. Of the 52, 30 are marked from your first sample. How many rattlesnakes are in the population? What is the variance of your estimate? What is the upper and lower 95% confidence limits of your estimate?

Equations and definition of variables:

n_1 = number of individuals marked in the population

n_2 = number of animals in the second sample

m_2 = number of marked animals in the second sample

$$\hat{N} = \left[\frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)} \right] - 1$$

$$\text{var}(\hat{N}) = \frac{(n_1 + 1)(n_2 + 1)(n_1 - m_2)(n_2 - m_2)}{(m_2 + 1)^2 (m_2 + 2)}$$

$$\hat{N} \pm 1.965 \sqrt{\text{var}(\hat{N})}$$

Double Sampling

You are assigned to estimate the number of sea otters along the coast of Washington. You have been allocated enough money to fly aerial surveys along 1/5 of the coastline of the state and to hire a few technicians to sample sea otters from the ground with spotting scopes. You decide to use double sampling to estimate your probability of observing sea otters during your aerial survey (β). During the double sampling phase, you observe 30 otters from the air and your ground observers count 47 otters. 670 otters are counted during the entire aerial survey. Use the above information to answer the following questions.

$$\hat{\beta} = \frac{\hat{Y}}{\hat{X}} \qquad \hat{N} = \frac{C}{\hat{\beta}} \qquad \hat{N} = \frac{C}{\alpha\hat{\beta}}$$

What is your estimate of β? _____

What is your estimate of the number of animals on the area that was surveyed from the air? _____

What is your estimate of the total population size on the entire study area? _____

Life table analysis:

Construct a life table for the following data. Fill in the spaces provided in the table below.

Tiger salamanders

x	n_x	d_x	q_x	s_x	l_x
0-1		438			
1-2		300			
2-3		150			
3-4		70			
4-5		22			
5-6		20			