|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Habitat type** | **# predated** | **# not** |
| 2002 | Forest | 32 | 3 |
| 2002 | Edge | 18 | 17 |
| 2003 | Forest | 28 | 7 |
| 2003 | Edge | 26 | 9 |

BIOL 196.04 – Ecological Models and Data – TEST #1 – 25 February, 2014

NB: Each subproblem is worth 10 points. There are a total of 120 points.

NB: There is a table of functions and formulas at the end of the test (pg. 4)

NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. The following data are from a study of Indigo buntings (birds). Researchers found nests in the forest interior and on the forest edge, and recorded whether the eggs in that nest were predated (eaten by other animals) or not.
   1. Find the MLE of the proportion of predated nests, using all nests in both years. Report this rate below:
   2. Find the 95% likelihood profile confidence interval of predation, using all nests in both years. Report this interval below.

* 1. Find the MLE of the predation rate, using a model with different predation rates on edges and in the forest interior. Report these rates below:
  2. Use LRT to compare these two models (one with a single predation rate, and one in which the rate differs among habitat types). Show the 2 statistic, degrees of freedom, and P-value. State your conclusion.
  3. Use AIC to compare these two models. Show the AIC for each model, and state your conclusion.

1. Consider a population of orchids with annual survival probability = 0.55, and annual reproduction probability = 0.45. Each orchid that reproduces makes exactly one capsule, that leads to exactly one young plant.
   1. If a population has 4 plants this year, what is the expected number of plants next year?
   2. Use the axioms of probability to calculate the probability that a population of 4 plants goes extinct within one year.

|  |  |
| --- | --- |
| **Fate in 1986** | **# of orchids** |
| Flowering | 60 |
| Vegetative | 4 |
| Dead | 1 |

1. The following data describe fates of 65 plants in a real population of lady’s slipper orchids (in Newton, Massachusetts).
   1. What is the MLE of the probability of flowering, conditioned on survival?

|  |  |  |  |
| --- | --- | --- | --- |
| Flowering probability | Likelihood | Prior Probability | Posterior Probabiity |
| 0.8 |  |  |  |
| 0.85 |  |  |  |
| 0.9 |  |  |  |
| 0.95 |  |  |  |
| 0.99 |  |  |  |

* 1. Consider five possible values for this flowering probability: 0.8, 0.85, 0.9, 0.95, 0.99. Calculate the likelihood of the data for each of these “models”, and enter the numbers into the table at left.
  2. Use Bayes’ theorem to calculate the probability of each of these “models”, assuming a uniform prior probability (i.e., all 5 values are equally likely, and, for this calculation, no other values are possible). Enter the prior probabilities and posterior probabilities into the table at left.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | # of islands | |
| year | sizeclass | with.voles | no.voles |
| 1972 | small | 16 | 24 |
| 1972 | medium | 11 | 7 |
| 1972 | large | 11 | 2 |
| 1973 | small | 17 | 23 |
| 1973 | medium | 14 | 4 |
| 1973 | large | 11 | 2 |
| 1974 | small | 28 | 12 |
| 1974 | medium | 14 | 4 |
| 1974 | large | 10 | 3 |
| 1975 | small | 21 | 19 |
| 1975 | medium | 12 | 6 |
| 1975 | large | 7 | 6 |
| 1976 | small | 4 | 36 |
| 1976 | medium | 14 | 4 |
| 1976 | large | 10 | 3 |
| 1977 | small | 19 | 21 |
| 1977 | medium | 16 | 2 |
| 1977 | large | 12 | 1 |

1. The following data describe whether islands in an archipelago (off the coast of Finland) were occupied by field voles, during a monitoring study from 1972-1977. Islands were divided into 3 size classes: small (< 1 Ha), medium (1-5 Ha) and large (> 5 Ha).
   1. Using data for large islands only, does variation in the proportion of occupied islands seem to be due to binomial sampling variance only? Explain the reasoning for your conclusion.
   2. What model would you use to describe island occupancy? Justify your answer using statistics.

Possibly-useful functions and formulas:

|  |  |
| --- | --- |
|  |  |
|  | dbinom(k,N,p, log = TRUE/FALSE) |
| logLik(model.name) |
|  | glm(Y ~ 1, family = binomial(link = “identity”)) |
|  | glm(Y ~ -1 + treatment, family = binomial(link = “identity”)) |
|  | confint(model.name) |
| cbind(successes, failures) |
| AICi = -2log(Li) + 2k1 | AIC(model.name) |