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Title:ESTIMATING POPULATION SIZE WITH OBJECTIVE BAYESIAN METHODS


The need for estimating population size arises in many fields. For example, in reliability study, one is interested in the number of potential faults in a system. In ecology, the scientists study how the population sizes of species living together as a group change over time and space. In this dissertation, I develop objective Bayesian approaches to estimate population sizes that appear in three different statistical models.

In the first part, I study a capture-recapture model (M_t model) that has been widely used to estimate the size of a wildlife population. I develop the objective prior for the population size parameter using a novel likelihood-based approach. The advantages of the objective prior over the traditional non-informative priors is shown by simulation results. Two real data examples are presented.

In the second part, I study a more complex capture-recapture model (M_th model). This model allows the capture probabilities affected by time and individual covariates. I use the objective prior developed in the first part and proved the posterior propriety in theory. The model and method are applied on the analysis of turtle data.

In the third part, I consider the survival model with exponential failure rate and type-I censored failure times. The total number of failures is unknown due to censoring and needs to be estimated. The problem is attacked with a hierarchical Bayesian model. Simulation results are reported to compare several objective priors.