Confidence Intervals for Population Size Based on a Capture-Recapture Design

Capture-Recapture (CR) experiments stemmed from the study of wildlife and are widely used in areas such as ecology, epidemiology, evaluation of census undercounts, and software testing, to estimate population size, survival rate, and other population parameters. The basic idea of the design is to use “overlapping” information contained in multiple samples from the population. In this report, we focus on the simplest form of Capture-Recapture experiments, namely, a two-sample Capture-Recapture design, which is conventionally called the “Petersen Method.”

We study and compare the performance of three methods of constructing confidence intervals for the population size based on a Capture-Recapture design, asymptotic normality estimation, Chapman estimation, and “inverting a $x^2$ test” estimation, in terms of coverage rate and mean interval width. Simulation studies are carried out and analyzed using R and SAS. It turns out that the “inverting a $x^2$ test” estimation is better than the other two methods. A possible solution to the “zero recapture” problem is put forward. We find that if population size is at least a few thousand, two-sample CR estimation provides reasonable estimates of the population size.