# Estimation in Closed Capture-Recapture Models When Covariates Are Missing at Random

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## 摘要

Individual covariates are commonly used in capture-recapture models as they can provide important information for population size estimation. However, in practice, one or more covariates may be missing at random for some individuals, which can lead to unreliable inference if records with missing data are treated as missing completely at random. We show that, in general, such a naive complete-case analysis in closed capture-recapture models with some covariates missing at random underestimates the population size. We develop methods for estimating regression parameters and population size using regression calibration, inverse probability weighting, and multiple imputation without any distributional assumptions about the covariates. We show that the inverse probability weighting and multiple imputation approaches are asymptotically equivalent. We present a simulation study to investigate the effects of missing covariates and to evaluate the performance of the proposed methods. We also illustrate an analysis using data on the bird species yellow-bellied prinia collected in Hong Kong. This is a joint work with Prof. Shen-Ming Lee and Dr. Jean de Dieu Tapsoba.