

Estimating Abundance from Large Data Sets of Counts in Irregularly-Spaced Plots

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Abstract: Monitoring environmental populations is an important goal for both academic research and management of natural resources. Successful management of populations often depends on obtaining estimates of their mean or total over a region. The basic problem considered in this paper is the estimation of the total from count data. The application has counts from thousands of irregularly-spaced aerial photo images. I model counts in images as a realization of an inhomogeneous Poisson process and use a fixed-rank spatial-design-matrix approach to model its spatial intensity surface. The fixed rank approach helps speed computations. The fitted intensity surface is integrated to provide an estimate of all unsampled area, which is added to the observed counts and also provides a finite area correction factor to variance estimation. The intensity surface from an inhomogeneous Poisson process tends to be too smooth for locally clustered points, as often happens for animals, so I consider three different overdispersion estimators. I use simulated data to examine estimation bias and to investigate several variance estimators with overdispersion. A real example is given of harbor seal counts from aerial surveys in an Alaskan glacial fjord.