On the Accuracy of Estimating Pest Insect Abundance from Data with Random Error

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Abstract

Numerical integration is a popular technique that can be successfully applied to evaluating the pest insect abundance in an agricultural field. In this paper we apply numerical integration in the problem where data about insects obtained as a result of a trapping procedure have random error (noise). We compare several methods of numerical integration that have different accuracy of evaluation when precise data are considered. In particular, we consider the composite trapezoidal and composite Simpson's rules of integration, and compare them with a statistical approach to obtaining an estimate based on the sample mean. The comparison is first done in the case when the number of traps where the data are available is large. It will be shown in the paper that noise in the data badly affects the accuracy of evaluation on fine grids of traps, so the different methods of numerical integration no longer differ in terms of their accuracy. We then consider an ecologically relevant case of a small number of traps, i.e. when the data available for evaluation are sparse. It will be discussed in the paper that the impact of noise is negligible on coarse grids of traps and therefore we can keep the accuracy hierarchy of numerical integration methods established from the consideration of precise data. We are then able to give recommendations on how to use methods of numerical integration to evaluate pest abundance. Our results are illustrated by numerical experiments.

Keywords: pest insect monitoring; noise; numerical integration; trapezoidal rule; Simpson's rule;

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