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Preface

Missing data in forest ecology and management: Advances in quantitative methods

In recent years, substantial progress has been made for handling missing data issues for applications in forest ecology and management, particularly in the area of imputation techniques. A session on this topic was held at the XXIII IUFRO World Congress in Seoul, South Korea, on August 23–28, 2010, resulting in this special issue of six papers that address recent advances and applications in imputation methods and related modeling techniques.

Missing data in natural resource applications include instances where some observations are missing for such reasons as nonresponse in surveys or hazardous sites in field data collections. In these cases the missing data can result in a sample that is not representative of the population, with the result that population estimators may be biased. Imputation and other statistical modeling methods have traditionally been used to improve the quality of results in these instances (Rubin, 1987).

However, in forest ecology and management there has been a recent increase in adaptation of similar techniques to different types of problems, where applications are needed to combine very disparate data sets, such as remote sensing data and field data. In these instances, imputation and related modeling methods are used to extend observations across space (e.g., Moeur and Stage (1995)) or update field measurements to a more current time period (e.g., McRoberts (2001)). The increasing popularity of these applications has in turn provided motivation for research on methods that improve spatial and distributional accuracy.

Imputation methods have been especially heavily utilized in remote sensing applications. Satellite images have been used to generalize field sample plot information in large area inventories (e.g., Tomppo et al., 2008). The rapid development of LiDAR has made it possible to map characteristics of vegetation accurately at a high resolution. In these remote sensing applications the role of imputation techniques is often emphasized, and such methods have already been applied in operational inventories (e.g., Packalén and Maltamo, 2007).

In this issue, the authors of the six papers explore recent advances in this emerging field. McRoberts (2012) provides a review of nearest neighbor techniques, focusing on recent advances in distance metrics, optimization, diagnostic tools, and inference. His paper provides a useful introduction to important issues for practitioners interested in trying nearest neighbors methods, and it will also serve as a helpful reference to those already working on such problems.

Three papers in this issue present new methods for improving the accuracy of nearest neighbor methods. Barth et al. (2012) use a heuristic optimization algorithm to improve spatial consistency at the stand and landscape level. Räty and Kangas (2012) combine the use of k-most similar neighbors with kriging to improve spatial predictions. One well-known problem with k-nearest neighbor applications is a tendency for resulting maps to have reduced variance; Baffetta et al. (2012) present a distribution-matching procedure to address this.

Two additional papers in the special issue illustrate the extremely wide variety of potential applications for techniques that address missing data issues. Ohmann et al. (2012) use gradient nearest neighbors for monitoring old-growth forest over a 23.2 million ha region in the Pacific Northwest, USA. Eskelson et al. (2012) compare nearest neighbor imputation and a parametric two-stage model to estimate density of snags by decay class.

Mapping for extensive areas, small area estimation, updating inventory information, and projecting future conditions are types of applications where use of nearest neighbors imputation and related methods will likely increase. Collectively these papers provide an introduction to using such methods, present some new improvements, and suggest future avenues of work in this area. We thank the authors, reviewers, the coordinating journal editor, and the presenters at the IUFRO session for their contributions to this special issue.

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