



Estimation of Finite Population Proportions for Small Areas—A Statistical Data Integration Approach

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(University of Maryland, College Park)

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Abstract

Empirical best prediction (EBP) is a well-known method for producing reliable proportion estimates when the primary data source provides only small or no sample from finite populations. There are potential challenges in implementing existing EBP methodology such as limited auxiliary variables in the frame (not adequate for building a reasonable working predictive model) or unable to accurately link the sample to the finite population frame due to absence of identifiers. In this paper, we propose a new data linkage approach where the finite population frame is replaced by a big probability sample, having a large set of auxiliary variables but not the outcome binary variable of interest. We fit an assumed model on the small probability sample and then impute the outcome variable for all units of the big sample to obtain standard weighted proportions. We develop a new adjusted maximum likelihood (ML) method so that the estimate of model variance doesn't fall on the boundary, which is otherwise encountered in commonly used ML method. We also propose an estimator of the mean squared prediction error using a parametric bootstrap method and address computational issues by developing an efficient Expectation Maximization algorithm. The proposed methodology is illustrated in the context of election projection for small areas.

About the Speaker:

Partha Lahiri is a Professor in the Joint Program in Survey Methodology (JPSM) and in the Department of Mathematics at the University of Maryland, College Park and an Adjunct Research Professor of the Institute of Social Research, University of Michigan, Ann Arbor. Prior to joining the University of Maryland, College Park in 2002, he held an appointment as the Milton Mohr Distinguished Professor of Statistics at the University of Nebraska-Lincoln. He has served on a number of advisory committees and panels, including the U.S. Census Advisory committee and U.S. National Academy of Sciences panel. Over the years he advised various local and international organizations such as

the United Nations Development Program, World Bank, and the Gallup Organization. He has been an associate editor of *Survey Methodology* and the *Journal of the American Statistical Association*. He is a Fellow of the American Statistical Association and the Institute of Mathematical Statistics and an elected member of the International Statistical Institute.

References:

Sen, A. and Lahiri, P., 2025. Estimation of Finite Population Proportions for Small Areas—A Statistical Data Integration Approach. *Journal of Survey Statistics and Methodology*, 13(3), pp.309-332.