

MARKOV CHAIN DESIGNS FOR ONE-PER-STRATUM SAMPLING

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ABSTRACT

Classical results in finite population sampling tell us that systematic sampling is the most efficient equal-probability one-per-stratum design for certain kinds of autocorrelated superpopulations, but stratified simple random sampling may be much better than systematic sampling if the superpopulation is a trend with uncorrelated errors. What if the superpopulation consists of a trend plus autocorrelated errors? Intuitively, some sort of "compromise" between the two designs might be better than either. Such compromise designs are constructed in this paper and are shown to be examples of Markov chain designs, a wide class of methods for one-per-stratum selection from a finite population. These designs include as special cases systematic sampling, balanced systematic sampling and stratified simple random sampling with one sampling unit per stratum. First and second-order inclusion probabilities are derived for Markov chain designs, yielding the Horvitz-Thompson estimator and its variance. Efficiency of the Horvitz-Thompson estimator is evaluated using superpopulation models. Numerical examples show that new designs considered here can be more efficient than standard designs for superpopulations consisting of trend plus autocorrelated errors. An example of the implementation of Markov chain designs for the 1992 National Resources Inventory in Alaska is given.