Multivariate Analysis and Its Applications
IMS Lecture Notes – Monograph Series (1994) Volume 24

BAYESIAN IMPLEMENTATION OF A COMPLEX HIERARCHICAL MODEL

BY A. P. DEMPSTER AND J. S. HWANG
Harvard University

Estimates are published each month for rates of employment and unemployment in each of the 50 United States plus the District of Columbia. The basic data source for these estimates is the Current Population Survey (CPS), a national survey that samples approximately 60,000 households each month according to a complex multistage design with rotating panel structure. Estimation procedures based on successively more detailed models can lead to corresponding successive improvements in accuracy of estimation. A three phase project-in-progress (i) models the multivariate time series structure of sampling errors from 8 parallel subsamples called streams, (ii) introduces time series models for the true series that are a basis for mean square error reduction through signal extraction methods, and (iii) jointly models true and covariate time series, from nonCPS sources, to achieve still more error reduction. Models and associated Bayesian posterior-sampler computing techniques are sketched in detail for the first phase that studies sampling error only.

1. Introduction. Any segment of a national population, such as U. S. residents aged 16 to 65, may be classified using appropriate definitions into "not in the labor force", "in the labor force and unemployed", or "in the labor force and employed", leading in turn to rates of employment (EMP) and unemployment (UNEMP) on any particular date. U. S. official statistics use the definitions embodied in the Current Population Survey (CPS) which is also the basic data source for the estimates released each month.

For practical reasons related to cost, and to a lesser extent related to accuracy of estimation, the CPS does not select an independent random sample from the population each month. Before introducing the actual design, and the consequent autocovariances of sampling errors implicit in the design, it may illuminate our analysis strategy, and forestall confusions, if we separate

---

AMS 1980 Subject Classifications: Primary 62D05.
Key words and phrases: Complex survey designs, sampling error autocovariances, small area estimates.