The three papers presented in the session “Design of surveys for measuring change over time” study important problems in repeated surveys and analyses of data coming from such surveys. The paper by Meza, Chattopadhyay, Lahiri and Tourangeau investigates a problem of a partial replacement of units from occasion to occasion in order to estimate the mean on the last occasion. Steel’s and McLaren’s paper deals with the analysis of aggregated data, namely with the trend estimation by using filters constructed under the criteria of fidelity, smoothness and minimal revisions between the initial and final estimates. The third paper by Smith is a discussion itself that puts a variety of relevant issues in repeated surveys into perspective.

The first paper readdresses a classic problem investigated by Jessen (1942), Yates (1949), Patterson (1950), Cochran (1963), Des Raj (1968). In particular, the authors consider an optimal retainment of primary sampling units (PSU) in a two-stage sampling design. Other design features, however, are assumed rather simple: The population has a fixed size \((NK)\) in two occasions; the PSU’s are of equal size \((K)\); the second stage subsamples are of equal size \((k)\) too; and the simple random sampling is assumed for both stages. The practice of survey sampling requires solutions for more complex situation, in particular, for the changing population sizes, for the unequal sizes of PSU’s, and for the unequal selection probabilities. The very first question that one may pose in a manner of the third speaker (Prof. Smith) is what exactly the current estimate estimates. Is it the population mean on the second occasion for the population “of the first occasion”, or is it the population mean for the population on the second occasion. Keeping the population size constant, the authors opted for the first option which can be labeled as a “longitudinal” option, as opposed to a second “cross-sectional” possibility. The parameters (variances and their components) are assumed known. In reality this is a rare case. They have to be replaced by their estimates. How much of the found relationship will be retained when using the estimates based on a complex sampling scheme. The “within” sample effects can probably be estimated accurately \((k\) is fairly large), but the “between” components can pose problems if there are few PSU’s per stratum. In addition, if the interest is in estimation of change \(\Delta\) a reasonable approach would be to find a solution in a form that combines the gross and the net change estimated independently from the overlapping and the nonoverlapping parts:

\[
\Delta = \Phi(\bar{y}_{2n} - \bar{y}_{1m}) + (1-\Phi)(\bar{y}_{2u} - \bar{y}_{1u})
\]

where \(\Phi\)is found to minimize the variance of \(\Delta\).

The second paper by Steel and McLaren deals with the trend estimation by using Henderson moving average filters according to the criteria of fidelity, smoothness, and minimal revision between initial and final estimates. Also they consider the effect of different rotation patterns on the properties of trend estimates. The optimal trend filters depend on: \(V_e\), the variance of sampling errors; \(V_\eta\), the variance of the irregular component; \(V_e\), the variance of the error terms in a local dynamic polynomial model (of order \(p\)); and also on the variances of the \((p+1)\) order differences of the corresponding errors.
The assumption is that all of these variances are known. In such a case the major concern of the authors is the variance of the sampling errors. The rotation pattern defines the structure of $V_e$, and the sampling design determines the magnitudes of $V_e$ elements. The estimation of $V_e$ itself can be a problem. That is why a kind of a robustness study of the optimal trend with the respect to the quality of $V_e$ is needed. If such robustness holds, only a working covariance matrix with the accurate structure coming from the known rotation pattern, and with the approximated values of variances and covariances is needed. However, the problem of confounding of sampling errors with irregular components remains, and the estimates of trend may be influenced by it.

The third paper by Smith is a discussion itself that puts a variety of relevant issues into perspective. Some of these issues are: The utmost importance of the clear definition of parameters of interest and objectives of analyses. In the repeated surveys context the understanding of the sampling over time plays an important role in establishing the appropriate variance structures, which further affect both the inference and the analyses. In the case of analyses of the aggregated data the filtering of time series is an issue. A good filter should eliminate the survey errors which otherwise become confounded with the trend and irregular components. I would like to add an important issue of the benchmarking of the time series which was not mentioned in paper. This method of combining information from different repeated surveys can be considered as a very general method of signal estimation under constraints.