WILLIAM G. COCHRAN, *Sampling Techniques*, Second Edition. John Wiley and Sons, New York and London, 1963. $9.95, £3/11/1 xvii + 413 pp.

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The first edition of Cochran's *Sampling Techniques* was one of several textbooks which appeared in the early 1950's. It was very favourably received, both in university circles and among survey statisticians. This success is explained by the outstanding professional competence of the author, the pedagogical merits of the presentation, and also by the reasonable size of the book (some 330 pages).

The second edition, published in 1963, represents primarily a useful modernization of the first edition. Several techniques have been included which were not presented at all in the first edition, in most cases because they were not as yet available, or only touched upon. As a result, the second edition has 413 pages; this size may still be called reasonable for a textbook.

The main novelties of the second edition are the following.

(1) Cochran has devoted several paragraphs to the problems associated with the concept of "domains of study" as coined by the U. N. Sub-Commission on Sampling; Cochran uses the term "subpopulations". A subpopulation is a part of the population for which one wants to have separate estimates; such separate estimates are called for in many, perhaps most, surveys. If such parts cannot be identified in advance and thus separate samples be selected from each part, the relevant sampling theory is more complicated than that applicable to estimates of parameters which refer to the overall population (or to separate strata).

(2) In the first edition, stratified sampling was discussed in one chapter of some 35 pages; in the second edition, close to 70 pages, divided into two chapters, are devoted to the same class of techniques. Among specialized topics introduced into these two chapters, I was pleased to find the following:

(i) *The problem of sample allocation with more than one item.* While the standard sampling theory is uniparametric, that is tied to the problem of estimating one single parameter (the overall mean, for example), sample survey practice is indeed multiparametric. In recent years, theory for coping with the multiparametric situation has been developed; Cochran summarizes these new results, pp. 118–125.

(ii) *Two-way stratification with small samples.* In some situations, there are two criteria of stratification, say by R "rows" and C "columns". Using both criteria in combination corresponds to breaking down the N units of the population into RC cells, but, if the sample size $n < RC$, it is not possible to select at least one unit from each cell.

Ingenious techniques have been developed for selecting a sample of $n < RC$ units in such a way as to get each one of the R row-strata and also each one

of the C column-strata represented. One such technique is presented in some detail by Cochran on pp. 126–128.

(iii) *The construction of strata.* Cochran presents some exact but hard-to-apply results, and also various approximate results, which are less complicated in practice. This topic is discussed on pp. 128–133.

(3) The discussion of ratio and regression estimation now includes unbiased ratio estimation, multivariate ratio estimation and regression estimation with preassigned coefficient of regression ("difference estimation"). These topics are discussed on pp. 176–181, 184–186 and 190–193.

(4) The discussion of one-stage cluster sampling and multi-stage sampling is somewhat enlarged; it covers some 90 pages in the second edition as compared with some 75 pages in the first edition. The additional pages have largely been devoted to the presentation of recent researches on sampling without replacement, with unequal probabilities of selecting (first-stage) units.

(5) Finally, the discussion of sources of error in surveys has been enriched by the inclusion of some new material. Two examples follow:

(i) Call-backs to cope with the non-response problem are discussed in two new paragraphs, pp. 361–366.

(ii) The reader is given a good introduction to the problem of errors of measurement and the contribution of such errors to the overall error.

The enlargement of the book has been accomplished in such a manner that the order of presentation of topics is essentially the same as in the first edition. Most of the new topics are treated in fresh paragraphs in the old chapters. The new chapter on stratified sampling is numbered 5A; thus its insertion does not change the old numbering of the chapters.

The new edition seems to be remarkably free from mistakes and I have failed to find any serious ones. I notice that on page xv in the table of contents, the title of Chapter 9 reads "One-stage cluster sampling", while on page 234, the title reads "Single-stage cluster sampling". On page 121, where Cochran discusses the problem of sample allocation in stratified sampling with more than one item, it would perhaps have been clearer had Cochran made a sharper distinction between (i) choosing the proper criterion, which in this case amounts to writing down certain crucial inequalities, and (ii) finding a general method of solution of these inequalities. This criticism is, however, epsilonic.

The second edition of Cochran's *Sampling Techniques* is an outstanding contribution to the field of statistics. Its influence on the improvement of sample survey theory and practice in the 1960's will no doubt parallel the influence of the first edition in the 1950's.