

UNIFIED THEORY AND STRATEGIES OF SURVEY SAMPLING

A. CHAUDHURI

Indian Statistical Institute Calcutta

and

J. W. E. VOS

Delft University of Technology



1988



NORTH-HOLLAND
AMSTERDAM · NEW YORK · OXFORD · TOKYO

TABLE OF CONTENTS

Part A - Unified Theory of Sampling

1.	Introduction	1
2.	Principal notation and formulation of the main problem	3
3.	Design-based estimation	
3.1	Motivation and certain preliminaries	5
3.2	Label-dependent estimators: UMV estimation	11
3.3	Optimal estimation: criteria for optimality	16
3.4	Necessary bestness and hyper-admissibility	48
3.5	Super-population approach	53
4.	Admissibility and other optimality properties of sampling designs	61
5.	Sufficiency and related concepts in survey sampling	65
6.	Sample Survey and General Statistical Model	73
7.	Further details on likelihood and Bayesian approach	90
8.	Predictive approach	101
9.	Robustness	120
10.	Concluding remarks	126
	Appendix	
A1	An optimality property of the sample mean	129
A2	Alternative models and relative performances of sampling strategies	129
A3	Inference about symmetric functions of exchangeable populations: non-informativeness of labels	131
A4	Robustness of strategies	133

Part B - Strategies of sampling

1.	Introduction and summary	143
2.	The Horvitz-Thompson estimator	145
3.	Subdivision of sampling schemes	148
4.	Sampling schemes for use of the HTE: $n=2$	
4.1	Method of Horvitz & Thompson	150
4.2	Method of Yates & Grundy	151
4.3	Method of Narain/Brewer & Undy	153
4.4	Method of Fellegi/Brewer	156
4.5	Method of Brewer (1963a)	158
4.6	Methods of Durbin (1967)	159
4.7	Method of Dodds & Fryer	161
4.8	Methods of Hanurav (1967)	163
4.9	Methods of Chaudhuri	168
4.10	Method of Singh (1978a)	169

4.11	Method of Kumar, Srivastava & Agarwal	171
4.12	Method of Deshpande & Prabhu-Ajgaonkar	172
4.13	Method of Durbin (1953)	173
4.14	Method of Rao (1963a)	174
4.15	Method of Rao (1965b)	175
4.16	Method of Agarwal, Kumar & Dey	176
4.17	Method of Hanurav (1967)	177
4.18	Method (2) of Durbin (1953)	179
4.19	Method of Narain (1951)	180
5.	Sampling schemes for use of the HTE: general n	
5.1	Systematic methods	181
5.2	Method of Grundy	182
5.3	Method of Horvitz & Thompson	183
5.4	Method of Deshpande (1982a)	184
5.5	Methods of Rao (1961) and Seth	185
5.6	Method of Sinha	186
5.7	Method of Rao (1963b)	188
5.8	Method of Fellegi	191
5.9	Method of Choudhry	193
5.10	Method of Hanurav (1962a)	194
5.11	Method of Brewer (1975)	196
5.12	Poisson sampling	197
5.13	Collocated sampling	199
5.14	List sequential sampling	201
5.15	Chromy's method	204
5.16	Sequential updating	206
5.17	Method of Vijayan	209
5.18	Methods of Rao (1963b) and Hajek	212
5.19	Sampford's rejective method	217
5.20	Rao's rejective method	221
5.21	Method of Kumar & Agarwal	223
5.22	Method of Stevens	226
5.23	Method of Agrawal, Singh & Singh	228
5.24	Hanurav's grouping method	230
5.25	Method of Fuller	232
5.26	Method of Samiuddin & Asad	236
5.27	Method of Mukhopadhyay	237
5.28	Methods of Jessen	240
5.29	Method of Nigam, Kumar & Gupta	244
5.30	Method of Gupta, Nigam & Kumar	245
5.31	Method of Kumar, Gupta & Nigam	247
5.32	Method of Das & Mohanty	248
5.33	Method of Choudhry & Singh	249
5.34	Method of Singh (1978b)	250
5.35	Method of Srivastava & Singh	252
5.36	Method of Sengupta	255
5.37	Method of Saxena, Singh & Srivastava	256
6.	Sampling with other strategies	
6.1	The Hansen-Hurwitz strategy	258
6.2	Strategy of Das	259
6.3	Strategy of Raj	261
6.4	Unordering of estimators	265
6.5	Unbiased ratio estimators	268
6.6	The Sen procedure	271
6.7	Method of Deshpande	272

6.8	An extended ratio estimator	273
6.9	Unbiased regression estimators	275
6.10	3-P sampling	278
6.11	Method of Rao, Hartley & Cochran	279
6.12	Method of Chikkagoudar	282
6.13	Inverse sampling	284
7.	Alternative estimators	286
8.	Ratio, product, and regression estimators	292
9.	Variance estimation	303
10.	Special designs	
10.1	Multi-stage sampling with varying probabilities	311
10.2	Double sampling with varying probabilities	317
10.3	Sampling in successive occasions	320
10.4	Controlled sampling	325
11.	Comparison of strategies	330
Appendix		
B1	Varying probability sampling for robust estimation	347
B2	Optimality of HTE under random permutation labelling	349
References		351 - 414