

SAMPLING ON TWO OCCASIONS
WITH PARTIAL REPLACEMENT OF UNITS

by 1264

NANTIT SUPAMONGKON
B.A., Chulalongkorn University, 1964

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Statistics

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1970

Approved by:

A. M. Feyerherm
Major Professor

LD
2668
R4
1970
585

TABLE OF CONTENTS

	PAGE
INTRODUCTION.....	1
FIXED SAMPLE, INDEPENDENT SAMPLES, AND PARTIAL REPLACEMENT.....	3
REPLACEMENT RATE.....	6
METHOD OF ESTIMATION.....	7
ESTIMATION PROCEDURE IN TWO OCCASION SAMPLING.....	8
COMPARISON OF PARTIAL REPLACEMENT WITH FIXED SAMPLE AND INDEPENDENT SAMPLES.....	17
OPTIMUM VALUE OF REPLACEMENT RATE.....	18
ESTIMATION OF CORRELATION COEFFICIENT.....	19

Introduction

When a population is subject to change over time, a single survey will only yield information about the properties of that population on a given occasion. A Survey must be repeated on several occasions in order to examine the changes of population characteristics and keep all aspects of the original estimated values up-to-date.

When the same population is sampled repeatedly, the opportunity for flexible sample design are increased. For example, on the second occasion, we may have parts of the sample that are matched with the first occasion. Such a method of partial matching has been termed "sampling on successive occasions with partial replacement of units" or "rotation sampling" or "sampling for a time series".

Yates (5) listed several alternatives for periodical re-survey as follow:

(1) A complete census or survey may be repeated in its original form at intervals.

(2) A sample census or survey may be repeated at intervals, a new sample being selected on each occasion without regard to previous sampling. He suggested the term "independent samples" for this sample scheme.

(3) A sample census or survey may be repeated on the same sample. The suggested term for this type of resurvey is "fixed sample".

(4) Part of the sample may be replaced on each occasion, the remainder being retained. The suggested term is "partial replacement".

(5) A resurvey of a subsample of the original sample may be made. In the case of complete census this is equivalent to a resurvey of a

sample of the whole population. The suggested term for this scheme is "subsample".

The procedure of partial replacement of units in successive sampling was initiated by Jessen (1). On two occasions, he computed two estimates on the second occasions as follows:

(1) a sample mean based on the new sample units

(2) a regression estimate based on the sample units observed on both occasions and an overall sample mean obtained on the first occasion.

A linear unbiased estimate of the population mean on the second occasion was obtained by combining the two estimates.

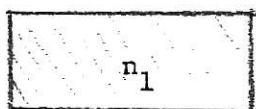
By Yates (5), this procedure was extended from two occasion to n , ($n > 2$) occasions under the restrictive conditions of constant sample size and fixed replacement rate on each occasion. Patterson (2) generalized the results further. Rao and Graham (3) employed a rotation sample design for these repeated occasion.

This paper is concern with estimate of some population values when alternative (4) with two occasions is adopted.

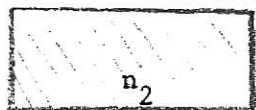
FIXED SAMPLE, INDEPENDENT SAMPLES AND PARTIAL REPLACEMENT

By comparison, we will clearly see the difference among the methods of fixed sample, independent samples and partial replacement. The advantages of partial replacement over the two schemes will be discussed.

(a) Fixed Sample



First Occasion.



Second Occasion.

Let n_1 = number of sampling units on the first occasion.

n_2 = number of sampling units on the second occasion.

$n_1 = n_2$ and they are the same sample.

Advantages of Fixed Sample

(1) In fixed sample scheme, we are able to evaluate a change of value in a characteristic under study. If there is a difference between values of our estimates from two occasions, we may say that it arises from the change of time.

This scheme is beneficial when used with non-human-populations as in a cropping survey or in forestry research.

(2) We can reduce cost and save time in survey planning since we use the same sample in the latter occasion.

Disadvantages of Fixed Sample

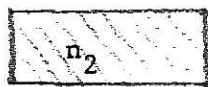
(1) Difficulty arises when the survey dealing with samples of human-populations. Enumerators frequently find lack of co-operation in giving information from the interviewees on the successive occasions.

(2) In the case that there is a change in our sample boundary such as damage from fire, we cannot substitute the lost sampling units by new selected units. If we do, there will be biasness in our estimate.

(b) Independent Samples



First Occasion.



Second Occasion.

n_1 and n_2 are defined as in a fixed sample scheme, but they are different samples from the same population.

Advantages of Independent Samples

(1) We get better co-operation from interviewees in fieldwork since we use a new sample on every occasion.

(2) Information based on all occasions yields an efficient total estimate. This is equivalent to simply increasing the number of sampling units.