

NON-TEXTBOOK PROBLEMS IN THE REVISION OF A  
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The paper illustrates several practical problems in the adaptation of statistical theory to survey design in the context of the revision of an employment survey programme.

## 1. INTRODUCTION

The practical problems in adapting statistical theory to survey design may often present more of a challenge than the associated theoretical development. The aim of the paper is to illustrate this point by describing a selection of practical problems encountered during the revision of an employment survey programme at Statistics Canada.

Section 2 of the paper provides a fairly comprehensive account of the environment within which the revision took place. Section 3 presents a selection of the problems arising. The progress which has been made towards resolving these problems, and some specific solutions, are described in Section 4.

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It should be noted that the perspective given here of the revision project, the Employment Statistics Development Project, is essentially a personal one. A list of more definitive documents follows the main text. References to the list are indicated by a number in brackets, for example, [1].

## 2. ESTABLISHMENT-BASED COLLECTION OF EMPLOYMENT DATA

### 2.1 Concepts, Terminology

A more precise title to this paper would have referred to revision of "establishment-based surveys of civilian employment and payroll in the non-agricultural sector of the economy". The objective of such survey activity is, in brief, to measure levels and month to month trends in paid employment, hours and earnings in all sectors of the economy (except agriculture, hunting, fishing and trapping) and to publish data at detailed geographic and industrial breakdown.

The term "establishment-based" implies that the data are collected from business and institutional establishments, in contrast to the Labour Force Survey [1] which also collects labour statistics but via households. Thus the survey universe is the set of all employers, i.e. firms incorporated or unincorporated, institutions, government departments, agencies, etc.

In this context "establishment" has a very particular meaning: it refers to the "smallest unit that is a separate operating entity capable of reporting all elements of basic industrial statistics" [2]. For the purposes of collecting employment, hours and earnings data, establishments are sometimes further divided according to geographic location and reporting capability into "reporting units".

Each establishment is assigned a standard industrial classification (SIC) code according to the nature of its principal activity.

There are just under 300 SIC codes grouped into a number of "industry divisions" [2].

"Employment" refers to all civilians drawing pay for services rendered or for paid absence during the survey reference period for when an employer makes CPP or QPP and or UIC contributions. Thus it includes full time, part time and casual employees but excludes owners of unincorporated businesses, self employed persons and unpaid family workers. The "survey reference period" is, in principle, the last pay period. "Hours" refers to time actually worked plus hours of paid absence, e.g. holidays, vacation, sick leave. "Earnings" refers to gross pay during the pay period including commissions, bonuses, overtime pay, etc., but excluding employers' contributions to pension plans, travelling expenses, etc.

## 2.2 Data Collection Methods in Current Use

Employment and payroll data are presently collected by survey and from administrative sources by two essentially separate programmes under the control of Labour Division and Public Finance Division respectively of Statistics Canada [4]. The principal features of these programmes are described below.

### (a) ES-1 Survey (Labour Division).

The ES-1 survey is a monthly census of larger firms in the commercial sector. In this context, "larger" refers to firms with 20 or more employees in any one month of the year, and the "commercial sector" excludes by definition education, health, welfare, public administration and defence. Approximately 50,000 questionnaires are mailed monthly from the Head Office (Ottawa). Also data for some government reporting units are obtained from the Public Finance Division programme. Non respondents are sent two reminders and finally contacted by telephone via the Regional Offices. The response rate at the time of publication is about 80%.

Returned questionnaires are clerically screened before entering the data capture and processing system. Edit, imputation and tabulation are automated. The monthly publication [3] is produced 3 months after the reference period. There is a preliminary release after about 60 days.

(b) ES-2 Survey (Labour Division).

The ES-2 survey is complementary to ES-1 for the commercial sector, i.e. it covers firms of less than 20 employees. The universe of 550,000 or so small firms is stratified into 17 industrial groups and 16 geographic areas. The monthly sample of some 37,000 is selected according to a panel rotation scheme. Within a stratum each firm is allocated to a panel. The number of panels depends upon the number of firms and the required stratum sampling fraction. In any given month 12 panels from each stratum are in sample. At the end of the month the oldest panel goes out of sample and a new one rotates in.

Questionnaires requesting employment data (not hours, earnings) are sent out by mail. They are followed where necessary by a single mailed reminder and, for non-respondents new to the sample, by Regional Office telephone contact. The response rate is about 75%. The employment figures are not published separately. They contribute about 25% of the total employment reported in a publication [5] which appears within 3 months of the reference period with a preliminary release after about 60 days.

(c) GAP Survey (Labour Division).

The GAP survey covers the non-commercial sector of the economy e.g. hospitals, education, institutions but excludes public administration and defence. It is a monthly census of about 6500 reporting units along the same lines as the ES-2 survey. The response rate is over 80% and the resulting data contributes some 16% of the total employment reported in the publication [5].

(d) Government Programme (Public Finance Division).

Government employment and earnings information is collected by 5 surveys on a monthly, quarterly or annual basis from about 4500 respondents, and from administrative sources. Response rates are 90% or better. Some data are exchanged at micro (i.e. reporting unit) level with the ES-1 and GAP surveys. At macro level the data provide the public administration and civilian defence component of publication [5], accounting for about 8% of the total employment. In addition there are 3 publications detailing employment and earnings for federal, provincial and local governments respectively [6, 7, 8].

2.3 Reasons for Revision

In brief, the major reasons which prompted Labour Division to undertake a revision of the programme were:

- (i) to improve timeliness;
- (ii) to reduce respondent burden, e.g. by decreasing the total sample size;
- (iii) to extend coverage by providing employment, hours and earnings data for small firms, and for the non-commercial sector including public administration;
- (iv) to investigate large scale use of data from administrative sources to supplement and/or replace survey data;
- (v) to review the employment category breakdowns, and the data presentation, and to consider provision of additional information, e.g. labour turnover;
- (vi) to examine the possibility of coordinating all data collection activities within a single programme;
- (vii) to incorporate advances in data processing technology and to improve man/machine interfaces;
- (viii) to correct inadequacies in the methodology of the small firm panel rotation scheme;

- (ix) to consider change of survey reference period to be closer to that of the Labour Force Survey.

The relative importance of these factors has changed somewhat since the revision started. Increased consciousness of respondent burden has now made this perhaps the most significant single factor. On the other hand, timeliness considerations are a less compelling reason than previously, owing to improved performance of the ongoing surveys.

#### 2.4 Revision Process: The Employment Statistics Development Project

##### (a) Phase I: Programme Objectives Team

The intention to revise employment data collection methods was announced at the 1976 meeting of the Federal-Provincial Committee on Labour Statistics. Subsequently, an interdepartmental team, the Programme Objectives Team, was established to review the current programme and to identify the information which should be produced by the revised scheme. Submissions were solicited from users of the data and were obtained primarily from the government sector. The team presented its final report [9] in May 1977.

##### (b) Phase II: Design Specification Team

A Design Specification Team, comprising senior personnel from several Divisions within Statistics Canada, was set up to develop the broad methodological framework within which the recommendations arising from Phase I could be met. The team completed its report [10] in August 1977.

##### (c) Phase III: Project Implementation Team

The Project Implementation Team began work in 1977. Its objectives were, and are, to design, build, test and hand over an operational

employment and payrolls survey programme developed in accordance with the recommendations of the Phase I and II reports. The strategy adopted has been to divide work along functional lines into tasks each of which is handled by a working group reporting periodically to the central team. Thus there are groups concerned with concepts, survey methodology, computer systems, manual processing, etc. The central team itself reports at regular intervals to the Design Specification Team which reviews progress and provides guidance. Starting from small numbers, the project now employs some 30 people on a full time basis, and will continue to do so until towards the end of the development scheduled for December 1981.

### 3. PROBLEMS ENCOUNTERED

During the course of Phase III implementation, numerous problems have been encountered, far too many to describe in a single paper. The following paragraphs present a selection of problems which are fairly specific to this type of survey and which seem particularly pertinent at this stage in the revision process. In an attempt to classify them in some sort of coherent order they have been put into four groups. Whilst such a categorization is not precise it does go part way towards identifying the underlying causes.

#### 3.1 Universe Related Problems

##### (a) Number, Growth, Size of Units

There are over 600,000 employers in Canada and the number is growing. This results in the necessity to have a highly automated system, both for frame maintenance and for data collection. Even so it is a massive problem to keep the frame up to date and to process data in a timely fashion. Firms and institutions may range in size from zero

employees up to thousands, and the distribution is highly skewed. For example about 95% of firms have less than 20 employees (see table 1). On the whole, these small firms are less than enthusiastic about supplying data because they derive little benefit from the resulting publications, yet they cannot be ignored as they account collectively for nearly 25% of all employment. Large units may be more inclined to respond but in their case it is time consuming to define and maintain coherent reporting structures which cover all aspects of their operations.

(b) Instability

Small firms are subject to quite frequent changes in ownership, and/or industrial activity, which it is not always easy to track. Also, some have a seasonal form of operation hence only respond during certain months of the year. Even larger firms can be difficult to identify as stable units. Mergers, amalgamations, changes of legal name, etc., may all serve to render a list of companies and their reporting structure quickly obsolete. The most stable aspect of many firms is physical location, buildings and plant, but use of an area frame to take advantage of this, is very expensive. In any case some types of business would be difficult to locate, e.g. wholesalers who arrange shipments direct from producer to retailer without storage space of their own.

The major problems arising from the size, growth and instability of the universe are:

- (i) undercoverage, for example omission of new units or of additions to existing ones;
- (ii) duplication, for example inclusion of the same unit under different names, perhaps a legal name and an operating name;

- (iii) inaccuracy of classification data, especially of industrial activity (SIC) and of size, due to initial misclassification or failure to detect change;
- (iv) changes in classification data, which, even when identified, are not necessarily easy to handle.

### 3.2 Problems Related to User Requirements

#### (a) Tabulation Detail

The specification of tabulations at industrial classification (SIC) by province level defines some 3500 strata. In combination with a requirement for stratification by size into, say, 4 groups this implies 14,000 cells. Spreading a sample of even 70,000 over this many cells is likely to leave many empty and hence to give rise to an estimation problem. Various techniques exist for handling this type of problem, e.g. synthetic estimation but these are not yet textbook tools.

#### (b) Reliability

It was originally recommended that a minimum acceptable level of overall reliability should be set after consultation with the user community. The problem with this approach is twofold. Firstly, the user generally requests estimates should be "as reliable as possible", which means a census; secondly the non sampling errors are difficult to estimate.

#### (c) Continuity

One important criterion upon which users always agree is that they want "continuity" of published data. It translates in practice into the need to run revised and existing programmes in parallel for a sufficiently long period to generate a basis for comparison purposes.

### 3.3 Problems Related to Respondents

#### (a) Respondent Burden

Although there has been increasing awareness of the workload imposed by administrative and survey demands, especially upon small firms, this "respondent burden" is not yet well quantified. There are no definitive measures of the relative burdens associated with mail questionnaires as opposed to telephone interviews, with regular as opposed to ad hoc questionnaires, with being surveyed every month as opposed to rotating in and out. Even the number of questionnaires sent or interviews conducted is not necessarily an exact measure of respondent burden as some firms may actually request additional questionnaires or interviews to suit their reporting arrangements, or may submit computer printouts or machine readable data in lieu of questionnaires.

#### (b) Data Availability

Not all respondents have ready access to data broken down into the required categories such as full time/part time, hourly paid/ salaried, regular payments/special payments, etc. The availability and relevance of such breakdowns are intimately related to the particular industrial activity involved.

### 3.4 Problems Related to Implementation Environment

#### (a) Microdata Transfer

It is a policy of Statistics Canada to move towards data integration, i.e. collecting and maintaining a central body of data capable of meeting many different needs. One aspect of this policy is reflected in a recommendation that, in order to reduce survey taking activity, data from the revised programme should be usable at micro level by

other programmes. Making such provision introduces constraints on the data collection strategy.

(b) Data Collection Vehicles

As previously indicated, data relevant to the programme are presently collected by two Divisions within Statistics Canada: Labour Division, which also has responsibility for the revised programme, and Public Finance Division. Whilst Labour Division can arrange to gather data in precise accordance with the requirements of the revised programme, the data collected by Public Finance Division is primarily acquired to suit the publication requirements of that Division. Slightly different concepts and coverage are involved. For example the programme excludes Canadians working abroad and employees on strike, whereas Public Finance Division publications include them. Thus the arrangement of sharing responsibility for data collection presents certain problems quite apart from the obvious time lags associated with data transfer between Divisions. On the other hand it is in accordance with the general principle of maximizing internal usage of data. It means that a respondent receives only one questionnaire in place of two. Also, contact with the respondent is confined to a single point within Statistics Canada which enhances the prospects of building and maintaining good relationships.

#### 4. PROGRESS TOWARDS SOLUTIONS

The problems outlined in section 3 are interrelated and it is difficult to treat their solutions separately. Thus, in this section, the various strategies adopted by the implementation team are described and are related back to the problems which they address.

A complete summary of the development work and progress up until February 1980 is contained in [11] and [12]. The list of test programme

milestones, which follows, gives some idea of the general status of the project. Not all the problems referred to have been fully solved; some 'solutions' have introduced further problems.

#### 4.1. Test Programme

The earlier part of the test programme was designed primarily to tackle the problems of respondent burden and data availability, for example by investigating to what data respondents might be expected to have ready access. The latter part of the programme is more concerned with checking the embryo revised system and providing the capacity to cope with problems related to user requirements, such as continuity of published data. The individual tests are as follows.

- (i) Employment Compensation Test (August 1977): to investigate the terminology best understood by respondents; where respondents tend to keep their records; what forms of compensation are paid.
- (ii) Field Test I (March 1978): to determine the availability of certain data items, e.g. overtime payments, data breakdown according to sex, etc., within various industry groupings.
- (iii) Reference Period Test (May 1978): to check respondents' capacity to report data for an earlier week in the month; to compare data for early and late reference periods. This resulted in the retention of a late reference period.
- (iv) Field Test II (September 1978): to check use of different questionnaires for different industries; to compare data collection by Head Office and by Regional Office, by mail and by telephone.
- (v) Quality Control Test (Oct. 1978): to investigate problems arising from certain reporting practices, e.g. separation of executive and other payrolls.
- (vi) Field Test III (January 1980): to test operational and systems procedures for the "front end" of the survey system; to collect data enabling comparison of figures for existing and revised programmes; results of this test are not yet available.

- (vii) Parallel run (scheduled for 1981): to test, correct and fine tune the revised survey system; to provide 12 months of comparable data.

#### 4.2 Universe Frame Maintenance Procedure

To handle the universe related problems, the frame maintenance system will be highly automated. It will be based, as for the current Labour Division surveys, partly upon feedback from survey process itself and partly upon the "Business Register Master File System". Although this system is outside the scope of the revision it is a cornerstone of existing and future activities and thus will be described.

The objective of the Business Register, developed at Statistics Canada over the past ten years, is to provide a frame suitable for all establishment based surveys, not just employment [13]. Unfortunately the system does not in fact maintain a "register", rather it keeps a list of units (firms or institutions) based primarily upon Revenue Canada payroll deduction (PD) information. New units or establishments may be indicated by new PD accounts, dead units by closed accounts, etc. As every employer is legally obliged to make regular deductions on behalf of employees and to remit them via a PD account the system provides, in concept, very good coverage of employment universe.

In practice, there is some undercoverage which can arise in various ways. Employers may be late in submitting their requests for new PD accounts, thereby causing a time lag effect. They may provide insufficient information to enable proper classification of units, or they may not even report at all. The extent of undercoverage is not easy to measure precisely; it is believed to be reasonably small.

The duplication problem is more difficult to tackle. Revenue Canada data is identified by PD account number. A firm or institution may have several PD accounts for one establishment, or may have a single

PD account for several establishments, thus the relationship between units and PD information is complex. Furthermore the only means of linking information associated with a new PD number to any unit already on the Business Register is by name and address. Slight variations in name and address prevent successful use of straightforward matching and a purpose built record linkage procedure [14] has been developed to accomplish the task. Even with this finely tuned procedure however, there are many situations where a proper linkage will not be established and a new unit will be inappropriately introduced to the Register. For example, a business may operate under a trading name but use its legal name or even an accountant's name when applying for a new PD account. The net result is quite severe duplication, evidence of which comes to light during the course of survey operations. An improved programme for Business Register Maintenance is currently being designed.

Assignment and maintenance of classification data items such as industrial activity (SIC) and size is also a source of unresolved problems. Initial assignment is based upon PD information which is somewhat inadequate for the purpose; maintenance through the PD system per se is negligible. With the objective of improving size classification, investigations are currently taking place into the use of other Revenue Canada data, in particular the annual "T4 supplementary" information which includes, amongst other items, the total earnings and total number of employees associated with every PD account for a year.

To summarize, frame problems have been addressed but not entirely solved. Efforts to improve the quality of the frame and to estimate for its inadequacies are continuing.

#### 4.3 Choice of Sampling Unit and Take-All Stratum

Problems associated with respondents' diverse reporting procedures together with constraints imposed by the implementation policy

of data integration combine to influence the choice of sampling unit and take-all stratum in the following way. Firstly, although the concept of "establishment" is, in principle, common to all business surveys, the "reporting unit" is dependent upon the particular programme and may well differ from one to another. Thus the requirement that micro-data from the revised programme be usable by other surveys implies that it must be obtained from all reporting units associated with an establishment so that data transfers can take place at establishment level. This in turn suggests that sampling should be at establishment rather than at reporting unit level. A second argument against sampling reporting units stems from their possible non-homogeneity. As previously stated, some reporting units are created essentially for respondent convenience, e.g. to separate executive from general payrolls. They do not reflect a genuine stratification requirement and may be quite heterogeneous. On the other hand, previous experience suggests that establishments are not satisfactory sampling units. An establishment may have reporting units in quite different geographic strata and the assignment of a single sampling weight associated with the establishment to each of these reporting units sometimes gives completely inappropriate results.

The net result of these considerations is that all firms or institutions with more than one reporting unit (called "multis") have been defined as belonging to the "take-all" stratum, i.e. they fall automatically in sample. This is not a pretty solution, involving some 25,000 reporting units. However it is not quite as bad as may seem at first sight because it is the larger firms and institutions which tend to be multi-reporting units, and any reasonable sampling scheme would be sampling these with higher probability than the smaller "single" companies anyway.

Other types of units are assigned in small numbers to the take-all stratum too. For instance, units in certain strata are considered so heterogeneous as to require a census, government departments and

hospitals being an example. Some units are "carriers" and include in their reports data for other "carried" units. As it is not possible to obtain data from carried units separately, complication is avoided by allocating both carriers and carried to the take-all stratum. Respondents who have arranged to submit their data by computer tape or printout in lieu of a completed questionnaire are also assigned to the take-all stratum. It would be more burdensome to stop and restart their reporting arrangements as they rotated out and back into the sample than to leave them in the sample all the time.

#### 4.4 Sample Size Determination and Allocation Procedure

The procedure for sample size determination and allocation has been assigned to cope with the user related problems of providing required tabulation detail at adequate reliability, within the context of a rather unstable and poorly classified universe. More specifically, the following considerations have been taken into account.

- (i) Monthly estimates of employment, hours and earnings are required both at industry division by province level and at individual industry (SIC) by Canada level.
- (ii) No specific indication of acceptable reliability has been given.
- (iii) The overall sample size should be as small as possible.
- (iv) Every unit in the universe is currently assigned an employment size coding, which is of somewhat dubious quality for the smaller units. No similar measure of size in terms of earnings currently exists.
- (v) The sampling units have a very skewed distribution as regards employment and earnings.
- (vi) Estimates of employment are available for all firms, but hours and earnings data is restricted to units of 20 or more employees.

- (vii) The number of reporting units in the take-all stratum is significant and should be recognized in determining the required allocation of take-some units.

Starting with the skewness of size distribution, it is clear that some allowance for size has to be incorporated within the scheme. As the only measure readily available is an employment size code it has been decided to stratify using this code. Sampling with probability proportional to size was not seriously entertained because of the poor quality of the size coding.

The cumulative  $\sqrt{f}$  technique was used to identify desirable stratum boundaries but the results had to be modified for practical reasons (essentially the absence of sufficiently detailed coding). The net result has been the decision to stratify into 4 size groups. In combination with 12 provinces and just under 300 SICs there is a total of some 14,000 "cells" at the finest level of stratification. Rather than attempt to allocate the sample directly to so many cells, it was decided to design for uniform reliability across all tabulation strata in the most important tabulation, namely, the one with an industry division by province breakdown. In essence, therefore, the scheme is to allocate according to size in each industry division, province stratum separately. As Neyman allocation is rather strongly dependent upon reasonable variance estimates, a more robust, "X-proportional" allocation procedure was preferred [15]. Under this scheme the sampling fraction is made proportional to the estimate of the average employment per unit with the size group. It is equivalent to Neyman allocation if the coefficient of variation of employment per unit is the same for each size group.

The value of reliability required uniformly across all tabulation strata is specified as an input parameter to the procedure in terms of coefficient of variation. This parameter setting determines, in conjunction with the estimate of total employment covered by take-all

units, the coefficient of variation required from the take-some sample in each tabulation stratum. Hence, given X-proportional allocation, the required sample size is determined at industry division by province by size level.

To define allocation at the finest (cell) level of stratification, proportional allocation across SIC, within industry division by province by size is used. In other words the sampling fraction which has been determined for a particular industry division by province by size stratum is applied to all SICs nested therein.

Given this allocation the resulting coefficients of variation for strata of the SIC, Canada level tabulation can be estimated. Of course the values are not uniform across SIC. Consideration is being given to an adjustment of sampling fractions to bring all coefficients of variation down to a specified acceptable level.

Direct application of the technique described above results in many cells at the finest level of stratification being allocated a sample of zero units, causing obvious estimation difficulties. To address this problem the procedure incorporates facilities to enforce a minimum selection of  $m$  units per cell (or as many units as are available for selection (if less than  $m$ )). Setting  $m=2$  to facilitate production of variance estimates results in a considerable increase in sample size, by, say, 3500 units in a total sample of 65,000. Of course even with  $m=2$  there is no guarantee that units will respond, thus variance estimation may still be difficult. Collapsing by grouping sets of cells across similar SICs within the same industry division, province and size, coupled with the use of domain estimation is being considered as a means of curtailing these problems.

In summary, the sample size determination and allocation procedure will determine an overall sample size and an allocation for any specified level of uniform reliability of the industry division by province

employment tabulation. Rerunning the procedure with a variety of reliability settings generates a graph of sample size versus reliability; see graph 1 which is of considerable assistance in deciding how large the sample should be. Growth or compositional changes in the universe can be allowed for by recomputing the required sample size and allocation [16].

#### 4.5 Sample Selection and Rotation Procedure

The scheme for sample selection and rotation has been designed with the problems of universe growth and change and of respondent burden foremost in mind. Firstly, as the number of units in the universe is increasing, use of a sample of fixed size would result in reduced reliability over a period of time. A fixed sample fraction, on the other hand would increase the sample more than necessary for specified reliability. Some form of sample size adjustment based on the output of the sample size determination procedure is preferable, and a rotation scheme can readily incorporate such provision. Secondly, the universe is constantly changing in composition. Thus, in the absence of rotation, a periodic redraw would be necessary with attendant risk of unwarranted jumps in the estimates. Again rotation can provide the means of adjustment on a monthly basis. Thirdly, there are a variety of rather subjective respondent burden considerations.

It is believed for example that for a respondent to be in the sample always is burdensome and should be avoided where possible by rotating the respondent out and another in, even though this does not reduce the total number of respondents. It is also felt that respondents are likely to experience more difficulty in completing the first questionnaire/interview than subsequent ones, i.e. that there is some sort of additional burden associated with the first month or two in sample. Thus it is unwise to rotate respondents rapidly out of and into the sample; they may actually prefer to remain in the sample all the time than to rotate out for short periods. The procedure in current use

for ES-2 survey is a panel rotation scheme. Within each stratum units are allocated to fixed panels, the number of which depends upon the required stratum sampling fraction. 12 panels are in sample at any given time, and at the end of each month one rotates out and another in. The advantages of such a scheme are its simplicity and the advance knowledge of exactly what units will be in sample. There are disadvantages. The design sampling fractions are fixed and cannot be adjusted to account for changing circumstances. New units are systematically allocated to panels, hence a new unit may be assigned to a panel which rotates out of sample one month later. Also, although new units can be systematically allocated, dead units occur at random. Thus in some strata the panels now vary considerably in size. This causes unevenness in the workload of the survey operations staff, and in the estimates.

The scheme proposed for the revised programme is not based on fixed panels. For each province by SIC by size stratum, the required sampling fraction is obtained from the sample size determination and allocation procedure. The numbers of units currently in sample and in the universe are derived from the frame file and the required stratum sample size is thereby determined. The units scheduled to rotate out of sample are identified and the units required to replace them and to produce the desired sample size are selected at random from those out of the sample. This simple strategy is augmented by controls to ensure that units stay in sample at least 12 months, that having rotated out they stay out for at least 12 months, that proper representation of new units occurs, and that changes in sampling fraction as generated by the sample size determination programme are phased in gradually [17]. Of course, in some strata there are insufficient units for any rotation at all.

In designing the rotation scheme no consideration has been given to the possibility of using composite estimation. It is not presently planned to exploit rotation in this manner as experience suggests the

potential gain in efficiency can be offset by increase in complexity and/or bias.

#### 4.6 Data Collection Procedure

The strategy for data collection by Labour Division has been chosen taking into account respondent related problems. Although no quantitative measures have been developed, decisions based on empirical observation and past experience have been made in an attempt to reduce respondent burden.

There is evidence from the Office for Reduction of Paperburden that telephone interviews impose less of a workload than mail questionnaires. Furthermore, Field Test II results suggest that telephone interviews lead to higher response rates and more timely data collection. However the cost of telephone interviews is higher than for mail questionnaires and the number of calls required tends to increase with size of firm. Thus the collection strategy proposed for the revised programme is to obtain data by telephone interviews from Regional Offices for firms of less than, say,  $p=50$ . For larger firms mail questionnaires will be used. Smaller firms will be given the option of reporting by mail if they wish. Also, following practices developed in the existing programme, respondents will be able to submit computer produced printouts in place of questionnaires, and to separate executive and other payroll reports if they choose to do so.

Following investigations into the terminology best understood by respondents and the data items readily available to them, two new questionnaires have been designed corresponding to categories of industrial activity. Each one is tailored to the data items likely to be available to the respondent in that particular category. For example, manufacturing firms are asked for an hourly paid/salaried breakdown, whereas educational institutions are asked for a full time/part time division instead.

#### 4.7 Linkage of Existing and Revised Systems

In order to tackle the problem of providing users with continuity of data it has been decided to run existing and revised systems in parallel for a time period of up to one year. At the same time sensitivity to respondent burden has prompted senior management to restrict the number of monthly questionnaires/interviews to one per reporting unit. This means that during the parallel run there will have to be a data exchange between the existing and the revised systems. Furthermore, as data exchange must be at micro level, the universe files for the two systems will have to be held precisely in step. The net result is, in effect, a single system considerably more complicated than either of its components, the price to be paid for meeting user and respondent demands. The complex details of system linkage and data flows have not yet been worked out and await a thorough evaluation of Field Test III results. It seems probable they will give birth to a whole new set of problems.

### 5. CONCLUDING REMARKS

The objective of this paper has been to indicate the general nature of problems arising during the course of a survey revision programme by citing specific examples. Some of the problems described have been more or less solved, others await satisfactory resolution. One feature most of them seem to have in common is that they are primarily practical, non-textbook, with no neat solutions.

It should not be imagined that all aspects of the development work have been covered. For example there has been no mention of data capture, of locating and correcting data errors, of detecting and allowing for outliers, of imputing for missing values, of estimation, etc. By and large, emphasis has been upon problems associated with the "front-end" of the survey system as this is where much of the work to date has taken place, but, even here, coverage is by no means complete.

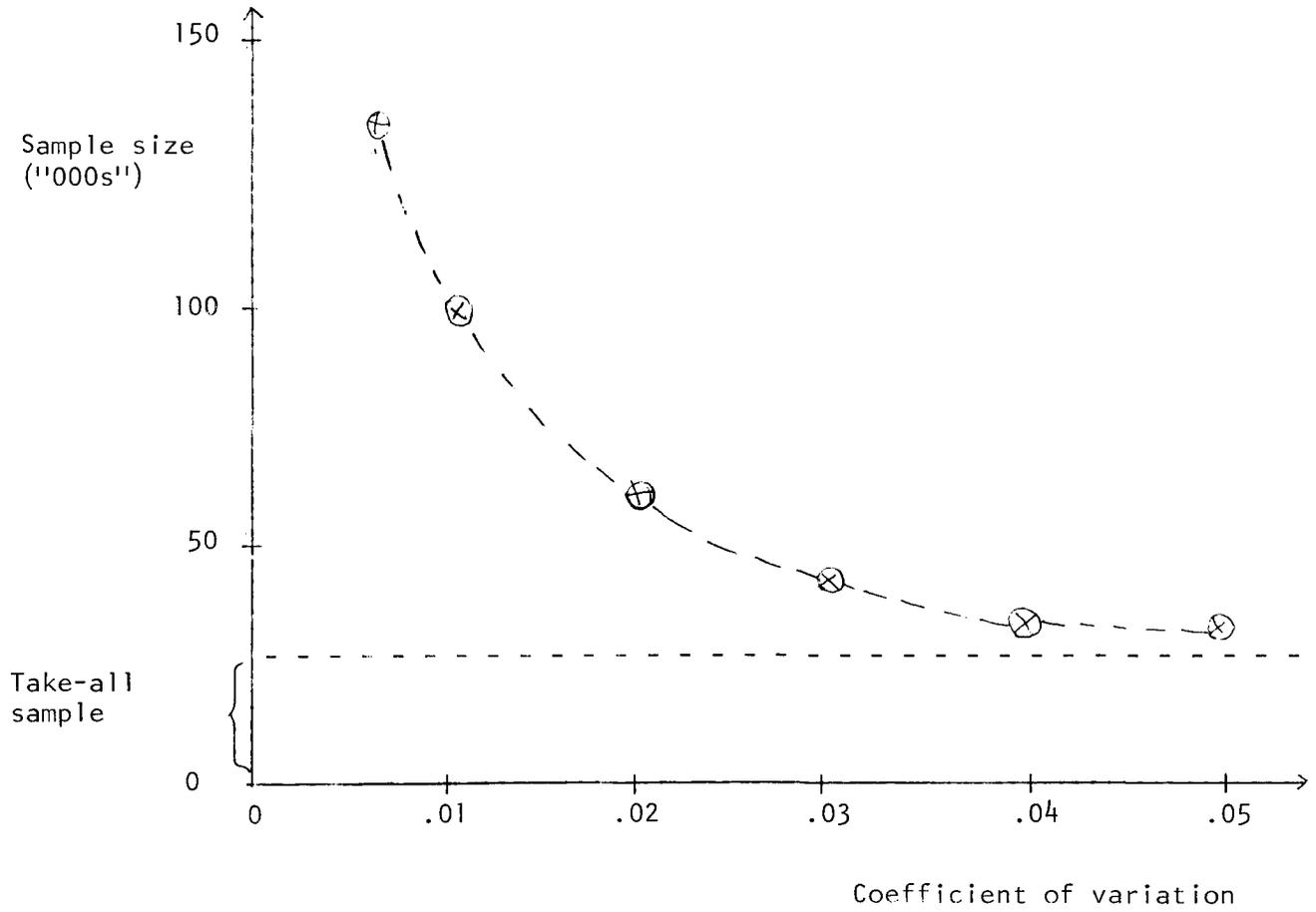
RESUME

L'article décrit plusieurs problèmes pratiques portant sur l'adaptation de la théorie de la statistique à l'élaboration des enquêtes, dans le contexte de la révision d'un programme d'enquête sur l'emploi.

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GRAPH 1.      Total Sample Size for Specified Reliability

(Results from Test version of sample size determination and allocation procedure).

TABLE 1: Distribution of Firms in Canada by Employment Size  
(approximate figures)

Employment size range	Number of firms
0 - 3	350,000
4 - 19	200,000
20 - 49	20,000
50 - 199	15,000
200 - 499	2,500
500 - 999	1,000
1000 - 1499	300
1500 - 2499	250
2500 - 4999	150
≥ 5000	100
<b>TOTAL</b>	<b>589,300</b>