RESEARCH PLANS FOR THE REDESIGN OF THE CANADIAN LABOUR FORCE SURVEY

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1. Introduction. The Canadian Labour Force Survey (LFS) provides a comprehensive picture of the current labour market situation [21] including production of basic statistics on unemployment, employment and not in labour force characteristics at the national and provincial levels with a specified degree of reliability. In addition, since the LFS is the only continuing (monthly) household survey conducted by Statistics Canada, most of the other household surveys use the LFS capacity to a varying degree. The LFS sample, since its inception in 1945, has been redesigned following each decennial census and plans are being formalized for the Redesign following the 1981 Census.

This document identifies and presents highlights of the proposed projects to be undertaken during the research phase of this redesign. In order to put the program into proper perspective some background on the current design and rational for individual projects has been included. The program is divided into 8 major projects and proposed research activities under these projects are briefly outlined in different sections as follows:

1. General Considerations and Issues (Sect. 2)
2. SR Design Considerations (Sect. 3)
3. Examination of Alternative NSR Designs (Sect. 4)
4. Extension of LFS Coverage to other Areas (Sect. 5)
5. Estimation and Variance Estimation (Sect.6)
6. Special Area Sample (Sect. 7)
7. Concepts and Definitions (Sect. 8)
8. Data Collection and Quality Control (Sect. 9)

Through these projects, the Redesign Program will aim at achieving:

(a) an updated sample reflecting population growth and changes in population characteristics and the boundaries of Census units,
(b) improved sampling and estimation methodology,
(c) more reliable LFS data at the subprovincial level to meet the changes in data requirements,
(d) greater flexibility for use of the LFS as a vehicle for conducting other household surveys,
(e) improved data collection methodology.

In addition to the above major objectives, the program will endeavour to achieve several other features such as: flexibility in the design for sample size changes (increases or decreases), increased automation in sampling and updating, more structured and cost effective quality control programs, less expensive methods for extension of the areas currently covered by the survey, and standardization of criteria for data publication and presentation of quality indicators.

The strategy for the introduction of the new sample will depend greatly on the decisions taken as the results of the research studies become available. The strategy developed will aim at measurement and if possible minimization of the disruptions to the time series resulting from a new design and new sample.

2. General Considerations and Issues.

2.1 Introduction. The LFS is based on a stratified multi-stage probability sample design. The area sample frame used in the LFS covers the ten provinces of Canada, and for operational and design purposes is divided into two main area types - the self-representing areas, consisting of the larger cities and the non-self-representing areas, composed of rural areas and small urban centers. A separate portion of the frame, special areas makes up about two percent of the population and includes hospitals, institutions, military compounds and remote areas. A detailed description of the LFS methodology is given in [12].

Of the objectives for the redesign project noted in section 1, this section briefly discusses some aspects related to items (c), (d) and (e). For a more detailed discussion on these, reference may be made to [20]. Remaining sections of the report focus primarily on items (a) and (b).

2.2 Re-establishment of Survey Objectives. When designing or redesigning a survey, a fundamental initial step is the establishment or re-establishment of survey objectives. Regarding the primary role of the LFS in providing labour market data, information needs must be ascertained as precisely as possible from users. A statement of information needs would include specification of: characteristics of interest; types of estimates required - rates, levels, changes in rates or changes in levels; required frequency of estimates - monthly, quarterly, annual; cross-classifications (if any) desired for the characteristic; area levels of interest - national, provincial, subprovincial; and finally, associated data reliability requirements. As regards the use of the LFS as a vehicle for conducting other surveys, a decision will have to be reached on whether to redesign the survey vehicle primarily for the LFS as is presently the case, or as a general purpose survey. As discussed in section 2.6, this decision will depend on the degree to which optimal designs for other surveys using the vehicle may differ from the LFS design, and the relative importance attached to these enquiries as compared with the LFS.

Following consultation and discussions with users of the survey data and users of the survey vehicle, their requirements will be translated, subject to budgetary and other constraints into clear and precise survey objectives. Concurrently with the initiation of these discussions, research studies will begin aimed at investigating the suitability of various means of achieving likely ranges of objectives. These studies will concentrate principally on survey options for increasing the amount and quality of subprovincial data, as demands for such data have noticeably increased in recent years. Individual studies will investigate alternative rotation patterns (2.3), increased use of standard geographical areas (2.4), sample allocation schemes (2.5), subprovincial ratio estimation (6.1), small area estimation (6.8), and data release criteria (6.9).

2.3 Alternative Rotation Patterns. In a large scale monthly survey such as the Labour Force Survey, the choice of rotation pattern is closely linked to the survey objectives. For a given monthly sample size, the rotation pattern is the major factor in determining (i) the reliability of estimates of change - whether month to month, quarter to quarter, or the same month from one year to the next and (ii) the reliability of average estimates of level or rates derived by combining monthly data to arrive at quarterly, semi-annual or annual estimates. In general, (i) and (ii) place conflicting demands on a rotation scheme - the better the scheme is for measuring change (particularly month to month) the worse it will be for estimates of level or rates based on several months data, and vice versa. See also [11].

The current LFS rotation pattern whereby households remain in the sample for six consecutive months and are then permanently retired is very efficient for estimating month to month change due to 5/6 of the sample being common between consecutive months. Alternative patterns which would be better for average estimates will be considered, such as the 4-8-4 pattern (4 months in the sample, 8 months out, 4 months in) used by the Current Population Survey [24], or a similar 3-9-3 pattern.

Choosing the most appropriate rotation pattern for the LFS will depend not only on establishing the relative importance of different types of estimates but on a variety of other factors such as the rate at which the survey frame is used up, and implications on cost and respondent burden; the capacity for longitudinal data describing the dynamics of the labour force; and the implications on processing of survey data, for instance, on the amount of independent collection and coding of industry and occupation data required in months following the first interview.

2.4 Use of Standard Geographical Areas. The first priorities in terms of use of standard geographical areas will be the adoption of recently defined standard Subprovincial Regions to replace the current LFS Economic Regions, and the incorporation of changes in boundaries of Census Metropolitan Areas. Research will focus on the extent to which smaller standard geographical units such as Census Division and Census Sub-divisions can be utilized at lower levels in the design of the survey (see Sect. 4.3).

2.5 Sample Allocation to improve Reliability for Subprovincial Data. Within province sample reallocations will be considered to improve data reliability for LFS estimates of the unemployment rate for Subprovincial regions for which current CV's exceed 25%. Similarly, re-allocation studies will be carried out to examine the degree to which data reliability could be improved for relatively permanent geo-statistical areas such as Census Divisions. The studies would be carried out under assumptions of both the present and alternative rotation patterns, and also under assumptions of both the present design and an alternative design where such areas themselves are used as sampling units and strata (see Sect. 4.3).

2.6 General Purpose Use of the LFS: The design and operations of most household surveys conducted by Statistics Canada are integrated with those of the LFS to varying degrees. Flexibility exists for other surveys to be carried out either as supplements to the LFS, or as surveys utilizing an independent set of households from either the same or separate clusters as those sampled for the LFS. While this flexibility has lead to increased demands for use of LFS vehicle by other surveys, the LFS nevertheless has some limitations for use as a general purpose survey (for example, stratification in NSR areas is based on LF specific variables). As a result, consideration is being given to redesigning the LFS with overall orientation towards a general purpose vehicle, as opposed to the present situation where primary emphasis is on cost/efficiency for LF characteristics.

Designs of household surveys utilizing the LFS vehicle are being reviewed with the aim of identifying optimal designs for the individual surveys. Following these reviews and completion of studies examining the advantages and disadvantages of various approaches in respect of LFS, a decision will be reached on the overall orientation. In either case consideration will be given to improving the capacity of the LFS vehicle for use by other household surveys.

3. Design for Self Representing Units (SRUs)

3.1 Present SRU Design. The Self-Representing Units correspond to those cities which in 1971 were sufficiently large to support one or more interviewer assignments. Minimum SRU sizes vary from a population of 10,000 in the Atlantic Region to 25,000 in Quebec and Ontario. Large SRU's are divided into sub-units and within sub-units, first stage sampling units or clusters are delineated on the basis of field counts initially obtained in 1973. The clusters correspond approximately to city blocks. A two stage sample of clusters and dwellings is selected following a pps method based on random groups of clusters [15]. A major advantage of the method adopted lies in its flexibility for sample increase [19] and sample updating [13], [2]. Sample updating is necessary in SRU's because over time the design counts used in the pps selection can become out of date leading to higher sampling variances for survey estimates. Some ad hoc updating of high growth areas was carried out in 1976-77, and in 1978-79 a regular program of updating was adopted.

3.2 Definition of Self Representing Universe. The impacts of the sample size increase, and of possible within province sample re-allocations will be considered on the classification of areas as Self-Representing under various criteria. As a result certain new cities may be included as SRUs.

3.3 Choice of Sampling Units and Allocation of Sample to Stages. As a result of sample expansion, currently there are up to eighteen clusters selected per sub-unit, with about 5-6 households per cluster. Census EA's, blocks and block faces will be considered as alternative units to the present clusters and based on the variance expression derived by Rao [16], variance components under alternative allocations of sample to the two stages will be obtained to derive optimum sampling ratios for the two stages of sampling. Further, in larger SRU's the effect of stratification based on dwelling type (in addition to geography as is presently done) will also be investigated.

3.4 Alternative Methods for Achieving an Up-to-date Design. The cost/variance implications of different combinations of three principal options for achieving an up-to-date design will be investigated. The options are (i) continuing the ongoing SRU update program, (ii) redesign based on independent field counts, and (iii) redesign based on 1981 census units, counts and maps. The distinction between (i) and (ii) is that formation and selection of clusters would be done independently of the current design in (ii), but not in (i).

In the 80% of the SR areas where geocoding of 1981 Census block faces will be carried out, option (iii) appears most advantageous in that Census counts would be equally as timely as data obtained under options (i) and (ii), without incurring the major expense of a field count. Also adoption of Census units would permit simplification of mapping operations by increased reliance on computer generated maps, and would allow for the use of small area estimation techniques requiring auxiliary census information for LFS units. Option (iii) would also be advantageous in terms of future updating possibilities. An agreement is being worked out underwhich Canada Post would provide Statistics Canada up-to-date base maps and dwelling counts for individual postal codes. Following establishment of a link between postal codes and block faces, one of the uses of such data would be in regularly updating the LFS sample without incurring field counting costs.

4. Examination of Alternative NSR Designs

4.1 Description of Present Design. In NSR areas, optimal type stratification based on industry classifications was carried out, subject to tne restriction that strata should be contiguous land areas. Within strata approximately 15 Primary Sampling Units (PSU's) were delineated such that each PSU represented its stratum to the extent possible with respect to the ratio of rural to urban population and important LF characteristics. At the time of the 1973 Redesign, two PSU's were selected per stratum using the randomized pps systematic method [6]. In 1977, the LFS sample size was increased from 33,000 to 55,000 households per month, with the additional sample being allocated to improve data reliability at the provincial level. Thus the smaller provinces received larger proportionate sample size increases. In NSR areas the increase was achieved by selecting additional PSU's [5] and at present from 3-6 PSUs are selected per stratum.

4.2 Custom Design by Provinces. In general, it seems that the data requirements as well as the design constraints, both technical and operational, vary from province to province. It is intended therefore to examine the alternative designs, mentionned in subsequent sections, by Provinces (or groups of Provinces) as against a uniform design at the national level. Studies in this context would include creation of separate urban strata within ER's, automation of stratification, reduction in the stages of sampling, optimum allocation of the sample to stages of sampling, increased use of telephone interviews, relaxed criteria for strata and PSU formation, increased emphasis on the use of census areas even at higher levels as Census Divisions, examination of the PSU sizes and interviewers' assignment and possibility of forming interviewing zones. Decisions will be arrived at separately for each province.

4.3 Empirical Investigations for Alternate Designs. Variations and combinations of two basic designs will be considered from the point of view of both cost and variance. Census data will be used to obtain variance components by stages of sampling separately for rural, urban areas following the expressions developed by Rao [16]. In order to obtain cost data necessary for design optimization a detailed time and cost study will be conducted for the current NSR design and in areas where design or data collection alternatives are being experimented with (4.4 and 4.6).

i. Three Stage Sampling with Current Design Structure. At present, four stage sampling is used in the NSR rural areas of the LFS. In this study, while retaining the present strata and PSU's, dwellings will be selected directly within selected Census Enumerations Areas (groups), which would form the second stage of sampling.

ii. A Design Fully Based on Census Areas. In this case, strata would consist of one or more Census Divisions (CD's), which may further be divided into rural and urban strata depending upon the composition of the CD. Two or more PSUs consisting of Census Subdivisions (CSD's) will be selected from each stratum following random pps systematic method [6]. For selected urban CSD's subsequent stages of selection would correspond to clusters and dwellings as is presently done and for selected rural CSD's subsequent stages of selection would be as in (i) above. This approach, where no optimization with special reference to the LFS is adopted, would indicate the efficiency of a general purpose design.

4.4 Study to Eliminate Cluster Stage of Selection. The lead time between selection of a group and interviewing dwellings within the group is presently 13 months, in order to allow for a field count of the group, delineation and selection of clusters within the group, and finally for creation and data entry of dwelling lists within selected clusters. The clusters correspond to identifiable land areas generally having from 3 to 25 dwellings.

This study will investigate the operational impact of eliminating the cluster stage of selection within groups, by listing and selecting a sample of dwellings from the entire group. A field test has been initiated in 19 newly rotated NSR groups in order to compare the present procedure with the alternative procedure from the perspectives of costs, lead times and coverage of dwelling lists. It should be noted that sampling efficiency will be examined using census data as mentioned in 4.3 (i).

4.5 Sample Design for Buffer Areas Bordering on CMA's. Generally Census Metropolitan Areas include surrounding municipalities with potential for further growth. However, in the present LFS design, built-up areas surrounding rapidly expanding cities such as Edmonton and Saskatoon have extended beyond the CMA boundaries into areas designated as NSR rural. In this study, individual 1981 CMA's will be examined to determine where it might be appropriate to include additional municipalities as a buffer zone. Design parameters would require special consideration for such areas.

4.6 Selective Telephone Interviews in NSR Areas
Telephone interviewing was introduced into SRU areas during the 1970's resulting in slightly reduced costs without any evidence of impact on data quality. The purpose of this project will be to investigate the feasibility of telephone interviewing in NSR areas, and to determine the impact of such a change in the data collection method on the sample design, the quality of data,and the cost of the operation for both the LFS and other surveys using the LFS structure. Due to concern over confidentiality of the data being collected, telephone interviewing will only be considered in areas where the instance of party lines is very low. On this basis information obtained from telephone companies suggests that most rural areas will have to be ruled out.

A field test will be conducted on a sub-set of the ongoing LFS interviewer assignments, augmented in some cases by 10-20 percent to study the effects of larger assignment sizes and different concentrations of the sample. Due to its major implications on the final design in NSR areas, this study will have high priority and early scheduling.

5. Extension of coverage. The present LFS excludes Yukon and the Northwest Territories and the population living on Indian Reserves and Crown lands, inmates of institutions and members of the armed forces. In response to an increased demand, feasibility of extending the LFS to the territories and Indian Reserves will be examined. Past survey experiences in these areas are summarized in [17].

In the Yukon Territory, a pilot survey will be conducted for 18 months beginning in July 1981. Objectives of the pilot are to assess: (i) operational problems related to hiring and retention of qualified interviewers, problems of data transmission, etc. (ii) operational performance measures such as response rates,(iii) conceptual validity of the data. Due to the increased severity of operational problems in the North West Territories, the experience gained in the Yukon pilot study will be relied upon in making a decision on whether or not to proceed with a test survey. Finally, due to severe operational and conceptual problems that were encountered in previous field tests of the LFS on Indian Reserves, it is planned to focus research efforts on development of improved model based estimators, or to work on measures based on administrative records or reports from reserve officials.

6. Estimation and Variance Estimation.

6.1 Alternative estimators in NSR to account for intercensal growth: There is no regular program of updating in the NSR areas, and as a result it has been found that uneven growth in certain parts has contributed significantly to increased NSR variances in recent years. This project will study the effect of various ratio adjustments [18] to account for uneven growth in PSUs between the 1971 and 1976 Censuses.

6.2 Ratio Adjustment at Sub-provincial levels: Research is currently being undertaken within Demography Division to develop post censal population estimates for subprovincial areas [24]. In anticipation of the availability of such estimates, this project will examine the relative efficiency and operational implications of ratio estimation at sub-provincial levels,such as Economic Regions and Census Metropolitan Areas, as compared to the present method of applying ratio estimation at the provincial level. A major advantage of subprovincial ratio estimation would appear to be in elimination of biases resulting from the application of uniform adjustment factors determined at the provincial level, when survey coverage and/or rates of population growth may differ for subprovincial regions.

6.3 Optimization of Post-Strata for Ratio Estimation: The LFS currently uses 38 age/sex post strata in the ratio estimation that is applied at the province level.

A detailed analysis to investigate optimal classes for post-stratification will be undertaken following the approach taken in [8], in which gains in efficiency were broken into gains due to ratio estimation and gains due to post-stratification. The problem can be considered in relation to both the LFS and the Survey of Consumer Finance which uses the LFS frame and follows a similar estimation procedure, except for its use of detailed class of worker post strata. Post strata such as farm/non-farm might help to reduce the high LFS design effects for estimates of employed persons in the agriculture industry.

6.4 Variance Estimation Procedures: The present variance estimation procedures based on Keyfitz' procedure [7] assume with replacement sampling within strata, whereas in fact sampling is done without replacement. The result is an overestimation of variance which may be quite severe, for instance in provinces where in the NSR 6 PSUs out of 12-15 are selected. The study would determine the extent overestimation.

Further, as an alternative in SRU areas, the variance estimation procedure given by Rao [16] will be studied with a view to implementation. The procedure will have to be extended to use of ratio estimation.

Also, research will continue into methods of variance estimation for seasonally adjusted data [5], as currently variance estimates are produced only for the original (unadjusted) data.

6.5 Alternative Procedures for Compensating for Non-Response: Alternative procedures for defining balancing units for non-response adjustments can be considered. Possibilities which could be investigated are formation of balancing units on the basis of household size, and/or rotation groups at higher areal levels than at present. As well investigation could take place into the trade-offs between imputation versus reweighting. In this context, data from the longitudinal file may be useful.

6.6 Treatment of Growth Clusters: The impact of high growth clusters on survey estimates will be studied, and alternative procedures for reducing the m.s.e. will be considered such as extending the life of the growth clusters in the sample [1], or deflating cluster sub-weights.

6.7 Integrated Estimation Methodology for Individual Household and Family Units: This project will produce an integrated weighting/estimation strategy for individual, family and household units by: (i) developing procedures for post-censal estimates of family units and households, including examination of what modifications to existing surveys, or what other data, such as ad-

ministrative data, could be used in production of the required estimates; and (ii) developing procedures for utilizing the post-censal estimates as external control totals in the survey estimation procedures, in such a manner that both inter- and intra-survey comparability of estimates based on individual and family unit weighting schemes would be improved [10].

6.8 Small Area Estimation: Ongoing research into development and evaluation of procedures for LFS based small area estimation [3] will continue with the objective of introducing a small area estimation capacity in conjunction with the sample redesign. Research efforts will focus on evaluation and comparison of alternative estimators - synthetic, composite, sample regression-, and development of models of relative bias of the various estimators for labour force categories using Census data.

6.9 Examination of Rounding and Release Criteria: The current LFS rounding and release criteria are intended to insure that released data should have a minimum 33.4% coefficient of variation. There is concern that the current rules which are uniform across Canada result in suppression of releasable data, particularly in smaller provinces for which sampling rates are high.

More rigorous criteria will be developed that take into account the variation in sampling rates between provinces, and which ensure that the rounding bias does not exceed some fixed percentage, say 20% of the standard error of the estimate. Similar rounding and release criteria will be examined for other regularly conducted household surveys associated with the LFS.

7. Special Areas. The frame for this sample consists of special enumeration areas as defined in the 1971 Census and remote areas. Census special enumeration areas are grouped into three strata, military establishments, hospitals and other institutions. The remote areas form the fourth stratum. Due to the relatively small percentage of the population in the special areas (2%), the special area strata were formed at the provincial level.

Issues include: different data collection strategies, such as use of an annual work pattern questionnaire or mail surveys in remote areas; availability of open ended list frames for hospitals and nursing homes; and methods for including special areas in sub-provincial estimates.

8. Concepts and Definitions. 8.1 Treatment of Institutions and Collective Dwellings: A realignment of LFS definitions with 1981 Census definitions for institutional population will be carried out, and field procedures for distinguishing between institutional and non-institutional populations and between institutions and other forms of collective dwellings will be strengthened.

8.2 Determination of Household Membership: The present procedure for determining household membership relies on the respondents' declaration of who usual residents are, resulting, it is felt, in classification errors which contribute to undercoverage of marginally attached household members. A review and strengthening of these procedures should be undertaken.

9. Quality Control and Evaluation. 9.1 Review of Existing Control Programs: In the LFS, preventive measures [14] such as Observation, Reinterview, interviewer training programs, listing checks and other special programs for coverage and frame checks are aimed at measuring and improving the overall quality of survey results. As the redesign strategy gets finalized, the control programs will be reviewed for their cost and benefit in relation to final design adopted. Integration of different programs and their intensity will be examined as part of an overall program of controls to improve the quality of data.

9.2 Measurement of Interviewer Variance: Studies carried out on Canadian Censuses of population [9] and the Current Population Survey by the U.S. [23] have shown that correlated response variance can be large relative to simple response variance and sampling variance for a wide range of characteristics. Research efforts to address the current lack of information on interviewer variance or correlated response variance in the LFS will begin in advance of the overall review of control programs due to the developmental work required and the need for testing of proposed methodology.

Initial efforts would be confined to SRU areas since: (i) distances between sampling units are not great, so that cost of interpenetration of assignments would be minimal, and (ii) currently published variance estimates for SRU areas underestimate this component ot the extent that individual SR sub-units are covered or mostly covered by a single interviewer.

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