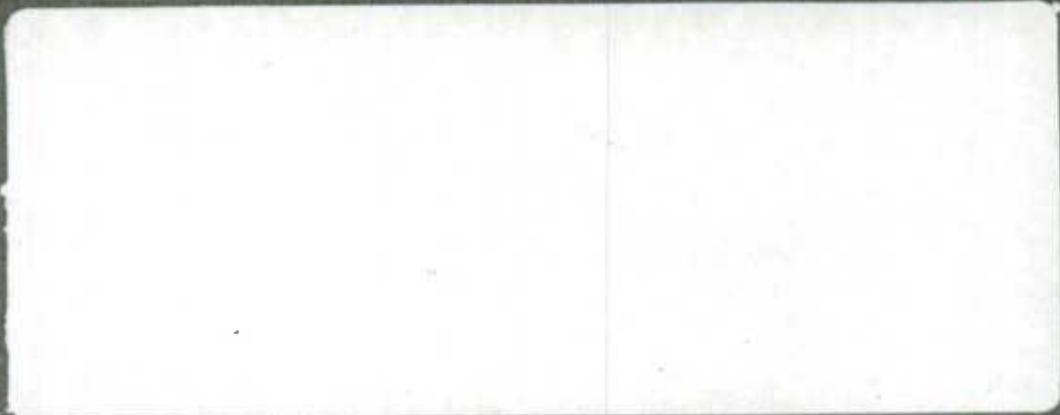




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DEALING WITH NON-RESPONSE IN BUSINESS SURVEYS

by

M.A. Hidioglou and Lyne Guertin
February 1991

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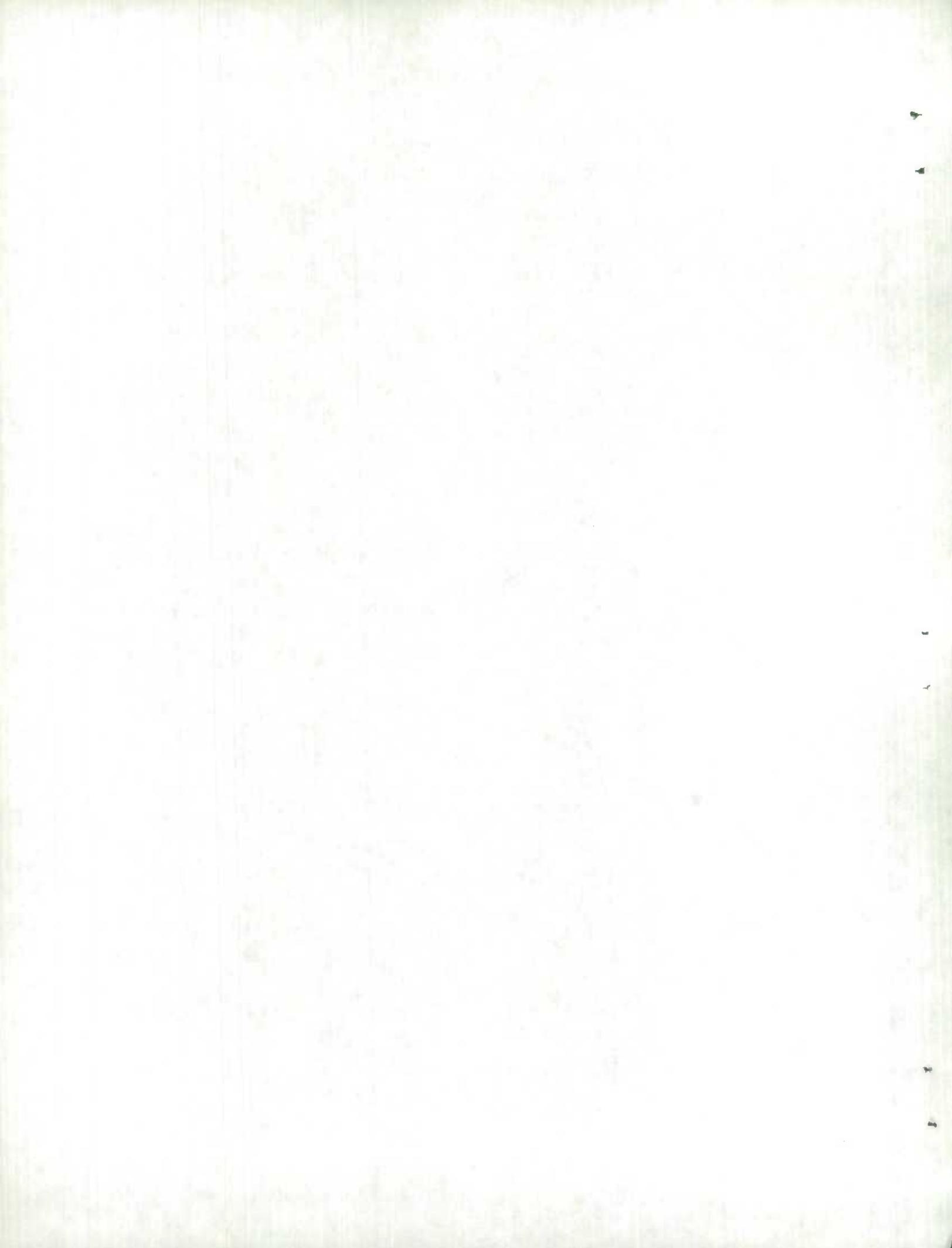
La Non-Réponse dans les Enquêtes Économiques

M.A. Hidiroglou et Lyne Guertin
Division des Méthodes d'Enquêtes-Entreprises

L'objectif de ce document est de discuter des problèmes occasionnés par la non-réponse dans les enquêtes économiques. Ces problèmes diffèrent quelque peu de ceux rencontrés dans les enquêtes sur les ménages.

La non-réponse se produit lorsqu'un sous-ensemble de l'information désirée par l'agence de sondage n'est pas fourni par le répondant. L'ensemble de données résultant sera déficient pour les raisons suivantes. En premier lieu, la taille d'échantillon observée sera réduite, nécessitant ainsi le recours à l'utilisation de techniques d'ajustement par pondération ou d'imputation. L'utilisation rigoureuse de telles méthodes occasionnera une augmentation de la variance espérée des estimés. En deuxième lieu et de façon plus importante, tel que Kish l'a souligné, un biais de non-réponse non-négligeable peut être introduit dans les estimés.

Le présent document est structuré de la façon suivante. On définira la non-réponse et on présentera plusieurs définitions de la mesure de cette dernière. Ensuite, l'expérience à Statistique Canada dans le traitement de la non-réponse sera décrite pour plusieurs enquêtes économiques. De plus, pour chacune de ces enquêtes, la définition de la non-réponse ainsi que les méthodes utilisées pour la mesurer et la réduire seront présentées. Finalement, une section couvrira de façon générale les différentes causes de la non-réponse et les moyens pour la réduire.



Dealing with Non-Response in Business Surveys

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Statistics Canada¹

1. Introduction

" Attempts to reduce the percentage or effects of non-response aim at reducing the bias caused by differences of non-respondents from respondents" ²

The purpose of this paper is to provide some discussion of the non-response problems in business surveys. They are somewhat different from those that are found in household surveys.

Non-response occurs when a subset of the information (possibly none), required by the survey agency is not provided by the respondent. The resulting data set will suffer from the following deficiencies. First, the effective sample size is reduced, thereby requiring the use of either weighting adjustment techniques or imputation. If properly accounted for, the use of such methods will result in an increase in the expected variance of the desired estimates. Second and more importantly, as Kish has pointed out, a significant non-response bias may be introduced into the estimates.

The structure of the paper is as follows. Non-response will be defined and several definitions of its measurement will be introduced. The experience with non-response will be described for several of our major business surveys at Statistics Canada. For each survey, it will be pointed out how non-response is defined, measured and reduced. A section will be devoted to the general causes of non-response as well as on ways to reduce it.

¹ The authors would like to thank S. Currie, L. Wainwright and K. Young for information related to the Monthly Survey of Manufacturing, Census of Manufactures and Census of Construction at Statistics Canada respectively. We would also like to thank D. Dolson and F. Maranda for preparing the sections related to the Survey of Employment Payrolls and Hours as well to Agricultural surveys respectively.

² Leslie Kish, Survey Sampling, John Wiley & Sons, Inc., New York, London, Sydney, 1965

2. Definition and some measures of non-response

As pointed out in Slowinsky (1988), there are basically three main types of non-response. These are noncontact, unit non-response and item non-response. Noncontact occurs when a contact for a sampled unit fails because either no contact is attempted or an attempted contact results in no contact. Unit or total non-response occurs when a sampled unit that is contacted fails to respond. Item non-response occurs when a contacted unit responds partially to the questionnaire, giving responses to some items only.

It is important to have an idea of the magnitude of non-response for several reasons. First, it will point out weak areas which need to be strengthened in future applications of the survey. Second, since non-response implies either weighting or imputation of the data, measures of non-response to be associated with corresponding variance estimates are needed (provided that these variance estimates have incorporated the impact of either weighting adjustments or imputation). Third, increasing magnitudes of non-response indicate potentially increasing biases.

As Platek and Gray (1986) have pointed out, the definition of non-response rates is not clear. The definition depends on the subsequent uses of the measurement, whether it is used to diagnose requirements for sampling activities, for data collection activities or to analyze published data. For example, in the case of sampling diagnostic requirements, the unit of measure used for computing non-response could be the sampled unit. Correspondingly, in the case of data collection activities the unit of measure for computing non-response could be based on the questionnaire. These measures would be used by the survey agency to identify weak areas of response, in order to identify potential causes and improvements. Note that there is not necessarily a one-to-one correspondence between targeted sampled units and the ensuing generated number of questionnaires. In the case of published data, the measure of non-response could be based on effective sampling fractions for selected key variables of interest in order to estimate the contribution of non-respondents to the key aggregates. In business surveys, such measures can be important on account of the relatively small number of units which have a disproportionate share of the market. The previous measures can be affected by the inclusion or exclusion of certain factors. For example, in the case of rates that deal with sampling diagnostics, should noncontacts (caused as a result of incorrect contact information) be part of the non-response rate computations? Should the sample weights be included and if so, how is the

resulting non-response rate to be interpreted? Questionnaire item non-response rates can be used to point to questions that need to be rethought in terms of wording or data availability.

The non-response rates must be informative, pointing out to weak areas of aggregation as well as to causes. Breakouts of the non-response rates should be available at pre-determined geographical levels, industrial and size levels and combinations thereof. If possible, the reasons for non-response should also be available (unable to contact, refusal categories). These can be used to produce diagnostics to establish causes of non-response. If the data are collected by using interviewers located throughout nationwide regional offices, then non-response rates by interviewers within each regional offices and non-response rates by regional offices can point to areas that need further strengthening.

3. Experiences with non-response for selected business surveys

3.1 Survey of Employment, Payrolls and Hours (SEPH)

3.1.1 Brief Description of the Survey:

SEPH is a monthly survey of business establishments which collects data on employment, earnings and hours. It is a rotating stratified simple random sample with stratification by province, industry, and employment size group. The sampling frame is the new Business Register (BR). The population size is about 700,000 establishments and the sample size is about 70,000. The methodology of SEPH is extensively discussed in Schiopu-Kratina and Srinath (1986). For about 85% of the units, data collection is done by mailout from and mailback to the regional offices (ROs). Most of the remaining 15% respond by telephone to the ROs. Those respondents who can provide computer readable responses are identified and allowed to send computer reports to the Head Office (HO) in Ottawa.

3.1.2 Non-Response:

All units for which no questionnaire data has been received by the cutoff date are called "blank questionnaires". In computing responses rates, only those among which there was no contact, refusal, data not available, or unable to locate are considered to be non-response. Most of the remaining "blank questionnaires" pertain to units for which, even though there may have been no questionnaire returned, it has been determined that there is zero employment; these are considered as responses because they are known

to be seasonal or temporarily inactive. Non-response rates are monitored by stratum, by cause, and by data collection method. The non-response rate is based on questionnaires or on the key variable employment. For questionnaires, it is

$$\% \text{ total non-response rate} = \left(1 - \frac{\text{\# of questionnaires returned with good data}}{\text{\# of mailed out questionnaires}} \right) \times 100$$

where the number of mailed out questionnaires excludes units which are known to be temporarily or permanently inactive. Follow-up for non-response and for basic data problems is done from the ROs by telephone. Imputation is applied only for total non-response. Preliminary estimates for a reference month m , are published in month $m+2$, at which time the response rate is about 80%, accounting for about 80% of employment. Final estimates are published in month $m+3$. By this time, response rates reach about 90%, accounting for about 91% of employment.

3.1.3 Prevention of Non-Response:

New entrants (births or rotated in units) to the survey and old respondents, are mailed two copies of the questionnaire - one to return and one for their records. New entrants also receive a brochure introducing them to the survey, and soliciting their cooperation by indicating the importance of their participation in it. Also, each new entrant is telephoned about three or four days after the expected receipt of the material. At this time, difficult concepts are explained and questions are answered.

For non-respondents to the initial mailing, SEPH has a priority follow-up system. All units which have not responded within about fifteen days of the mailout are considered for follow-up. All non-responding computer reporters and new entrants are contacted. Of the remaining non-respondents, priority is given to units which have not responded for two consecutive months, to large units and to units in strata with poor representation in terms of the percentage of employees represented by the responding units within each "industry group * province" combination.

Respondents having partial non-response are all followed-up. If this follow-up is not successful then the value is estimated based on responses for previous months.

SEPH has a rotating sample for the smaller sized units in order to alleviate the response burden. The rate of rotation is approximately one twelfth of the sample every month.

Survey weights are not adjusted for non-response. Instead, missing data are imputed for all units which continue to be non-respondents after follow-up.

For non-responding new entrants in the smaller size group, the imputation method consists of calculating means of eligible respondent units in the same stratum. For old non-respondents in the smaller size group, previous month values are projected forward on the basis of trends computed using units in the same stratum which responded in both the previous and current months.

Currently the SEPH questionnaire and supporting materials are being redesigned to make them more respondent-friendly in order to better motivate the respondent to cooperate and supply accurate survey data with minimum response burden.

3.2 Monthly Wholesale and Retail Trade Survey (MWRTS)

3.2.1 Brief Description of the Survey:

The MWRTS is a monthly survey of retail locations and wholesale establishments which collects sales and inventories. Estimates of the total and change are generated for these two variables. The estimates produced are used for several purposes: they are part of the series published by the National Accounts, they are used to monitor the performance of policies on the retail sales tax and to forecast trends in the economic market. The sampling frame used is the new Business Register (BR). The sample design is a rotating stratified simple random sample of statistical companies stratified by province, industry and gross business income. For the Retail survey, the population size is approximately 165,000 companies, and the sample size is about 15,100. For the Wholesale survey, the population size is about 50,000 companies and the sample size about 6,000. More details concerning the methodology used in these two surveys are provided in Hidioglou (1989). Data are collected by telephone for approximately 40% of the units within each survey. The remaining units respond by mail. Preliminary estimates are based on a response rate of at least 90% for Retail and of at least 80% for Wholesale, for the reference month. Revised estimates for the preceding month are based on more data resulting from follow-ups.

3.2.2 Non-Response:

Throughout the collection period, each regional office captures, edits, corrects and transmits to Head Office the respondent data for which it is responsible. Every sampled unit sent to a RO must be returned to HO by a pre-specified date with response data or a reason why the data are missing. The measures of non-response are similar to those used for SEPH. They are based on the number of questionnaires with good data content or on monthly sales. These measures are available by province, industry, size, or cross-combinations of these variables, by data collection method, as well as by RO. For monthly sales, the measure of non-response rate is

$$\% \text{ total non-response rate} = \left(1 - \frac{\text{sum of good monthly sales}}{\text{sum of good monthly sales} + \text{sum of imputed monthly sales}} \right) \times 100$$

where good monthly sales are the monthly sales as provided by the respondent after data editing.

3.2.3 Prevention of Non-Response:

Once each month, the BR and the survey data base are scanned at the HO to detect units for which data are to be collected for the current reference period and units which are to be followed-up for a previous reference period. The latter units include non-respondents as well as unresolved preliminary edit failures. Priorities for collection of data within each RO change through the collection period. Immediately after the receipt of the HO to RO transmission, the collection priority is as follows: follow-up of edit failures from previous month, follow-up of previous month delinquents and finally collection of current month telephone respondent data. Later, priorities shift towards the follow-up of edit failures for current month and follow-up of current month delinquents. At all times, within each of the above priorities, an additional level of priority exists as follows: births, must units, important units and regular units. For the purpose of the MWRTS, a birth is a responding unit which is new to the MWRTS sample regardless of whether or not it is new to the MWRTS universe, whereas a delinquent is a reporting unit which was a non-respondent in the previous survey month regardless of its status in the current survey month. A must unit is a unit for which a response is required for estimation purposes because the unit either dominates the estimates or is important for some

other reason. Finally, an important unit is simply a reporting unit whose contribution to stratum estimates has been shown to be important by survey data analysis.

New entrants (births or units rotated into the sample) to the survey are mailed a "birth" letter which introduces them to the survey and solicits their cooperation by indicating the importance of their participation. A blank questionnaire is also mailed for their information. Furthermore, each new entrant is telephoned about a week after his expected receipt of the material. At this time, difficult concepts are explained and questions are answered.

All units which have not responded within about twenty days of the mailout are considered for follow-up. All non-responding units and new entrants are contacted. Respondents having partial non-response are all followed-up.

MWRTS has a rotating sample for the smaller sized units in order to alleviate the response burden. The rate of rotation is approximately one twenty-fourth of the sample every month.

Survey weights are not adjusted for non-response. Instead, missing data are imputed for all units which continue to be non-respondents after follow-up.

Imputation is applied to all missing entities. Data for the current occasion, as well as for the previous occasion, are imputed as required. Late data can also be accepted and used to re-impute for all following occasions as well as the current occasion. Backward imputation is used for births using an inverse monthly change. A variation of methods is available and the selection of the method is done automatically by the system depending on the availability of the data.

3.3 Census of Construction (COC)

3.3.1 Brief Description of the Survey:

The Census of Construction (COC) is an annual survey of businesses in Canada whose primary activity is construction. Only businesses with a pre-specified minimum value of Gross Business Income (GBI) are considered in scope for the survey. These are divided into "large" and "small" businesses. A census is taken of all large businesses (about 9,000 units). They are mailed a

questionnaire asking for a comprehensive set of data. For the small businesses, however, information is derived from two sources: Revenue Canada Taxation and a mailout survey. For these small units, a sample of about 23,000 tax records is selected from 170,000 units in the population, and financial data are obtained from Revenue Canada Tax files. A subsample, of about 17,000 units out of the 23,000 originally sampled, is then selected and an Other Characteristics Questionnaire (OCQ) is mailed requesting non-financial data. More details about this survey are available in Giles (1983).

3.3.2 Non-Response:

For both large and small businesses, the total non-response rate is calculated in the following way:

$$\% \text{ total non-response rate} = \frac{\# \text{ records received inactive}}{\text{net universe}} \times 100$$

where

received active - questionnaire received with some data;
received inactive - questionnaire received but not filled out;
net universe - number(received inactive) + number(received active).

Note that this definition of non-response does not account for all units which were mailed out.

3.3.3 Prevention of Non-Response:

An introductory letter, which describes the objectives of the survey, is sent to units that will be surveyed.

The timing is very important for the survey and the questionnaires are sent a few weeks after the end of the fiscal year in order to improve the response rates.

For the larger units two or three mail follow-ups occur. Each successive follow-up provides messages to the unit which become stronger worded. After the last mail follow-up, a telephone follow-up occurs. This follow-up is focussed on the larger units which have been prioritized on the basis of business income.

For the smaller units, no follow-up of the non-responding units occurs as data collection stops after a specified response rate (75%) has been achieved.

For large businesses, non-response is flagged for imputation. Editors who collect the data impute non-response using fixed ratios or averages for the province and industry based on a universe file of tax filers or previous results from construction surveys. However, if total non-response occurs, the GBI on the universe of tax filers is used to get an idea of the size of the business. Thus, every large business will be imputed, if necessary by multiplying these fixed ratios by the GBI.

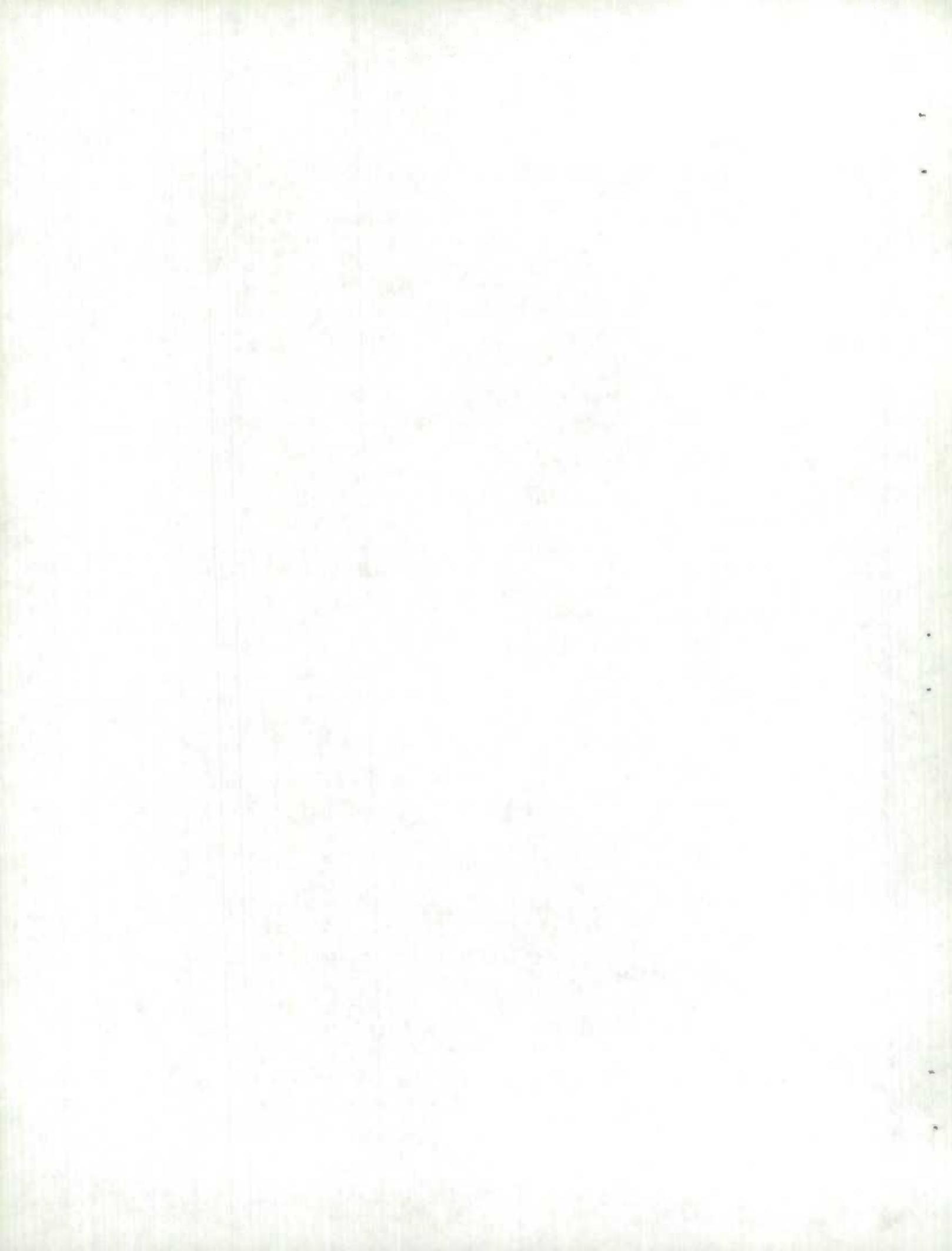
In the case of small businesses, a different procedure is adopted. A large sample size is considered for the actual mailout of questionnaires for which regional offices (ROs) collect the data. But once a pre-specified number of questionnaires is received, the collection stops. There is no follow-up of the non-respondents. Their status is determined via tax returns. For example, only the first 13,000 units out of 17,000 become respondents for the OCQ. Surveyed units which do not match to the tax transcription sample, because the information on the latter is outdated, are dropped because there is no tax data to combine with the OCQ data. The non-matching occurs because the OCQ is drawn from a tax frame which is two years older than the reference period. During this time period, the stratification associated with the sampled units can change from in-scope to out-of-scope on the construction universe. All units in the tax transcription sample for which no survey data exists are mass imputed. Mass imputation is basically an imputation method using nearest neighbor (Kovar et al, 1988).

Recent improvements have been made to the questionnaires based on a study by a consulting group. Gower and Zylstra (1990) provide details on the results of this study.

3.4 Annual Survey of Manufactures (ASM)

3.4.1 Brief Description of the Survey:

The Annual Survey of Manufacture (ASM) covers all establishments and associated units (head offices, sales offices, etc.) in the manufacturing sector. Information collected includes principal statistics (employment, wages, costs of materials and supplies used, shipments, inventories) and commodity outputs. The larger units (some 22,000 establishments) are directly surveyed, while for most of the smaller units the principal statistics are obtained from



sampled tax data transcriptions. Although this is basically a mail survey, significant amounts of data are being collected by telephone. The reliance on tax data for principal statistics has increased markedly in recent years and most small units are now estimated from tax information rather than survey data.

3.4.2 Non-Response:

The total non-response rate is computed like the one for COC. For the larger units the total non-response rate is less than 5% whereas for the smaller ones it is about 25%.

3.4.3 Prevention of Non-Response:

Large establishments are sent long questionnaires which include extensive breakdowns of commodities and a few other statistics depending on the industry. Almost all long questionnaires when received are either incomplete or fail some of the edits. The result is extensive use of telephone follow-up to gather missing items, to resolve inconsistencies in the reported data and to seek reasons/confirmation for large year-to-year changes. Most of this follow-up work is handled routinely by operational staff, but a few cases ("must" firms) which are particularly important to the aggregate statistics for an industry may require the direct intervention of the subject matter officer in order to elicit an adequate response. "Must" firms are a subset of the long form establishments (five or six largest establishments in each Standard Industrial Classification). There are about 1200-1500 establishments on the "must" list and these are given priority in collection and processing. Every effort is made to collect survey data for all long form establishments. For non-responses, the imputation is done manually, based on either adjusting the previous year's data for this establishment by an estimate of its growth rate, or based on other information available to the subject matter officer.

For small establishments, automated imputation is performed using the short-form imputation system, which makes use of past data for the same unit, or uses the tax data whenever possible. The follow-up effort concentrates on determining that the establishment operated in the reference year and is a valid manufacturer. Often, follow-up activities are terminated by time and resource constraints before the status of all units has been fully determined. In that case, some establishments are "deferred" which means

that they are not included in the estimates but kept in the frame for the following year. On the other hand, units which are found to be operating will be assigned for estimation when survey data are not obtained.

Tax data stands as the method of estimating total activity of an establishment for which no other information is available. This is equally true for units excluded from surveying and units for which collection was unsuccessful. It should be stated that the quality of tax data also varies and is subject to partial non-response. The response problems in the tax data are resolved by automated imputation routines. Not all units in the survey frame which are left for tax estimation are found in the tax files. Unmatched units are generally dropped, i.e. assumed to be dead units, unless there is other evidence of activity which would lead to a manual imputation of their values.

Larger establishments receive more individual attention when imputation is required. There is a preference for using past patterns for the same establishment to estimate detailed statistics. In particular, this type of historical imputation has been used to impute commodity data in order to have a commodity census of the largest establishments in each 4-digit industry group.

For both large and small establishments, three post-card follow-ups are sent to non-respondents. The first follow-up card is sent 60 days after the start of the survey. Then, if required, the two others are mailed at 30-days intervals. On each post-card, one of three possible messages pre-printed by the computer can be stated. The choice of the appropriate message is determined by a computer system which keeps track of the follow-ups that have been sent or to be sent. The messages become stronger worded after each follow-up. After the third follow-up, any remaining long form establishments with incomplete data are contacted by telephone and if required, visited by subject matter officers for data collection. However, for the small establishments, the number of telephone follow-ups depends on the resources available and on the outstanding workload, and, calls are made only to the largest of the small units. The remaining smaller units are imputed using tax data from Revenue Canada.

In the future, it is planned to use personalized questionnaires which will hopefully improve response rates.

3.5 National Farm Survey (NFS)

3.5.1 Brief Description of the Survey:

The National Farm Survey (NFS) is a survey carried out annually in all Canadian provinces except Newfoundland. The primary objective of the NFS is to provide timely, reliable estimates of levels and changes at the provincial level for crops areas, livestock and the financial situation of farmers in terms of farm income and operating expense items. The target population includes all farms in the provinces surveyed which received \$250 or more from the sales of agricultural products during the 12 months preceding the survey date. The survey population is divided into two groups, the first of which includes the farms enumerated in the census and the second all other farms. These include the undercoverage from the census and so-called new farms, that is, those which began operating after the census. The first group is covered by a list frame of census farms. To complement the list frame and ensure complete coverage of the survey population, an area frame, created from agricultural enumeration areas, is used. The list frame is stratified by sub-provincial regions, and a number of key agricultural variables. Samples are taken from the list frame using a one-stage stratified sample design where the farm constitutes the sampling unit. There are 282,000 farms in the list frame and 36,000 are selected. Area samples are selected according to a two-stage stratified sample design. The census enumeration areas and segments represent the primary and secondary sampling units respectively. The area frame is stratified by sub-provincial regions, and a number of key agricultural variables. The sample design for this survey is discussed in Julien and Maranda (1990).

3.5.2 Non-Response:

Face-to-face interviews are used when collecting financial data whereas telephone interviews are used to collect physical data. There are practically no more mailout/mailback surveys in agriculture.

Item non-response occurs mostly when the respondent refuses to give certain information, especially information related to financial data. The total non-response rate is defined as

$$\% \text{ total non-response rate} = \frac{\# \text{ of questionnaires with no usable data}}{\# \text{ of questionnaires sent to the field}} \times 100$$

The number of questionnaires sent to the field is usually smaller than the total sample size, the main difference being that questionnaires are not mailed to inactive units. Inactive units are retained on the file until a redesign of the survey takes place (every five years) or until it is ensured that inactive units on the frame are properly accounted for in terms of weighting. In general, the rate of non-response for crops and livestock data is less than 15%.

3.5.3 Prevention of Non-Response:

Because non-response tends to increase when the same respondents are intensively "surveyed", which is the case for take-all units, the number of take-all units is limited by a compromise between the requirements of an efficient sampling plan and wanting a small number of take-all units.

The questionnaire design has been improved by taking advantage of cognitive research conducted as part of the planning of the Census of Agriculture.

Interviewers manuals are reviewed thoroughly in order to ensure that the instructions are clear and precise. The manuals contain an excellent description of the survey's objectives that serves to convince the respondent of the need to participate in the survey.

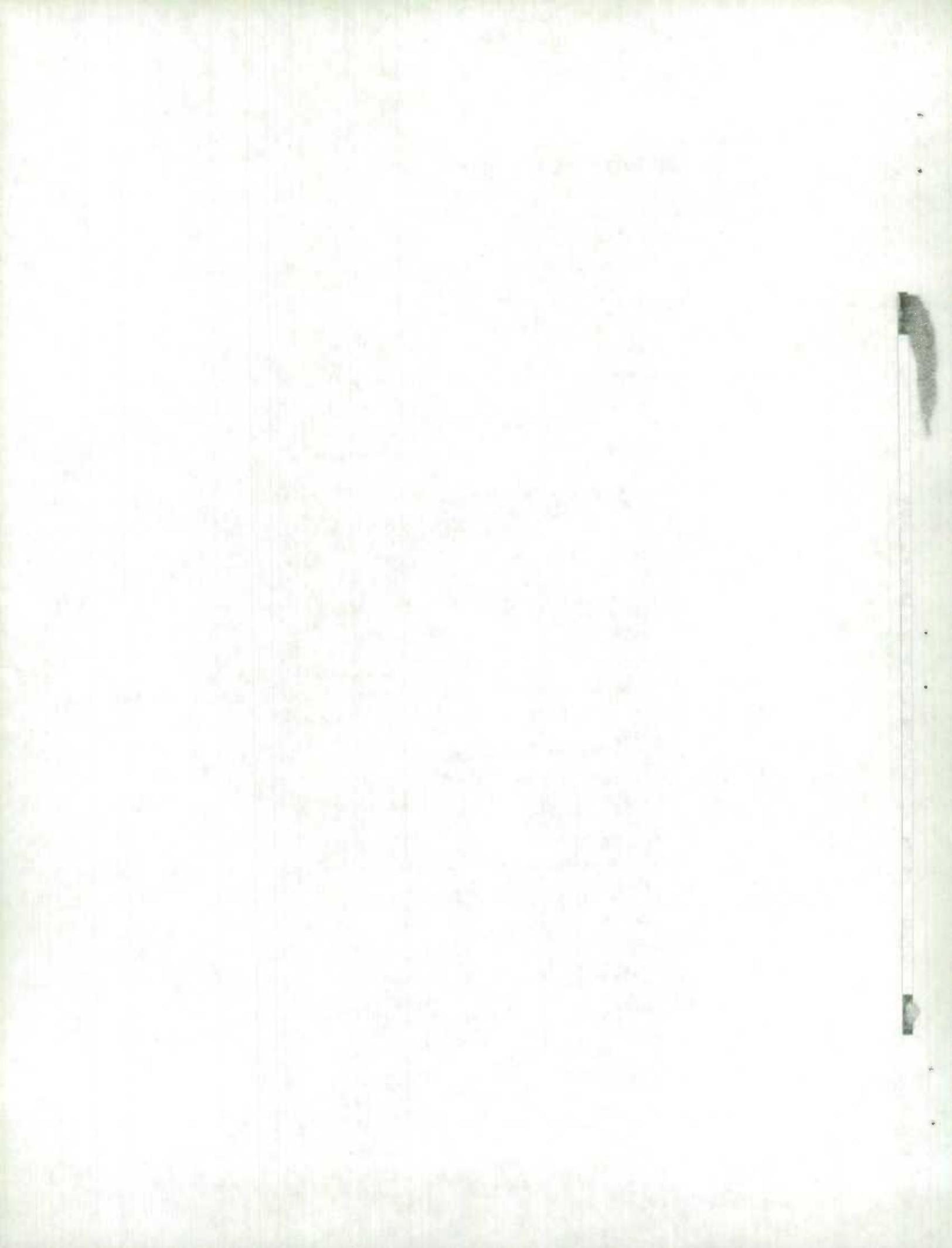
Survey designers participate in the training of managers for the agriculture surveys in the regional offices (ROs) and observe some interviews in an effort to understand the data collection process better and improve it.

If possible, the data collection method is based on the preference of the farm being surveyed, within the framework of the survey. Telephone interviews are conducted, to the extent possible, at a time that is convenient for farmers.

Response rates are compared between the ROs and they are given these comparisons. This improves the response rates since ROs tend to compete with one another.

Total non-response is handled by adjusting weights. Item non-response is imputed using deterministic or donor imputation.

Telephone follow-ups are used but no priority system exists.



More and more administrative data are used instead of survey data in order to reduce greatly the response burden. This also helps to reduce non-response.

4. Causes for non-response

The review of non-response for five major Business Surveys (SEPH, MWRTS, COC, ASM and NFS) at Statistics Canada leads us to point to a number of common causes of non-response.

4.1 Noncontact

Noncontact (with an attempted contact) could occur for the following reasons. The sampled unit is no longer known as previously on account of death, splitting or merging. The sampled unit may have moved or changed its telephone number. An incorrect address may have been used. This is quite possible since names, addresses, and telephone numbers are initially provided by administrative sources which can be inaccurate for some units. In the case of mail surveys, the questionnaire might have been sent to the wrong location, misplaced before mailing or lost during the mailing process. The unit might be closed for the season at first contact (e.g., ice creams parlours in the winter, ski lodges during the summer). The unit might be temporarily closed due to strikes, work stoppage, bad debts or fire.

4.2 Unit non-response

There are a number of factors which contribute to unit non-response. Sampled units may participate in several surveys. The probability of being sent a questionnaire increases with the size of the unit, resulting in the larger units being requested a good deal of information repeatedly from the same survey without being rotated out or from several surveys. The requested information may also repeat itself across the various surveys, thereby adding to the respondent's irritation.

If sampled businesses have responded to one or more surveys for a long time, the respondent may feel that there is a limit to how long it remains in the survey. The aggravation may increase if it is known that other businesses have either never or rarely been asked to participate in a survey.

Inaccurate contact information on the questionnaire, failure to correct the information once updated by the respondent will also cause non-response.

Some of the questions being asked may be too difficult to interpret, thereby causing the respondent not to respond to any of the questions. Respondents may also question the relevance of the information being requested. They may feel that they cannot provide accurate data, thereby raising concerns about the resulting accuracy of the data. They may simply be irritated with the constant probing of the survey agency. If they feel that it is not useful for the previously mentioned reasons, they will most likely toss out the forms.

The requested information may not exist in the format being sought, thereby requiring time on the respondent's part to assemble the data. Such instances occur when the survey agency requires data that has to be manipulated (aggregated/disaggregated) by the respondent. If a sampled unit has a complex structure, then the data may not be available at the required level. Such data retrieval will involve costs and time (ranging from hours to days) commitments on the part of the respondent which may be resented. It is also possible that one questionnaire cannot be applied across the different types of units or size groups. The required data may not be relevant to all types of units and for smaller units the data may simply not be available at the level of detail being requested or on a periodic basis. For example, it is well known that the smaller retail businesses in Canada have difficulties with reporting on their inventory status on a monthly basis.

The information being requested may simply not yet be available. An example of such an instance is when the respondent's fiscal year is not been taken into account when contacted, potentially resulting in a contact that is too early.

There is also the literacy aspect that must be considered. The format used for requesting the information may simply not be understood. In other words, the questionnaire may not be adequately understood by some of the respondents. Another aspect is the appearance of the questionnaire itself. It may be badly structured, have an unappealing appearance, request too much detail, have ambiguous questions or unclear instructions.

Another cause for non-response is overediting of the data. Overediting of the data may cause several recontacts with the respondent for the same questionnaire, thereby increasing unwillingness to cooperate on future occasions.

4.3 Item non-response

Many of the above reasons could cause item non-response also. Item non-response is more likely for difficult items, items that are considered to be private (e.g. financial), items that are not easily available or that may require manipulation on the respondent's part. An example of such problems is when the respondent is asked for breakouts of his data that may not be available.

Finally, there is also the confidentiality aspect. Respondents may simply not believe or not understand the confidentiality clause and therefore refuse to respond.

5. Reduction of non-response

There are a number of ways to reduce non-response which range from proper updating of the frame to eventual follow-up. In any event, these actions require the building of a data collection system which is integrated with easy connection between all systems that are used to contact and update the status of the selected units, so as to profit from the maximum available information. The following sections address current practices to reduce response burden and other ways that need to be investigated.

5.1 Frame Updating

On the newly designed Business Register, up-to-date information on the contacted sampled units is immediately reflected by automatically building a collection system. This collection system is a set of collection units for each survey of interest. The collection units are automatically built using well defined rules which vary from survey to survey and which reflect the statistical level at which data collection is to take place. They contain the most up-to-date information (available on the frame and to all surveys using the frame) related to contact (for example: name and address of unit, telephone number, contact name), questionnaire type (for example: survey being considered, periodicity of data collection, type of questionnaire, as well as any seasonal considerations for sub-annual surveys and fiscal year ends for annual surveys) and coverage (for example: geographical and industrial detail being requested, as well as special reporting arrangements required to accommodate the respondent). The maintenance of these collection units is done via a combination of administrative updates and direct survey feedback. Maintenance of these collection units involves a wide range of updates to the Business Register which encompass activity status (live, dead, seasonal), name, address and telephone changes as well as structural

changes to the surveyed unit. Proper and timely updating of the frame will reduce respondent irritation (and consequently improve unit non-response) because the feedback will have been taken into account. It will also reduce the noncontact impact for those units that are known to be seasonal or no longer active.

5.2 Sample Design

The overall sample size should be manageable so as to be able to perform various follow-ups of the non-responding units. The sample size must consequently be arrived at by taking budgets into account, survey objectives and desired level of reliability for key variables for the primary domains of interest.

For the larger units integration of questionnaires across several surveys will reduce response burden and consequently improve response rates. These units will need to be surveyed because of their size.

One way to reduce response burden across the smaller units is to minimize the overlap between surveys. This can be accomplished using a technique known as synchronized sampling. This technique essentially attaches a permanent random number between 0 and 1 to each unit in the population. Different surveys are then allotted subsets of the interval $[0,1)$ and all units whose random number falls within a survey's allotted subset are selected for that survey. This technique is being used by the Australian Bureau of Statistics and Statistics Sweden. It is also used at Statistics Canada to draw samples from administrative sources.

Periodic rotation of sampled units is another way to reduce response amongst the smaller units. However, that increases the cost of the survey because the introduction of new units in a survey is costly both for the survey agency and the surveyed unit. Often, a rotation rate that compromises between these conflicting requirements is used.

5.3 Questionnaire Design

The questionnaire is one of the principal means that the respondent has to provide data. Questions should be to the point and worded so as to be easily understood by the respondent. Clear and concise instructions should be included so as to clarify difficult questions. The questions should be relevant to the respondent. A precise description of the survey's objectives and uses will add relevance to the data being collected. It should be made clear to the respondent that the data provided are confidential. This promotes the trust of respondents and

generates higher response rates. It is also good practice to provide written advance notice to sampled units that have been selected for a survey. Such a notice should include the objectives of the survey as well as the number of occasions for which the unit is expected to participate in the survey. A contact name and phone number in the agency should be included if the respondent has any queries on the questionnaire or the survey. In Canada, the choice of language for communication purposes is very important. Respondents should be offered the choice of questionnaires in their preferred language.

The questions should be tailored to some of the respondent's known characteristics if necessary, taking into account previous responses. For example, in the case of the Census of Manufactures, long and detailed questionnaires are sent to the larger establishments, whereas smaller questionnaires requiring less information are sent to the smaller ones.

Questionnaires should go through a review process which is independent of the questionnaire designer. This process may take the form of peer reviews by experts within the agency or focus groups comprised of representatives of surveyed units. The resulting questionnaire should have a professional appearance and should be clear, clean and friendly with no cluttering of the questions.

Gower and Zylstra (1990) have recently reported on the use of such methods to upgrade the Statistics Canada Construction Industry questionnaire. Their study demonstrated the viability of using qualitative and cognitive research methods to examine the process that business survey respondents go through while completing a questionnaire and complement the results of pretesting. In the case of the Census of Construction Industry, the pretest provided valuable feedback about response rates and the completeness of reporting. The qualitative research added significantly to those findings by providing in-depth, first hand knowledge about how respondents reacted to the questionnaire, their perception of response burden, the compatibility of the questions asked with their record-keeping practices, the placement and use of instructions, the availability and perceived usefulness of data, and the complexity of the response task.

Response rates for each question should be monitored so as to point out to difficult or poorly worded questions while the survey is in production.

5.4 Mode of Data Collection

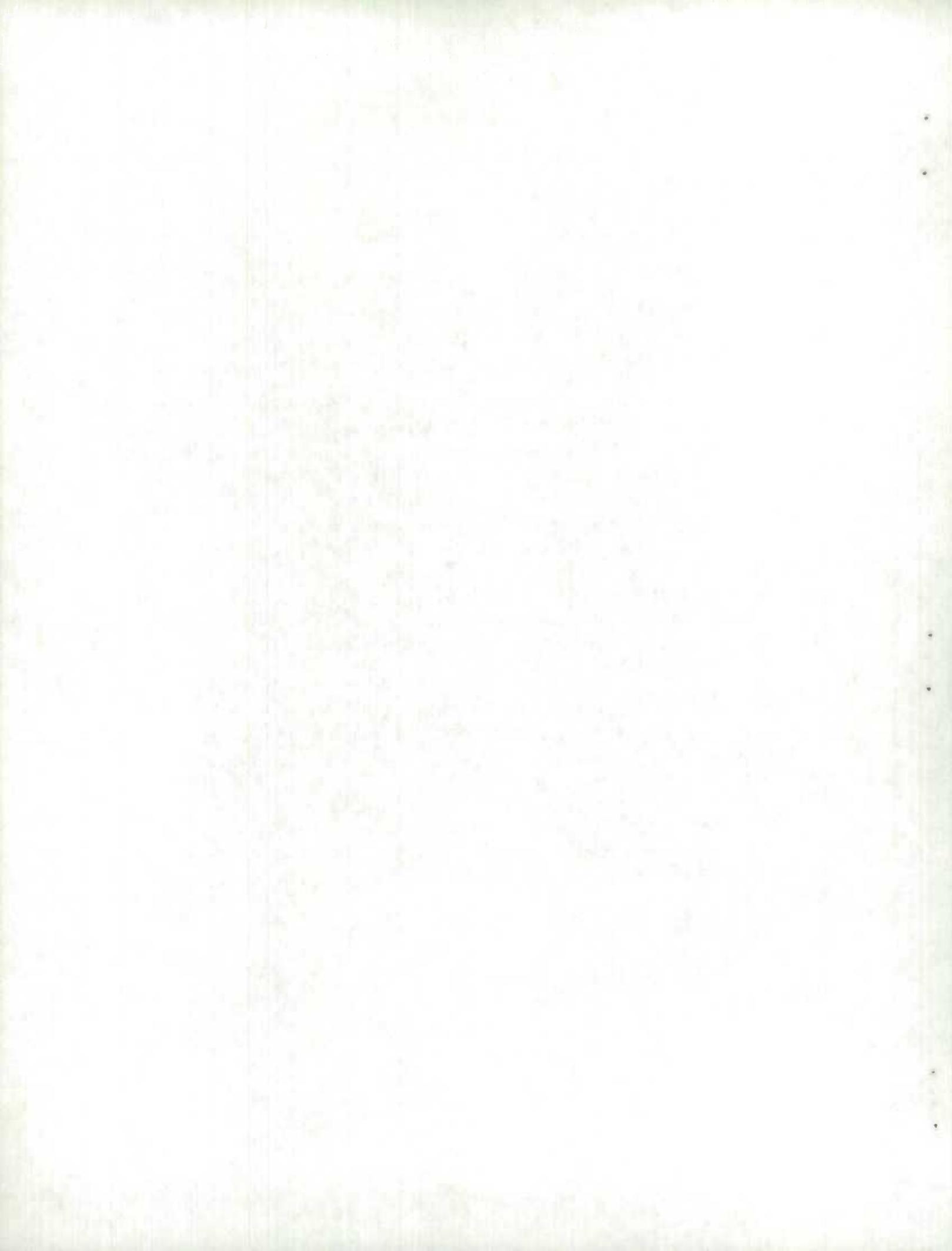
There are several ways of obtaining the data from the potential respondent. Some of those in increasing order of sophistication are as follows:

- i) Mailout of a questionnaire
- ii) Telephone interviewing
- iii) Personal interview
- iv) Data submission on magnetic tapes or floppy disks
- v) Computer Assisted Telephone Interview

The respondent should be given the choice amongst those modes, taking into account the flexibility of the survey agency and collection costs. Giving the respondent a preference for mode of data collection will improve response rates.

The timing for mailing out questionnaires is also important. This timing is linked to the availability of data on the respondent's part. In the case of monthly surveys, one has to respect bookkeeping practices for keeping track of monthly data. Most respondents operate within the calendar month, whereas others strictly operate within four and five week cycles. In both cases, data are usually available to the survey agency one or two weeks after the end of the monthly period. In the case of annual surveys, the fiscal year of the respondent does not necessarily correspond to the calendar year. The fiscal year may end anywhere within the calendar year. Hence, mailout must be done after the end of a respondent's fiscal year. This will improve response rates because the data will then be easily available. It will also decrease the ambiguity associated with the reference year being requested.

Telephone interviewing is used to collect data from businesses for a variety of reasons that range from clarification of instructions to the respondent to follow-up action. The quality of response may suffer if this mode of collection is improperly used. For instance, a respondent who does not have the reporting instructions available for guidance, may be forced to estimate the data due to lack of availability of records near the telephone. If telephone interviewing is used on a periodic basis, such as in monthly surveys, then a best day and time arrangement with the respondent will improve response rates as well as the quality of response.



5.5 Data Capture and Preliminary Data Editing

Data capture and preliminary data editing may be done in one of two ways:

- i) Data capture and instantaneous editing as the respondent is providing the data. This would occur in CATI type applications. For this case, the inter-field edits should be simple in order to give the interviewer and respondent a chance to clarify one another's queries and responses about potential errors.
- ii) Data keyed from a questionnaire with transcribed responses followed by editing. This would occur when a questionnaire has been mailed back by the respondent or an interviewer has obtained the data from the respondent. In this case, the inter-field edits can be more complex than those in case i) because there is time on the survey agency's part to study the errors and to correct them by contacting the respondent.

For both cases, the inter-field edits should be set up so as to minimize the number of times that the survey agency needs to go back to the respondent to correct potential errors. The use of an inter-field edit analyzer and error localizer in the Generalized Edit and Imputation System (GEIS) developed at Statistics Canada is recommended to respond to this requirement (see Kovar, MacMillan and Whitridge (1988)). If too many errors are detected, but the original data proved to be correct on follow-up, the edits must be revised to alleviate response burden.

The significance of the errors as measured by their influence on the estimates must be taken into account as well. In the case of edit failure for completed questionnaires, Latouche and Berthelot (1990) have developed a score function which assigns a relative score of error importance to each respondent. A score is computed for each variable on a questionnaire. This score contains four major elements: the size of the unit, the size and number of suspicious data items on the questionnaire and the relative importance of the variables. It is then summed up over all variables within the questionnaire to obtain a global score for each respondent. The respondents with the highest score values are considered to be the most influential. Using this concept, Latouche and Berthelot (1990) have demonstrated in a simulation study that recontacting a limited number of units is sufficient to ensure acceptable data quality for the final estimates.

In the case of change from survey occasion to survey occasion, Hidioglou and Berthelot (1986) have developed a function which allows to put more emphasis on the change of the larger units. This function can be used to detect units which show unusual changes from occasion to occasion.

5.6 Follow-up

Follow-up is undertaken either to obtain data from non-respondents or to recontact respondents with significantly high edit failures in their returns. In the case of non-respondents, often a subsample is selected for follow-up in order to reduce costs. If response bias exists, this bias can be reduced by properly weighting up this subsample to the domain of non-respondents or by imputing the whole domain if sufficient data exist. The follow-up sample is allocated so as to optimize survey efficiency. The allocation and selection of the non-responding units, as described in Strauss and Hidioglou (1981) or Hidioglou (1982), will usually be based on the following factors:

- i) a take-all stratum of must follow-up units must be selected in order to concentrate on the larger non-responding units,
- ii) response rates should be equalized amongst the design strata
- iii) rotation of the smaller sized non-responding units targeted for follow-up should occur.

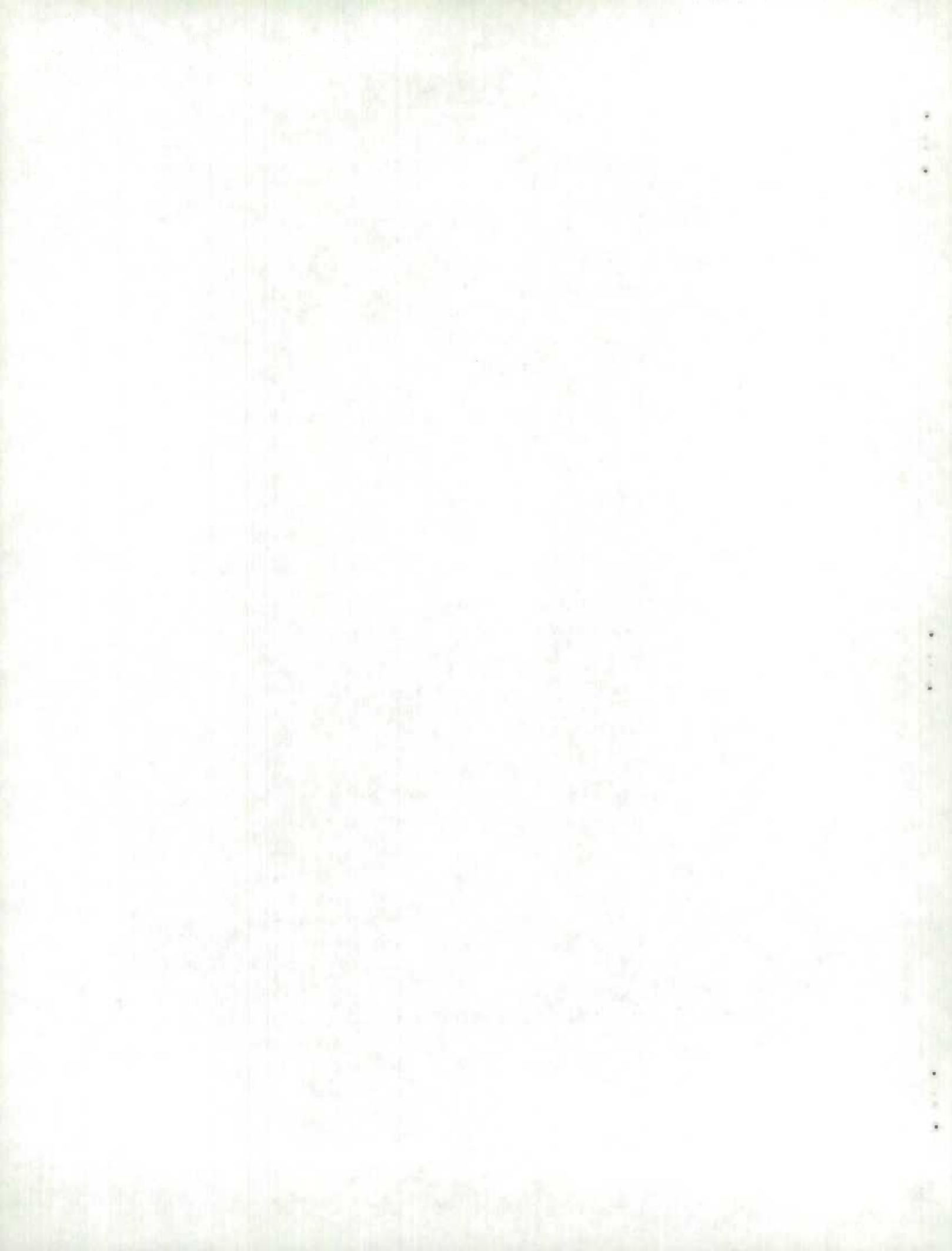
It should be noted that a core of units may never respond and the resulting bias due to these units cannot be completely eliminated.

5.7 Administrative Data Considerations

Response burden for Annual Business Surveys at Statistics Canada is being alleviated by obtaining some of the data for the smaller sized units from administrative sources. Such data also needs editing and imputation to replace illegible, inconsistent or missing data.

5.8 Management System for Data Collection

A good tracking system is required in order to know the stage at which the collection process is at any point in time. Collection status codes (whose history is kept) are used to control the collection process. These collection status codes must be used in conjunction with other codes that reflect the activity status of the unit (active, seasonal with operating dates provided, out of business, temporarily closed, etc.). They must also occur in a natural



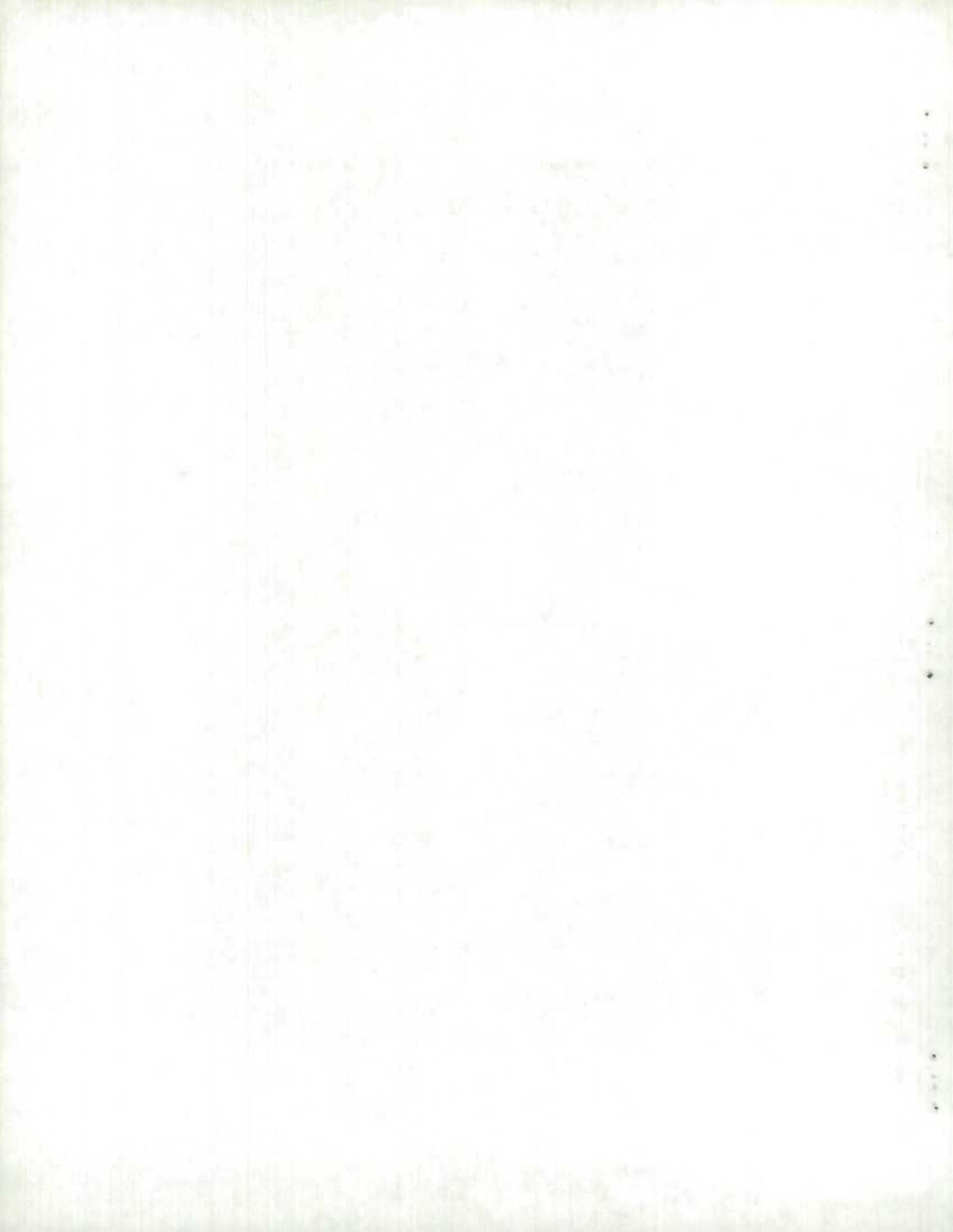
sequence. Typical examples of such collection status codes are: initial mailout for active units (units that are known to be active during the reference period at hand), and exclusions from such a mailout (which include closed units, out of business, temporarily closed). Expected dates for returns of the questionnaire are also required in order to prompt follow-up. If no data have been received by the expected dates, then a follow-up action occurs. This action must be reflected in the collection status code (along with the date that the follow-up was initiated). If no response is obtained the follow-up will become increasingly more demanding (starting with a mail reminder, escalating to telephone follow-up for the more important units). If in the interim, an outside source has indicated a change in the activity status of the unit, then the follow-up is terminated and a collection status code of "received" is noted. If after several attempts to follow-up no response is obtained, then the unit is classified with a collection status of non-respondent. This status will be of use in subsequent recontacts with this unit. If data have been obtained, then the collection status of "received" is reflected. Such a tracking system, if properly designed, will help in reducing non-response because the contact status is known to the survey agency. Consequently, misunderstandings on the sampled unit's response status are minimized.

6. General Conclusions

Any survey, whatever its type and method of data collection, will suffer from missing data due to non-response. Hence it is important to anticipate and minimize the possibility and effects of missing data due to non-response at the onset of planning and design of the sample survey. Non-response has been generally recognized as an important measure of the quality of data since it affects the estimates by introducing a possible bias in the estimates and an increase in sampling variance because of the reduced sample. The relation between sampling variance and the non-response rate is fairly straightforward. However, the relationship between the bias and the size of non-response while perhaps more important is less obvious since it depends on both the magnitude of non-response and the differences in the characteristics between respondents and non-respondents.

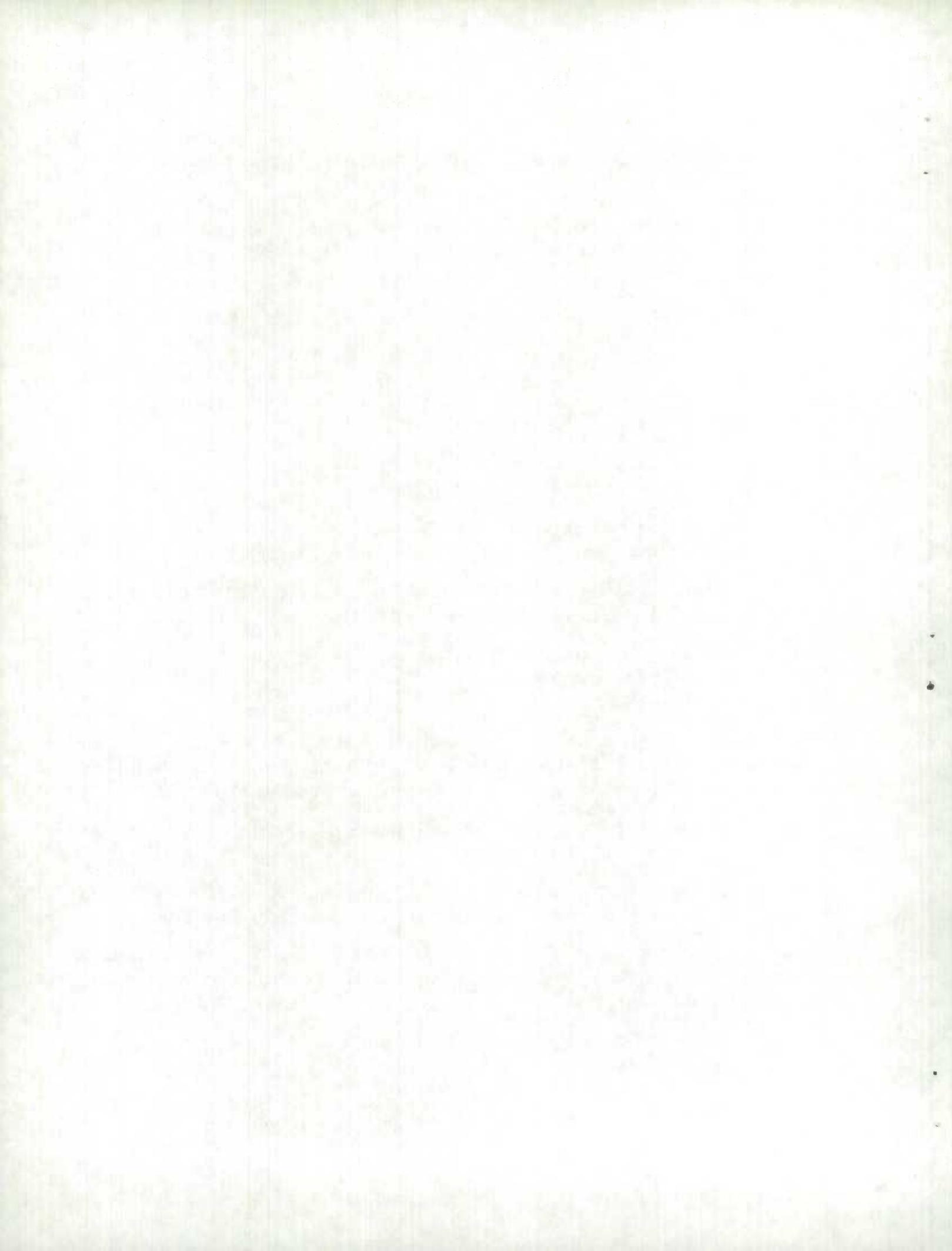
Standardization of the definitions of the response/non-response rates appears to be difficult, owing to the variety of uses and studies of non-response and owing to the careful record keeping demanded of survey takers.

It has been observed in publications such as Wiseman and McDonald (1980) that there are many opinions of the way non-response should be defined and measured. Thus, it appears that one must grapple with the alternative definitions and terms to obtain relationships between them under various survey conditions. A proper study (Gray (1988)) can really be undertaken only with a thorough evaluation of survey records, which is possible only when good records are kept. Often, particularly in the case of quota samples, in telephone and mail surveys, non-respondents are set aside and other units are substituted for them and treated like the originally selected units. The result is a higher observed quality of survey than is the case in reality because of the hidden non-response bias. Consequently, the way of treating non-respondents and the evaluation of non-response, completion, etc. must be planned in advance of the survey data gathering in order to deal with it properly rather than during or after the survey.



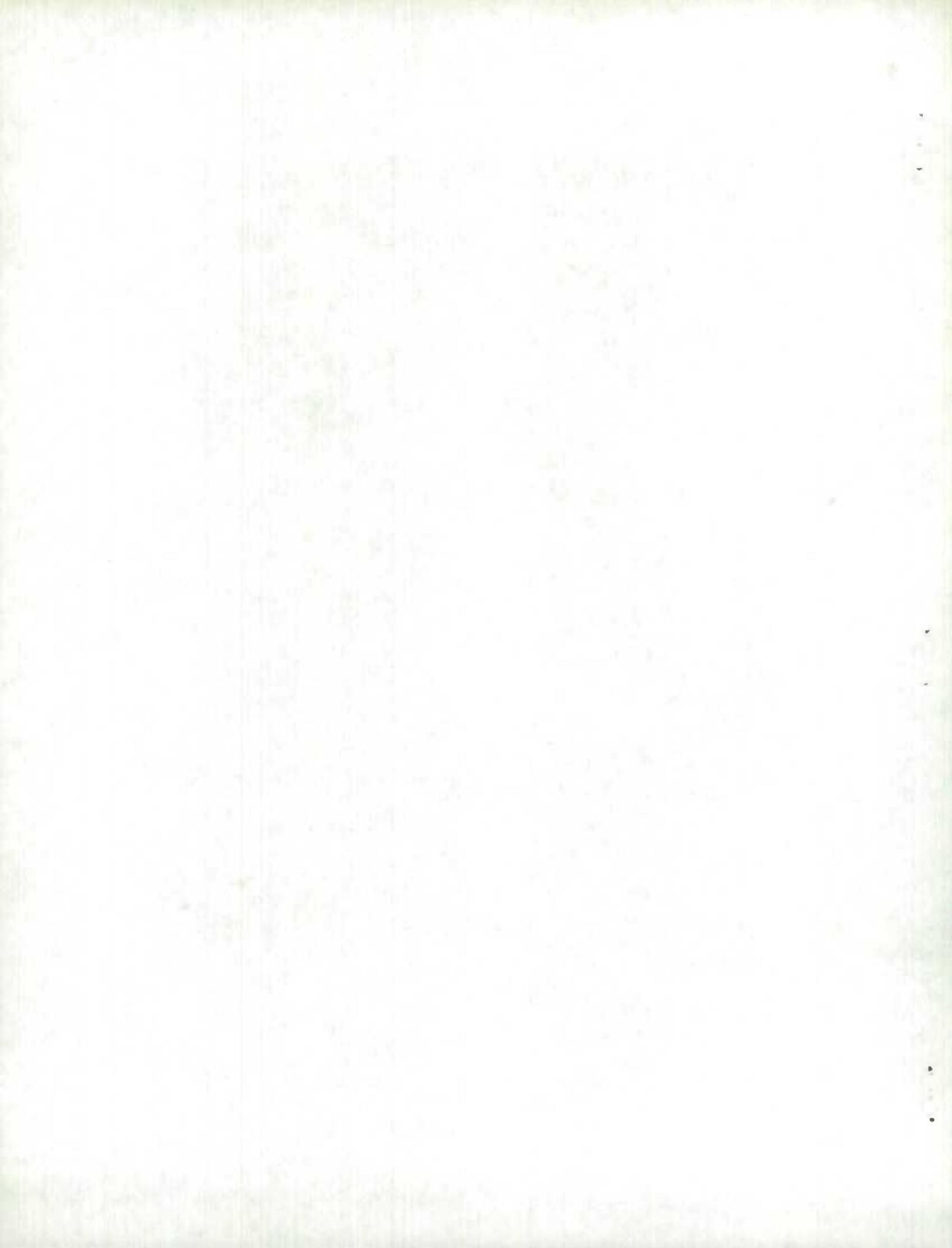
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