Monthly Survey of Food Services and Drinking Places (MFS): Impact of Restratification

This report describes the restratification of the MFS frame and the development of an updated sample. It explains how the old MFS monthly series (before restratification) and new series (after restratification) were linked together.

The purpose of restratification is to improve a sample by accounting for changes to a population that occur over time. The original MFS sample design was based on the list of enterprises and establishments on the Business Register (BR) in March 2007. The restratified sample is based on the BR list as of December 2008.

Both designs were run in parallel for six months to monitor quality and also, more importantly, to provide a means for linking the old and new series. This allowed for the development of a revised series covering the period from September 2007 to March 2009. The new restratified series has run independently since April 2009.

Section 1 of this paper discusses events leading to the need for a restratification. Section 2 compares estimates from the old and new series. Section 3 describes the methodology used to link the old and new series.

Appendix 1 provides a short glossary of terms and acronyms. Appendix 2 provides an overview of the history and the methodology of the MFS. It will be useful to refer to the appendices during the sections that follow.

Section 1: The need for a restratification

The original sample, i.e., before restratification, was based on the Business Register's list of establishments coded to NAICS 722 in March 2007 (original MFS population). This list of establishments, as represented on the BR, changes each month. There are births and deaths. Establishments grow smaller or larger and sometimes move to a different province or industry. Thus, as time passes, samples become less optimal.

The strategy of the MFS sample design includes processes to ensure estimates remain of high quality and accuracy despite continuously changing populations. Yet unavoidably the standard errors of the MFS estimates grow larger. The processes are these:

- When deaths are detected in the MFS sample, they are not removed but remain in the sample. These deaths no longer contribute to the sales estimates. They do, however, represent the undetected deaths in the whole MFS population.

- When births are detected (each month from the BR), they are added to the MFS in-scope population and a sample of them is selected.

- When a sampled unit remains in the MFS in-scope population but changes its province or its original in-scope NAICS to a different in-scope NAICS, it continues to contribute but its contribution goes to its new province or NAICS.

Despite these adjustments, as months pass, the original sample becomes out of date and is no longer optimal. A non-optimal sample leads to a larger standard error (or CV) than the original sample and less reliable estimates. As well, it is possible for an unknown bias to creep into estimates if the structure of the population changes significantly since the original sample.

For these reasons the MFS frame is restratified and a new sample is selected. The MFS strategy is to perform a restratification and select a new sample every two years for the December reference month. Based on results of the recently concluded restratification, the benefits and timing of future restratifications for the MFS will be evaluated.

In comparing the list of sampling units from the original and new MFS frame: 1.2% of units had a different province or NAICS code; 23% were births; 24% were deaths. Also, 17% moved to a different sample design stratum. Overall, this amounts to a significant number of changes to the MFS population and sample design.

During the 21 months between the new and old sample design, there were two major changes:

- A significant number of new chain agreements were reached and integrated into data collection. A chain agreement is an agreement with a franchisor to provide consolidated data by province and NAICS for itself and its franchisees.

  In the old sample there were 25 chain agreements. This number was increased to 47 for the new sample.

  Chain agreements help improve the efficiency of data collection, reduce response burden for franchisees, and reduce the variability of sample estimates as more population units are covered without increasing the sample size. They also help ensure more complete and up-to-date coverage of the population as births, deaths and units missing from the population are captured immediately.

- The BR Redesign Project was completed in time for the January 2008 reference month. One key aspect of the BR Redesign was an improved measure of firm size. The size measure is a key variable used in sample design, implying a more efficient sample design for the restratification.

Diagram 5 (see Appendix 2) provides an illustration of the sample design; it is applicable for both the original and restratified designs. The main purpose of a restratification is to calculate updated and optimal sample design boundaries between the Take-all, Take-some, and Take-none strata (see Appendix 1). The updated strata better reflect the true MFS population.

In the MFS restratification, the new sample was selected independently of the previous sample. But there is high overlap between the old and new sample since the largest sampling units, assigned to the original Take-all strata, are likely to remain large and assigned again to the Take-all strata in the new sample.

Section 2: Comparing the old and new MFS estimates

The original sample (called C1) was run in parallel with the new restratification sample (called C2). There are two sets of estimates covering the period December 2008 to May 2009.

We expect the C2 estimates to be more accurate because they are based on the most recent information available from the BR. Also, some immeasurable or unknown bias may have crept into the C1 estimates as the structure of the MFS population changed from the time when the original list frame was created.

i) Month-to-Month Changes

The changes from month-to-month for the C1 and C2 estimates are very similar. This is most evident when smaller domains are amalgamated into larger ones. For this reason, in linking the original C1 series to the new C2 series, we could choose either of the two to provide the month-to-month movements.

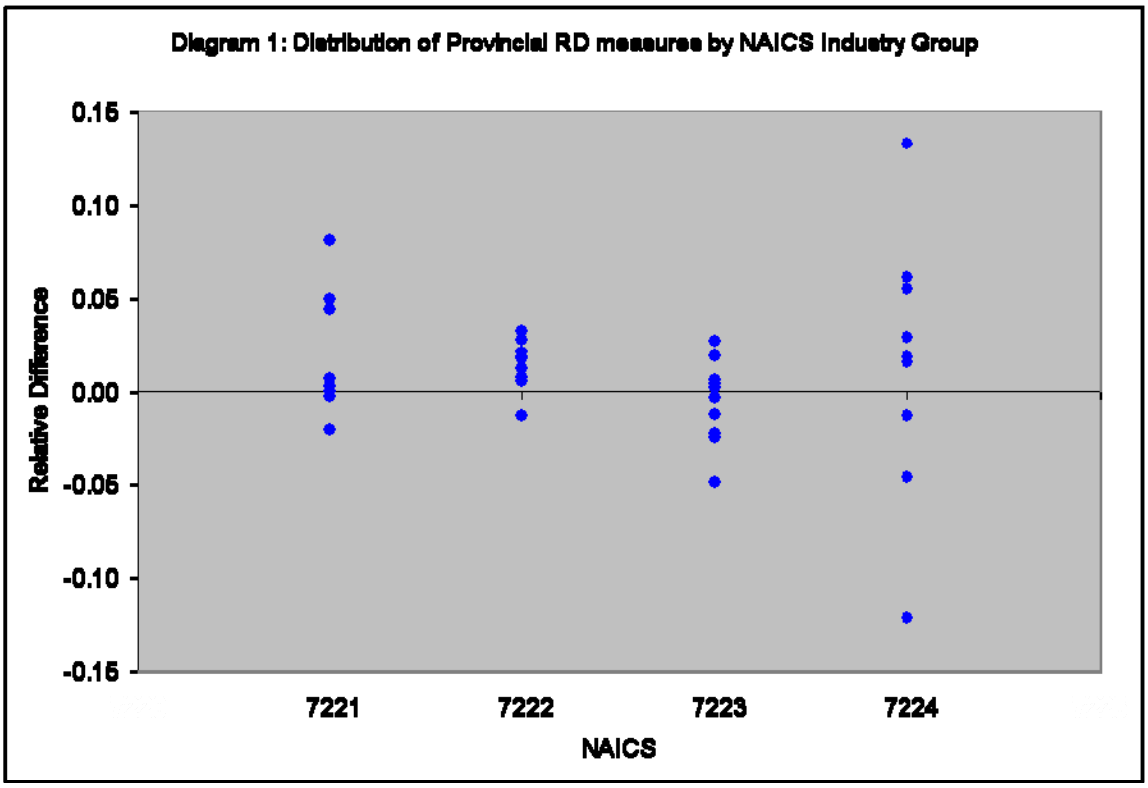
ii) Differences in level

Diagram 1 displays four dot plots comparing the C1 and C2 estimates graphically for March 2008 using the Relative Difference: RD = (C2 – C1) / (C2 +C1). The RD measure is symmetrical around 0, and varies from -1 to +1. Each dot represents the RD between C1 and C2 for a particular province for its corresponding NAICS industry group.

For NAICS 7221 and 7223, most of the dots are clustered around 0, with a relatively small spread. This leads to the conclusion that on average there is very little difference for C1 and C2 for these two NAICS.

For NAICS 7222 the dots are all, except one, above zero. This indicates that the C2 estimates are higher than the C1 estimates. The small spread and its closeness to zero show that, while the C2 is higher, the differences between C1 and C2 are minimal, and are consistent across all provinces.

For NAICS 7224, while the dots are spread fairly evenly around zero their spread is large. This implies that the differences between the C1 and C2 estimates in this NAICS industry group are large for some of the provinces.



Section 3: Methodology used to link the old and new series

The C1 and C2 series were combined using a benchmarking process. As noted above, the monthly movements of the C1 and C2 are very similar. Thus, a decision was taken to base the linked series on the month-to-month changes of the C1 series. (Note: If the C1 and C2 series had also been very similar in level, then the C2 series could simply continue on from the C1 series without the need for a method of linkage.)

Before the linkage, "annual revisions" were applied to the C1 series. Annual revisions are performed once per year, and are based on updated and more complete data from GST, data from late reporters and revisions to collected data. Thus, the C1 series in the linked data set is the annual revised series for C1.

The purpose of the linkage method is to produce a single revised series covering the period from September 2007 to March 2009 (March was chosen as the linking month out of the six-month parallel run of C1 and C2). For data before September 2007, the C1 (annual revised) series is used. After March 2009, the C2 series is used. For the period between September 2007 and March 2009 statistical methods are used to link the two series.

There are two approaches taken for linkage: Gradual Level Shift ("wedging") and Abrupt Level Shift. When the differences between the C1 and C2 estimates were relatively

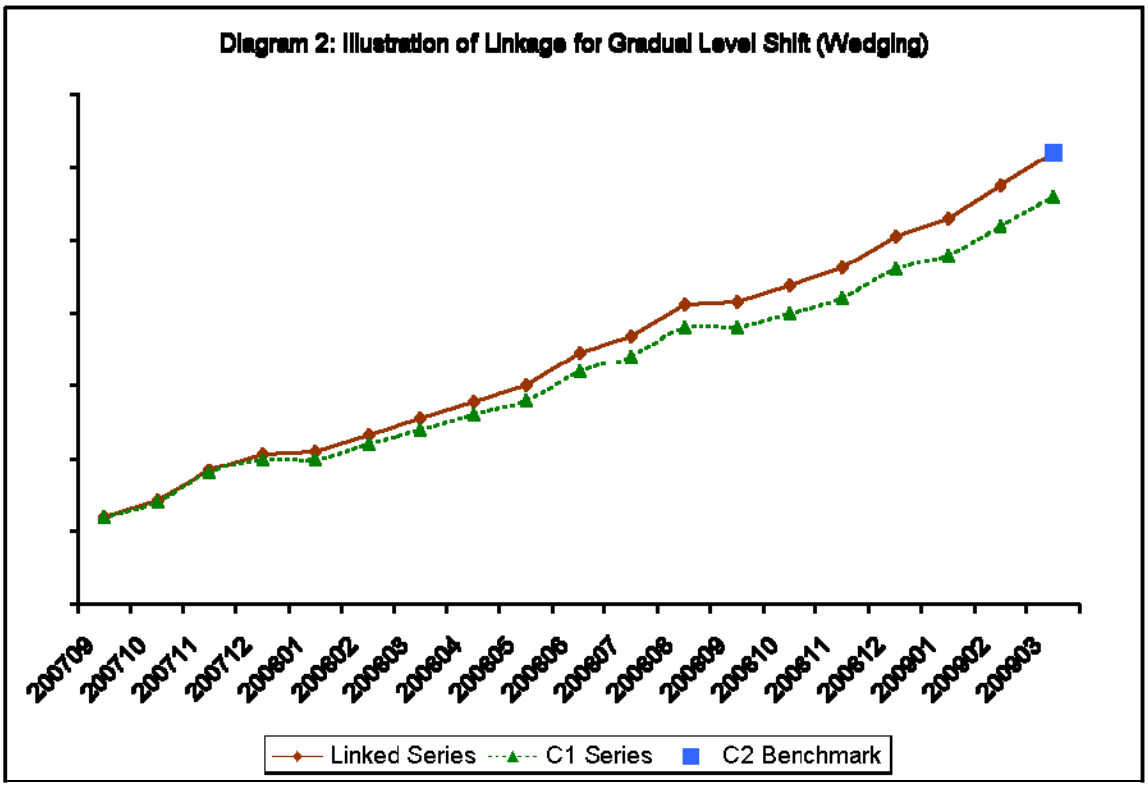
small, linking by Gradual Level Shift (or wedging) was used. When the differences were larger, the Abrupt Level Shift was used.

The linkage was performed at the 4-digit NAICS by Province domain. Approximately half of domains used the wedging methodology (representing about 70% of MFS sales revenue) while the other half used the abrupt level shift methodology.

i) Wedging

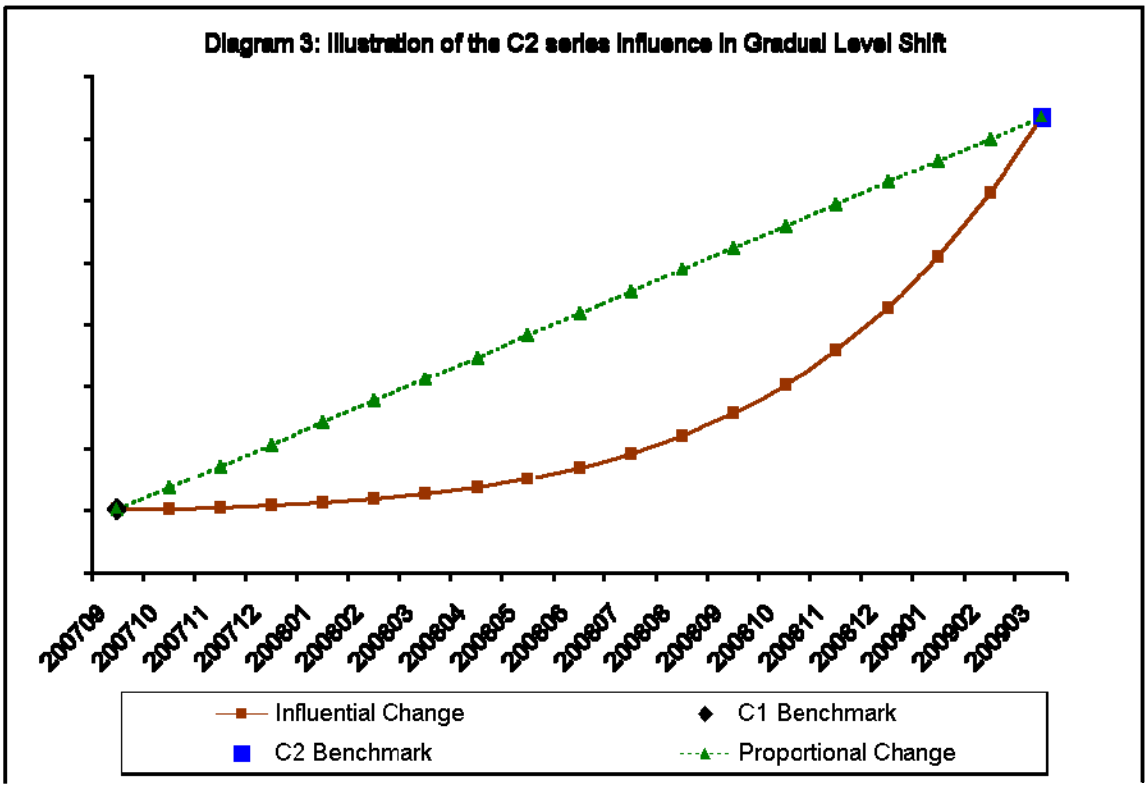
In this approach, the series begins in September 2007 with the C1 estimate. It is the starting benchmark (also called the anchor). The ending benchmark is the C2 estimate of March 2009. The difference between the C1 and C2 estimates as of March 2009 is the amount that was wedged into the C1 series, going back in time to September 2007.

Diagram 2 illustrates the wedging methodology: A methodology that preserves both the beginning C1 estimate and the ending C2 estimate and derives a linked series in between. The dotted line represents the original C1 series and the solid line representing the new linked series.



The solid line in Diagram 3 below illustrates how the difference between the C1 and C2 estimates is wedged in. It shows the relative influence of C2 through time. At the beginning of the series, the C2 benchmark has little influence and the C1 series dominates. As months pass, the C2 benchmark of March 2009 dominates. It pulls the C1

series to itself. The dotted line, while not used, demonstrates an equal distribution of the difference between C1 and C2 across the 18 months.



ii) Abrupt level shift

In this approach, there is only one benchmark, the C2 estimate of March 2009. From this C2 estimate, the linked series follows the C1 monthly trend series backwards. The percentage difference, {100 ∗(C2 - C1) /C1} is always the percentage distance between the linked series and the C1 series in March 2009. Thus (in Diagram 4), the linked series, the solid line, is “parallel” to the C1 series, the dotted line.

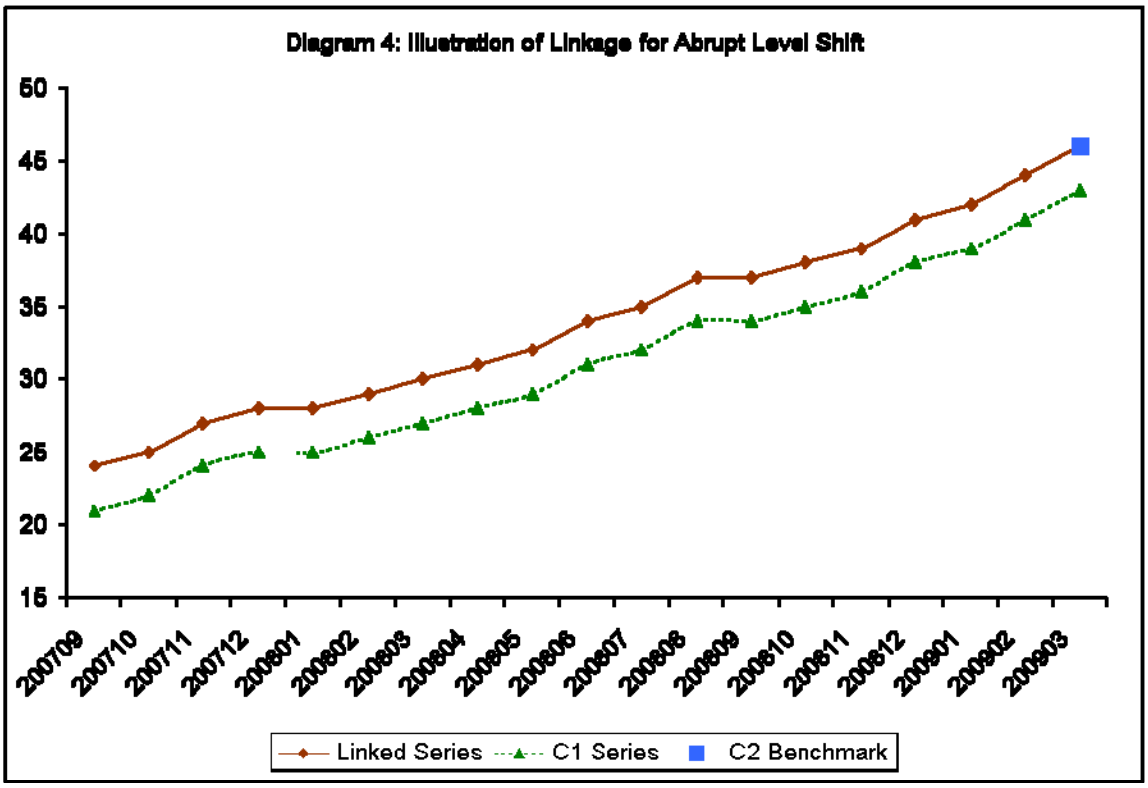


Diagram 4: Illustration of Linkage for Abrupt Level Shift
50
45
40
35
30
25
20
15
200709
200710
200711
200712
200801
200802
200803
200804
200805
200806
200807
200808
200809
200810
200811
200812
200901
200902
200903
Linked Series
C1 Series
C2 Benchmark

Appendix 1: Glossary

Bias	A measure of the difference between an estimator's expectation and the true value of the parameter being estimated.
BR	The Business Register is a list of all businesses in Canada derived and maintained by Statistics Canada; also referred to as the "frame" from which a sample design is derived and a sample is selected.
Enterprises and Establishments	Enterprises and establishments are statistical representations of a business used to developing sample designs. In the Business Register, if the operating structure of a business has "children" entities then a business is called "complex". The entity at the top of the operating structure is called the enterprise and its "children" are called establishments. In Canada, in the whole economy, 99.1% of businesses are "simple". This means that the operating structure and the statistical representation are represented by a single entity on the BR. In effect, the statistical enterprise and statistical establishment are one and the same! The complex business, though few in number (0.9%) account for 60% of the economy.
GST	Goods and Service Tax data: GST data are administrative data and are accessed by Statistics Canada from CRA (Canada Revenue Agency). These data provide monthly revenue and are used as a replacement for collected survey data, thereby reducing cost and response burden.
MFS	Monthly Survey of Food Services and Drinking Places
NAICS	North American Industry Classification System. Enterprises and establishments belonging to the MFS population begin with NAICS "722".
Sampling unit	The MFS sampling unit is the enterprise. This is a cluster of establishments that are coded to NAICS 722 and belong as "children" to the enterprise. The dominant establishment is the establishment with the largest annual revenue measure of size on the BR. Its (5-digit) NAICS / Province is the assigned NAICS and Province of the cluster (enterprise).

Standard Error	A measure of the sampling variability or precision of the estimate.
Types of sample design strata:	Take-all (TA): All units in this category are selected for data collection based on size or other pre-defined criteria. These are the most important contributors in an industry and cannot be represented by other units in the population; rather, each unit is self-representative. Take-Some (TS): A sample of units is selected for data collection, and each unit selected is weighted to represent other units that were not selected. Take-None (TN): No units are selected for data collection; instead administrative data is used for these units.

Appendix 2: Overview of the MFS: purpose, goals, challenges, and methodology

Purpose:

The MFS publishes estimates of the monthly value of sales and the number of locations by province / territory for food service industries based on the North American Industry Classification System (NAICS). The 4 digit NAICS in scope to the survey are listed below:

NAICS 7221	Full-service restaurants
NAICS 7222	Limited-service restaurants
NAICS 7223	Caterers, Food Service Contractors, and Mobile Food Services
NAICS 7224	Drinking Places

The MFS is a redesign of (and replaced) the Monthly Restaurants, Caterers and Taverns Survey (MRCTS). The redesign was developed during 2006 and 2007 and, on February 1 2008, the first preliminary estimates for the reference month of November 2007 were released in Statistics Canada's Daily. The September 2007 reference month was used to link the original MRCTS data series and the redesigned MFS data series using the abrupt level shift methodology.

Goals:

The goals of the original redesign were to:

- improve the target population to cover the non-employers (in addition to the employers from the old MRCTS);
- reduce response burden and make better use of collection resources by:
    - implementing more data collection agreements for the chains;
    - introducing take-none strata;
    - expanding the use of administrative (GST) data;

- produce seasonally adjusted data;
- restratify periodically to update the sample design and improve the MFS estimates.

Challenges:

There are several challenges in the MFS related to estimation. First, there is considerable volatility in the industry population in terms of births, deaths and changes of ownership. Identifying them from month-to-month is important to ensure changes in the population are reflected in the sample estimates. Secondly, chain stores have a large impact on the estimates; identification and classification of chain locations helps to improve the quality of data collection by developing reporting arrangements which significantly reduce response burden while increasing the coverage of units in the population.

In a particular month, four sets of estimates are published: the preliminary estimate for the latest reference month, 'm', the first revision of the previous reference month 'm-1', and the second revision of reference month 'm-2'. In addition, seasonally adjusted estimates undergo one extra month of revision for the third revision of reference month 'm-3'. One exception occurs during the release of the March reference month when seasonally adjusted values are revised back to January of the previous year.

Methodology:

a) Frame and sampling unit:

The MFS in-scope population is a list of establishments coded to NAICS 722, derived from the Business Register (BR). The MFS sampling unit is the enterprise (see the Glossary of Appendix 1).

In the MFS, for any given month, approximately 1.7% of the enterprises (sampling units) are "complex" (i.e., the enterprise comprises more than one establishment in different provinces or NAICS) and 98.3% of the enterprises are "simple" (i.e., the enterprise comprises one or more establishments all within the same province and NAICS).

b) Sample design and estimation and the use of GST data:

One goal of the MFS redesign was to increase the use of administrative data. The Goods and Service Tax (GST) data from the Canada Revenue Agency provides monthly revenue. The use of GST data (instead of collected survey data) is intended to reduce data collection costs, response burden and to improve data quality.

GST data can be used for simple businesses because there is a one-to-one link between the MFS establishment unit and its GST monthly revenue. But the link for complex businesses to the GST data response is many-to-one or many-to-many; thus, for these cases, GST data are not used. Instead, monthly MFS sales must be obtained through collected survey data for these complex units.

One limitation to the GST data is that the date that units go out of business is often unknown until several months after it actually takes place. To account for this, a death rate is applied to adjust for the expected number of deaths in the reference month. At the time of an annual revision, many more months of empirical information is available on actual deaths, which are then applied to the historical estimates.

c) Sample Design:

There are two estimation design approaches in the MFS. The traditional sample design based on collected MFS survey data is one approach. The Simple Business Model based on GST data is the second approach used for certain provinces and NAICS domains.

i) Traditional design:

In each province and NAICS, there is a Take-all stratum (where all units in a stratum are selected), two Take-some strata (a random sample of units are selected), and a Take-none stratum (no units are selected and instead GST data are used). Large sampling units are assigned to the Take-all; medium or small-sized sampling units are assigned to the Take-some strata; and the smallest simple enterprises are in the Take-none.

The boundaries between these strata (in a particular NAICS / province cell) are derived based on the MFS annual revenue measure of size from the BR using an algorithm (Hidiroglou-Berthelot) that is designed to derive the minimum required sample size for a desired level of accuracy.

For the take-some strata, simple random sampling without replacement (SRSWOR) is used. Thus each sampling unit within a stratum has the same probability of selection as any other unit. For a stratum, let N be the number of frame units and n be the number of units selected in the sample. Therefore the probability of each unit being selected is n/N. For estimation, the Horvitz-Thompson estimator is used: thus, the weight of a sampled unit is {1 / (n/N)} = N / n. The weight for each Take-all strata unit is 1 (and also the weight for chain units is 1).

- Each birth is given a probability of selection (P_{birth}) in the sample. P_{birth} is equal to the probability used to select the original sample in its stratum. It is possible for none, some, or all of a month's births to be selected, but we expect the number of births selected to be close to (B multiplied by P_{birth}). The sampling weight of the stratum changes from N/n to {(N+B) / (n+b)} where B is the number of births detected in the BR and b is the number of births selected in the sample.

The source of data for the traditional design is collected MFS survey data for the chains, Take-all, and Take-some units. The source of data for the Take-none strata is revenue data from the GST files using the Simple Business Model that is described next.

ii) Simple Business Model:

The MFS Simple Business Model is based on estimating total MFS sales using the ratio estimator.

A small sample of simple businesses is selected and their MFS Sales response is collected. This sampled unit is matched to its associated GST unit to derive the GST revenue response. Then the ratio: (sum of MFS collected sales) / (sum of GST revenue) is calculated for each Province by NAICS cell. This ratio is the ratio used in the MFS Simple Business Model. It is used for each Take-none strata and for some of the MFS population (see Diagram 5).

The purpose of the ratio is twofold. One is to estimate (or model) the conceptual relationship between MFS collected sales data and GST revenue data. Usually this ratio is close to 1, implying that there is little conceptual difference between an MFS Sales response and a GST Revenue response.

The second purpose is that for the preliminary estimate, the GST data of the reference month is not yet available. Instead, the GST data of the previous month is used and therefore the model also estimates the economic change from "m-1" to "m".

Diagram 5 summarizes the MFS sample design frame, and is illustrated below.

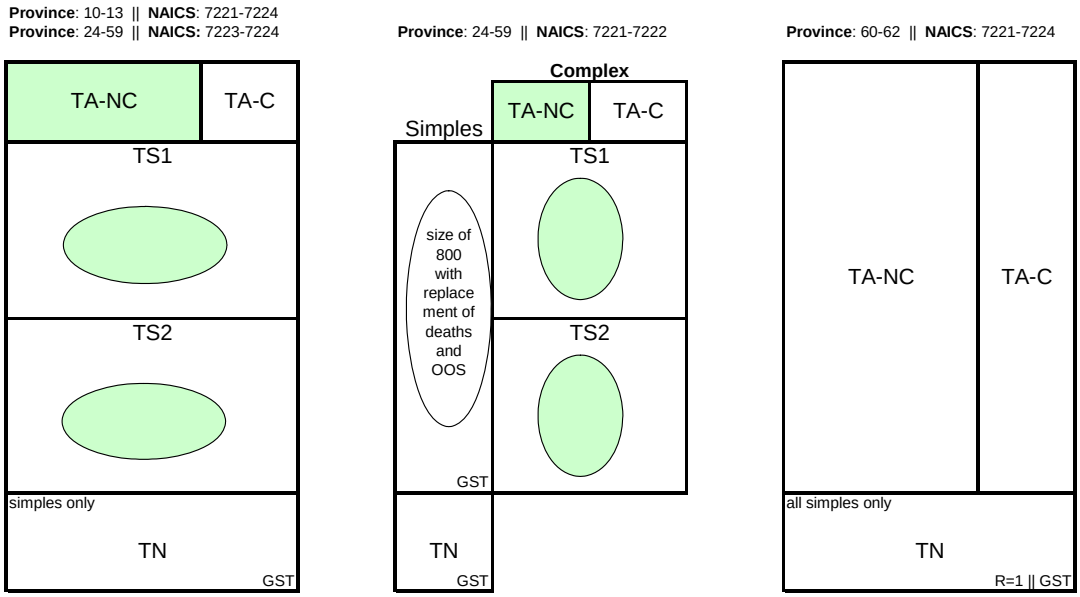
1. The traditional design of Take-all, Take-some 1 & 2, and Take-none strata is used for:
   - Newfoundland & Labrador (10), Prince Edward Island (11) Nova Scotia (12) and New Brunswick (13) in NAICS 7221, 7222, 7223, and 7224
   - Québec (24), Ontario (35), Manitoba (46), Saskatchewan (47), Alberta (48), and British Columbia (59) in NAICS 7223 and 7224.

2. The traditional design of Take-all, Take-some 1 & 2, and Take-none (TN) strata is used for complex business in provinces 24, 35, 46, 47, 48, and 59 and in NAICS 7221 and 7222.

3. For simple business, the Simple Business Model (SBM) is used in provinces 24, 35, 46, 47, 48, and 59 and in NAICS 7221 and 7222.

4. Yukon Territory (60), Northwest Territory (61), and Nunavut (62) are limited to two strata, a Take-All and Take-None strata.

Diagram 5: The Design of the MFS



Classical sample
TA-NC = Take-all non-chains stratum || **TA-C** = Take-all chains stratum
TS1 = Take-some1 stratum || **TS2** = Take-some2 stratum || **TN** = Take-none stratum