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A COMPARISON OF ROTATION-BY-DWELLING VERSUS ROTATION-BY-CLUSTER IN THE CANADIAN LABOUR FORCE SURVEY

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ABSTRACT

The Canadian Labour Force Survey (LFS) uses a sampling design based on six rotation groups. In any given month, one of the six groups is rotated out (called the death rotation) and replaced with a group consisting of new sample (called the birth rotation). Typically, a rotation group is defined in terms of geographically grouped households called clusters. From time to time, instability in estimates of change from one month to the next in employment and unemployment have been observed. These have been attributed to instability in estimates arising from the birth and death rotations (or clusters), and have put into question the current rotation-by-cluster design used by the LFS. An alternative design has been proposed, whereby rotation groups would be defined across clusters, in the hopes of spreading any instability at the cluster level across rotation groups. This paper describes the rotation-by-dwelling design and presents the results of a simulation using LFS data for two sets of consecutive months: June and July of 1996, and December 1995 and January 1996. Estimates of month-to-month change as well as measures of relative contributions coming from each rotation group are given under both methods, at both the province and Canada levels. Finally, some comments on the GREG versus composite estimator are given.

Key Words: rotation group; cluster; month-to-month change; GREG estimator

RÉSUMÉ

L'Enquête sur la population active (EPA) canadienne emploi un plan d'échantillonage fondé sur six groupe de rotations. À chaque mois, l'un des six groupes est supprimé de l'échantillon par rotation (appelé les décès) et est remplacé par un nouveau groupe d'échantillon (appelé les naissances). En général, un groupe de rotation est défini en termes de ménages regroupés géographiquement, appelés grappes. De temps en temps, on observe une instabilité dans les estimations du changement d'un mois à l'autre de l'emploi et du chômage. Cette instabilité a été attribuée à l'instabilité des estimations provenant des naissances et des décès, et a mis en question le plan de rotation par grappes employé par l'EPA. Un plan alternatif a été proposé, où les groupe de rotations sont définis à travers les grappes, dans l'espoir de répartir l'instabilité au niveau de la grappe parmi les groupe de rotations. Cet article décrit le plan de rotation par logement et présente les résultats d'une simulation utilisant deux paires de mois consécutifs: juin et juillet 1996, et décembre 1995 et janvier 1996. Les estimations du changement d'un mois à l'autre, ansi que de mesures de la contribution relative de chaque groupe de rotation sont présentées pour les deux méthodes, au niveau des provinces et du Canada. Finalement, quelques commentaires sur l'estimateur de régression généralisé (ERG) versus l'estimateur combiné sont donnés.

Mots Clés: groupe de rotation; grappe; changement d'un mois à l'autre; estimation GREG

Introduction

The Canadian Labour Force Survey (LFS) produces, among other things, estimates of month-to-month change in employment and unemployment. These estimates are based on six rotation groups, each of which can be used on their own to produce independent estimates. Five of the six groups have common sample from one month to the next, whereas the sixth group is rotated out (called the death rotation) and is replaced with new sample (called the birth rotation).

From time to time, the LFS has noticed an instability that occurs between estimates of month-to-month change coming from different rotation groups. For example, between May and June of 1996, the seasonally adjusted estimate of the total number of employed dropped by 41,000 in Québec, and that for unemployed rose by 32, 000, causing consternation by some economists. Then between June and July of 1996, the figure for employed dropped by another 35,000, and that for unemployed rose by 21, 000, whereas almost everywhere else in the country, these figures had the opposite trend, indicating growth in the economy. Further investigation revealed that there was "instability" at the rotation group level for the second pair of months, i.e., between June and July of 1996, whereas this instability did not appear to be present between May and June of 1996.

The "instability" in June-July came from the birth-death rotation where the sample is not common from one month to the next. (i.e., it is attributable to sampling error). In explanation, it is possible that the employment or unemployment status of the dwellings that were "rotated" out after a six month tenure was very different from that of the dwellings that replaced them. Thus, defining rotations at the cluster level, as they currently are, where sometimes entire clusters rotate out at a time, could be contributing to the problem. It was suggested that defining rotations at the dwelling level instead, i.e., having rotations cut across clusters, could diminish the effects of any such future occurrences. This is because the net effect of a cluster would be then spread across rotations. This study was initiated to investigate the possibility of implementing such a "rotation-by-dwelling" design.

This paper presents an empirical study which uses existing LFS data to simulate a rotation-by-dwelling design. The results are then compared to those under the current "rotation-by-cluster" design. Two pairs of months (December 1995-January 1996 and June-July 1996) of LFS data allow for the production of two sets of estimates of month-to-month change for both employment and unemployment at both the national and provincial levels. Corresponding stability measures allow for a comparison of each rotation group estimate, under both the current design and the simulated proposed design. In addition, a comparison of overall estimates under the two designs is made and concluding remarks are given.

Design of the Study

The current design of the LFS is stratified and multi-stage; for the most part, there are two stages, and in certain places three. In the two-stage design, clusters are selected without replacement using either (randomized) probability proportional to size (pps) systematic sampling or random group pps sampling at the first stage. Then, dwellings are selected within sampled clusters using systematic sampling at the second stage,. For more elaboration on these designs, see Gambino et al. (1998). The current design of the LFS is a rotating paneldesign, where, at any point in time, the sample consists of six rotation groups (which for the most part consist of clusters). As mentioned earlier, each month one of the six is rotated out and is replaced with new sample in the same cluster. Therefore, from any one month to the next, there is a 5/6th overlap in sample. In addition, it takes six months to rotate out all six groups, and replace them with new sample.

The major challenge for this study was to simulate a design which would, using existing LFS data and hence the current LFS design, mimic a design having rotations defined at the dwelling level, i.e., have rotations cut across clusters uniformly. Consider Diagram 1, which represents the current design, where each circle represents a sampled cluster within a stratum. The circles or clusters are labeled I, II, III, IV, V, and VI reflecting rotation numbers (i.e., clusters) under the current design. The numbers 1-6 inside each cluster represents the selected dwellings within each cluster. Although this diagram assumes only 6 sampled dwellings per cluster, the ideas here are easily extended to a more general scenario. The shaded area in the diagram illustrates the notion that, when it is time for rotation I to be rotated out and replaced with fresh sample, all selected dwellings within cluster I are replaced by new dwellings from within the same cluster. These then become rotation 1.

Next, consider Diagram 2, which illustrates rotation by dwelling (for rotation 1) under the proposed design. Here, rotations are in fact dwellings, and are labeled 1,2,3,4,5, and 6. That is, the collection of all dwellings labeled 1 across clusters constitute rotation 1 in this design. When it is time to rotate, all dwellings labeled 1 across clusters are replaced by new dwellings from within the same clusters. Thus, instead of rotating an entire cluster at a time, part of each cluster rotates each month. It is easy to see that defining rotations in this way spreads out the effect that any one cluster might have.

In order to illustrate how the two designs were simulated with existing LFS data, consider Table 1. In this table, each row represents a cluster, with the cluster labels I-VI given in the far left hand column. Note that these labels also represent the six rotation groups under the current design. Each entry in a particular row represents a sampled dwelling within the cluster. To simulate a rotation-by-dwelling design, first a "reserve" rotation needed to be established. The reasoning behind this will become apparent later. Within each cluster or row, a random starting point was chosen between 1 and 7 and assigned to the "first" dwelling in the cluster (for example, 3 was chosen in the case of the first row). The remainder of the dwellings in each row were then labeled sequentially modulo 7. For example, the labeling of dwellings in the first row is: 3,4,5,6,7,1,2. All those dwellings with a label 1 attached would then become part of rotation group 1 under the proposed design, those with a label 2 would become part of rotation group 2, and so on. In this way, rotation groups would be defined at the dwelling level and would cut across clusters uniformly, with one dwelling per cluster contributing to each of the newly defined rotation groups.

For this study, two consecutive months of data were considered at a time, in order to produce estimates of month-to-month change. Specifically we chose two such pairs of months: December 1995 - January 1996 and June-July 1996, the latter pair being the problematic months in Québec. Note that in the first pair of months (between December and January), there is usually a marked seasonal component, whereas in the second pair of months (between June and July), there is usually only a negligible seasonal component. Note also that under the current design, in both January and in July, the rotation group with cluster label I is rotated out and replaced with new sample. This choice simplified the implementation of the study since rotation I was always the one being "rotated" in the months in question.

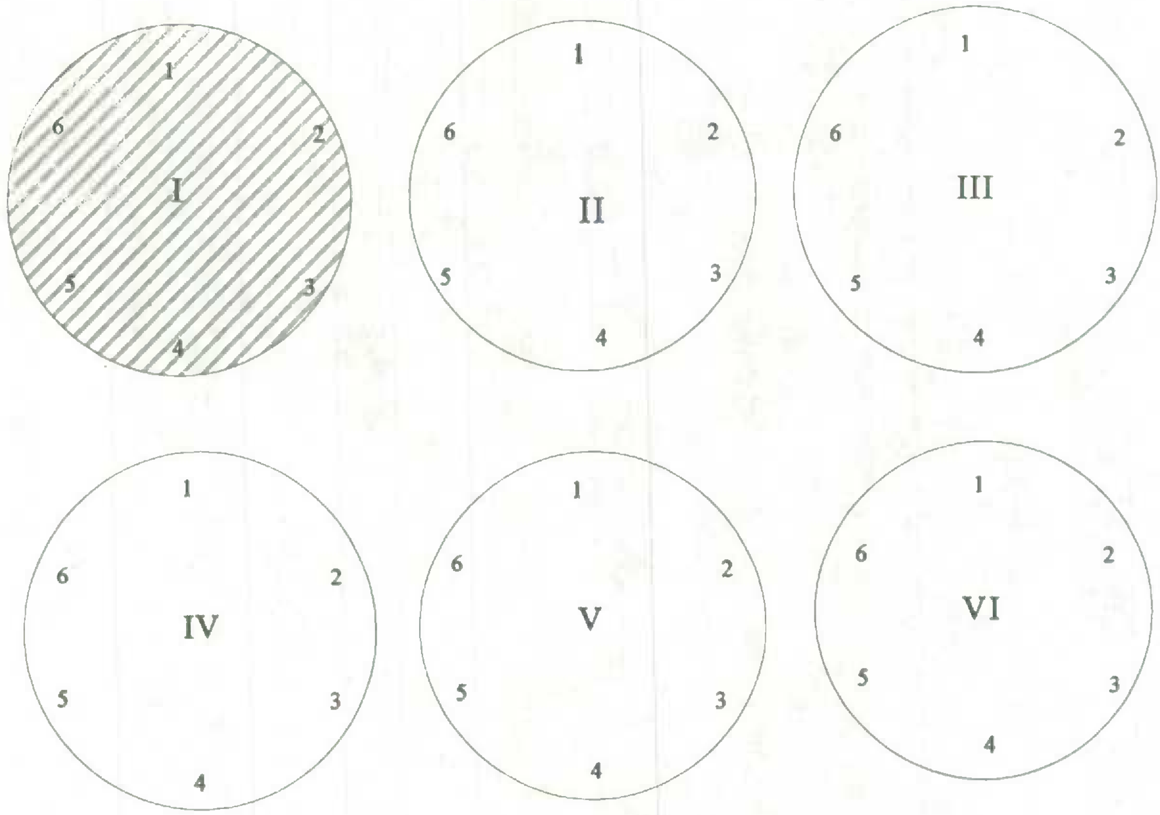

Diagram 1: Current Design

Proposed Design - "Rotation-By-Dwelling":
In the simulation, we are using real data which inherently reflects the current design where all dwellings in cluster I (rotation 1) are rotated out in the second months under consideration. However, this would *not* happen under the proposed design, since rotation 1 is defined differently. Therefore, a mechanism was needed to suppress the rotation of cluster I in these second months and to simulate a "seventh" month of data collection from the cluster I dwellings. In order to do this, a transition table of counts, scaled into row-wise probabilities was formed using all the data from rotations II-VI (intentionally excluding rotation I) for the two months in question. Table 2 shows the transition table that was used for December 1995-January 1996. This table shows that, of those who were employed in December 1995, 94.67% remained employed in January 1996, 2.49% became unemployed in January 1996, and 2.84% were not in labour force in January 1996.

This table was used to create or "impute" data at the individual level for January 1996 in rotation I, in order to simulate a seventh month of collected data. For instance, if an individual in rotation I is unemployed in December 1995, according to Table 2, we would impute that, in January 1996, he was employed with probability 14.17%, unemployed with probability 67.54%, and not in labour force with probability 18.29%. In this way, the "toss" of an unbalanced, three-sided coin could generate specific values at the individual level for January, 1996. For rotation I, these values replaced the January 1996 values from newly rotated sample (which we needed to suppress). Thus, we used the 5/6th common sample (from rotation II-VI) to impute what might have been the value had we collected one more month of data from the same people, rather than rotating these individuals out and replacing them with individuals from a fresh, rotate-in sample.

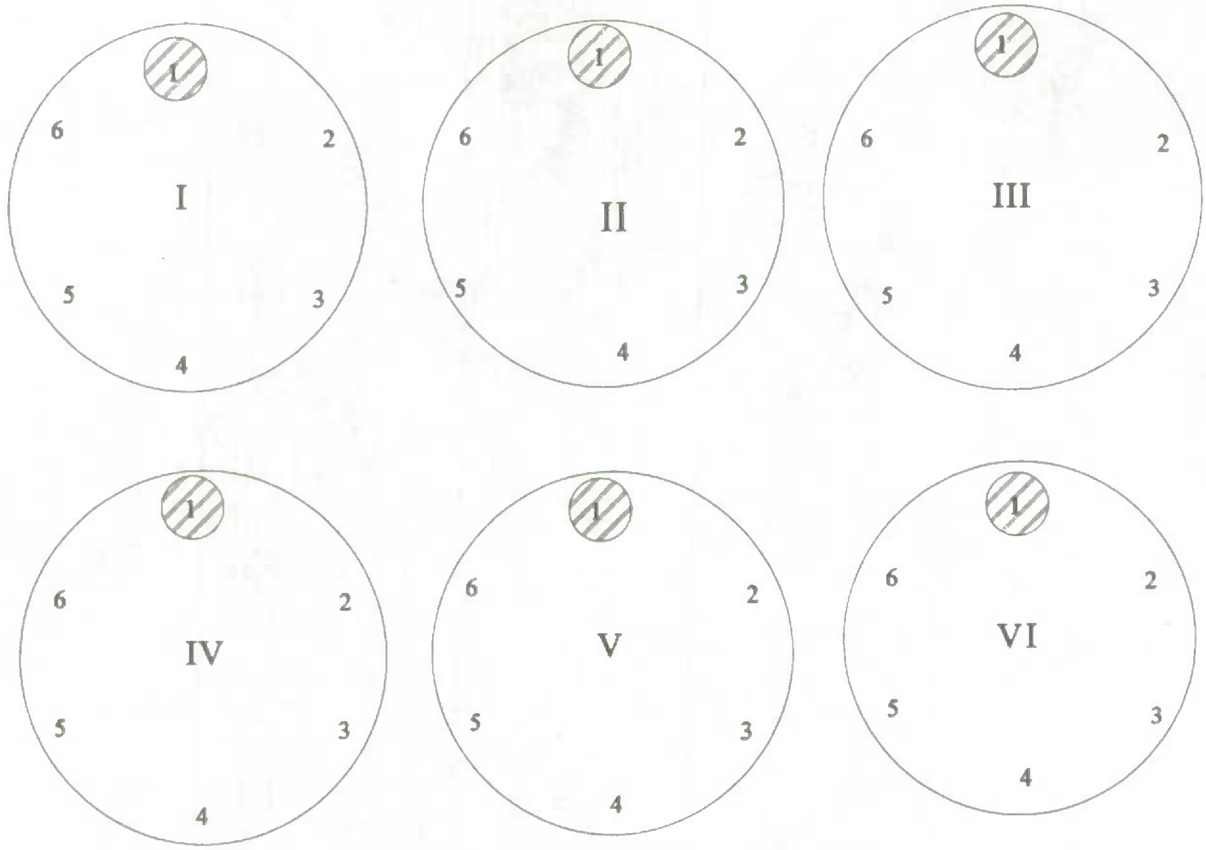

Diagram 2: Proposed Design

In the next step, we simulated a rotate-out scheme under the proposed design. In the first of the two paired months (December, 1995 and June, 1996), all those dwellings with rotation group label 7 (one per row) were dropped from the sample. Then, in the second of the two paired months (January, 1996 and July, 1996), all dwellings with rotation label 1 were dropped (rotated out) and replaced with those dwellings having rotation label 7 from the same row. That is, in the first month, all those dwellings with rotation label 7 were kept in "reserve" in order to be able to rotate them in during the second month.

This simulates treating all dwellings with rotation label 1 (one per row) as having "last month in sample" status in the first of the two months, and simulates them being rotated out and replaced by dwellings with rotation label 7 (one per row) in the second of the two months. For the proposed design, Table 3 shows the modification made to Table 1 in the first of the two paired months. Dwellings included in the sample are indicated by the shaded area only. Similarly, Table 4 shows the modification made to Table 1 in the second of the two paired months under the proposed design. Note that in either table, there are only six active rotations at any one time, since one set of dwellings is always being suppressed.

Current Design - "Rotation-By-Cluster":
Under the current design, there are automatically six rotations (labeled I-VI). However, to balance things along the lines of Tables 3 and 4, under the current design, 1/7 of the sample was dropped

within a cluster for both of the paired months. All those dwellings with the (arbitrarily selected) label of 7 were chosen.Table 5 shows the modification made to Table 1 in all months under the current design. Note that the net result of dropping sample is that, under each design, there are 6 rotations of sample with 1/7 fewer sampled dwellings per rotation than usual.

Table 1 : Rotation Group Labels Under Current and Proposed Design

Cluster Labels (Rotation Groups Under Current Design)	Rotation Group Labels Under Proposed Design (Attached to Dwellings)						
I	3	4	5	6	7	1	2
II	1	2	3	4	5	6	7
III	4	5	6	7	1	2	3
IV	1	2	3	4	5	6	7
V	7	1	2	3	4	5	6
VI	7	1	2	3	4	5	6

Table 2 : Transition Probabilities Between December 1995 and January 1996

	Employed January 1996	Unemployed January 1996	Not In Labour Force - January 1996	Sum of Row Probabilities
Employed December 1995	0.9467	0.0249	0.0284	1
Unemployed December 1995	0.1417	0.6754	0.1829	1
Not In Labour Force - December 1995	0.0253	0.032	0.9427	1

Table 3 : Dwellings in Sample (shaded area) Under Proposed Design for December 1995 and June 1996 (Final Scheme)

Cluster Labels (Rotation Groups Under Current Design)	Rotation Group Labels Under Proposed Design (Attached to Dwellings)						
I	3	4	5	6	7	1	2
II	1	2	3	4	5	6	7
III	4	5	6	7	1	2	3
IV	1	2	3	4	5	6	7
V	6	7	1	2	3	4	5
VI	6	7	1	2	3	4	5

Table 4 :Dwellings in Sample (shaded area) Under Proposed Design for January 1996 and July 1996 (Final Scheme)

Cluster Labels (Rotation Groups Under Current Design)	Rotation Group Labels Under Proposed Design (Attached to Dwellings)						
I	3	4	5	6	7	1	2
II	1	2	3	4	5	6	7
III	4	5	6	7	1	2	3
IV	1	2	3	4	5	6	7
V	6	7	1	2	3	4	5
VI	6	7	1	2	3	4	5

Table 5 : Dwellings in Sample (shaded area) Under Current Design for December 1995, January 1996, June 1996 and July 1996 (Final Scheme)

Cluster Labels (Rotation Groups Under Current Design)	Rotation Group Labels Under Proposed Design (Attached to Dwellings)						
I	3	4	5	6	7	1	2
II	1	2	3	4	5	6	7
III	4	5	6	7	1	2	3
IV	1	2	3	4	5	6	7
V	6	7	1	2	3	4	5
VI	6	7	1	2	3	4	5

Part I of Simulation - The Relative Contribution To the Estimates Coming From Each Rotation Group

Since under both the current and proposed designs, one set of dwellings with a fixed rotation group label (either 7 or 1) was knocked out of the sample, the LFS basic weight had to be boosted by a factor of 7/6. The LFS weighting system was then rerun under both the current and proposed design, since it is affected by rotation group definition, which differs under the two designs. For instance, the nonresponse adjustment is typically calculated at the level of rotation group crossed with Employment Insurance Economic Region. Since the nonresponse adjusted weight is an input to the benchmarking adjustment, it too is affected. If the proposed design were to be implemented in the field, it would likely only be in urban clusters, and so we limited the study to those strata containing urban clusters only. That is, although the weighting system was rerun on the entire country, urban strata "domains" were selected after the fact.

Under both designs, the seasonally unadjusted estimates of month-to-month change for both the number of employed and unemployed based on the two pairs of months were obtained at both the Canada and province levels, for each of the 6 rotations (which of course were defined differently under the two designs).

Since the above study had some element of randomization present in that dwellings were assigned to rotation groups within a cluster based on an initial random number, it is clear that different random assignments might give slightly different results. Therefore, the above "experiment" was repeated 30 times in order to stabilize the results.

Two measures of the contribution of each rotation group relative to the total were used. The first is defined in the following way. Let Δ_{ij} be the (seasonally unadjusted) estimate of month-to-month change of either the number of employed or the number of unemployed for rotation i in trial j; $i=1,...,6$; $j=1,...,30$. Then, the average absolute estimate is defined over all rotation groups as $\sum_{i=1}^{6} |\Delta_{ij}|/6$. A measure of the contribution over the 30 trials of the absolute estimate coming from rotation i relative to the average absolute estimate is then given by:

$$\Delta_i = \frac{1}{30}\sum_{j=1}^{30} \frac{|\Delta_{ij}|}{\sum_{i=1}^{6} |\Delta_{ij}|/6}; \; i=1,...,6. \qquad (1)$$

Note that in the publication of usual LFS estimates, absolute values are not used; however, they are used in this measure. The reason for this is that since month-to-month change can be negative, summing negative and positive quantities together distorts the true contribution from any one rotation. Note that since $\sum \Delta_i$ is 6, then if all rotation groups contribute roughly equally to the overall, the value of each Δ_i should be roughly 1 for each $i = 1,...,6$. This is what we are expecting to see in the results.

A measure of the relative variability over the 30 trials of each rotation group's contribution to the total variability across rotation groups is given by:

$$V_i = \frac{1}{30}\sum_{j=1}^{30} \frac{(\Delta_{ij} - \bar{\Delta}_{.j})^2}{\sum_{i=1}^{6} (\Delta_{ij} - \bar{\Delta}_{.j})^2/6}; \; i=1,...,6 \qquad (2)$$

where $\bar{\Delta}_{.j} = \sum_{i=1}^{6} \Delta_{ij}/6$. Note that since $\sum V_i$ is 6, then if all rotation groups are contributing roughly equally to the overall variability of the estimator, the value of each V_i should be roughly 1 for each $i = 1,...,6$. Thus, these two measures give an indication of how stable each rotation group is, relative to all six rotation groups.

Results From Part I

Tables 6 to 16 contain the results of the simulation under both designs using equation (1) for each of the 6 rotations, for month-to-month change of both employment and unemployment totals, for both sets of months, for Canada and the ten provinces. Note that for these tables, under the current design, rotations I-VI have been relabeled 1-6 to maintain consistency with the labeling convention under the proposed design. Recall that between June and July of 1996 in Québec, there was a large drop in the seasonally adjusted estimate of the total number of employed, and a large rise in that for unemployed. The suspicion was that in July, the dwellings which rotated in were substantially different from those which rotated out, creating a big month-to-month change. Although it was felt that this event might be somewhat of an anomaly, the idea was put forth that defining rotations so that they were spread across clusters would minimize the effect on the estimators in the event of such a reoccurrence. The desired result of the proposed design is that it should help make the contribution coming from each of the six rotations relative to the overall estimate roughly equal - or at least more so than under the current design. In terms of equation (1) and the results given in Tables 6-16, this should translate to entries that are closer to one under the proposed design than under the current design. In particular, since rotation I (or rotation 1 as it is called in the tables) is the contentious rotation group, a value closer to one for that case is especially desirable.

First, we consider Québec (Table 11) for June-July 1996, since this was the province having the problematic estimates that gave rise to this study. For "employed", the proposed design does a much better job of equalizing the contribution from rotation 1 (.783) as compared to the current design (2.7222). However, for "unemployed", curiously, the opposite is true, the value being .498 under the proposed design as compared to 1.008 under the current design. However, in both cases, the proposed design does a better job in general (i.e., across all 6 rotations) of keeping the contribution from each rotation closer to one, when a comparison is made entry by entry.

Across all tables (Canada and the ten provinces), for both "employed" and "unemployed", for both time pairs, the proposed design does as good or better a job of keeping the contributions due to each rotation close to one, when considering the behaviour across all six rotations as a whole. For example, in Nova Scotia (Table 9), for the three cases: "employed" June-July, "unemployed" December-January and "unemployed" June-July, comparing each of the six rotation groups entry by entry, the proposed design is systematically better than the current. To see this, consider one of the cases and compare the results entry by entry: "employed" June-July which gives 1.0356, 1.0374, .6474, .7176, 1.005, 1.5576 under the proposed design as compared to 1.191, .516, .6246, .6138, .687, 2.3676 under the current design. The only exception to the proposed design being equal or better is in Alberta (Table 15) for "unemployed" December-January where the current design gives: 1.1226, .3504, .306, 1.3758, 1.0476, 1.7982 as compared to the proposed design: .45, .6828, .6858, 1.497, .612, 2.073, i.e., 4 of the 6 cases are better under the current design.

When considering only rotation 1, across all tables, for both "employed" and "unemployed", for both time pairs, the proposed design does as good or better a job of keeping the contributions close to one in roughly 3 of the 4 cases ("employed" and "unemployed" crossed with the 2 time periods). In four provinces (PEI, NS, Manitoba and Saskatchewan), the proposed design does a better job in 4 out of 4 cases. For example, in Manitoba (Table 13), the proposed design gives the following results for rotation 1 for the 4 cases considered: 1.2702, .834, .9324, .9936 which is systematically better than those of the current design: 1.7022, 1.791, 2.0232, 2.1402.

The measure of relative variability over the 30 trials of each rotation group's contribution to the total variability across rotation groups is given by equation (2). The results of the simulation for this part are omitted here due to space considerations and since they are of secondary importance. In any case, they were very similar to the results above.

Part II of Simulation - Overall Estimates Under the Proposed Versus Current Design

In the previous section, we considered the relative contribution to the estimates coming from each rotation group. Perhaps of even greater importance is the impact of the proposed design on the overall estimates. In this section we attempt to see the effects of the proposed design on the overall estimates of month-to-month change of employment and unemployment, across Canada, but particularly in Québec. Since it is not too useful to consider month-to-month change of seasonally *un*adjusted estimates, given that unadjusted estimates from different months are not really comparable quantities, we limited ourselves to seasonally adjusted estimates. The only useful comparison for seasonally unadjusted estimates would have been for year-to-year change, but simulation results were not available for time points twelve months earlier. However, given that the simulated estimates were not seasonally adjusted, we needed to simulate the seasonal adjustment itself. It was suggested that a close proxy could be given by:

$$\tilde{\Delta}_j = \Delta_j^S - \left(\sum_{i=1991}^{1995} \Delta_{ij}/5\right) \qquad (3)$$

where $\tilde{\Delta}_j$ is the approximate seasonally adjusted estimate of month-to-month change for the pair j= {June/July} for the year 1996; Δ_j^S is the seasonally unadjusted estimate of month-to-month change coming directly from the simulation (for either the proposed or current design) for the pair j={June/July} for the year 1996; and Δ_{ij} is the published seasonally unadjusted estimate of month-to-month change for the pair j={June/July} for year i, i= 1991, ..., 1995. A similar formula can easily be written for the pair j={December/January}.

The values for equation (3) are given in Tables 17 and 18 in the columns titled "New Design (Simul)" and "Current Design (Simul)". Also given in the tables are the actual published values for seasonally adjusted estimates of month-to-month change, for comparison sake. Note in Table 17 for Québec in the "actual published" column, we see the problematic values of -35 and 21 that gave rise to this study. The desired outcome of this part of the study is that (1) the proposed and current designs give results that are close to each other and that, (2) they track the actual published results quite closely. That is, everywhere except in Québec for June-July 1996. For June-July 1996 in Québec, the proposed design should diminish the estimate of the month-to-month change in absolute value, relative to the current design.

Table 6: Canada:
Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	0.6624	0.6894	1.4742	0.5142	1.5444	1.0422	1.6296	0.516
2	1.3896	1.5918	0.264	0.8364	0.792	0.399	1.4856	0.822
3	1.1676	1.0596	0.5856	1.8558	0.8232	0.9504	0.276	0.6504
4	0.9642	1.1094	0.9084	0.6504	1.05	1.218	0.6162	1.9218
5	1.1316	0.5898	0.4242	1.2762	0.6864	0.9492	1.635	1.4904
6	0.6846	0.96	2.3436	0.867	1.104	1.4412	0.3582	0.5994

Table 7: Newfoundland:
Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	0.6402	1.8402	2.2884	1.0404	1.6212	1.2696	1.9434	0.7692
2	1.5108	0.5292	1.308	1.257	1.4502	0.7248	2.0466	0.696
3	1.2978	0.5568	0.4914	1.2222	1.3158	1.1106	0.2394	0.8406
4	0.3024	1.0368	0.7794	1.0944	0.234	0.6882	0.4572	2.016
5	1.443	1.2348	0.4932	0.6534	0.7008	0.5568	0.2274	0.849
6	0.8058	0.8022	0.6396	0.7326	0.678	1.65	1.0866	0.8286

Table 8: Prince Edward Island:
Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	0.9	1.0254	1.5516	1.5306	1.9038	1.155	1.3812	1.2294
2	0.8562	1.2036	1.0284	0.9906	0.423	1.32	0.3834	0.8484
3	0.7326	1.1868	0.399	1.023	0.4602	1.041	0.2964	1.0764
4	0.66	0.888	0.7254	0.9228	0.8388	0.984	0.6894	1.0878
5	1.3278	0.771	0.9744	0.7788	0.5772	0.6456	1.8696	0.9444
6	1.5234	0.9252	1.3212	0.7542	1.7976	0.8538	1.3794	0.813

Table 9: Nova Scotia:
Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	2.577	1.1922	1.191	1.0356	2.1354	1.3794	2.3328	0.7818
2	0.5304	0.6216	0.516	1.0374	0.1458	0.462	0.4386	0.8034
3	0.5676	0.7134	0.6246	0.6474	0.3204	0.4704	0.5562	1.2564
4	0.609	0.5232	0.6138	0.7176	0.6798	1.2906	0.585	1.5438
5	1.0812	0.8412	0.687	1.005	1.3548	1.1526	1.197	0.9126
6	0.6348	2.1084	2.3676	1.5576	1.3644	1.245	0.8904	0.702

Table 10: New Brunswick:
Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	0.8424	1.9386	1.8846	1.6392	1.59	0.918	0.6096	1.4412
2	1.0686	0.567	0.492	0.735	1.3578	1.2138	0.726	1.1466
3	1.4748	0.804	1.5342	0.843	0.4146	1.2762	1.2714	0.7902
4	1.5414	0.603	1.3494	0.7776	1.149	1.092	1.1448	0.9582
5	0.6036	1.266	0.4806	0.6696	0.732	0.7506	1.8546	0.642
6	0.4686	0.8214	0.2592	1.335	0.7566	0.7488	0.3936	1.0212

Table 11: Québec:
Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	2.2248	1.9914	2.7222	0.783	0.7164	0.6216	1.008	0.498
2	0.8196	0.6672	0.8988	0.7344	0.699	0.6408	2.4666	1.095
3	0.3606	0.8712	0.315	0.921	0.4014	0.5142	0.825	1.5786
4	0.5514	0.9894	0.3996	0.8664	2.0022	1.6056	0.6114	0.9216
5	1.188	0.6378	0.2166	1.11	0.3168	0.9798	0.3402	1.1532
6	0.8556	0.8436	1.449	1.5846	1.8636	1.638	0.7488	0.7536

Table 12: Ontario:
Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	2.8524	1.7496	0.7656	0.7086	1.5504	1.2216	0.6792	0.5748
2	1.11	1.3164	1.2762	0.7338	1.5072	0.6726	0.351	0.822
3	0.7974	0.8058	0.3696	1.1094	0.7134	1.0086	0.5304	0.6396
4	0.3798	0.5844	0.8718	1.3506	1.1712	0.8646	0.8154	2.0466
5	0.5706	0.4818	0.3204	0.7896	0.4614	1.3776	3.1932	1.1364
6	0.2892	1.062	2.3958	1.3086	0.5964	0.855	0.4314	0.7812

Table 13: Manitoba: Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	1.7022	1.2702	1.791	0.834	2.0232	0.9324	2.1402	0.9936
2	1.1472	0.609	0.8418	1.5846	0.4254	0.7596	1.6608	2.085
3	0.5784	0.7824	0.5862	0.7284	0.6486	0.84	0.6696	0.7482
4	1.5588	1.5066	0.5562	0.717	1.329	0.7914	0.6192	0.6972
5	0.4068	0.9108	1.431	1.3152	0.834	1.779	0.4386	0.7986
6	0.6072	0.921	0.7938	0.8208	0.7398	0.8982	0.4716	0.678

Table 14: Saskatchewan: Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	1.7406	1.5468	3.3264	0.7044	0.4128	0.5982	0.513	0.597
2	0.7434	1.227	0.5076	1.32	1.8876	0.924	0.417	0.4578
3	0.6138	0.8178	0.7872	1.5138	1.3002	0.606	0.8178	0.6462
4	1.4688	0.789	0.3486	0.717	0.8874	1.2678	1.1664	1.041
5	1.0242	0.7764	0.324	0.7734	0.3726	0.9804	1.6812	1.728
6	0.4086	0.843	0.7062	0.972	1.1388	1.6236	1.4046	1.53

Table 15: Alberta: Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	1.3062	1.0302	1.9992	0.6762	1.1226	0.45	1.1856	0.7194
2	1.623	0.9816	0.2676	0.9546	0.3504	0.6828	0.7896	0.7608
3	0.3432	1.698	1.6098	2.157	0.306	0.6858	0.495	1.0374
4	1.4094	0.6564	1.0776	0.8748	1.3758	1.497	1.8462	1.8774
5	0.501	1.0284	0.2358	0.6072	1.0476	0.612	0.6594	0.8964
6	0.8172	0.6054	0.8094	0.7302	1.7982	2.073	1.0236	0.7092

Table 16: British Columbia:
Relative Contribution to the Total Absolute Estimate From Each Rotation Group (Δ_i)

Rot. #	Employed: Dec '95 - Jan '96		Employed: June '96-July '96		Unemployed: Dec '95- Jan '96		Unemployed: June '96-July '96	
	Current Design	New Design	Current Design	New Design	Current Design	New Design	Current Design	New Design
1	2.0904	0.924	0.9276	0.8286	1.6542	1.0386	0.8742	0.8886
2	0.4284	2.0886	0.4068	1.3884	0.2742	0.6282	1.0356	1.2534
3	1.7604	0.6018	0.2682	0.9348	1.7412	1.4376	0.4986	1.1172
4	0.861	0.852	0.7932	1.2012	0.3438	0.4632	0.5538	0.6522
5	0.5784	0.6444	1.3398	0.8274	1.0752	1.8114	1.431	1.1598
6	0.282	0.8892	2.265	0.8196	0.912	0.621	1.6068	0.9294

Results From Part II

Considering Table 17 first, unfortunately the proposed design appears to dampen only mildly the drop in month-to-month change in employment relative to the actual published value in Québec (from -35 to -31.6). The same can be said for dampening the gain in month-to-month change in unemployment (from 21 to 16). And for some reason, the current design does not track the actual published value very well in Québec. This may be due to the fact that the approximate seasonally adjusted values are based on averages of unadjusted differences over a 5 year period that includes the recession years of the early 1990's. In addition, the simulated results cannot be expected to track the published results exactly, even under the current design, since the simulation is based on urban areas only, whereas the published results are based on all areas. Apart from Québec, the values for the proposed and current design are reasonably close, except at the Canada level. For example, at the Canada level for "employed", the proposed design gives a value of 37.96 whereas the current design gives 22.96; here the current design tracks the actual published estimate of 19 quite well. On the other hand, for "unemployed", the proposed design gives -20.8 as compared to the current design value of -10.8; here the proposed design does a better job of tracking the actual value of -22. Finally, the simulated values under both designs track the actual values fairly well, except in Newfoundland for "employed", and in Ontario.

In Table 18, similar results can be seen. The two designs give results that are similar everywhere except at the Canada and Ontario levels for "unemployed". The two designs track the actual published results, as desired, except at the Canada, Québec and Ontario levels for "employed". Again this may be due to reasons similar to those cited above for Table 17.

Table 17: Seasonally Adjusted Estimates of Month-to-Month Change (in thousands)

Region	June 1996 - July 1996 Employed			June 1996 - July 1996 Unemployed		
	New Design (Simul)	Current Design (Simul)	Actual Published	New Design (Simul)	Current Design (Simul)	Actual Published
Canada	37.96	22.96	19	-20.8	-10.8	-22
NFLD	8.44	10.44	4	-6.2	-5.2	-5
PEI	0.56	0.56	0	-0.6	0.4	0
NS	-5.64	-6.64	-7	-2.66	-1.66	-2
NB	2.14	3.14	3	-1.18	-1.18	1
Québec	-31.6	-49.6	-35	16	25	21
Ontario	22.3	26.3	31	-5.94	-2.94	-18
Manitoba	5.16	5.16	2	-0.44	-0.44	1
SASK	0.24	1.24	1	0.04	0.04	-1
Alberta	15.5	13.5	12	-7.88	-6.88	-10
BC	20.82	18.82	16	-12.86	-15.86	-12

Concluding Remarks

Overall, the above tables give mild but certainly not conclusive evidence that a rotation-by-dwelling design would help correct a problem such as the one that occurred in Québec in June-July 1996, while keeping the values for the other cases unchanged. That is to say that, although the corrections were in the right direction, they were not large enough to alleviate the problem.

Further work would be needed to explore the possibility of using the proposed design. For instance, it would have been preferable to be able to produce proper seasonally adjusted estimates for the simulation, rather than the approximate versions given by equation (3), in order to make a fair comparison with the actual published result. However, given that seasonal adjustment requires several years of data, this would have meant implementing the simulation on many time points of data, which would have been too computationally cumbersome.

As a post-note, this simulation was run in late 1998, before the advent of composite estimation for the LFS in January 2000. The proposed design was not adopted at the time since there was some speculation that composite estimation would help to alleviate the effects of any future event such as the one that occurred in Québec in June-July 1996 and May-June 1996 because composite estimation gives less weight to the birth rotation. After the launching of the composite estimation system in January 2000, historical revisions of figures were recalculated back to 1976, and thus are now available. The seasonally adjusted composite estimation figures of month-to-month change compared to the published figures using the GREG estimator can be seen in Table 19.

Table 18: Seasonally Adjusted Estimates of Month-to-Month Change (in thousands)

Region	Dec 1995 - Jan 1996 Employed			Dec 1995 - Jan 1996 Unemployed		
	New Design (Simul)	Current Design (Simul)	Actual Published	New Design (Simul)	Current Design (Simul)	Actual Published
Canada	52.26	54.26	44	35.84	27.84	27
NFLD	-2.34	-3.34	-4	6.2	6.2	7
PEI	0.8	0.8	1	-0.06	-0.06	0
NS	-3.34	-5.34	-4	4.82	5.82	4
NB	-5.52	-4.52	-2	1.52	1.52	1
Québec	45.12	44.12	28	-12.62	-15.62	-9
Ontario	-2.08	-1.08	3	30.3	26.3	24
Manitoba	-0.72	0.28	-2	2.66	3.66	3
SASK	-4.36	-3.36	-3	0.28	0.28	0
Alberta	7.46	10.46	9	-3.96	-3.96	-2
BC	16.2	18.2	20	5.8	4.8	2

Table 19: Estimates of Seasonally Adjusted Month-to-Month Change for Québec

	June 1996 - July 1996		May 1996 - June 1996	
	Composite	GREG	Composite	GREG
Total Employed	-10.7	-35	-22.2	-41
Total Unemployed	22.1	21	30.7	32

For "employed", composite estimation seems to go quite far in correcting the problem (-10.7 compared to -35, and -22.2 compared to -41), whereas for "unemployed", it does practically nothing. The latter observation is not too surprising since the differences in GREG and composite estimators for "unemployed" are rarely large. However, it is interesting to see how big an effect composite estimation actually has on "employed", although it does not completely eradicate the problem. As further work, it would be interesting to see another simulation similar to the one done here, but attempting the proposed design with composite estimation rather than with the GREG (which was used in this simulation). Perhaps the two together would go further towards fixing the problem. It should be noted, however, that some of the reason for the results in Québec could simply have been that the economy was not growing as quickly as elsewhere in the country. This is in part supported by the fact that the same phenomena was observed between May and June of 1996 *and* June and July of 1996. Given that there are different birth/death rotations in these two sets of months, the phenomena cannot be explained entirely by instability in the birth/death rotations.

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