

Longitudinal Surveys versus Continuous Surveys and Surveys with Flexible Periodicity

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Abstract

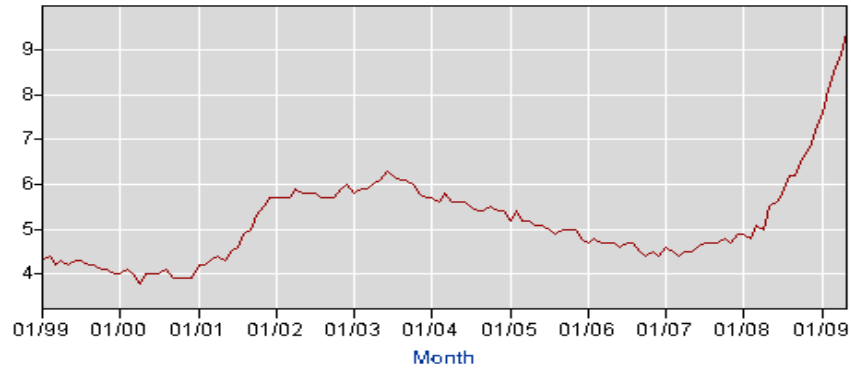
Statistical bureaus in most countries conduct periodic sample surveys to obtain socioeconomic data used for developing indices of interest to policymakers and public agencies. The fixed periodicity of these surveys is a relic of the days when the primary data collection method was a census. Surveys, we argue, should be done continuously (i. e., as often as is practical and cost-effective) with much smaller samples. The policymakers and agencies are interested in changes in indices, and when continuous sampling uncovers such changes, larger surveys can be done to confirm them with modified scope and allocation. This dynamic approach, in contrast to the static approach reminiscent of a census, will provide challenges to survey practitioners but will be more useful to policymakers and other users of data. To illustrate the challenges and opportunities, we consider several examples.

Key Words: dynamic sampling, small samples, indices

1. Change and Stability

Figure 1 and Table 1 show the National Unemployment Rate in the USA month by month for months from January 1999 through July 2009. The range in each calendar year is: 4.0 to 4.4 (1999), 3.8 to 4.1 (2000), 4.2 to 5.7 (2001), 5.7 to 6.0 (2002), 5.7 to 6.3 (2003), 5.4 to 5.8 (2004), 4.8 to 5.4 (2005), 4.4 to 4.8 (2006), 4.4 to 4.9 (2007), 4.8 to 7.2 (2008), and 7.6 to 9.5 (so far in 2009). In 35 of the 125 months the change from one month to the next was 0.0, for 89 of the months the change was from 0.0 to +/- 0.1, and for 112 of the months the change was from 0.0 to +/- 0.2.

The conclusion to be drawn is that the changes are usually small, occasionally large. A naive proposal is to decrease the monthly sample size when recent changes are small and increase it when recent changes are large. The resources conserved by taking smaller samples can be applied elsewhere or perhaps reserved for occasions when larger samples are called for. Later we shall discuss the obstacles to such an innovation. (Our discussion considers the National Unemployment Rate as an illustrative example only, and the considerations in this article may apply equally well or better to other measures that are routinely collected.)



Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1999	4.3	4.4	4.2	4.3	4.2	4.3	4.3	4.2	4.2	4.1	4.1	4.0	
2000	4.0	4.1	4.0	3.8	4.0	4.0	4.0	4.1	3.9	3.9	3.9	3.9	
2001	4.2	4.2	4.3	4.4	4.3	4.5	4.6	4.9	5.0	5.3	5.5	5.7	
2002	5.7	5.7	5.7	5.9	5.8	5.8	5.8	5.7	5.7	5.7	5.9	6.0	
2003	5.8	5.9	5.9	6.0	6.1	6.3	6.2	6.1	6.1	6.0	5.8	5.7	
2004	5.7	5.6	5.8	5.6	5.6	5.6	5.5	5.4	5.4	5.5	5.4	5.4	
2005	5.2	5.4	5.2	5.2	5.1	5.1	5.0	4.9	5.0	5.0	5.0	4.8	
2006	4.7	4.8	4.7	4.7	4.7	4.6	4.7	4.7	4.5	4.4	4.5	4.4	
2007	4.6	4.5	4.4	4.5	4.5	4.6	4.7	4.7	4.7	4.8	4.7	4.9	
2008	4.9	4.8	5.1	5.0	5.5	5.6	5.8	6.2	6.2	6.6	6.8	7.2	
2009	7.6	8.1	8.5	8.9	9.4	9.5							

Figure 1/Table 1: National Unemployment Rate (%) – BLS, U. S. Census Bureau

A trivial heuristic rule for deciding how to proceed is the following. . Suppose \bar{x} is the sample mean of some quantity measured monthly on a random sample of size n and e is its standard error. Let the subscript indicate successive months. Then

i) if $|\bar{x}_1 - \bar{x}_2| < \frac{1}{2} \max\{e_1, e_2\}$, take $n_3 < n_2$;

ii) if $|\bar{x}_1 - \bar{x}_2| > 2\max\{e_1, e_2\}$, take $n_3 > n_2$; and

iii) otherwise leave $n_3 = n_2$.

This heuristic is similar to the standard t-test for judging whether two samples come from the same population. We do not pursue here the technical matter of how much to change the sample size by.

2. Another Idea: Continuous Surveys

Another approach to getting maximum benefit from resources is to sample more often. A monthly survey can be replaced by a weekly survey. This is what is meant by a "continuous" survey. Take the weekly sample to be one-quarter the size of the monthly sample. The weekly standard error will be twice that of the monthly sample. However,

now we average the weekly results over the four weeks, and the monthly average will have a standard error about the same as the original measurement.

Often the original monthly sample is based on a fixed reference week in the month, and thus the monthly average over four successive weeks is more representative of the month as a whole. This is especially true if the weekly numbers reach an extremum in the reference week.

Furthermore we can also apply the previous idea, varying the weekly sample size on the basis of the weekly number in previous weeks. Another benefit is that each week we obtain a new four-week estimate by accumulating the past four weeks.

3. Yet Another Idea: Variable Frequency

Yet another approach, when a clear trend is present from month to month together with a regular level of noise, is to sample with variable frequency. For example, instead of doing a survey every month, do one every other month or quarterly.

One can decide periodicity of a longitudinal survey by minimizing the expected total error for fixed total cost over some fixed time interval. Thus, for example, over a six month period one can decide whether to sample every month, or every two months, or every three months. The expected total error depends on both the sampling error and the magnitude of the noise: in months when no sampling is done and last month's estimate is used again the variance includes the noise term (Ghosh 2003).

4. A Final Idea: Combining Surveys

Also one can combine surveys. Do not do separate surveys for employment, household expenses, health, education, transportation, etc. Possibly different households may get different versions of the same survey, with common core questions plus variants. From time to time themes of special interest can be introduced.

5. Obstacles

Numerous obstacles exist if one is to implement one or more of these ideas, of course. We mention some of them. An obvious one is that most surveys look at many variables. Some variables will be stable and others will not. Surveys can be adjusted to leave off the stable ones and thus decrease response burden, but those who make the adjustments must be nimble. Another is that surveys often collect regional or local data as well as national data. A variable sample size may lead to an unacceptably small or unacceptably unstable local sample size.

Just as serious is the workforce situation. If sample sizes are variable and the geographic distribution varies, the workforce may have to do interviews over an unacceptable large radius or else some workers will be overworked and others underworked. For part-time workers the work week would become more variable since workers would be needed more at some times and less at others. Workers would need additional training if they are pulled off one survey and assigned to another, or if the questions change from week to week. Workers would have to be more flexible regarding hours, topics, and site visits.

There would also be many management headaches associated with the proposed changes. Decisions about the marshalling of workforces take time. Planning must be done to ensure that the work proceeds as smoothly as possible. Statistical methodologies would need to be somewhat more sophisticated to judge needed sample sizes for multiple variables, and to do extrapolations to estimate values of omitted variables. Time lags would depend on both how quickly data from the last time period can be summarized and how quickly management can make the necessary course corrections.

The politics of surveying would be more complicated. Policymakers may balk at any adjustments to the frequency of fresh data, and may be particularly miffed if regions other than their own appear to get better or more frequent coverage, if local data are not refreshed as often in their constituencies as in others. If a pet variable does not get the attention that another more unstable variable does, there may be repercussions. Resistance to change by survey field offices, by customer agencies, and by legislators protecting their turf may present formidable challenges.

6. Afterword: Some Examples

The obstacles noted above are not necessarily prohibitive. Below is a table indicating what is going on in some countries.

Country	Survey	Features
BLS-Census Bureau (USA)	Current Population Survey	Monthly – 60,000 households, in-person and by telephone, rotation (four months on, eight off, four on); employment in reference week of the month among those looking in last four weeks
BLS (USA)	Consumer Expenditure Survey	Quarterly data from 7,000 households, each in survey for five quarters, two-week diaries from 7000 households per year; “In the last three months...?” Annual report
Canada (Link: Statistics Canada)	General Social Survey	Annual- core plus annual themes – 25,000 in sample, 10 months, individuals and households, by telephone Some questions begin “In the last month..?” others say “In the last twelve months..?”
	Canadian Community Health Survey	Annual – core plus annual theme plus regional theme, 65,000 in sample, 12 months, individuals, by telephone; “In the last week [six months] [twelve months] ..?”
	Canadian Labour Force Survey	Monthly – 54,000 households, six month rotation, staggered, phone or interview; reference week
Deutsches Bundesamt (Germany)	ILO Labour Market Statistics	Annual Sample of persons, households; 700,000 persons per year, rotating panels in sample for four years, moving reference week, microcensus; “Last week did ...?”

Country	Survey	Features
National Sample Survey Organization (India)	Rounds	Annual; sample of up to 125,000 households, thematic, moving reference month “In the last 30 days ..?”
Central Bureau of Statistics (Israel)	Household Expenditure Survey	Annual – 7000 in sample, 13 months, households, interviews plus diary Two week diary, three month and twelve month questions
Central Bureau of Statistics (Israel)	Labour Force Survey	Quarterly sample of 10,000 households, in four rotating panels (two quarters in, two out, two more in), each week in a quarter 1/13 th of sample is interviewed. “During last week ...?”
Office for National Statistics (United Kingdom)	Labour Force Survey	53,000 households quarterly in five panels, each wave is in for five quarters, interviews plus telephone, each week interviewing takes place; “Last week did you..?”
Office for National Statistics (United Kingdom)	General Household Survey	9,000 households annually, data collected on five core topics throughout the year, panel interviewed once each of two years “Last week did you, last month, last year, when...?”
Office for National Statistics (United Kingdom)	Integrated Household Survey	Survey that will combine the last two above together with the English Housing Survey, the Expenditure and Food Survey, and the Omnibus Survey in successive years

Table 2: Surveys done in various countries around the world (from the Web)

Table 2 shows that Canada, Germany, Israel, and the United Kingdom have moving reference weeks, so that new data are coming in each week of the year. Canada, India, and the United Kingdom have moving reference months. Sample sizes appear to be relatively constant from one time period to the next, depending in some cases on annual funding (rather than the results of prior sampling), although topics covered vary somewhat. The most interesting development is the United Kingdom’s new Integrated Household Survey that is attempting to combine several previously separate surveys. This initiative has been under way for several years and is not yet complete, but it shows that change is possible.

References

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