MEASUREMENT OF NONSAMPLING ERRORS IN A SURVEY OF HOMEOWNERS' EXPENDITURES FOR ALTERATIONS AND REPAIRS

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I. Background and Purpose of Study:

A survey designed to provide quarterly data about expenditures for maintenance, repairs, alterations and additions to residential properties was assigned high priority among the construction statistics programs when the responsibility for these programs was given to the Bureau of the Census.

After examining alternative methods for collecting such statistics, it was decided to conduct personal interviews with owner occupants of 1 to 4 household properties in their own homes. These constitute the bulk of residential property owners. Information from renters was obtained in the same way. A high proportion of responses in these interviews were based on respondent's memories of expenditures.

Personal interviewing and reliance on respondent's recall are commonly used in consumer expenditure surveys though relatively little is known about the accuracy of the results obtained in this way. Previously conducted studies, designed by market research firms and university analysts were limited in scope and based on samples so small that definitive conclusions were difficult to reach. However, these studies did indicate the kinds of problems which could be anticipated.

Consequently, a program was designed to study response errors in the survey of residential alterations and repairs. The immediate purpose was to provide a rational basis for establishing permanent survey methods. However, the results of the research have bearing on the design of other consumer expenditure studies which are faced with similar problems. In fact some of the subjects studied, such as the impact of memory recall over variable periods of time, the effect of using different household members as respondents, are significant in many kinds of surveys and the results of the research may be of more general applicability in survey methodology.

In the current survey of residential alterations and repairs, data are also being collected by mail from owners of large properties and nonresident owners of small properties. However, the experimental studies are restricted to the interview survey in which only owner occupants of 1 to 4 family homes and renters are included. Although a study of renters expenditures was included in the original research plan it soon became apparent that the expenditures reported by renters are such a small part of the total that they have virtually no impact on the total estimate. Consequently, all of the analyses made are of owner expenditures.

II. Subjects Studied:

The research program was designed initially to provide information about the following subjects:

- 1) Effect of length of recall period on recall of expenditures
- 2) Effect of length of reference period on recall of expenditures
- 3) Effect of choice of household member as respondent on recall of expenditures
- 4) Extent of shifting of expenditures in time by respondents
- 5) Effect of repeated interviews in household
- 6) Effect of using detailed, probing questionnaire as compared with the use of a less intensive one

As a second step, information will be obtained about the items below. Information on these subjects is not yet available.

- 7) Effect of using alternative types of questionnaires
- 8) Feasibility of using mail questionnaires
- 9) Use of diary techniques
- 10) Use of double-sampling procedure

III. Experimental Design:

Most of the work that has been done, is in connection with the first five items listed above. These items were studied by measuring expenditures for identical periods of time by different random samples of households with a different enumeration technique used for each sample. An alternative research method, involving record checks, was considered but records of sales or contracts on a broad enough scale to provide useful results do not seem to exist.

More direct methods of measuring the erroneous allocation in time of expenditures and the effect of obtaining replies from more than one respondent in a household have been tried recently, but the results are not yet available. Nor have procedures been developed for studying the subjects listed for future study (Items 7 to 10 above). Therefore, the remainder of this report will describe only the initial research program results.

The effect of using detailed probing questionnaires as compared with the use of a less intensive form (listed as Item 6 above) was studied by adding a relatively simple questionnaire to the Bureau's Current Population Survey for one quarter and comparing the results with the reports for the same quarter obtained in the regular survey of residential alterations and repairs. Since a variety of enumeration methods were used for the regular survey, there were reasons for differences in addition to those caused by questionnaire design. Consequently, comparisons have been made between the CPS supplement results and data from a subsample of the regular survey for which the same length of recall and choice of respondents were used as in the CPS supplement. Comparisons were also made between the CPS supplement results and those from the full Survey of Residential Alterations and Repairs sample.

Assigning the wrong time period to expenditures, effect of length of reference period, recall problems and conditioning of respondents (items, 1, 2, 4 and 5 listed above) were studied by using the following enumeration procedures:

- Unbounded type 1 -- In this type of interview, the enumerator has no information from a previous interview about the household expenditures and asks only about expenditures for the preceding month.
- 2) Unbounded type 6 -- Enumerator has no information from a previous interview about the household's expenditures and asks about expenditures during the preceding 6 months. The respondent allocates the expenditures he reports to the specific months in which he thinks the expenditures were made.
- 3) Bounded 1 month This describes the second and third interviews in the same household. The interviewer asks about the preceding month only, but he brings with him a record of the previous interviews which he reads to the respondent in order to eliminate any possibility of duplication of expenditures, and to fix the time period of reference more clearly in the respondent's mind.
- 4) Bounded 3 months This interview is similar to the bounded 1 month, but is performed after a lapse of 3 months from the previous interview in the household and covers expenditures during the 3 months. The respondent also allocates expenditures to the specific months in which they were made.

In order to study conditioning and problems associated with the respondent's allocation of expenditures by months, it was necessary to keep households in the sample for more than one interview. This feature also appeared useful in that it took advantage of whatever correlation over time existed for identical households and segments, minimizing the sampling error of the differences. Consequently, a rotation scheme was established in which, to the extent possible, all of the different enumeration techniques were used in the same households over the course of time. It was not possible to conduct unbounded 1 and 6 month interviews in the same households but all the other procedures were used for each household.

The rotation scheme operated in the following way. Each household remained in the sample for four interviews. Half of the first interviews were unbounded type 1 and the other half unbounded type 6. In the second and third interviews the bounded 1 month interview was used. The fourth and last interview was of the bounded 3 month type.

The rotation system used to implement this randomization is shown on the attached chart. Each panel is an independent random sample of 50 segments containing an expected 300 households. Two new panels were introduced each month. Once the rotation system became stabilized, during any month the enumeration comprised about 2400 households distributed as follows:

> Unbounded type 1 -- 300 households Unbounded type 6 -- 300 households Bounded 1 month -- 1200 households Bounded 3 months -- 600 households

For the study of the effect of alternate household members as respondents, the sample households were also randomized and a specific respondent designated for interview in each random group. This randomization was done independently of the type of interview pattern described above. The randomization was in four groups and these were designated for interview as:

- 1) Head specified as respondent
- 2) Wife specified as respondent
- 3) Joint interview with head and wife specified
- 4) Respondent unspecified

The designated respondent remained the same for all 4 interviews. During any month 40 percent of the households were designated for nonspecified respondent and each of the other 3 types of designation was used in 20 percent of the households.

The identical questionnaire was used for all of the interviews. It was designed to provide intensive interviewing and enumerators were instructed to probe carefully for reports of expenditures and their timing. Before the first interview a letter was sent describing the nature of the survey and indicating the scope of expenditures covered by it. During the second and subsequent interviews the enumerators were given a shuttle record containing the information reported previously and were instructed to read it before asking the questions about expenditures. The questionnaire provided for the reporting of each maintenance, addition or repair job separately, to improve reporting, permit classification of expenditures by type, and make possible the analysis of response accuracy by type or size of job.

IV. Method of Analysis:

Comparisons of expenditures were made for identical time periods using different enumeration techniques and involving different lengths of recall periods. Tabulations of this type have been made for estimates of the number of jobs reported and the value of expenditures for these jobs. However, the value of expenditures is subject to such large variances that, with the sample sizes used, very few inferences can be made. A clearer picture of the factors affecting response accuracy is obtained by comparing estimates of the number of jobs, by size of job. These estimates are subject to much smaller sampling variability. Of particular interest are the estimates of the number of jobs over \$100 and over \$500, which account for about 75 percent and 35 percent, respectively, of all expenditures.

In order to minimize the effect of sampling variability, the longest time period, for which data were available, was used for each comparison. This period varied for different kinds of analyses because the rotation plan did not provide data for some enumeration methods in the early or late months of the survey. For example, data for 3 month recall bounded interviews were not available until the survey had been conducted for 4 months. As a result, different comparisons use different time periods, though each comparison shows the effect of different enumeration methods within the same time period.

In the analysis of the results, it has been assumed that the bounded 1 month interview provides the greatest accuracy. Evidence of bias for some of the procedures therefore follows from comparisons made with this type of interview. This assumption is not made in the more detailed studies whose results will be available later.

The problems of assigning expenditures to the wrong time period and the effect of differing lengths of reference periods are studied by comparing: (a) the unbounded with the bounded 1 month interviews, (b) the unbounded type 1 with type 6 interviews, (c) the bounded 3 month and unbounded type 6 interviews. Two aspects of time-reference problems are thus studied: displacement from the time before the one designated as the desired recall period and displacement within the desired recall period (usually from the earlier to the current months). For most of the analysis, however, only data from the most recent 3 of the 6 month recall period have been analyzed.

Problems of recall failure are examined by comparing the bounded 3 month with bounded 1 month interviews. Data for the unbounded type 6 interview also provide some evidence about recall.

Conditioning is studied by: (a) comparing the first and second bounded 1 month interviews, and (b) comparing the trends throughout the four interviews for each type of respondent.

Information about choice of respondent is based on comparisons among the sample groups designated for each type of respondent. Enumerators were not always successful in interviewing the specified respondent. Their rate of success varied from about 75 percent for the husbandwife designates to 90 percent for the wife designates. It would have been possible to restrict the analysis to the cases in which the specified respondents were enumerated, but this would have led to uncertainty about the extent to which the groups were samples of the same universe.

An additional source of information on conditioning and effectiveness of different household members as respondents is data on nonresponse rates.

V. Preliminary Results:

Preliminary summaries of results are shown in the attached tables. More detailed data will be published at a later date. They show that major differences exist among procedures. In many cases the reasons for the differences are clear, but some differences can be explained by more than one hypothesis. These cases are being studied by work in progress. Until this work is completed, all conclusions are tentative.

Inference cannot be drawn on any one subject by examining a single table because there are relationships between length of reference period, time reference problems, recall failure and even, to some extent, conditioning. However, by combining the results of the various tables, the following conclusions seem to be indicated:

1) Reporting Expenditures in Wrong Month-There is strong evidence that it has a major impact on estimates. In general, it results in respondents tending to report expenditures in a more recent month than actually made. This phenomenon has been observed before, and is frequently referred to as "telescoping". It seems to have a greater effect on reporting of large jobs than small ones. For example, the allocation of expenditures by month within a three month bounded interview period indicates that the overstatement of the report for the most recent month is of the order of 40 percent for jobs of \$100 or more and 5 percent for jobs under \$20. (See Table 2). However, if some effect of conditioning, as described in paragraph 4 below, is assumed the estimated overstatement for jobs of under \$20 can be more like 20 percent than 5 percent.

- Recall Failure Large jobs are apparently remembered over a long period of time and reported well. Smaller jobs are susceptible to serious lorses. The three month recall resulted in losses of nearly 40 percent of jobs under \$20, but no measurable decreases in reporting of jobs of \$100 or more. (See Table 2).
- 3) Effect of Length of Reference Period -Some of the small expenditures seem to be missed when there is a long reference period. This is distinct from the recall failure discussed in the previous paragraph which relates to the effect of differing lengths of recall periods. For the same recall period (one month), the six months interviews showed a smaller number of jobs than the one month interviews. (See Tables 1 and 2). However, the magnitude of this effect is not very clear since the data contain the combined effect of length of reference period, length of recall period and telescoping. In any case, no appreciable effect appears to exist for the larger and more important jobs.
- 4) Conditioning There is a little evidence of a loss of small jobs after repeated interviewing, but the larger jobs seem to be as well reported. (See Table 3). This is further supported by evidence of an increase in households reporting no expenditures between the lat and 2nd of the bounded 1 month interviews. Repeated interviewing, however, had no effect on nonresponse rates. (See Table 5).
- 5) Choice of Respondents This seems to have no important effect on the estimates. (See Tables 4 and 5).
- 6) Use of Simpler Questionnaires This resulted in an important downward bias. (See Table 6). However, the conditions under which the interviews were performed were different, and the training of the CPS enumerators on this survey was not as extensive as for SORAR, so that further work is necessary before final conclusions can be drawn.

VI. Implications for Survey Design:

If the conclusions described above are borne out by later studies, they imply that a survey to measure maintenance, repair, additions and alterations on residential properties should have the following properties:

> 1) Long-term (at least 3 month) recall period for large expenditures.

- 2) A shorter-term recall period for small expenditures.
- Coincidence of recall and reporting periods to avoid respondents having to allocate timing of expenditures within the interview period.
- 4) Bounded interviews for data about larger expenditures.
- 5) Limited number of consecutive monthly contacts with the same respondents.
- 6) A detailed and probing questionnaire in order to stimulate maximum recall.

VII. Applicability to Other Expenditure Surveys:

Most expenditure surveys which are based on respondents' memories are subject to similar types of problems. The need for a probing type questionnaire has been reported in other studies. Telescoping and problems associated with the length of recall period have also been described in the past. In fact, these have been noted in quite dissimilar surveys, such as ones covering illness records.

However, it is possible that the magnitude of the effect of these items varies greatly from survey to survey, depending on conditions peculiar to a particular survey. For example, we suspect that one reason for the major impact of telescoping is the nature of the measurement process in this survey. An expenditure for a job is reported in the month the job ended; an expenditure for the purchase of materials is reported in the month the purchase was made. There is frequently some ambiguity as to the exact date on which a job is finished, and this could be responsible for much of the telescoping. This ambiguity does not extend to the date of purchase of materials. Consequently, additional analyses are being made of the data on materials purchases to see whether telescoping occurs to the same extent on these expenditures. This will shed some light on whether the telescoping occuring here is something inherent in a respondent's memory or whether it is a reflection of a survey which attempts to assign a time period to an action extending over a period of time.

There is another illustration of the way specific surveys may be affected differently. Woolsey, in a small-scale survey on illnesses, reported that the effect of telescoping was quite different, depending on whether the questionnaire was constructed to inquire about the most recent month first and then go backwards in time, or to inquire first about the earliest month and proceed in the reverse order.

It is probable that importance of the effects discussed in this paper will depend on the subjects covered by the survey, the kind of questionnaire used, the interviewers' training and experience, the respondents' motivation and other aspects of the survey.

Size of	Enumeration Method		Percent of Bounded 1 Month		
Job	Unbounded Type 6 1/	Unbounded Type 1	Bounded 1 Month	Unbounded Type 6 1/	Unbounded Type 1
All jobs	213.9	300.6	215.1	99•4	139.7
\$ 1-9	89.4	145.1	112.2	79•7	129.3
10-19	40•9	47.2	35.5	115.2	133.0
20 -49	40.7	52.7	34.6	117.6	152.3
50-99	17.6	25.6	13.5	130.4	189.6
100-499	19.5	25.3	15.7	124.2	161.1
500+	5.8	4.6	3.5	165.7	131.4
		SUM	IMARY		
Under 20	130.4	192.3	147.8	88.2	130.1
20-99	58.3	78.3	48.2	121.0	162.4
100+	25.3	30.0	19.2	131.8	156.2

Table 1. Analysis of One-Month Recall: Number of Jobs by Size of Job, for Estimates Based on One-Month Recall With Different Enumeration Methods, Feb. 1960-Mar. 1961

(in millions of jobs)

1/ Obtained by using only the most recent month of the 6 for which data were collected.

Note: Most of the differences are statistically significant. The c.v. of the difference in estimates of total jobs between either of the unbounded and the bounded 1 month is of the order of 3-4 percent. The c.v. on jobs over \$100 is about 10 percent.

Table 2.- Analysis of Three Month Recall: Number of Jobs by Size of Job for Estimates Based on One, Two and Three Months Recall, June 196 - Jan. 1961

(in millions	of jobs)			
	Size of Job				
Enumeration Method	All Jobs	Jobs Under \$20	Jcbs of \$20	Jobs \$100	
and Recall Period			to \$99	and over	
Bounded 1 month	116•3	79 . 1	25 . 2	12.0	
Bounded 3 months Average Expenditures reported as having been made:	84 . 1	49.4	22.5	12.1	
1 month before interview	133.1	82.7	34.1	16.4	
2 months " "	70.7	37.7	20.9	12.0	
3 months " "	48.4	27.9	12.6	8.0	
Unbounded type 6 Average	87.8	45 . 8	26.7	15.3	
as having been made.					
I wonth before interview	122.5	69.1	35.0	18.0	
2 months " "	75.0	34.6	26.9	14.5	
3 months " "	65.0	33.3	18.2	13.5	
	Percent of	bounded 1 month	estimates		
Bounded 3 months			[1	
Average Expenditures reported	72 %	63 %	89 %	101%	
l month before interview	1 11/	105	135	137	
2 months # #	61	1.8	83	100	
3 months " "	42	35	50	68	
Unbounded type 6					
Average	76	58	106	128	
Expenditures reported					
as having been made:	1.05	00	120	150	
1 month before interview		88	139	1 1 20	
2 months "	07	44	101		
j months "	20	42	14		

3 months Note:c.v. of difference between total jobs for bounded 1 month and average bounded 3 months or unbounded type 6, is about 3 percent. For jobs over \$100, it is about 10 percent. Most of the percentages shown above are significantly different from 100 percent.

(in millions of jobs)					
Size of Job	l <u>s</u> t Bounded Interview	2 <u>n</u> d Bounded Interview	2 <u>n</u> d as % ff 1 <u>s</u> t		
All jobs.	215	195	91		
\$1-9	114	105	92		
10-19	36	32	89		
20-49	34	30	89		
50-99	13	12	9 0		
100-4 99	1 5	14	93		
500 and over	3	3	100		

Table 3.	Analysis of Conditioning: Comparison of Number
	and Sizes of Jobs Reported in 1st and 2nd Bounded
	One Month Interviews, March 1960-March 1961.

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Note: c.v. of difference for total jobs is about 3 percent; c.v. for jobs \$1-9 is 4-5percent. For other classes, the c.v. is higher and the individual differences are within 2 standard errors.

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Size of Job and Respondent Designated	Bounded 1 Month	Unbounded Type 6 1/	Unbounded Type 1
Total Jobs Head Wife Head & Wife Unspecified	7.3 6.0 7.01 6.6	6.0 6.9 7.1 6.7	8.9 9.7 9.7 9.2
Jobs under \$20			
Head Wife Head & Wife Unspecified	5.0 4.1 4.6 4.6	3•7 4.6 4.3 3.8	5•6 6•6 6•2 5•8
Jobs \$20-99			
Head Wife Head & Wife Unspecified	1.6 1.5 1.6 1.4	1.7 1.8 2.0 1.8	2.6 2.1 2.3 2.5
Jobs \$100 and over			
Head Wife Head & Wife Unspecified	.7 .4 .8 .6	.6 .5 .8 1.1	.7 1.0 1.2 .9

Table 4. Analysis of Choice of Respondent: Mean Number of Jobs per Household Reported by Each Type of Respondent, by Size of Job, Feb. 1960-Mar. 1961 (Estimates Shown for Three Different Enumeration Nethods)

Note: For total jobs, c.v. of difference between head, wife, and head and wife is about 5 percent for bounded 1 month and 10 percent for the other two groups. It is somewhat less for comparisons with unspecified respondents. Most differences shown, therefore, are not statistically significant.

1/ Only the most recent month of the 6 for which data were collected has been used in this table, to provide a uniform recall period.

Respondent	Percent Noninterview			
Designated	l <u>st</u> Interview	2 <u>nd</u> Interview	3rd Interview	4 <u>th</u> Interview
Head	8₀9	8.6	7.9	6.7
Wife	7•3	8.6	7•9	6.3
Head & Wife	7.9	7.8	7.1	8.1
Unspecified	6.5	6.4	6.3	5.9

Table 5. Analysis of Conditioning: Noninterview Rates by Designated Respondent and Order of Interview, July - Dec. 1960

Table 6. Analysis of Simple Questionnaire(as CPS Supplement 1/)for Collecting Expenditure Data: Number of Jobs Estimated in CPS Supplement as Percent Reported in the Regular Survey Oct-Dec. 1960

Size of Job	% of Bounded 1 Month Estimate	% of Bounded 3 Month Estimate	% of Unbounded Type 6 Estimate
Total	43	63	66
Under \$20	29	52	61
20 - 99	58	71	70
100 and over	100	85	74

l/ CPS supplement included 2 random subgroups - telephone enumeration was permitted in one group and not in the other. The analysis here is restricted to the group not permitting telephoning, to eliminate this as a source of difference. The number of jobs reported by the group permitting telephoning was 36 percent of those reported by the group for which telephoning was not permitted.



Chart Showing Rotation Scheme Employed for Survey of Residential Alterations and Repairs