

## RESULTS FROM THE METHODS DEVELOPMENT SURVEY (PHASE I)

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### I. Introduction

In May of 1978, a large-scale research project was begun by the Census Bureau, in cooperation with the Bureau of Labor Statistics, with the intent of gathering information towards redesigning the Current Population Survey (CPS). This project, the Methods Development Survey (MDS), was to be carried out in several phases with different pertinent issues being addressed in each phase. Phase I was to research certain methodological issues relating to labor force and other socioeconomic data as collected in the Current Population Survey. Phases II and III were to address conceptual issues such as the identification of discouraged workers.

This paper will focus entirely on Phase I and will describe the first wave of results from this project. More detailed reports of results are scheduled by the Bureau in the future. Results from the remaining phases of the MDS will be reported as they become available.

### II. Overview of Phase I

Phase I of the MDS began in May 1978 and was concluded in November 1979. Each month a sample of 1,536 households was enumerated for this study. The sample was evenly spread among 4 primary sampling units (PSU's). These PSU's were purposely selected to display a wide variety of characteristics pertaining to unemployment. Phase I of the MDS used a rotation pattern in which a sample household was enumerated for 4 consecutive months and then retired permanently. This resembles the first 4 months of the traditional CPS rotation pattern in which households are enumerated for 4 consecutive months, retired for 8 months, and then enumerated for 4 additional months before being retired permanently. The MDS rotation pattern allowed for a faster startup time in the experimental survey while still permitting most of the major questions about rotation groups from the CPS to be addressed. Information about the sample and experimental designs of Phase I can be found in much greater detail in Cowan, et. al. [1].

Three methodological issues were selected for testing in Phase I of the MDS. They were: 1) mode of interview (telephone vs. personal visit), 2) assignment of interviewers (maintaining the same interviewer vs. alternating interviewers within the sample households), and 3) type of respondent (the household respondent as currently practiced in the CPS vs. a random designation of a household respondent vs. self response by all household members). A discussion of the reasoning for choosing these three specific issues can be found in Cowan, et. al. [1]. For clarity, from this point on, the three issues (i.e., mode of interview, etc.) will be referred to as the treatments of Phase I while the categories of these issues (e.g., telephone and personal visit for mode of interview) will be referred to as the levels of the treatments.

Regarding the first treatment, mode of interview, each month 1/2 the sample households were assigned to be enumerated by personal visit with the remaining 1/2 being assigned to telephone. No centralized location was used for telephone interviews as interviewers worked out of their homes.

Two deviations were allowed from the assigned treatment level. First, all first month in sample households were enumerated by personal visit. This was necessitated by the fact that telephone numbers for sample households (addresses) could not be obtained until an initial interview was performed. Second, a household assigned to be enumerated by one treatment level could be enumerated by the other in order to prevent the complete loss of an interview.

The second experimental treatment was assignment of interviewers. Here, 1/2 the sample households were assigned to be enumerated by the same interviewer all 4 months they were to be in sample. The remaining 1/2 were to be enumerated by a system which called for one interviewer enumerating the household in its first and third months in sample while a different interviewer would enumerate the household in its second and fourth months in sample. The treatment assignments were made in such a way that 1/4 of the sample received telephone with the same interviewer, 1/4 received telephone with different interviewers, and likewise for personal visit households.

The third experimental treatment was type of respondent. For this treatment, each month 1/3 of the sample households were to be enumerated using the current definition of a CPS household respondent. Under this procedure, any responsible adult and generally the person who answers the door or the phone is chosen to respond for all household members. The second treatment level involved randomly selecting a different household member each month to respond for all household members. Under this procedure a respondent could not be interviewed in 2 consecutive months unless the household had only 1 eligible respondent. The third treatment level, self response, had each household member responding for him/herself. Again the assignments were made in a manner constituting a 2 x 2 x 3 factorial design. In other words, 1/12 of the households received personal visits with the same interviewer and with the household respondent and likewise for the remaining 11 possible combinations of treatment levels. As was the case with interview mode, the assigned treatment level for type of respondent could be abandoned in lieu of another level only to prevent the complete loss of an interview.

In Phase I, each interviewer performed all possible combinations of treatment levels in each month of interviewing. This was done in a completely balanced manner so that each interviewer performed the same amount of treatment level combinations each month. Due to the experimental nature of this project, certain differences between the MDS and the regular CPS could be expected. For instance, the interviewer workload in the MDS is less than the usual workload for CPS interviewers. Training of interviewers also differed somewhat in order to familiarize MDS interviewers with all the various procedures regarding each treatment level. Interviewer supervision also varied from the regular CPS in order to insure that the experimental treatments were being applied as accurately as possible.

### III. Analysis of Phase I

Phase I of the MDS is considered such an interesting data set that many possible avenues exist for analysis. The major analytical procedures considered will be highlighted here.

#### A. Analysis Using Studentized Statistics

The Studentized Statistic approach was used to make inferences about treatment effects by looking at estimated contrasts, such as the difference  $d = r_1 - r_2$ , where  $r_1$  is an estimated ratio (e.g., unemployment rate) based on observations from one treatment level combination and  $r_2$  is the comparable ratio from another treatment level combination. Ratios were estimated in the classical way. A jackknife variance estimator was used in accord with the sampling design and the form of the estimator and Studentized Statistics were used for testing purposes. Eight pseudo-values were used to estimate the variance with each pseudo-value reflecting the multiple-stage design of the MDS. The estimated variance of the estimator  $d$ ,  $(\hat{\sigma}_d^2)$ , was used to calculate the Studentized Statistic  $t = d/\hat{\sigma}_d$ .

In using this approach, it was necessary to assume that no second order interactions existed among the 3 treatments from Phase I. Also, since no exact test existed for possible first order interactions (e.g., the usual F test associated with an analysis of variance), Studentized Statistics were used to infer the existence of these interactions. In this instance, estimators were constructed of the form  $\Delta = d_1 - d_2$  where the  $d_i$ 's were appropriately defined estimators of the form

$d_i = r_j - r_k$ . Then,  $\hat{\sigma}_\Delta^2$  denotes the estimated variance of the estimator  $\Delta$  and was calculated as

$$\hat{\sigma}_\Delta^2 = \hat{\sigma}_{d_1}^2 + \hat{\sigma}_{d_2}^2 - 2 \text{Cov}(d_1, d_2).$$

Again approximate tests were performed using the Studentized Statistic  $t = \Delta/\hat{\sigma}_\Delta$ .

Multiple range procedures were also used in the course of this analysis. The exact method applied was a modification of Duncan's new multiple range test to the case of means with heterogeneous variances and covariances. This procedure is described by Kramer [2].

#### B. Analysis Using a Log-Linear Model Approach to Sample Data

A second analytical method applied to Phase I data concerns the fitting of log-linear models. Generally, it has been felt that log-linear models applied to survey data collected through complex samples cannot be safely analyzed with the usual Pearson or log-likelihood chi-squared tests. This is due to the fact that stratification, clustering of observations, and weighting of observations have an impact on the null hypothesis sampling distribution of these test statistics. Recent work by Fay [3-5] on jackknifing chi-squared statistics has proposed one solution to this problem.

In applying this approach to Phase I data, we have constructed a 24 cell contingency table comprised of counts of employed and unemployed persons for each of the treatment level combinations from the 2 x 3 x 2 factorial design. We

then fit various log-linear models and test for the presence of first and second order interactions. This analysis has been completed in its initial form but is currently being expanded to include additional aspects of the survey design.

#### C. Other Analyses

Quite a lot of data modeling (in the tradition of a general linear models analysis) has been performed on Phase I data. Unfortunately, up to this time no adequate model has been found to reflect these data. Currently, we are intensifying our efforts in this area and hope to soon have some progress. Any results from this approach will be reported by the Census Bureau in future reports.

Also, it was decided that more simple data exploration would be beneficial for Phase I. Currently, a variety of exploratory and graphical data analytic techniques are underway. Some of the topics being investigated with this approach are regional effects and segments within region. Data from individual interviewers are also being examined.

Finally, the log-linear modeling approach is being expanded to include counts of persons not in the labor force. This way, the complete employment trichotomy is being accounted for. This approach is also being used to examine month in sample effects and regional effects.

### IV. Results

#### A. Overall Results

Unless otherwise noted, all results cited in this paper are from analyses of the unemployment rate. In considering all 4 months in sample and all 18 months of data from Phase I, both the Studentized Statistic and the log-linear modeling procedures described earlier led to the same conclusions. Estimates of the unemployment rate along with their estimated sampling errors are presented in Table 1 at the end of this paper. A relationship was discovered between interview mode and interviewer assignment which affects the measurement of unemployed. In examining this relationship and relating it to current CPS procedures, it was seen that if the same interviewer enumerates sample households each month then no difference could be detected between interview modes.

More specifically, no second order interaction was found among the 3 treatments. In examining the first order interactions, respondent type was found not to interact with either of the 2 remaining treatments while interview mode and interviewer assignment were found to interact with each other. In comparing the 4 possible combinations of these 2 treatments, the following 3 groups were composed where members within a group were found not to differ significantly in producing estimates of the unemployment rate. Treatment level combinations that do not appear together within any group were found to differ significantly. The groups, along with their estimated rates, are:

Group 1	
telephone-alternating interviewers	8.59%
personal visit-same interviewer	7.85
Group 2	
personal visit-same interviewer	7.85
telephone-same interviewer	7.49

Group 3	
telephone-same interviewer	7.49
personal visit-alternating interviewers	6.92

Since respondent type was found not to be involved in any interaction terms, direct comparisons were made among the types of respondent. No statistically significant differences were found but self response did produce a larger estimate of the unemployment rate than did the CPS household respondent (8.04% vs. 7.34%). The significance level of this comparison was approximately .11.

Currently, the CPS uses a household respondent with the same interviewer enumerating sample households each month they are in sample. Overall, approximately 60% of the CPS interviews are conducted by telephone. Relating the previous results to the current CPS, mode does not appear to be an issue in measuring the unemployed. Mild, yet inconclusive evidence exists that states that a change to self response could increase the estimated unemployment rate.

These same analyses were performed considering only the data from months in sample 2 through 4. This was due to the peculiar nature of the first month in sample households as regards the applications of the treatment levels cited in section II of this paper. The conclusions from these analyses closely reflected the month in sample 1 through 4 case. Namely, no second order interaction was found while the only first order interaction found was between interview mode and interviewer assignment. The grouping of the 4 possible treatment level combinations was slightly different. Only 2 groups were composed with the first containing all but the personal visit with alternating interviewers combination. The second group contained the telephone with same interviewer and the personal visit with alternating interviewers combinations. Again, self response produced a somewhat larger estimate of the unemployment rate than did the CPS household respondent (8.04% vs. 7.38%). Significance was now at approximately .12. The same conclusions can be reached in relating the results to current CPS procedures.

Finally, since the sample design of Phase I called for testing in 4 groups of counties, the log-linear modeling approach was extended to test for various interactions among the treatments and county group. Recent results from this analysis have shown the existence of a higher order interaction with county group. Specifically, a respondent type by interviewer assignment by county group interaction has been found. This result is currently being examined in greater detail and will be included in a final report planned for this project.

#### B. Second Month in Sample Results

Currently in the CPS, all first month in sample households are interviewed by personal visit. For second month in sample households, interviewers are instructed to attempt a personal visit interview but accept a telephone interview if necessary. Due to this situation, the question was raised as to whether all second month in sample interviews could be performed by telephone without affecting the estimate of unemployed from that month in sample.

Results of analyses of second month in sample households present a similar situation to previ-

ously stated results. As regards interview mode, a first order interaction was found with interviewer assignment. Again in comparing the 4 possible treatment level combinations, 2 groups were composed. The first has all but the personal visit with alternating interviewers combination while the second had only this single combination.

Relating these results to the CPS and considering that the same interviewer is maintained for all interviews within a household, then the conclusion can be reached that increasing the use of telephone interviews in second month in sample households does not appear to affect the unemployment estimate from those households.

#### C. First Month in Sample Results

An unexpected situation developed in the first month in sample households from Phase I of the MDS. The only treatment applied to these households was respondent type. Effects due to alternation of interviewers could not be seen until the second month of interviewing and as previously stated all first month interviews were conducted by personal visit. Despite this, a significant mode effect exists in which those households assigned to the telephone mode produce a larger estimate of unemployment than those assigned to the personal visit mode. This situation has caused a careful examination of first month in sample data.

It is not known why the unemployment estimates are higher for the assigned telephone households, however a reason why this may occur begins with the fact that interviewers know the assigned treatment levels that each household will receive in months in sample 2 through 4 before they conduct a first month interview. These levels were clearly stamped on the control cards interviewers used during the first month interview. This prior knowledge could affect the manner in which interviewers perform first month interviews. For instance, in those households assigned to the telephone mode, the interviewers may have spent more time conducting a first month interview since they knew that this would be the only personal contact ever made with the household. The fact that interviewers knew this was an experimental survey in which methodology was being studied may also have amplified this effect.

Additional aspects of the mode difference were displayed in graphs over time. From these graphs, it could be seen that the magnitude of the final difference in modes appears to have slowly grown across time as a result of the unemployment estimate from telephone households tending to increase over time while the estimate from personal visit households remained relatively constant. This is displayed in Graph 1 at the end of this paper. This indicated that interviewer experience may also be a factor in producing this effect.

Finally, close scrutiny of these data has revealed a clustering of unemployed persons in first month households assigned to telephone within one of the sample groups of counties. This clustering involves 8 segments of this county group which were enumerated by 2 particular interviewers. It occurs in the latter 9 months of the survey at around the time the telephone estimate appears to begin its increasing tendency. The magnitude of the effect of this clustering is currently being actively investigated.

Generally, this situation for first month

households is peculiar to the MDS and in no way relates to the CPS. The MDS interviewers know this is an experimental survey and so may approach interviews with a completely different attitude than regular CPS interviewers. Interviewer training, supervision, and workload also differ between the CPS and the MDS. These factors may all play some part in producing this first month in sample result. The peculiar nature of these results has demonstrated the need for the exploratory and graphical data analytical techniques currently being tried. Hopefully, results from these procedures will shed even more light onto this area.

#### V. Final Comments

A few final comments should be made in summing up this first wave of Phase I results. The first involves the topic of rotation group bias, that is, differences in estimates produced by different rotation groups. The CPS has long demonstrated a particular rotation pattern for unemployment in which the second month in sample produces an estimate quite smaller than the first month. The third month drops smaller still before an increase is observed in the fourth month (See Bailar [6]). Despite the fact that the MDS uses a CPS questionnaire, the rotation patterns by treatment from the MDS display quite different trends. For example, in personal visit households, an almost linear increasing trend exists from first month through fourth. Other patterns exist for other treatments. An example of this situation is displayed in Graph 2 at the end of this paper. In examining this graph, it must be remembered that the MDS curves are based on data from 4 purposely selected PSU's while the curve for the CPS is based on a national probability sample. Still, there is no evidence to date to suggest that these 4 PSU's behave differently in regards to rotation group patterns within the CPS. Plans are currently underway to use this information from the MDS as a data base for studying rotation group problems in general. It may very well be that not only methodology, but such factors as interviewer workload can affect the rotation pattern.

Secondly, the MDS was carried out in only 4 groups of counties. Although these county groups were selected to display a wide variety of characteristics that pertain to unemployment, a proper probability selection was not made. Thus, inferences cannot be made on a national level. Budgetary considerations and the availability of field staff necessitated this methodology. Hence the results presented in this paper

pertain only to the 4 groups of counties. Also, no validation procedure was used in this experiment, as accurate validation is extremely difficult to attain, so the true value of any characteristic of interest for each individual is not obtained. Thus, the absolute nonsampling error bias of any particular treatment level cannot be estimated. Only the differential nonsampling error biases of each treatment level or combination of treatment levels can be estimated.

Finally, the information from Phase I of the MDS has proved to be an exceedingly interesting data set. This paper has only described the first wave of results and has concentrated solely on analyses of the unemployment rate. Other variables such as hours worked, response rates, and employment to population ratios are being examined. Other analyses such as the exploratory and graphical data analytical techniques previously mentioned are planned. Other uses for the data such as to study rotation group curves and gross changes are underway. Overall, this research will provide a great deal of information to aid in redesigning the CPS, but also will provide for increasing the knowledge about demographic surveys in general.

#### References

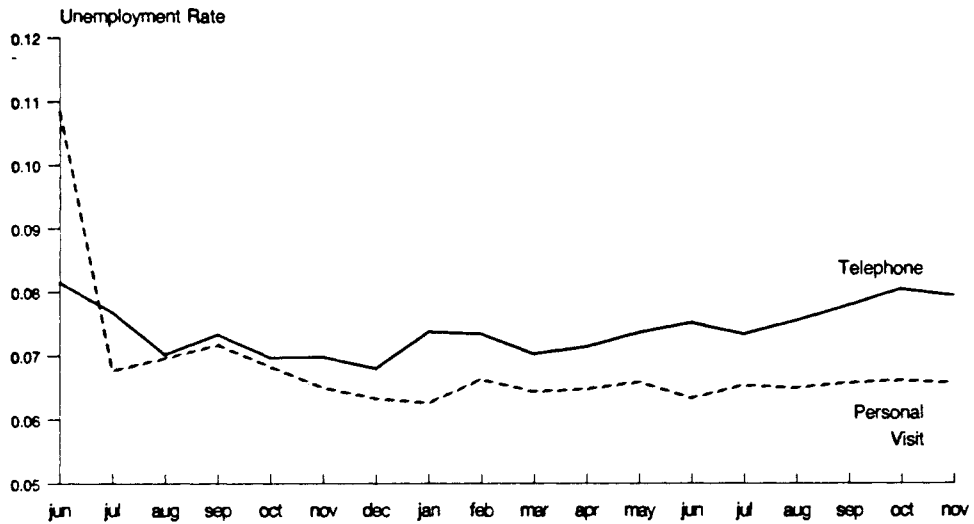
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Table 1: Average Unemployment Rate By Treatment Level Combination For Months in Sample One Through Four From Phase I of the MDS

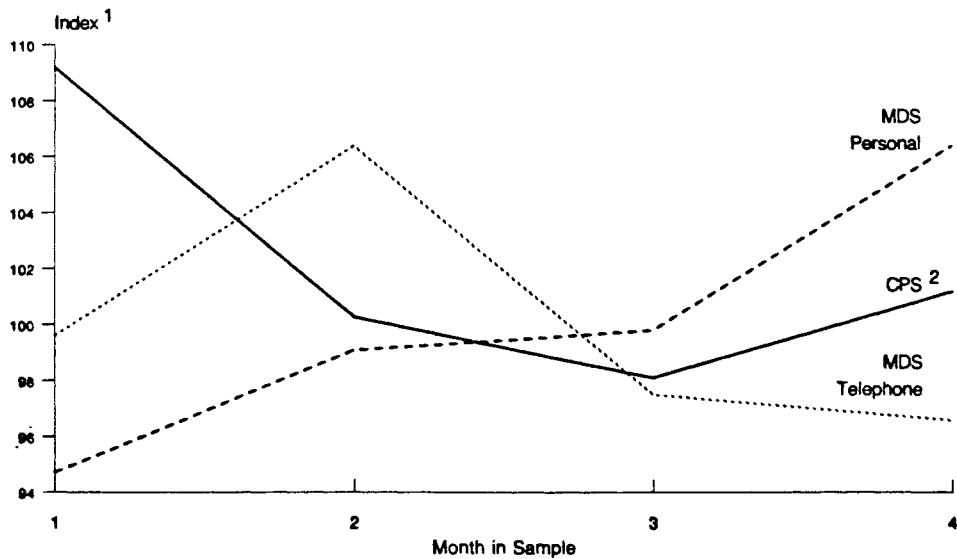
Mode	Treatment/Level Int. Assignment	Respondent Type	Unemployment Rate (percent)	Estimated Sampling Error
Personal Visit	Same	Household	7.32	1.01
"	"	Designated	8.13	0.71
"	"	Self	8.09	0.80
Telephone	"	Household	6.87	0.48
"	"	Designated	7.74	1.10
"	"	Self	7.81	0.56
Personal Visit	Different	Household	6.97	0.48
"	"	Designated	6.94	0.36
"	"	Self	6.82	0.30
Telephone	"	Household	8.15	0.88
"	"	Designated	8.24	0.80
"	"	Self	9.32	0.85
Personal Visit	*	Household	7.15	0.50
"	*	Designated	7.56	0.28
"	*	Self	7.48	0.47
Telephone	*	Household	7.54	0.45
"	*	Designated	7.96	0.67
"	*	Self	8.59	0.49
Personal Visit	Same	*	7.85	0.57
Telephone	Same	*	7.49	0.33
Personal Visit	Different	*	6.92	0.14
Telephone	Different	*	8.59	0.44
*	Same	Household	7.07	0.60
*	"	Designated	7.98	0.75
*	"	Self	7.97	0.24
*	Different	Household	7.59	0.46
*	"	Designated	7.60	0.46
*	"	Self	8.10	0.49
Personal Visit	*	*	7.41	0.30
Telephone	*	*	8.03	0.35
*	Same	*	7.68	0.35
*	Different	*	7.76	0.24
*	*	Household	7.34	0.39
*	*	Designated	7.78	0.44
*	*	Self	8.04	0.28

\* indicates the estimate is collapsed across the levels of the given treatment.

**GRAPH 1: First Month In Sample Estimates for Assigned Telephone and Personal Visit**  
(data is accumulated through the various months)



**GRAPH 2: Rotation Group Indices for Unemployed Persons**



<sup>1</sup> Indices are computed by dividing the number of unemployed in a rotation group by the average number of unemployed over all rotation groups, and multiplying by 100.

<sup>2</sup> This curve is taken from Baker [6].