DETAILED COST DATA FOR CENSUS BUREAU DEMOGRAPHIC SURVEYS

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1. INTRODUCTION

The U.S. Bureau of the Census routinely collects cost data for its demographic surveys. These cost data are primarily used to allocate costs to the surveys in which they were incurred; but they are also used for other purposes, such as developing standards for various components of the survey operations, including establishing a standard for an interviewer's performance, making decisions to reduce a survey's budget such that the data quality is least affected, and preparing budget estimates for a new survey by utilizing cost data for similar functions from other surveys. A more extensive use of cost data in recent years has been in the redesign of the Current Population Survey (CPS), National Crime Survey (NCS), Annual Housing Survey (AHS), Health Interview Survey (HIS), and Survey of Income and Program Participation (SIPP). Because salaries paid, overheads charged and the costs of employee benefits can vary from one organization to another, this paper presents the cost data in hours, minutes and miles for CPS, NCS, AHS, HIS, and the Income Survey Development Program (ISDP). (ISDP served as a dress rehearsal for the SIPP.) The remainder of this first section summarizes the statistical design of these surveys. In Section 2, a brief description of the components of the surveys' designs and operations is presented, and Section 3 gives the costs of these components. Section 4 presents some results of the post 1980 census redesign research. A brief summary is provided in Section 5.

Background Summary of the Statistical Designs of the Surveys

The basic frame from which the CPS, NCS, AHS and HIS samples of the 1970's and early 1980's were drawn was the complete inventory of housing and persons defined in the 1970 Census of Population and Housing. This frame is updated continuously to reflect new construction since the 1970 Census. These four surveys utilize multistage stratified cluster probability samples of the United States. This involved dividing the entire area of the United States consisting of 3146 counties or equivalents and independent cities into 1931 primary sampling units (PSUs). Of these 1931 PSUs, 156 have such large populations that they are included in sample with certainty and are defined as self-representing (SR) strata. The remaining 1775 PSUs are grouped into 220 homogeneous groups called non-self-representing (NSR) strata. These 376 SR and NSR strata provided the basic stratification for all of these five surveys. More details on the overall design may be found in [1].

The NCS and the HIS use 376 sample PSUs, the AHS uses 461 sample PSUs. The initial 1970 CPS design used 461 sample PSUs but in the late 70's, a large number of these strata were altered to meet the changed requirements of the CPS. The CPS now uses 629 sample PSUs. The ISDP used 130 by subsampling 376 sample PSUs from CPS. The first stage of selection consisted of selecting one PSU from each stratum; for the CPS and AHS, the first stage further involved pairing the 220 NSR strata and independently selecting one additional PSU within each strata. The second stage of selection involved selecting the sample housing units or the sample persons within the sample PSUs.

For CPS, NCS, and HIS a systematic sample of clusters of approximately four housing units was selected. The AHS selected a sample of clusters of approximately two housing units in urban areas and four housing units in rural areas and for new construction.

ISDP used a multiple frame sample of individuals and clusters of housing units. For ISDP about 17 percent of the sample was selected using clusters of approximately four neighboring housing units. The remainder of the sample, about 83 percent, consisted of an unclustered unit sample. About 62 percent consisted of housing units selected from the retired Survey of Income and Education Sample (SIE). The remaining 21 percent of the ISDP sample was selected from the Supplemental Security Income (SSI) record file and the Basic Educational Opportunity Grant (BEOG) administrative records. From the SSI and BEOG frames, a sample of persons was selected instead of housing units. [2]

2. SURVEY DESIGNS AND OPERATIONS

Table 1 provides a general overview of the surveys' designs and operations. The information in this table is vital for the proper application of this paper's cost data to other surveys, but will not be discussed in the text. Only a couple of comments on items not contained in Table 1 will be given.

Interviewing for all surveys except HIS is generally done by resident interviewers. For HIS, interviewers live in only 80 of the 376 sample PSUs and thus there is extensive travel between PSUs which accounts for about 35 percent of the direct field costs for travel and interview.

CPS is the "basic" survey. About 40 percent of CPS interviewers also work on other Census Bureau surveys. The current design uses a rotating sample in which a panel of designated units called a rotation group is interviewed for four months, dropped from the sample for eight months, interviewed for another four months and then retired permanently. For more detail about the design of specific surveys refer to [1],[2],[3], [4],[5].

3. SURVEY COST COMPONENTS

The cost components for CPS, NCS and HIS can be presented in the context of a production model. They are most commonly used to establish standards against which each interviewer's productivity is measured. These models can be refined for panel surveys since they allow for improvements to the model on a regular basis.

Production models were not established for ISDP. However, cost enumeration and mover cost studies were conducted during the 1979 ISDP and these studies are the basis for the cost data presented here. [8][9]

CPS, NCS, and HIS Production Models

The production model has been divided into

two components; travel time and interviewing time.

a. Travel Time Travel time (TT) is defined as segment to segment travel, home to segment travel and within segment travel.

$$TT = (\lambda_1 s_1 - \lambda_2) d_1 r_1 + 2(\lambda_2 d_2 r_2) + (\lambda_1 s_1) d_3 r_3$$

segment to segment; home to segment; within segment

Parameters for CPS, NCS and HIS are calculated according to five "travel strata" used by the Bureau and are presented in Table 2. Travel strata group PSUs by urban population density. A PSU in which virtually all of the population lives in rural areas would normally be in stratum E. The travel strata are defined as follows:

A = 260.01 or more urban population/sq. mile
B = 64.01 - 260.00 urban population/sq. mile
C = 26.01 - 64.00 urban population/sq. mile
D = 8.01 - 26.00 urban population/sq. mile
E = 0.00 - 8.00 urban population/sq. mile

Data for CPS are from time and travel records completed by interviewers in 1973 and 1975. NCS data are from a sample of NCS interviewers who were asked to keep time and travel records for November 1980 and from NCS production worksheets completed by the regional offices in April 1982.

By substituting the travel time parameters into the appropriate model, comparisons can be obtained for the average amount of time used for segment to segment (T_{SS}), home to segment (T_{HS}) and within segment (T_{WS}) travel. Table 3 provides these comparisons for CPS and NCS by travel strata.

A weighted average based on the number of interviews occurring in each travel stratum provided the following U.S. averages.

	CPS	NCS
T_{SS}	45.9%	26.2%
T_{HS}	43.1%	55.4%
T_{WS}	11.1%	18.3%
	100.1%	99.9%

In Table 2, note that $d_3 r_3$, the average time spent traveling within a segment, increases rapidly across the strata for CPS and NCS. This is not unexpected since clusters usually consist of neighboring housing units in urban areas but are usually spaced out (every fourth or fifth housing unit) in rural areas. We have no explanation, however, for why the pattern for HIS is not the same as for CPS and NCS. We also are puzzled as to why NCS within segment travel time is so much greater than for CPS.

In Table 3, the increase across strata in the percentage of time spent on within segment travel is largely the result of the increase in $d_3 r_3$, discussed above. The decrease across strata in the percentage of time spent in segment to segment travel is caused by several factors and is more difficult to understand. One major reason is the increase in λ_2, the average number of trips from home to segment per interview assignment, from stratum D to E. Apparently, interviewers in very rural areas tend to make more trips directly from their home to a segment. The underlying reasons for this are not apparent.

b. Interviewing Time in Minutes CPS and HIS have a similar model for interviewing time. [6] The NCS interviewing time production model is somewhat more complicated because of the different types of interviews that an interviewer can have. [7] The general production model for interviewing time (IT) is:

$$IT = \sum_{j=1}^{k} n_i$$

where for CPS: K =3; for NCS: K = 6; and for HIS: K =2

Table 4 shows the parameter values for CPS, NCS and HIS according to the travel strata. Note that none of the average times include travel time, but only in-house interviewing and editing time.

ISDP Costs

Two aspects of ISDP, the total cost breakdown and the mover follow-up costs, are discussed below.

a. Total Costs There was no production model used for ISDP. A cost enumeration study of the ISDP was tabulated that included usual survey costs and the mover follow-up costs. The average costs for the entire 1979 ISDP are presented below by cost per interviewer assignment. [8]

	Average per Interviewer Assigned
Hours Charged	60.05
Miles Charged	617.37
Households Assigned	17.79
Households Interviewed	15.31
Type A Households	1.35
Persons Interviewed	31.59
Hours/Person Interviewed	2.12
Miles/Person Interviewed	21.25
Hours/Household Assigned	3.50
Miles/Household Assigned	35.55
Hours/Household Interviewed	4.17
Miles/Household Interviewed	42.18

b. Mover Follow-up Costs An important feature of the ISDP design was to follow movers throughout the survey. This design provided the opportunity to gather information on the composition of mover households, mover interview rates and, for the first time, costs of following movers over an extended period of time.

There was approximately a 7 percent increase in the number of hours for data collection and an 11.4 percent increase in the number of miles charged due to the following of movers and interviewing additional households during the entire survey. Of the 751,397 mover-related minutes charged, 47 percent were during the wave they actually moved for locating, following, and interviewing movers, with 53 percent for subsequent waves; 81 percent of the mover minutes were spent in determining new addresses and follow-up (both initial and revisits) for the additional households.

There were 198,097 total mover miles charged, of which 52 percent were from the initial wave of move as opposed to revisits in later waves, and of which 30 percent were spent locating the new addresses of mover households as opposed to follow-up traveling to obtain interviews.

These movers represented about 22 percent of the sample as of Wave 6. Using dollar cost information from ISDP, the additional hours and miles charged for the data collection activities represented an overall cost increase of about 8 percent in the 1979 ISDP Panel. [9]

4. POST 1980 CENSUS REDESIGN RESEARCH

An extensive research program has been conducted to optimize the redesign of the current demographic surveys. Most of the research projects were set up to make a decision regarding optimality with respect to variances and costs.

In the sections below, some of the cost estimates that were prepared for the redesign research are presented. We have been highly selective, only including those that we feel are most easily applied by other organizations and those that are reasonably good cost estimates. All the estimates, however, are rough; many assumptions were required, and actual costs could turn out to be substantially different from the estimates. The cost data is generally presented in relative terms rather than the absolute numbers that were actually used. Our goal is only to present the cost data and we have not discussed the decisions we made based on the costs. In some cases the decisions were different from what the cost data would suggest due to administrative and other considerations.

Single County versus Multiple County

Before redesign, Non-SMSA (Standard Metropolitan Statistical Area) PSUs have generally consisted of two or three adjoining counties, although where counties have very large land areas, PSUs have consisted of a single county. SMSAs have remained intact as single PSUs, sometimes consisting of one county but occasionally consisting of many counties (e.g., Minneapolis-St. Paul consisted of five counties). An important issue in the sample survey redesign research was to determine whether to continue to use a multiple-county definition or to generally use a single county in defining PSUs. Since the multiple-county design has a larger area per PSU than the single county design, the distances between segments is expected to be larger, resulting in greater travel costs.

a. Current Population Survey A comparison between single-county and current PSU definitions was made for five states: Alabama, Georgia, Mississippi, Ohio, and Illinois. Each state was run through our stratification program once for single county PSUs and once for current PSU definitions. Data from the 1970 Census was used for stratification, and sample sizes and numbers of sample PSUs were determined in order to achieve a 10 percent coefficient of variation on total unemployment 10 years away from the date of stratification data. Census data was used to estimate between PSU variance components, and within PSU design effects derived from some CPS variance runs were used to estimate the within PSU variance components. Thus, for each state we determined two different sample designs that produced the same level of reliability. Information on interviewer travel time and interviewing cost was then used to compare the cost of the two designs. The variance estimates used are subject to error, the cost data used only approximations, and the stratification variables used for this comparison were different from those actually used in the redesign. Thus, small cost differences between PSU definitions are not meaningful. Table 5 shows that in summing the data across the five states, there is no apparent advantage of one definition over the other (the ratio of single county to multiple county costs was .988). For Georgia, however, single county appears considerably more expensive than multiple-county (the ratio of costs was 1.168, Table 5). As expected, multiple-county always requires smaller sample size (7 percent less on the average) and fewer interviewers than single county, but the travel time per interviewer is higher. (The non-integer number of required interviewers occurs because we assumed a desirable workload per interviewer, and divided the workload in each self-representing PSU by the desired workload to determine the number of interviewers needed. In reality, of course, an integer number of interviewers would be used.)

The last row of Table 5 shows the increase in between PSU variance that single county PSUs cause. (Since the overall variance for the alternative PSU definitions is the same, there is a compensating decrease in within PSU variance for single county PSUs based on the larger sample size.) If we had had more time before needing to make decisions, we would have also made comparisons for PSU definitions intermediate between all single county and the current definitions. [10]

b. Annual Housing Survey For AHS we calculated average distances between segments by estimating the average area per working assignment under alternative PSU definitions. The average area per working assignment was computed for self-representing (SR) and nonself-representing (NSR) PSUs. Computations were based on the south region only. The average distances and distance ratios are shown below:

	Average Distance in Miles	Ratio of Distances to Average Multi-County Distance	
		SR	NSR
Multi-county	3.64	.84	1.14
Single-county	2.78	.63	.85

This information, together with travel cost estimates and variance estimates, was used in making a decision on PSU definitions for AHS.

c. National Crime Survey and Health Interview Survey NCS and HIS used travel strata as described above to estimate total cost. Weights were assigned to each stratum for each design to obtain a weighted mean for each parameter. These weights were determined by finding the proportion of PSUs that fell into each travel stratum for each respective survey.

The travel time (TT) and weighted estimated means for the production model parameters are given below for only those parameters which were dependent on the design: d_1 (segment to segment distance) and d_2 (home to segment distance). The others remained relatively constant.

Survey	Parameter	DESIGN			
		Multi-County		Single-County	
		SR	NSR	SR	NSR
NCS	TT	823.39	906.00	639.16	737.92
	d_1	10.49	13.33	7.87	9.91
	d_2	13.05	20.86	9.25	14.96
HIS	TT	553.50	661.68	429.77	538.81
	d_1	9.89	12.56	7.42	9.34
	d_2	13.14	21.00	9.31	15.06

Compact versus Non-Compact Segments

As part of the CPS redesign, a study was performed to obtain the relative increase in CPS interviewer cost if non-compact segments were formed.

Non-compact segments would reduce the within enumeration district component of variance. The CPS production model for travel time was used as the basis for the cost model. Other assumptions were that the formation of non-compact segments would increase the travel time within segments by a factor guessed at by field division, but would not affect between segment or home to segment travel time, distances or costs, and that no increase in the number of interviewers would be needed. For the research study, only self-representing PSUs were looked at. A non-compact segment with designated units 15 units apart was considered. Finally, it is estimated that an average of an additional 0.2 to 0.5 miles per household would be driven by an interviewer for non-compact segments.

Table 6 shows the percent increase in monthly travel time in minutes per CPS interviewer if non-compact segments were formed. The increases are computed only for travel strata A, B and C. Table 7 shows the total percent cost increase over compact segments for strata A, B, C and combined strata ABC and ABCDE. [11]

Optimum Number of PSUs

In the past, HIS and other surveys have shared the design of the CPS. For the post 1980 census redesign, much more consideration was given to the specific requirements of individual surveys. In particular, we performed an interesting study on the optimum number of sample PSUs for HIS.

Table 8 shows data for some of the designs considered in the study on optimal number of sample PSUs for HIS. Design number (1) is a sample design similar to the current design in which interviewers outside of the large metropolitan areas typically must interview in several PSUs in addition to the one they live in. Designs (2) and (3) have many fewer sample PSUs but larger sample sizes to compensate for the resulting increase in between PSU variance. Typically, interviewers outside of large metropolitan areas would interview in one PSU besides the one they live in under these designs. The costs for (1), (2), and (3) are quite similar. There are major reductions in travel costs for designs (2) and (3), but the increased cost of larger sample size is about equal to the decreased travel cost. Since a number of assumptions had to be made regarding the effect on variance, upper and lower bounds of relative variances were computed. There may be some reduction in variance in design (2) compared to (1). Note that these computations were based on the assumption that the between PSU variance for design (1) is 10 percent of the total variance. If the between variance were much greater than this, design (1) would be preferred; if the between variance were much smaller, designs (2) and (3) would be preferred. (Good information on variance components is not available from the survey sponsor, but we have estimated that the average between PSU variance for major statistics is about 10-12 percent of the total.)

Design (4) has a small enough number of PSUs that each interviewer covers only his or her resident PSU. This design appears slightly preferable to the other designs. Again, however, the extra costs of the larger sample sizes are nearly equal to savings in travel costs. Note also that a number of assumptions and approximations were made in deriving these figures, and thus definite conclusions about lower costs and variances between designs are not possible. [12]

5. SUMMARY

It was the purpose of this paper to provide general time and mileage data for some of the Bureau's demographic surveys. These surveys included some major on-going surveys (CPS, NCS, AHS, HIS) and ISDP. It is hoped that this paper provides some basic data useful to other researchers for projecting costs for their purposes or planned survey activities. Readers are urged to refer to the appropriate references for more details on survey designs and operations before trying to make major applications of the cost data. Table 1 gives a general overview of interviewing patterns, sample size and processing information for the five surveys and could help to decide which survey is more closely related to the reader's needs.

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REFERENCES

[1] U.S. Department of Commerce, Bureau of the Census. "The Current Population Survey: Design and Methodology," by Robert Hanson. Technical Paper 40. Superintendent of Documents No.: C2.2.2:40; January 1978.

[2] Ycas, Martynas A. and Lininger, Charles A. (1980). "The Income Survey Development Program: A Review." Proceedings of the Section on Survey Research Methods, American Statistical Association, pp. 486-490.

[3] Tadros, William H., Moore, Thomas F. and Chakrabarty, R. P. (1982). "Determining the Optimum Number of Primary Sampling Units To Be Selected For the Health Interview Survey." Proceedings of the Section on Survey Research Methods, American Statistical Association, pp. 217-222.

[4] Montie, Irene C., and Schwanz, Dennis J. (1977). "Coverage Improvement In the Annual Housing Survey." Proceedings of the Section on Survey Research Methods, American Statistical Association, pp. 163-172.

[5] Bateman, David and Bettin, Paul (1975). "Standard Error Estimation for the National Crime Survey." Proceedings of the Section on Social Statistics, American Statistical Association.

[6] Blass, Richard F. "Relative Size of the Components of CPS Travel Time," Bureau of the Census internal memorandum for Maurice Kniceley, March 12, 1981.

[7] Love, Lawrence T. "NCS/GPS Redesign," Bureau of the Census internal memorandum for Charles D. Jones, October 5, 1982.

[8] White, Glenn D. "Enumeration Cost Study for the Income Survey Development Program 1979 Panel." Bureau of the Census internal memorandum for The Record, August 10, 1981.
[9] White, Glenn D. and Huang, Hertz (1982). "Mover Follow-up Costs for the Income Survey Development Program." Proceedings of the Section on Survey Research Methods, American Statistical Association, pp. 376-381.
[10] Cahoon, Lawrence S., "CPS Redesign-Summary of Research Comparing Single-County and Multiple-County PSUs," Bureau of the Census internal memorandum for Gary M. Shapiro, November 19, 1982.
[11] Cahoon, Lawrence S., "CPS Redesign-Within-PSU Sampling: Estimated Increase in CPS Interviewer Cost if Non-Compact Segments Are Formed," Bureau of the Census internal memorandum for Gary M. Shapiro, August 19, 1982.
[12] Jones, Charles D., "HIS Redesign: Costs for Redesign Alternatives," Bureau of the Census internal memorandum for Thomas C. Walsh, August 12, 1983.

Table 1. Summary of CPS, HIS, AHS, NCS and ISDP Designs and Operations.

Survey	Number of PSUs	Number of Interviewers	Total No. of Assigned Interviews	Avg. No of Interviews per Interviewer Assignment	Household Interviewing Rotation	Type of Interview	Respondent Unit	Length of Interview (In-house time)
CPS	629	1500	68,500	50	Monthly for 4 months, out for 8 months, in for 4; 7/8 month-month overlap	Personal visit & telephone (60%)	Household	10 min
HIS	376	120	52,000	18	In sample one time; no overlap	Personal visit	Family & each unrelated individual in household	45 min.
AHS	461	1250	81,850	60	Interviewed once per year for 10 years; comlete year-year overlap	Personal visit	Household	35 min.
NCS	376	525	72,000	25	Every 6 months for 3 years; 6/7 overlap	Personal visit & telephone (Alternatting interviews)	Each household member (proxy for 12-13 year olds)	30 min.
ISDP	130	180	13,300	25	Quarterly for 6 quarters; complete overlap	Personal visit	Household	46 min.

Table 2. Cost Parameters for Travel Time Model by Travel Strata for CPS, NCS, and HIS

Survey	Travel Time Components Abreviated Definitions	Parameter	Travel Strata A	B	C	D	E
CPS	λ_1 - number of visits per segments	λ_1	2.1	2.3	1.8	1.7	2.0
	s_1 - number of segments per interviewer assignment	s_1	15.3	13.0	12.5	13.1	14.0
	λ_2 - number of trips from home to segment per assignment	λ_2	11.6	6.9	5.2	5.2	9.3
	d_1 - miles from segment to segment	d_1	7.4	9.8	9.1	10.7	9.1
	r_1 - minutes per mile for between segment travel	r_1	3.0	2.1	2.2	2.1	1.8
	d_2 - miles from home to segment	d_2	6.1	12.1	12.0	15.8	16.9
	r_2 - minutes per mile for home to segment travel	r_2	3.2	2.0	2.0	1.6	1.6
	d_3r_3 - time spent traveling within a segment	d_3r_3	1.2	2.0	5.7	8.6	9.9
NCS	λ_1 - number of visits per segments	λ_1	3.0	3.0	2.5	2.5	2.4
	s_1 - number of segments per interviewer assignment	s_1	6.1	6.5	5.6	5.0	5.1
	λ_2 - number of trips from home to segment per assignment	λ_2	7.9	8.1	7.0	6.3	8.1
	d_1 - miles from segment to segment	d_1	10.0	13.0	13.0	13.0	15.0
	r_1 - minutes per mile for between segment travel	r_1	2.5	2.0	1.9	1.9	1.6
	d_2 - miles from home to segment	d_2	12.0	18.0	21.0	22.0	24.0
	r_2 - minutes per mile for home to segment travel	r_2	2.3	1.8	1.6	1.6	1.6
	d_3r_3 - time spent traveling within a segment	d_3r_3	5.9	9.5	9.9	22.3	18.3
HIS	λ_1 - number of visits per segments	λ_1	2.9	2.3	2.3	2.3	2.3
	s_1 - number of segments per interviewer assignment	s_1	4.0	4.0	3.8	4.1	3.8
	λ_2 - number of trips from home to segment per assignment	λ_2	5.4	3.9	4.7	4.2	4.3
	d_1 - miles from segment to segment	d_1	10.0	12.0	12.4	16.0	15.3
	r_1 - minutes per mile for between segment travel	r_1	2.7	2.2	2.1	2.0	1.8
	d_2 - miles from home to segment 1/	d_2	17.8	21.3	17.5	21.5	14.6
	r_2 - minutes per mile for home to segment travel	r_2	2.1	1.9	1.9	1.7	1.8
	d_3r_3 - time spent traveling within a segment	d_3r_3	10.3	9.6	14.0	7.3	9.0

1/ Only includes travel from "Base" (home or motel) within PSU, not travel from home to non-resident PSU

Table 3. Percentage Comparison of CPS and NCS Travel Time by Type of Travel Components

Parameter	Survey	Travel Strata A	B	C	D	E
TOTAL	CPS	100.0%	100.0%	100.0%	100.0%	100.0%
T_{SS}		48.1	54.6	47.8	45.8	28.2
T_{HS}		47.8	38.5	35.4	31.4	46.3
T_{WS}		4.1	6.9	17.7	22.9	25.2
TOTAL	NCS	99.9%	100.0%	100.1%	100.1%	99.9%
T_{SS}		31.4	29.1	23.7	17.6	10.5
T_{HS}		55.1	52.4	58.6	50.5	65.5
T_{WS}		13.4	18.5	17.8	32.0	23.9

Table 4. Cost Parameters for Interview Time Model by Travel Strata for CPS, NCS, and HIS

SURVEY	TYPE OF INTERVIEWS ABREVIATED DEFINITIONS	Parameter*	AVERAGE VALUE BY TRAVEL STRATA A	B	C	D	E
CPS	Personal visit interviews	n_1 1/	11	11	11	11	11
		t_1	35	34	34	34	30
	Telephone interviews	n_2 1/	31	31	31	31	31
		t_2 1/	17	17	17	17	17
	Noninterviews	n_3 1/	10	10	10	10	10
		t_3 1/	9	9	9	9	9
NCS	Personal visits with crime	n_1	4	3	3	3	2
		t_1	40	45	44	44	46
	Personal visits without crime	n_2	12	11	10	9	8
		t_2	32	35	33	34	31
	Telephone with crime	n_3	32	35	33	34	31
		t_3	40	44	44	44	39
	Telephone without crime	n_4	8	7	7	6	6
		t_4	32	35	33	34	31
	Noninterviews where eligible respondents reside	n_5	2	2	2	2	2
		t_5	15	18	19	9	7
	Out-of-scope units	n_6	4	4	4	5	5
		t_6	7	7	7	7	7
HIS	Interviews (all are personal visit)	n_1	11	13	12	13	10
		t_1	57	55	57	58	54
	Noninterviews	n_2	3	3	3	4	3
		t_2	10	10	10	11	12

1/ Data not available by Travel Strata

* n_i = average number of households
  t_i = average number of minutes per household

Table 6. Monthly Travel Time per CPS Interviewer for Compact and Non-compact Segments

Travel Stratum	Within Segment Factor (f) for Noncompact Segments	Travel Time (minutes) Compact	Noncompact	Percent Increase Compact to Noncompact
A	4	947	1,063	12.2
B	3	867	987	13.8
C	2	724	852	17.7

Table 7. CPS Percent Cost Increase over Compact Segments for Travel Strata A, B, C, ABC, ABCDE

Travel Stratum	Number of Interviewers	Percent Cost Increase Over Compact Segments Assuming: 6.2 miles of travel per sample unit in non-compact segments	6.5 miles per travel sample unit in non-compact segments
A	581	5.2	6.5
B	219	5.5	6.8
C	160	6.1	7.5
ABC	960	5.4	6.7
ABCDE	1315	3.9	4.9

Table 8. Cost and Variance Comparisons for Various HIS Sample Designs

	Design Alternatives (1)	(2)	(3)	(4)
No. of PSUs	347	200	160	118
Sample Size	54,400	57,600	59,800	64,300
No. of Interviewers	121	131	120	136
Relative Yearly Costs 1/2/	1.00	1.00	.99	.96
Total Costs 1/3/ (Including startup redesign costs)	1.00	1.01	1.01	.99
Relative change in variance: 1/				
Upper Bound	1.00	1.00	1.00	1.00
Lower Bound	1.00	.97	.99	.96

1/ All comparisons are relative to design (1), e.g., a ratio of .99 means that the design is 1 percent lower than design (1).

2/ This is total Census Bureau costs for 1 year, including all fixed costs.

3/ Redesign startup costs were assumed to be a once per 10 year cost and, thus, total costs were estimated as the sum of 1 year's operational costs plus $\frac{1}{10}$ redesign costs.

Table 5. Comparisons of Stratification 1/ for Single County and Multi-County PSU Definitions for Five States

	ALABAMA Results of Stratification for Single County PSUs	Results of Stratification for Multi-County PSUs	GEORGIA Results of Stratification for Single County PSUs	Results of Stratification for Multi-County PSUs	MISSISSIPPI Results of Stratification for Single County PSUs	Results of Stratification for Multi-County PSUs	OHIO Results of Stratification for Single County PSUs	Results of Stratification for Multi-County PSUs	ILLINOIS Results of Stratification for Single County PSUs	Results of Stratification for Multi-County PSUs	FIVE-STATE SUMMARY Results of Stratification for Single County PSUs	Results of Stratification for Multi-County PSUs
Sample Size (HUs)-Total	861 (1.066)* 808		996 (1.248)* 798		981 (1.185)* 828		2,739 (1.023)* 2,678		2,690 (1.028)* 2,617		8,267 (1.070)* 7,729	
SR	230(27%)	359(44%)	369(37%)	297(37%)	233(24%)	201(24%)	1,745(64%)	1,945(73%)	1,965(69%)	1,957(75%)	4,442(54%)	4,759(62%)
NSR	631(73%)	449(56%)	627(63%)	501(63%)	748(76%)	627(76%)	994(36%)	733(27%)	825(31%)	660(25%)	3,825(46%)	2,970(38%)
No. of PSUs-Total	67	45	159	68	82	44	88	46	102	52	498	255
SR	2	4	15	8	4	3	16	12	11	5	48	32
NSR	65	41	144	60	78	41	72	34	91	47	450	223
No. of Interviewers-Total 2/	17.6	17.2	20.4	15.9	20.	18.0	54.9	53.9	54.3	53.1	167.9	158.1
SR 2/	4.6	7.2	7.4	5.9	4.7	4.0	34.9	38.9	37.3	39.1	88.9	95.1
NSR	13	10	13	10	16	14	20	15	17	14	79	63
Est. Interviewer Travel (min.)-Total	7,029	7,883	7,386	6,580	8,332	8,496	23,256	27,445	24,601	24,911	70,604	75,315
SR	1,583	3,140	2,836	2,133	1,659	1,548	16,398	21,364	17,916	18,622	40,392	46,807
NSR	5,446	4,743	4,550	4,448	6,673	6,948	6,858	6,082	6,686	6,290	30,213	28,511
Est. Travel Time per Interviewer Total	399	458	362	413	403	471	424	509	453	469	421	476
Total Monthly Interviewing Cost	$ 4,019 (.944)* $ 4,260		$ 4,615 (1.168)* $ 3,952		$ 4,670 (1.045)* $ 4,468		$ 12,217 (.914)* $ 13,365		$ 13,193 (1.001)* $ 13,176		$ 38,714 (.988)* $ 39,201	
Cost Per Interviewer	$ 228	$ 248	$ 226	$ 248	$ 226	$ 248	223	248	243	248	231	248
1960 Adjusted Between PSU Variance (1,000)	11,654 (1.402)* 8,313		43,660 (2.031)* 21,495		6,922 (1.825)* 3,793		23,488 (2.299)* $ 10,216		26,999 (2.831)* $ 9,537		112,724 (2.113)* 53,354	

*Ratio of single to multi-county PSU definition.

1/ Minimum cost stratifications were run for single and multi-county definitions to achieve a 10% coefficient of variation on total unemployment 10 years

2/ Fractional numbers based on desirable workloads. Actual numbers would of course be integers.