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#### 1. Introduction

Many papers over the last 30 years have been written on the subject of interviewers as a source of error in survey data. Yet few largescale experiments have been conducted which give precise measures of this interviewer effect. Some efforts which have been made were reported by Fellegi (1) on an experiment carried out by Statistics Canada, by Kish (4) on an experiment carried out at the University of Michigan, and by the U.S. Bureau of the Census (6).

The Bureau of the Census has had experiments to measure the enumerator (interviewer) effect in the last three censuses of population and housing. Hanson and Marks (3) reported on the 1950 Enumerator Variance Study which took place in 21 purposively selected counties in Ohio and Michigan. The results of that study showed that the variability in census statistics which could be attributed to interviewers was, on the average, roughly equal to the sampling variability one might expect from a 25-percent sample of the population.

The results of the 1950 experiment greatly influenced the Census Bureau to introduce the use of self-enumeration on a widespread basis in the 1960 Census. To find out whether the increased use of self-enumeration had any effect on the level of enumerator variability, a large-scale experiment was conducted as part of the 1960 evaluation and research program. The results of that study showed that the level of variability in census statistics accounted for by enumerators in 1960 was reduced to about one-fourth of the 1950 level. However, even in 1960 enumerator variability had a considerable impact on statistics for small areas.

In 1970, some important changes were made in the census-taking procedures. The United States was divided into three kinds of areas, in each of which a different kind of census-taking procedure was used. The large central city areas were enumerated by a "centralized mail" procedure. The less densely settled areas of the country were enumerated by a "conventional procedure". The remainder of the country, containing about 50 percent of the population, was enumerated by a "decentralized mail" procedure.

The 1970 Enumerator Variance Study was confined to the decentralized mail areas on the ground that this type of census-taking procedure was most likely to be followed in the future. Thus, the estimates of enumerator variability presented in this paper are applicable to decentralized mail areas only.

Within the decentralized areas, the field procedure was as follows: An Address Register, a list of housing unit addresses to which blank questionnaires had been mailed, was supplied to the enumerator for an enumeration district (ED). The enumerator was to see that a completed census questionnaire was returned for each address listed in the Address Register for an ED. Enumerators were instructed in four areas: (1) how to checkin forms received by mail; (2) how to edit the short-forms (100 percent census schedules); (3) how to edit the long-forms (the sample census schedules); and (4) how to followup for nonresponses and inconsistencies.

As we shall show later, there was considerable variability among the enumerators in the interpretation of the editing rules. The possibility that this change in the enumerator's editing role might affect the level of enumerator variability was a primary consideration in deciding to carry out another enumerator variance study as part of the 1970 Census.

## 2. The Design of the Enumerator Variance Study

Of the 167 census district offices established in which a decentralized mail procedure was used a probability selection of 35 was made in which to carry out the Enumerator Variance Study (EVS). In each area two crew leader districts were selected, within which the enumerator assignments were grouped into clusters of four. All clusters within the two selected crew leader districts were included in the study. Altogether 259 of these clusters of enumerator assignments were included in the study.

The assignments of four enumerators were interpenetrated in each of these clusters. The listings within an Address Register were randomized such that within every group of eight listings designated to receive a long-form two were assigned to each of the four enumerators.

As far as possible, the procedures followed in the EVS areas were exactly the same as those followed in other decentralized mail areas. The major exceptions were:

- 1. A statistician was assigned to each EVS district office to supervise the study.
- The enumerators were paid higher piece rates in EVS areas since they would travel more.
- 3. The enumerators and crew leaders received additional training on EVS procedures.
- 4. The enumerators worked with copies of the Address Registers while the crew leaders kept the original.

#### 3. Processing of the Data

As with the regular census materials, all EVS census materials were sent to the Jeffersonville, Indiana office for processing. The census schedules were coded, microfilmed, converted to magnetic tape, edited, and the final census data tabulated. In all of this processing, the EVS schedules were treated just as any other schedules. Thus, the results of this study are applicable to the final published census statistics.

The data for the ED's included in the EVS were copied from the census sample tapes for the States in which the EVS offices were located. A basic identification record was made for each address in each ED showing the State, ED number, cluster number, group-of-eight number, and interviewer number. These identification records were matched against the census tapes so that enumerator assignments could be identified in the computations. The matching operation left only 1.6 percent of the originally randomized addresses unmatched. This was an improvement over the 1960 matching operation when we were unable to match 13 percent of the originally randomized units.

At the completion of the matching operation, the EVS sample contained approximately 127,000 housing units and 378,000 persons. This was slightly larger than the sample for the 1960 study which contained about 122,500 housing units and 370,000 persons.

## 4. The Estimation Procedure

The mathematical model used in this study is the model described by Hansen, Hurwitz, and Bershad (2). The basic assumption in this model is that a response from a given unit of the population is a random variable from a probability distribution. Thus, if it were possible to record responses for each individual repeatedly, a distribution of responses for each unit would be generated. In a census or survey, we first sample respondents and then sample from the distribution of possible responses for each sample person.

The survey process is regarded as being repeatable. Each survey is a trial from all possible repetitions of the survey process under the same general conditions which include the auspices of the survey, the questions used, the method of recording and processing responses, and the general social environment.

If one is interested in estimating a mean,  $\bar{x}$ , for an area the size of one enumerator's assignment, then it can be shown that under certain assumptions the mean-square error of that mean may be written as;

$$MSE(\bar{x}) = \frac{1}{n} \left\{ \sigma_{R}^{2} [1+(n-1)\rho_{R}] + \frac{N-n}{N-1} \sigma_{S}^{2} + 2(n-1)\sigma_{RS} \right\} + B^{2} .$$
(1)

In this expression N is the number of sampling units in the population, and n is the number of sampling units in the sample. The simple response variance,  $\sigma_R^2$ , is the trial-to-trial variability of response for a given unit. The sampling variance,  $\sigma_{\theta}^2$ , is the variance of the mean response of the units in the population. The square of the bias is denoted by B<sup>2</sup>. The term  $\rho_R \sigma_R^2$  is the correlated component of response variance, measuring the contribution to total variability caused by the correlation,  $\rho_R$ , of response deviations within trials. One reason for a correlation among response deviations is that one enumerator may interpret a question differently from other enumerators. His tendency to accept nonresponses, his possible misunderstanding of the training on certain questions, and other such factors tend to cause a positive correlation in the response deviations within his assignment. The correlations can also be introduced by crew leaders and by coders. The EVS is designed so that this term measures the correlations induced by the enumerators only. The remaining term in equation (1) is  $\sigma_{RS}$ , the covariance between response and sampling deviations, often assumed zero.

One reason for using interpenetrating subsamples is to estimate the correlated component of response variance. Of each group of eight successive listings in each of the 259 clusters, two listings were assigned to each of the four enumerators.

There were N listings, of which 20 percent were included in the census sample, the sample total designated by n. The sample listings were assigned to enumerators in groups-of-eight. We index groups-of-eight by the subscript g, and denote by b the number of groups-of-eight in the area. Within each group-of-eight there were  $\overline{N}$ listings.

Within a group-of-eight sample listings, each enumerator was assigned  $\bar{n} = 2$  listings. The subscript j indexes the listings within a group. The subscript h indexes the enumerators working in the cluster and the range is from 1 to k where k = 4. Thus, the recorded response for a given characteristic for the j-th unit in the g-th group-of-eight assigned to the h-th enumerator in the t-th trial of the process is denoted by  $x_{htgj}$ . From the data available from the EVS, there are five sample sums of squares and cross-products which can be used in estimation. These are:

$$S_0 = \frac{1}{kbn} \sum_{h=1}^{k} \sum_{g=1}^{b} \sum_{j=1}^{n} x_{htgj}^2$$

$$S_{1} = \frac{1}{kb\overline{n}(\overline{n}-1)_{h=1}} \sum_{g=1}^{k} \sum_{\substack{j \neq j}} \sum_{x_{htgj}, x_{htgj}} x_{htgj}$$

$$S_{g} = \frac{1}{kb(b-1)\overline{n}} \sum_{h=1}^{\infty} \sum_{g \neq g'} \sum_{j \neq j'}^{n} X_{h \neq g j} X_{h \neq g' j'}$$

$$S_{3} = \frac{1}{k(k-1)bn} \sum_{h\neq h'}^{k} \sum_{g=1}^{b} \sum_{j\neq j'}^{\bar{n}} x_{h} \varepsilon_{gj} x_{h'} \varepsilon_{gj'}$$

$$S_{4} = \frac{1}{k} \sum_{h'}^{k} \sum_{g=1}^{b} \sum_{j\neq j'}^{\bar{n}} x_{h'} \varepsilon_{gj'} x_{h'} \varepsilon_{gj'}$$

$$S_{4} = \frac{\Sigma}{k(k-1)b(b-1)\overline{n}} \sum_{h\neq h'} \sum_{s\neq s'} \sum_{j\neq j'} X_{h \neq s j} X_{h' \neq s' j'}$$

An estimator of the total variance which we used in this study is:

$$\hat{var}(\bar{x}_t) = \frac{1}{b\bar{n}}S_0 + \frac{\bar{n}-1}{b\bar{n}}S_1 + \frac{b-1}{b}S_9 - \frac{1}{b}S_8 - \frac{b-1}{b}S_4$$
 (2)

An estimator of the sampling variance is:

$$s_{\overline{t}}^2 = \frac{1}{b\overline{n}}S_0 - \frac{1}{b\overline{n}}S_1.$$

The difference of these two estimators, an

estimator of the correlated component of response variance, is:

$$u^{2} = \frac{1}{b}(S_{1}-S_{3}) + \frac{(b-1)}{b}(S_{2}-S_{4}).$$
(3)

Many of the statistics are in the form of ratios. For example, one may be interested in the proportion of persons 16 years of age and over who are employed as service workers. Let y denote service workers and x denote persons 16 years of age and over. Then, we estimate

$$\frac{\mathbf{y}}{\mathbf{x}} = \frac{\begin{array}{c} \sum \sum \sum \mathbf{y}_{htej} \\ \frac{h \ e \ j}{4} \end{array}}{\sum \sum \sum \mathbf{x}_{htej}}$$
(4)

An approximation to the relative variance of a ratio, y/x, is:

$$\nabla_{\mathbf{y}/\mathbf{x}}^{2} = \nabla_{\mathbf{y}}^{2} + \nabla_{\mathbf{x}}^{2} - 2\nabla_{\mathbf{x}\mathbf{y}}$$
 (5)

where  $V_y^2$  is the relative variance of y,  $V_x^2$  is the relative variance of x, and  $V_{xy}$  is the relative covariance of x and y. A consistent estimate of the relvariance of a ratio is:

$$\hat{\sigma}^2 = \frac{u_x^2}{(Ey)^2} + \frac{u_x^2}{(Ex)^2} - \frac{2u_{xy}}{(Ey)(Ex)}$$
 (6)

where  $u^2$  is of the form shown in equation (3).

Estimates of the numerators and denominators of the terms shown in equation (6) were computed for each of the 259 clusters. Numerators and denominators were each weighted and averaged over the clusters, and the weighted figures were substituted in equation (6).

## 5. <u>Results</u>

## A. <u>Comparison with 1960 Results</u>

The main result of the study can be stated simply: the level of enumerator variability in the 1970 census is at least as high as the level in the 1960 census.

We make the 1960-1970 comparison by comparing response relvariances for identical items in the two censuses. We can compare these relvariances directly since the estimates in each case were for an area enumerated by one enumerator. For this comparison, the correlated components were estimated by use of equation (3) to keep the estimation procedure identical with that used in the 1960 census. Table 1 shows this comparison for the 82 items for which the correlated component of response relvariance was estimated in both 1960 and 1970. For 43 of these items, the 1970 response relvariances were larger in 1970 than in 1960 and for 39 they were smaller.

However, one is not usually interested in looking at statistics for an area of the size that could be enumerated by one enumerator. Rather, one is more interested in statistics for blocks, tracts, or States which are usually based on the work of several enumerators. The size of an enumerator's area in 1970 was about twice as large as the size in 1960. Thus, even if the level of variability in 1970 was the same as in 1960 for an area which was enumerated by one enumerator, the level of variability for tracts and other larger areas would be about twice as large as in 1960.

To make the comparison more meaningful, one should look at the ratio of 1970 to 1960 variiances by classes of items. Then, we see that for items concerned with payment of utilities for rented units, the correlated response variance was <u>smaller</u> in 1970 than in 1960. We notice also that though the response relvariances for "not reported" items were large in 1970, they were about half of the size that they were in 1960.

For nativity items, the 1970 relvariances were at least twice as large as the 1960 relvariances. Also for the characteristic "residence 5 years previous to the census", we see an increase in the 1970 response relvariances. This was a complex item for respondents and interviewers in 1960 as well as 1970.

The educational attainment items show a somewhat mixed pattern. Of nine categories, six showed larger response relvariances in 1970 than in 1960. For some of these categories, the increases were substantial. The school enrollment items when defined as actual year in which enrolled show larger relvariances in 1970 than in 1960 except for college years. The kind of school in which enrolled shows larger 1970 relvariances for public school enrollments and smaller 1970 relvariances for private school enrollments.

Response relvariances were larger in 1970 than in 1960 for three of four categories for number of children ever born.

There are only two labor force items which were studied in both 1960 and 1970. One shows a smaller relvariance and one shows a larger relvariance.

We see a somewhat mixed pattern for occupation items. Four of the seven categories have larger 1970 relvariances.

The pattern for the three kinds of income items is also mixed. One consistent note throughout the three types of income was that for the category "males, 5,000 to 6,999". For wage and salary income, the ratio of 1970 to 1960 relvariances was 2.2; for self-employment income, the ratio was 2.9; and for income other than earnings, it was 2.3.

The single veteran status item had a relvariance three times as big in 1970 as in 1960.

These results are preliminary. We have much more work to do in arriving at a statement on the overall level of response variability in the 1970 census as compared with the 1960 census. However, the relvariances shown in Table 1 give the impression that the level of response variability in 1970 is at least as large as the 1960 level, if not larger. How do we account for this? The change in census-taking procedures that would have had the greatest impact on the enumerators was their editing function. In 1960, enumerators copied the entries made by the householders or which they themselves had made on the household questionnaires to another form which could be machine processed. This transcription operation, though it provided an opportunity for copying error, forced the enumerators to review the questionnaires. In 1970, the original entries were made on forms which could be machine processed. The enumerators were instructed in editing procedure.

As the result of applying the editing instructions, an enumerator could judge a form to be complete, or could judge a form to fail the edit, in which case he would have to contact the unit for additional information. The contact could be by telephone or in person. The instructions told how to make the decision on whether to followup by telephone or personal visit.

During the course of the census, it was important to have accurate information about the percentage of census questionnaires returned by mail, about the failure rates from editing short- and long-forms, and about the size of the followup assignments. Each enumerator filled out a form giving such information. We examined these forms for EVS ED's, computed the mail-return rates, the short- and the long-form edit-failure rates for EVS offices and compared them with the rates for all decentralized mail areas. These rates were as follows:

All decentralized of	fices	EVS offices
Mail-return rates	.81	.83
Short-form edit-failure rates	.13	.12
Long-form edit-failure rates	.43	.47
The rates were comparable as wa	s expect	ted. We
now wanted to estimate the vari	ability	among
enumerators in the edit-failure	rates.	Tepping
(5) developed a model to estima	te the o	overall
variability in the rates and th	e vari <b>a</b> l	oility at-
tributable just to enumerators.	It is	this latter
part of the variability which a	ccounts	for the
non-uniformity of the applicati	on of th	ne editing
rules. He found that the avera	ge s <sup>g</sup> , t	the part of
the total variance accounted fo	r by enu	merator
variability was .00356 for the	short-fo	orm edit-
failure rate and .02370 for the	long-fo	orm edit-
failure rate. Thus, a long-for	m edit-i	failure rate
of .47 has a standard error of	.15. Th	nis means
that there was a considerable a	mount of	E varia-
bility among the enumerators in	the app	lication of
the editing rules.		

## B. Levels of Variability in 1970 Census Statistics

Tables 2 and 3 show detailed results on response and sampling relvariances for a small number of all the 1970 Census statistics that were studied. We selected a number of characteristics over a broad range which might be of interest before we looked at the results. The selected characteristics included some items contained on the 100 percent census schedules as well as the sample schedules. The complete description of the results for all characteristics studied will be issued in two evaluation reports sometime in 1974. Table 2 shows results for selected housing items; Table 3 shows results for selected population items. Almost all of these items were ratios. Thus, equation (6) was used to compute the estimates.

These estimates apply to an enumeration by one interviewer in an area having about 2,500 housing

units and 7,500 persons. To determine the response relvariance for areas having more than 7,500 persons, the response relvariances must be divided by N/7,500 where N is the population in the area of interest.

Table 2 shows that the ratios of response to sampling variability for duration of vacancy for vacant units were over 1.0 for all categories. This is an item for which the enumerator would have had to followup, since no schedules would have been returned for vacant units. Thus, the enumerator variability exhibited by this set of items shows no gain due to the increased use of self-enumeration.

Another interesting result in Table 2 is the ratio for 1-room units of 1.51. This probably relates to a difficulty among enumerators in the classification of efficiency apartments.

The first four items shown in Table 3 for population items were 100 percent items and, in the complete census, would not be subject to sampling variability. We would usually consider them to be exact except for simple response variances. Thus, the response relvariance shows the amount of variability which should be used for these items for an area of one enumerator assignment. The sampling relvariances shown are those that are applicable to the proportions which we estimate using the 20-percent sample.

For most of the characteristics shown in Table 3, we see that the ratios of response to sampling variance are usually below .50. Only the nonresponse categories show ratios over 1.0.

The results presented above give some indication that enumerator variability was still a problem in the 1970 Census. The level of variability increased over 1960 for some items and decreased for others. For some items, the variability attributable to enumerators was an important part of the total variability of census statistics.

### REFERENCES

- Fellegi, I.P. "Response Variance and Its Estimation". Journal of the American Statistical Association, Vol. 59, 1964, pp. 1016-1041.
- Hansen, M.H., Hurwitz, W.N., and Bershad, M.A., "Measurement Errors in Censuses and Surveys". <u>Bulletin of International Statistical Insti-</u> <u>tute</u>, Vol. 38, Part 2, Tokyo, 1961, pp-359-374.
- Hanson, R.H., and Marks, E.S., "Influence of the Interviewer on the Accuracy of Survey Results". <u>Journal of the American Statistical</u> <u>Association</u>, Vol. 53, 1958, pp. 635-655.
- Kish, Leslie, "Studies of Interviewer Variability for Attitudinal Variables". Journal of the American Statistical Association, Vol. 57, 1962, pp. 92-115.
- 5. Tepping, B.J., Variability in Edit-Failure Rates, Unpublished Bureau of the Census memorandum, September 15, 1970.
- 6. U.S. Bureau of the Census, <u>Evaluation and Research Program of the U.S. Censuses of Population and Housing, 1960: Effects of Interviewers and Crew Leaders</u>, Series ER60, No. 7, Washington, D.C., 1968.

	Response re	lvariances		
Characteristic	1960 (1)	1970 (2)	Ratio of 1970 to 1960 relvariances (3)	
Destad housing units pouring for				
Rented housing units paying for:	00270	00151	0.4	
Electricity	.003/9	.00151	0.4	
Gas	.00848	.00322	0.4	
Water	.12531	.00555	. 0.0	
Fuel	.14710	.00598	0.0	
Year built:				
30 years ago or more	.00236	.00344	1.5	
Not reported	.48828	.24611	0.5	
Nativity:				
Native	.00024	.00052	2.2	
Foreign	.00760	.03043	4.0	
Desidence 5 means and				
Residence J years ago:	00013	00435	32 5	
Same nouse	.00013	.00433	33.5	
Different nouse, same county	.00331	.01041	1.5	
Different county or abroad	.00385	.005/1	1.5	
Educational attainment:				
Highest grade attended, not				
completed	.01438	.00816	0.6	
Elementary 1-2	.05840	.20191	3.5	
Elementary 8	.00296	.01651	5.6	
Grade 9 or more	.00030	.00077	2.6	
High school 4	.00208	.00290	1.4	
College 1	.00667	.01288	1.9	
College 1 or higher	.00192	.00195	1.0	
College 5 or higher	.01599	.00978	0.6	
Not reported	.23341	.12620	0.5	
School Enrollment:				
Kindergarten or first grade	00122	.00727	6.0.	
Flementary 8	00000	.02104	L _ 1	
High school 1	.00000	01806	1.0	
High school /	.010/5	03161	1.0	
Gallage 1	.01005	02681	0.3	
College I	.14344	.03001	0.5	
College 5 or more	.44102	.00015	0.2	
Public elementary	.00000	.00305		
Private elementary	.04042	.01073	0.4	
Public high school	.006/5	.01230	1.8	
Private high school	.06/61	.00000	0.0	
Not reported	.58555	.26258	0.4	
Number of children:		!		
None	.00274	.00398	1.5	
1-3 children	.00040	.00064	1.6	
3 or more children	.00081	.00112	1.4	
5 or more children	.00548	.00322	0.6	
Labor force:				
Unemployed	.07552	.04522	0.6	
Worked less than 35 hours				
last week	.00281	.00385	1.4	
Occupation groups:				
Professional, technical	,00026	.00000	0.0	

# TABLE 1.-+COMPARISON OF CORRELATED COMPONENT OF RESPONSE RELVARIANCES FOR IDENTICAL ITEMS: 1960 AND 1970 CENSUSES

 $\mathbf{1}'$  When 1960 estimate is 0.0, this ratio is not defined.

	Response relvariances			
Characteristic	1960 (1)	1970 (2)	Ratio of 1970 to 1960 relvariances (3)	
Occupation groupscontinued		ł		
Farmers, farm managers	.00868	.25916	29.9	
Clerical	.00247	.00381	1.5	
Sales workers	.00000	.00766		
Craftsmen, foremen	.00408	.00000	0.0	
Operatives	.00281	.00573	2.0	
Farm laborers, paid workers	.04845	.00630	0.1	
Wage and salary income:		}		
None	.00090	.01565	17.4	
\$2,500 or more	.00026	.00155	6.0	
Males, less than \$3,000	.00745	.01218	1.6	
Females, less than \$3,000	.00322	.00639	2.0	
Males, \$3,000 to \$4,999	.00425	.00000	0.0	
Females, \$3,000 to \$4,999	.01060	.00343	0.3	
Males, \$5,000 to \$6,999	.00320	.00711	2.2	
Females, \$5,000 to \$6,999	.02848	.00649	0.2	
Males, \$7,000 to \$9,999	.01118	.00867	0.8	
Females, \$7,000 to \$9,999	.00000	.00841	J	
Males, \$10,000 or more	.00256	.00056	0.2	
Females, \$10,000 or more	.00000	.00000	0.0	
Not reported	.19134	.08275	0.4	
Self-employment income:				
\$2,500 or more	.00704	.00000	0.0	
Males, less than \$3,000	.01235	.02391	1.9	
Females, less than \$3,000	.07884	.02163	0.3	
Males, \$3,000 to \$4,999	.00000	.04469	_ ປ	
Females, \$3,000 to \$4,999	.16999	.00000	0.0	
Males, \$5,000 to \$6,999	.04805	.13789	2.9	
Females, \$5,000 to \$6,999	.38484	.00000	0.0	
Males, \$7,000 to \$9,999	.00000	.00000	0.0	
Females, \$7,000 to \$9,999	.00000	.20046	1 _ IJ	
Males, \$10,000 or more	.02356	.03072	1.3	
Females, \$10,000 or more	.00000	.40936	l _ 1j	
Not reported	.19721	.13332	0.7	
Other income:				
\$2,500 or more	.02868	.00511	0.2	
Males, less than \$3,000	.00003	.00378	126.0	
Females, less than \$3,000	.00709	.00178	0.3	
Males, \$3,000 to \$4,999	.05200	.03701	0.7	
Females, \$3,000 to \$4,999	.13785	.00000	0.0	
Males, \$5,000 to \$6,999	.02590	.05832	2.3	
Females, \$5,000 to \$6,999	.00000	.20822	( <u> </u>	
Males, \$7,000 to \$9,999	.00000	.08168	[ _ ป	
Females, \$7,000 to \$9,999	1.18107	.00000	0.0	
Males, \$10,000 or more	.00000	.13260	U	
Females, \$10,000 or more	2.44674	.24646	0.1	
Not reported	.18532	.18390	1.0	
Veteran status:				
World War II veterans	.00304	.00902	3.0	

## TABLE 1.--COMPARISON OF CORRELATED COMPONENT OF RESPONSE RELVARIANCES FOR IDENTICAL ITEMS: 1960 AND 1970 CENSUSES--CONTINUED

 $\mathbf{1}'$  When 1960 estimate is 0.0, this ratio is not defined.

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## TABLE 2.--1970 ESTIMATED CORRELATED RESPONSE RELVARIANCE AND ESTIMATED SAMPLING RELVARIANCES FOR SELECTED HOUSING ITEMS FOR AN ENUMERATION BY ONE ENUMERATOR IN AN AREA OF 2,500 HOUSING UNITS

	Percent of housing units	Relvariances		Ratio of response to
Characteristic		Response	Sampling	sampling variance
All housing units	100.0	-	_	-
Occupied units	94.9	.00017	.00040	.42
Vacant	5.1	.05866	.13841	.42
Vacant units,	100.0	-	_	_
Vacancy status:	<b>[</b>	{		
For rent	44.1	.06713	.19357	.35
For sale	14.8	.30926	.91600	.34
For rent or sale	58.9	.05678	.10550	.54
Other vacant	41.0	.00715	.21767	.54
Not reported	10.3	1.7419	1.3796	1.26
Occupied unit, Tenure:	100.0	-	-	-
Owned or being bought	63.5	.00001	.00309	.00
Cooperative, or condominum	1.4	.25748	.22754	1.13
Rented, cash rent	33.8	.00035	.01059	.03
Rented no cash rent	1 4	00506	57512	01
Not reported	1.4	.24887	.60020	.41
<b>.</b>	100.0			
Vacant units,	100.0		- 1	-
lace than 2 months	12.6	26728	10225	1 30
$2 \pm 6$ months	21 1	1 0032	33076	3.03
2 to 0 months	25.2	1 2097	4/261	2 72
Not reported	16.3	1 7/57	82702	2.72
Not reported	10.5	1.7457	.02702	2.11
All housing units,	100.0	-	-	-
Number of rooms:	1 /	62714	41402	1 51
	1.4	.02/14	.41405	1.51
2 rooms	2.7	.08184	.24400	.33
5 rooms	10.9	.00000	.03127	.00
	19.0	.00300	.02935	.20
5 rooms	24.7	.00292	.02240	.13
6 rooms	21.5	.00000	.02/4/	.00
/ rooms	10.8	.00049	.06269	.01
8 rooms	5.7	.00617	.12068	.05
9 rooms or more	3.2	.094/9	.22003	.43
Not reported	1.5	.39478	.54493	.72
Occupied units,	100.0	-	-	-
Persons per room:				
.50 or less	48.4	.00000	.00841	.00
.51 to .75	25.1	.00929	.02480	.37
.76 to 1.00	19.9	.00365	.03242	.11
1.01 to 1.50	5.0	.00000	1.5741	.00
1.51 or more	1.5	.16008	.50754	.32
Occupied units, Number of persons in unit:	100.0	-	-	-
1 person	15.4	.00843	.04308	.20
2 persons	29.3	.00179	.02011	.09
3-4 persons	34.8	.00332	.01567	.21
5-6 persons	16.0	.00087	.04305	.02
7 persons or more	4.6	.00658	.17762	.04
All units	100.0			
Year built:	100.0	-	-	-
1969 or 1970	3.5	.04061	.13863	.29
1965 to 1968	10.2	.00822	.04860	.17
-				

TABLE 2.--1970 ESTIMATED CORRELATED RESPONSE RELVARIANCES AND ESTIMATED SAMPLING RELVARIANCES FOR SELECTED HOUSING ITEMS FOR AN ENUMERATION BY ONE ENUMERATOR IN AN AREA OF 2,500 HOUSING UNITS--CONTINUED

Characteristic	Percent of	Relvariances		Ratio of response to sampling
	housing units	Response	Sampling	variance
Year builtcontinued				
1960 to 1964	15.4	.00066	.03135	.02
1950 to 1959	27.1	.00085	.01483	.06
1940 to 1949	14.6	.01559	.03774	.41
1939 or earlier	29.3	.00343	.01109	.31
Not reported	6.9	.24506	.10600	2.31
Occupied, owned units and	<i>.</i>			
vacant units for sale	100.0	-	- 1	-
Value:	· · · · · · · · · · · · · · · · · · ·		1	
Less than \$5,000	1.6	.00000	.94179	.00
\$5,000 to \$9,999	9.0	.00000	.12638	.00
\$10,000 to \$14,999	17.9	.00000	.06041	.00
\$15,000 to \$19,999	23.6	.00000	.04358	.00
\$20,000 to \$24,999	17.7	.00852	.06463	.13
\$25,000 to \$34,999	18.6	.00215	.05355	.04
\$35,000 to \$49,999	8.2	.04484	.13612	.33
\$50,000 or more	3.3	.04745	.29936	.16
Not reported	2.4	.17789	.62656	.28
Occupied, rented units,	100.0	-	-	· _
Gross rent:				
No cash rent	4.2	.00820	.55334	.01
\$1 to \$29	.1	.00000	3.5817	.00
\$30 to \$39	2.0	.00000	1.2606	.00
\$40 to \$49	1.6	.19743	1.4067	.14
\$50 to \$59	2.6	.05732	.89119	.06
\$60 to \$69	4.2	.02585	.57597	.04
\$70 to \$79	5.3	.00000	.43266	.00
\$80 to \$99	12.8	.03343	.15896	.21
\$100 to \$119	14.0	.02135	.14496	.15
\$120 to \$149	19.7	.00000	.08882	.00
\$150 to \$199	24.2	.05533	.05936	.93
\$200 to \$249	6.3	.03228	.32178	.10
\$250 to \$299	2.2	.27808	.94106	.30
\$300 or more	1.5	.13675	1.5607	.09
Occupied units,	100.0	-	-	-
Type of family:				
Husband-wife	72.5	.00030	.00295	.10
Other, male head	2.2	.03961	.37672	.11
Other, female head	8.3	.00366	.09425	.04
Male primary individual	5.7	.00581	.13653	.04
Female primary individual	11.3	.00900	.06352	.14

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FOR SELECTED POPULATION ITEMS FOR AN ENU	MERATION BY O	NE ENUMERATOR	IN AN AREA O	F 7,500 PERSONS
Characteristic	Percent of people	Relvariances		Ratio of response to
		Response	Sampling	variance
All persons.	100.0	_	_	· _ ·
Sex:		1		
Male	48.2	.00019	.00165	.11
Female	51.8	.00016	.00144	.11
Not reported	1.8	.13087	.43902	.30
All persons,	100.0	- 1	- 1	-
Race:		00010	00000	
White	90.8	.00019	.00082	.23
Negro	0.2	.02494	1 1022	.20
Utner NA	2.0	21526	45120	.00
NA	2.0	.21520	.45120	.40
All persons,	100.0	-	-	-
$\frac{Age}{0}$ to 14 years	29.7	.00038	.00813	.05
15 to 24 years	15.8	.00000	.01821	.00
25 to $34$ years	12.7	.00077	.02350	.03
35 to 44 years	12.0	.00010	.12171	.00
45 to 54 years	12.1	.00285	.02688	.11
55 to 64 years	8.9	.00553	.04052	.14
65 years and over	8.8	.00397	.04132	.10
Not reported	4.1	.27619	.17607	1.57
All persons,	100.0	-	-	-
<u>Marital status</u> :	ł			
Married	65.4	.00000	.00241	.00
Widowed	7.1	.00000	.05209	.00
Divorced or separated	4.7	.00648	.08467	.08
Never married	22.8	.00069	.01442	.05
Not reported	2.8	.25637	.262/6	.98
Persons 5 years and over,	100.0	-	-	-
Residence in 1965	54.0	00056	01108	05
Different house same county	- 23 3	.000.20	.01108	.05
Different county same State	23.5	01/18	12020	.10
Different State	8.2	01457	13610	11
Abroad	1.3	.10623	92275	12
Moved, residence in 1965 not	1.5	.10025	.,	.12
reported	3.7	.13124	.21773	.60
State reported, but place or county				
not reported	1.1	.09470	.58595	.16
Not reported	3.8	.09899	.21210	.47
Persons 3 to 34 years, attending				
school	100.0	-	-	_
School enrollment:				
Nursery school	13.3	.02650	.60650	.04
Kindergarten or elementary l	43.3	.01054	.07930	.13
Elementary 2-7	43.3	.00257	.01692	.15
Elementary 8	6.8	.01408	.15117	.10
High school l	6.7	.00235	.15919	.01
High school 2-3	12.6	.00000	.08225	.00
High school 4	5.7	.02875	.20418	.14
College 1-4	8.1	.01728	.17529	.10
College 5 or more	1.4	.06412	.99288	.06
Not reported	3.1	.24390	.68511	.36

TABLE 3.--1970 ESTIMATED CORRELATED RESPONSE RELVARIANCES AND ESTIMATED SAMPLING RELVARIANCES FOR SELECTED POPULATION ITEMS FOR AN ENUMERATION BY ONE ENUMERATOR IN AN AREA OF 7,500 PERSONS --CONTINUED

	1	· ·		Ratio of
	Percent of	Relvariances		response to
Characteristic	people			sampling
	· · · · · · · · · · · · · · · · · · ·	Response	Sampling	variance
Demons 25 means and amon	100.0		l	ł
Fersons 25 years and over,	100.0	-	-	-
Educational attainment:	1			
kinderzerten	1 2	24222	61077	50
Riemontary 1 to /	25	0/238	21547	20
Elementary 5 to 7	7 0	01590	06649	24
Elementary 8		01565	04550	3/
High school 1 to 3	19.6	00731	02300	32
· High school 4	34 7	00245	01097	22
College 1 to 3	11.4	.00414	.04245	.10
College 4	6.5	.00123	.07906	.02
College 5 or higher	4.9	.00704	.10915	.06
Not reported	7.9	.12620	.08400	1.50
		}		
Persons 14 and over,	100.0	<b>-</b> -	-	-
Employment status:				
In labor force	57.7	.00021	.00241	.09
At work	52.6	.00026	.00304	.08
With a job, not at work	1.7	· .02551	.24169	.11
Unemployed	2.4	.04543	.16716	.27
Armed Forces	1.0	.06091	.35738	.17
Not in labor force	42.3	.00039	.00449	.09
Not reported	4.6	.28882	.12940	2.23
Persons 14 and over who worked since			•	
1960,	100.0	- '		-
Industry:				
Agriculture, forestry and fisheries	2.2	.04563	.25259	.18
Mining	0.3	.36765	1.8685	.20
Construction	5.2	.00000	.10173	.00
Manufacturing, durables	15.8	.00000	.02786	.00
Manufacturing, non-durables	10.5	.00000	.04591	.00
Transportation, communication and	6.0	00501	09264	06
Wholegale trade	0.2	.00501	.00204	.00
Roteil trade	4.5	.01005	.12033	.10
Finance incurance and real estate	6.2	.00109	02323	.04
Business and renair carvices	3 3	02189	16517	13
Personal services	43	01476	12685	12
Entertainment and recreation	1.0	.06610	56488	.12
Professional services	16.5	.00649	.02919	.22
Public administration	5.7	.00716	.089047	.08
Not reported	6.8	.19010	.09283	2.05
Persons 14 and over who worked since				1
1960,	100.0	-	-	-
Occupation:			'	
Professional, technical, and				
kindred workers	14.2	.00000	.03484	.00
Managers	7.3	.01866	.06381	.29
Sales workers	9.1	.00549	.05179	.11
Clerical	22.4	.00331	.01658	.20
Craftsmen	12.7	.00111	.03326	.03
Operatives	12.8	.00560	.036604	.15
Transport equipment operators	3.0	.01640	.16553	.10
Laborers, except farm	3.9	.01440	.13061	.11
Farmers	.4	.26662	1.3336	.20
Farm laborers	1.3	.00000	.46027	.00
Service workers	11.4	.00353	.04242	.08
Frivate household workers	1.5	.01708	.34988	.05
NOT reported	/.8	.11082	.07733	1.51
			1	