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A. INTRODUCTION

The National Health Interview Survey (NHIS) is one of the primary sources of information on health conditions in the U.S. Most of the estimates from the NHIS are person-level estimates. The sponsor of the NHIS, the National Center for Health Statistics (NCHS), is interested in using the NHIS to provide family-level estimates. This paper describes research comparing four family weighting methods for the NHIS.

Estimates of the numbers of different types of households (e.g. female householder, no husband present), obtained by using four different family weighting methods, were compared to 1990 Census results. The four methods were: average person, basic principal person, adjusted principal person, and generalized least squares (GLS). Only the GLS method produces person estimates that match the person controls.

Section B gives a general background on the problem of family weighting. Section C outlines the research methodology. The results are detailed in Section D. Section E summarizes the findings. Tables following the main text illustrate many of the conclusions.

None of the four methods gave estimates that were consistently close to the Census results. All of them generally gave overestimates of numbers of households. The GLS method tended to give the largest estimates and the basic principal person method tended to give the smallest. The Estimate/Census ratios tended to be higher for types of households with black householders than for the corresponding types of households with nonblack householders.

B. BACKGROUND

The NHIS is a survey that covers the civilian noninstitutionalized population of the United States. Data is collected through personal interviews conducted by staff of the Bureau of the Census. In 1990, data was collected on 119,631 persons living in 46,476 interviewed households.

The current NHIS weighting procedure has no special provisions for calculating family weights. The procedure starts with the basic weight (inverse of the probability of selection). To take household nonresponse into account the basic weight is multiplied by a noninterview adjustment factor. A separate noninterview adjustment factor is calculated for each cluster (usually about eight housing units) of sample housing units. A first-stage ratio adjustment (by race/region/metropolitan residence status) is then performed on persons from noncertainty primary sampling units. Finally, a ratio adjustment to age-race-sex control totals is performed. The resulting weight, here called the second-stage weight, is used for the calculation of person-level estimates. Household-level estimates are currently calculated using the weights following the noninterview adjustment. These weights are not adjusted, even indirectly, to any control totals. Further information on the NHIS design and weighting procedures is given in Massey et al (1989).

For person weights, the ratio-adjustment to person control totals provides a method for reducing both bias (due to undercoverage) and variance of estimates. We would like to use family control totals for

family weights. However, we do not currently have a reliable way to update control totals from the Census for either families or households (note that there is usually only one family in a household).

Currently, the usual method for obtaining family (or household) weights is some form of principal person weighting. The reasoning behind principal person weighting is that the family (or household) should be represented, for weighting purposes, by a single person with good coverage, defined as the principal person. Sometimes the unmodified second-stage weight of the principal person is used. Sometimes (as in the March Supplement to the Current Population Survey (CPS)) the second-stage weights are modified before the principal person weights are assigned. The principal person is the reference person unless the reference person is a male, married with spouse present. In the latter case, the principal person is the wife of the reference person since females generally have better coverage than males. The assignment of the reference person is somewhat arbitrary. In practice, the concept of the "reference person" is similar to the previous concept of the family "head" except that the reference person of a married-couple family is not necessarily the husband.

A problem with the principal person method is that person estimates using principal person weights will not agree with person control totals. In addition, principal person weighting is very difficult to model mathematically. The definition of the principal person depends not only on family composition but also on who happens to be assigned to be the reference person. Therefore theoretical support for the use of the principal person method is lacking.

One alternative method for calculating family weights is multivariate raking ratio estimation (MRRE). This is an extension of the method used to calculate person weights. The family weights are iteratively adjusted to agree with person control totals. Details can be found in Alexander (1987), (1990).

A second method is GLS weighting. In this method, the final weights are obtained by minimizing a GLS objective function (with respect to a set of initial weights). The minimization is subject to the constraint that person estimates obtained by using family weights agree with person control totals. Unlike MRRE, the GLS method has a closed-form expression for the final weights. One problem is that the final weights can be negative. Note, however, that none of the GLS weights in this research were negative.

A third possibility, that does not seem to have been much studied, is to simply take the average of the second-stage weights of family members as the family weights. This method does have the advantage of simplicity. However, the family weights will only agree with the overall control total and not with the individual age-race-sex cell totals.

Alexander (1987), (1990) groups GLS and MRRE together as part of the class of constrained minimum distance (CMD) methods. These methods choose final weights that minimize some distance function with respect to the initial weights, subject to the constraints of the person controls. CMD methods are divided into methods based on household weights and methods based on person weights (where each term in the distance function is multiplied by household size). Alexander suggests that the different household-based CMD methods give results similar to each other as do the different person-based

CMD methods. He argues against the household-based CMD methods since they do not allow for any systematic undercoverage. The person-based CMD methods allow for whole-household undercoverage but not within-household undercoverage. Principal person methods do allow for both whole-household and (to some extent) within-household undercoverage. Alexander cautions that this does not mean that principal person methods are superior to CMD methods, only that more research needs to be done into the actual nature of the undercoverage.

Other investigations give mixed recommendations. For example, Peitzmeier, Hughes, and Hoy (1988) compare MRRE, GLS, and two principal person methods. They conclude that MRRE performs the best (in part, because of the possibility of negative weights in GLS). Zieschang (1990) prefers GLS, arguing that it is equal or better in precision to the alternative methods and is more straightforward and flexible. Bankier (1989) also prefers GLS, arguing that MRRE is less flexible and may be slow to converge.

C. METHODS

The basic data file used in this research was the 1990 NHIS public use person-level file, from which separate files for the first and second quarters of 1990 were created. The file for the first quarter contained records for 27,366 persons and the file for the second quarter contained records for 31,075 persons. The quarterly files were sorted by families within households.

The NHIS second-stage weighting procedure was redone using control totals (for the civilian noninstitutionalized population as of April 1, 1990) based on the 1990 Census. The control totals were obtained from the Population Division, Bureau of the Census. They were based on 1990 Census tabulations for the noninstitutionalized population and administrative estimates of the military population. Age and race modification procedures were applied to the raw Census tabulations as part of the process for obtaining the civilian noninstitutionalized population. Some persons classified as "other race" in the Census are reclassified as "black" in the civilian noninstitutionalized tabulations. Most persons classified as "other race" are reclassified as "white". Note that the civilian noninstitutionalized population does not quite cover all Census households: some (not many) households will be composed entirely of military persons.

In the final step, weights calculated using each of the four different family weighting methods were added to the file. The first method used was the average person method, for which the family weight is the average of the second-stage weights of the members of the family.

The next two methods are the basic principal person method and the adjusted principal person method. In both principal person methods the family weight is the weight of the principal person. The principal person was the reference person for the family unless the reference person was a male, married spouse present. If the reference person was a male, married spouse present, then the principal person was the spouse of the reference person.

In the basic principal person method the principal person weight is the second-stage weight of the principal person. In the adjusted principal person method the second-stage weights of males 15 and older are adjusted before the principal person weights are assigned. The adjustment procedure is analogous to that used for the CPS March Supplement.

The first step in the adjustment procedure is to assign the second-stage weight of the spouse to any male, married spouse present. Note that to be defined by CPS as married spouse present, one must be the reference person or the spouse of the reference person of a primary family. Also note that persons under 14 are defined to be unmarried for the purposes of estimation and weighting.

The second step in the adjustment procedure is to ratio-adjust the weights of all other males (males not married spouse present) so that the adjusted second-stage weights still result in estimates that agree with the control totals. If N_j is the control total for the j th control category ($j=1, \dots, J$), $OLDMSP_j$ is the estimate of males, married spouse present in the j th category using the original second-stage weights and $NEWMSP_j$ is the estimate of males, married spouse present in the j th category using the adjusted second-stage weights, then the ratio adjustment factor for a given other male in control category j , is equal to:

$$(N_j - NEWMSP_j)/(N_j - OLDMSP_j).$$

Usually this factor will be greater than one, since the adjusted second-stage weight of a given male, married spouse present tends to be lower than the original second-stage weight. This means that the principal person weights for families with a male principal person will tend to be higher under the adjusted principal person method than under the basic principal person method. The weights for families with a female principal person are identical under the two principal person methods.

The final method was GLS weighting. In this method, a generalized least squares objective function is minimized with respect to a set of initial weights subject to the constraint that person estimates obtained by using family weights agree with the person control totals. The particular GLS method used is what Alexander (1987) calls GLS-P, in which the families (Alexander used households) are weighted by the number of persons. Using his basic terminology, the method is given below.

Consider K families with initial weights given by the vector $\underline{S}=(S_1, \dots, S_K)'$. The initial weights used for this research were the noninterview adjustment weights (the weights before the first-stage ratio adjustment). Let there be J post-stratification cells with control counts given by the vector $\underline{N}=(N_1, \dots, N_J)'$. Let the sample households be described by the matrix $A=(a_{kj})$, where a_{kj} is the number of persons in the k th family who are in the j th post-stratification cell. Let a_k be the total number of persons in the k th family. Finally, let M be the $K \times K$ diagonal matrix with the values $S_1/a_1, \dots, S_K/a_K$ on the main diagonal. Then the vector of final weights $\underline{W}=(W_1, \dots, W_K)'$ is given by

$$\underline{W} = \underline{S} + MA(A'MA)^{-1}(N-A'S).$$

One concern about GLS weighting is the possibility of negative weights. However, none of the weights were negative in this research. One approach to dealing with negative weights is to place some sort of lower bound on the GLS weights.

The four family weighting methods were used to calculate estimates for a number of race/household type categories. We calculated household estimates since the available Census data was for households. The household weight was simply the family weight for the primary family (in a family household) or the primary individual (in a nonfamily household). This means that the average person and basic principal person weights will be identical for nonfamily households. The Census results that were compared to the household

estimates can be found in the 1990 Census CPH-1-1 and CP-1-1 reports.

D. RESULTS AND DISCUSSION

General. Tables 1-6 summarize the results. Each table contains the Estimate/Census ratios for different race and/or household type categories under the four main estimation methods. Tables 1-3 contain ratios for household types by race of householder while Tables 4-6 contain overall ratios for different household types. Tables 1 and 4 summarize results for the first quarter. Tables 2 and 5 summarize results for the second quarter. Table 3 contains the average of the first and second quarter ratios from Tables 1 and 2. Table 6 contains the average of the first and second quarter ratios from Tables 4 and 5. Note that (aside from rounding error) the averages in Tables 3 and 6 are equivalent to taking the ratios of the estimates for the first half of 1990 to the 1990 Census results. In all tables "Prin Per" refers to the basic principal person method and "Adj Prin" refers to the adjusted principal person method.

Estimates of standard errors were not calculated either for the Estimate/Census ratios or for the differences between corresponding ratios from different methods. This strongly argues for caution in generalizing these results. Some indication of the inherent variability can be obtained by comparing the results for the two quarters.

All four estimation methods generally overestimate the number of households. The GLS method tends to produce estimates slightly larger than those obtained from the other methods. The basic principal person estimates tend to be slightly smaller (where there are differences) than the estimates from the average person or adjusted principal person methods. Since all four methods are usually overestimating the number of households, this means that the basic principal person method tends to perform slightly better than the other methods and the GLS method tends to perform slightly worse. Note that the basic principal person and average person methods are identical for nonfamily households. Also note that the basic and adjusted principal person methods are identical for any household type composed entirely of households with female principal persons (e.g., married-couple households).

All four methods control directly (GLS) or indirectly to the NHIS control categories. It appears that controlling to person controls generally results in overestimating the number of households (and presumably the number of families). This is presumably due to within-household undercoverage. Such undercoverage means that the weights must be increased to meet the person controls. This results in households being assigned weights higher than they should be for calculating household estimates.

Estimates by Race and Household Type. Estimate/Census ratios are generally higher for household types with black householders than for the corresponding household types with nonblack householders. The main exception to this tendency is the category other family households, female householder, no own children present. The estimates for blacks will be substantially more variable than the estimates for nonblacks because of the smaller sample size. Different methods perform best for different race/household type categories.

The worst overestimates are for married-couple households, no own children present, black householder. The adjusted principal person and GLS methods also give large overestimates for black male single-person households. All four methods produce underestimates of other family households, nonblack male householder. Within each

race category, the highest Estimate/Census ratios generally are for married-couple households. Note the unexpected underestimate of black female single-person households produced by the GLS method. The Estimate/Census ratio for this GLS estimate is not only smaller than the ratios produced by the other methods, it is also smaller than the ratio for the corresponding GLS estimate for nonblacks. The worst underestimates for any household type are for nonfamily multi-person households. All of the methods produce severe underestimates for this household type.

Quarterly Differences. Comparing Tables 1 and 2, we can see that the patterns of results for nonblacks are generally similar in the two quarters. There are some exceptions. There is a large rise for all four methods in the Estimate/Census ratio between the first and second quarters for the category other family, nonblack female householder, no own children present. This is compensated for by a large drop in the ratios for the category other family, nonblack female householder, own children present. This may be an indication that the classification into these two categories is subject to substantial error. Note that the same pattern appears for blacks, although less strongly.

In general, the differences between quarters are more substantial for blacks. This is probably due to the inherently greater variability in the estimates for blacks. The most striking difference is the sharp rise for all four methods in the Estimate/Census ratio between the first and second quarters for the category married-couple households, own children present, black householder. There are also sizeable drops for all four methods in the Estimate/Census ratios for the black single-person subcategories. Both of the above patterns also appear for nonblacks, although not quite as strongly.

Comparison Between Two Principal Person Methods. Most households will have identical weights under the two principal person methods. The adjusted principal person method tends to increase those estimates that it affects. This means that the estimates produced by the basic principal person method tend to be slightly better when there are differences between the two. The overall effect of the adjusted principal person method is larger in the first quarter. The adjusted principal person method seems to have more effect on estimates of households with black householders than on estimates of households with nonblack householders. Note, however, that the effect of the adjusted principal person method on estimates of households with nonblack householders is larger in the first quarter while the effect on households with black householders is similar in the two quarters.

E. SUMMARY AND CONCLUSIONS

The results of this comparison of the average person, basic principal person, adjusted principal person and GLS methods indicates that

- ▶ no estimation method is consistently close to Census results
- ▶ which method is judged the best overall depends on which estimates are most important
- ▶ all four methods tend to overestimate the number of households; presumably this would also hold for families
- ▶ the Estimate/Census ratios for a given household type are generally higher for blacks than for nonblacks
- ▶ overall, the basic principal person method perhaps does slightly better than the other methods, the GLS method perhaps slightly worse
- ▶ results are generally similar between quarters for nonblacks

- ▶ the worst overestimates are for black married-couple households, no own children present
- ▶ nonfamily multi-person households cannot be estimated well using any of the methods.

Note that, of the methods used, only the GLS method produces person estimates that match the person controls.

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REFERENCES

Alexander, C.H. (1987), "A Class of Methods for Using Person Controls in Household Weighting," Survey Methodology, 13, 183-198.

Alexander, C.H. (1990), "Incorporating Person Estimates into Household Weighting Using Various Models for Coverage," Proceedings of the Bureau of the Census 1990 Annual Research Conference, U.S. Department of Commerce, Bureau of the Census, Washington, DC, 445-462.

Bankier, M. (1989), "Generalized Least Squares Estimation Under Poststratification," Proceedings of the Section on Survey Research Methods, American Statistical Association, 730-735.

Bureau of the Census (1992), 1990 Census of Population and Housing, Summary Population and Housing Characteristics, United States Summary, CPH-1-1, U.S. Department of Commerce, Bureau of the Census, Washington, DC.

Bureau of the Census (1992), 1990 Census of Population, General Population Characteristics, United States Summary, CP-1-1, U.S. Department of Commerce, Bureau of the Census, Washington, DC.

Massey, J.T., Moore, T.F., Parsons, V.L., and Tadros, W. (1989), Design and Estimation for the National Health Interview Survey, 1985-1994, National Center for Health Statistics, Vital Health Statistics 2(110), Hyattsville, MD.

National Center for Health Statistics (1991), Public Use Data Tape Documentation, Part I, National Health Interview Survey, 1990 (Machine readable data file and documentation). National Center for Health Statistics, Hyattsville, MD. (Producer). Commercial Technical Information Service, U.S. Department of Commerce, Springfield, VA, 22161 (Distributor). NCHS is not responsible for any analyses, interpretations or conclusions reached in this paper.

Peitzeimer, F.K., Hughes, A.L., and Hoy, C.E. (1988), "Alternative Family Weighting Procedures for the Current Population Survey," Proceedings of the Section on Survey Research Methods, American Statistical Association, 437-442.

Zieschang, K.D. (1990), "Sample Weighting Methods and Estimation of Totals in the Consumer Expenditure Survey," Journal of the American Statistical Association, 85, 986-1001.

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Table 1. Comparison of 1990 1st Quarter NHIS Estimates and 1990 Census Results Estimates by Race of Householder

	Ratio of NHIS Estimate to 1990 Census				1990 Census
	Ave Per	Prin Per	Adj Prin	GLS	
Households, Black Hhldr	1.0888	1.0567	1.0775	1.0877	9976161
Family Households	1.1262	1.0805	1.0888	1.1223	6986624
Married-Couple	1.1918	1.1308	1.1308	1.1981	3410435
Own Chldrn Pres	1.0878	1.0263	1.0263	1.1150	1779772
No Own Children	1.3053	1.2449	1.2449	1.2889	1630663
Other Family	1.0636	1.0324	1.0486	1.0500	3576189
Female Hhldr	1.0738	1.0334	1.0334	1.0448	3051679
Own Chld Pres	1.1027	1.0701	1.0701	1.0637	1897145
No Own Chldrn	1.0263	0.9730	0.9730	1.0136	1154534
Non-Family Households	1.0013	1.0013	1.0513	1.0067	2989537
Single-Person	1.1075	1.1075	1.1627	1.1090	2536353
Male	1.1156	1.1156	1.2383	1.2615	1140836
Female	1.1008	1.1008	1.1008	0.9843	1395517
Hhlds, NonBlack Hhldr	1.0317	1.0247	1.0346	1.0352	81971249
Family Households	1.0668	1.0568	1.0595	1.0659	57531323
Married-Couple	1.0833	1.0716	1.0716	1.0844	47297887
Own Chldrn Pres	1.0586	1.0566	1.0566	1.0497	21714954
No Own Children	1.1041	1.0843	1.0843	1.1139	25829333
Other Family	0.9907	0.9884	1.0038	0.9805	10233436
Male Householder	0.8716	0.8734	0.9335	0.9065	2619072
Female Hhldr	1.0316	1.0280	1.0280	1.0060	7614364
Own Chld Pres	1.0541	1.0623	1.0623	1.0137	4131264
No Own Chldrn	1.0050	0.9873	0.9873	0.9968	3483100
Non-Family Households	0.9492	0.9492	0.9758	0.9628	24439926
Single-Person	1.0295	1.0295	1.0589	1.0405	20044067
Male	1.0067	1.0067	1.0798	1.0744	8065975
Female	1.0448	1.0448	1.0448	1.0177	11978092

Source: National Center for Health Statistics, National Health Interview Survey, 1990

Table 2. Comparison of 1990 2nd Quarter NHIS Estimates and 1990 Census Results
Estimates by Race of Householder

	Ratio of NHIS Estimate to 1990 Census				1990 Census
	Ave Per	Prin Per	Adj Prin	GLS	
Households, Black Hhldr	1.0694	1.0423	1.0644	1.0690	9976161
Family Households	1.1441	1.1055	1.1128	1.1413	6986624
Married-Couple	1.2524	1.1984	1.1984	1.2689	3410435
Own Chldrn Pres	1.2482	1.2148	1.2148	1.2706	1779772
No Own Children	1.2570	1.1806	1.1806	1.2671	1630663
Other Family	1.0409	1.0169	1.0311	1.0195	3576189
Female Hhldr	1.0608	1.0303	1.0303	1.0247	3051679
Own Chld Pres	1.0332	1.0354	1.0354	0.9970	1897145
No Own Chldrn	1.1060	1.0219	1.0219	1.0703	1154534
Non-Family Households	0.8947	0.8947	0.9512	0.9002	2989537
Single-Person	0.9956	0.9956	1.0587	0.9975	2536353
Male	0.9946	0.9946	1.1349	1.1378	1140836
Female	0.9964	0.9964	0.9964	0.8827	1395517
Hhlds, NonBlack Hhldr	1.0157	1.0123	1.0166	1.0227	81971249
Family Households	1.0716	1.0667	1.0678	1.0710	57531323
Married-Couple	1.0905	1.0854	1.0854	1.0900	47297887
Own Chldrn Pres	1.0940	1.0940	1.0940	1.0771	21714954
No Own Children	1.0874	1.0781	1.0781	1.1009	25582933
Other Family	0.9846	0.9805	0.9868	0.9834	10233436
Male Householder	0.8904	0.8911	0.9158	0.9253	2619072
Female Hhldr	1.0170	1.0112	1.0112	1.0034	7614364
Own Chld Pres	0.8903	0.9035	0.9035	0.8417	4131264
No Own Chldrn	1.1673	1.1389	1.1389	1.1951	3483100
Non-Family Households	0.8841	0.8841	0.8958	0.9090	24439926
Single-Person	0.9801	0.9801	0.9914	1.0020	20044067
Male	0.9731	0.9731	1.0010	1.0291	8065975
Female	0.9848	0.9848	0.9848	0.9837	11978092

Source: National Center for Health Statistics, National Health Interview Survey, 1990

Table 3. Comparison of 1990 First Half NHIS Estimates and 1990 Census Results
Estimates by Race of Householder

	Average of 1st and 2nd Quarter Ratios of NHIS Estimate to 1990 Census				1990 Census
	Ave Per	Prin Per	Adj Prin	GLS	
Households, Black Hhldr	1.0791	1.0495	1.0710	1.0783	9976161
Family Households	1.1352	1.0930	1.1008	1.1318	6986624
Married-Couple	1.2221	1.1646	1.1646	1.2335	3410435
Own Chldrn Pres	1.1680	1.1205	1.1205	1.1928	1779772
No Own Children	1.2811	1.2128	1.2128	1.2780	1630663
Other Family	1.0523	1.0246	1.0399	1.0347	3576189
Female Hhldr	1.0673	1.0318	1.0318	1.0348	3051679
Own Chld Pres	1.0679	1.0528	1.0528	1.0304	1897145
No Own Chldrn	1.0662	0.9975	0.9975	1.0420	1154534
Non-Family Households	0.9480	0.9480	1.0013	0.9535	2989537
Single-Person	1.0515	1.0515	1.1107	1.0532	2536353
Male	1.0551	1.0551	1.1866	1.1996	1140836
Female	1.0486	1.0486	1.0486	0.9335	1395517
Hhlds, NonBlack Hhldr	1.0237	1.0185	1.0256	1.0290	81971249
Family Households	1.0692	1.0618	1.0637	1.0685	57531323
Married-Couple	1.0869	1.0785	1.0785	1.0872	47297887
Own Chldrn Pres	1.0763	1.0753	1.0753	1.0634	21714954
No Own Children	1.0958	1.0812	1.0812	1.1074	25582933
Other Family	0.9876	0.9844	0.9953	0.9820	10233436
Male Householder	0.8810	0.8822	0.9246	0.9159	2619072
Female Hhldr	1.0243	1.0196	1.0196	1.0047	7614364
Own Chld Pres	0.9722	0.9829	0.9829	0.9277	4131264
No Own Chldrn	1.0862	1.0631	1.0631	1.0960	3483100
Non-Family Households	0.9167	0.9167	0.9358	0.9359	24439926
Single-Person	1.0048	1.0048	1.0251	1.0212	20044067
Male	0.9899	0.9899	1.0404	1.0517	8065975
Female	1.0148	1.0148	1.0148	1.0007	11978092

Source: National Center for Health Statistics, National Health Interview Survey, 1990

Table 4. Comparison of 1990 1st Quarter NHIS Estimates and 1990 Census Results

	Ratio of NHIS Estimate to 1990 Census				1990 Census
	Ave Per	Prin Per	Adj Prin	GLS	
Total Households	1.0379	1.0282	1.0392	1.0409	91947410
Hhlds, Black Hhldr	1.0888	1.0567	1.0775	1.0877	9976161
Hhlds, NonBlack Hhldr	1.0317	1.0247	1.0346	1.0352	81971249
Hhlds, Hispanic Hhldr	1.0608	1.0541	1.0628	1.0587	6001718
Family Households	1.0732	1.0593	1.0627	1.0720	64517947
Married-Couple Hhlds	1.0906	1.0756	1.0756	1.0921	50708322
Own Children Pres	1.0609	1.0543	1.0543	1.0546	23494726
No Own Children	1.1162	1.0939	1.0939	1.1244	27213596
Other Fmly Hhlds	1.0096	0.9998	1.0154	0.9985	13809625
Male Householder	0.8938	0.8990	0.9675	0.9355	3143582
Female Householder	1.0437	1.0295	1.0295	1.0171	10666043
Own Chldrn Pres	1.0694	1.0648	1.0648	1.0295	6028409
No Own Chldrn	1.0103	0.9837	0.9837	1.0010	4637634
Non-Family Households	0.9549	0.9549	0.9841	0.9676	27429463
Single-Person	1.0383	1.0383	1.0705	1.0482	22580463
Male Hhldr	1.0202	1.0202	1.0994	1.0976	9206811
Female Hhldr	1.0507	1.0507	1.0507	1.0142	13373609
Hhldr 65+	0.9904	0.9904	0.9947	0.9917	8824845
Multi-Person	0.5667	0.5667	0.5813	0.5923	4849043

Source: National Center for Health Statistics, National Health Interview Survey, 1990

Table 5. Comparison of 1990 2nd Quarter NHIS Estimates and 1990 Census Results

	Ratio of NHIS Estimate to 1990 Census				1990 Census
	Ave Per	Prin Per	Adj Prin	GLS	
Total Households	1.0215	1.0155	1.0218	1.0277	91947410
Hhlds, Black Hhldr	1.0694	1.0423	1.0644	1.0690	9976161
Hhlds, NonBlack Hhldr	1.0157	1.0123	1.0166	1.0227	81971249
Hhlds, Hispanic Hhldr	1.0857	1.0828	1.0930	1.0886	6001718
Family Households	1.0795	1.0709	1.0727	1.0786	64517947
Married-Couple Hhlds	1.1013	1.0930	1.0930	1.1020	50708322
Own Children Pres	1.1057	1.1031	1.1031	1.0918	23494726
No Own Children	1.0976	1.0842	1.0842	1.1109	27213596
Other Fmly Hhlds	0.9992	0.9899	0.9983	0.9927	13809625
Male Householder	0.8962	0.8991	0.9358	0.9359	3143582
Female Householder	1.0295	1.0166	1.0166	1.0095	10666043
Own Chldrn Pres	0.9353	0.9450	0.9450	0.8906	6028409
No Own Chldrn	1.1520	1.1098	1.1098	1.1641	4637634
Non-Family Households	0.8853	0.8853	0.9019	0.9080	27429463
Single-Person	0.9819	0.9819	0.9989	1.0015	22580463
Male Hhldr	0.9758	0.9758	1.0176	1.0425	9206811
Female Hhldr	0.9860	0.9860	0.9860	0.9732	13373609
Hhldr 65+	1.0190	1.0190	0.9854	1.0194	8824845
Multi-Person	0.4354	0.4354	0.4500	0.4729	4849043

Source: National Center for Health Statistics, National Health Interview Survey, 1990

Table 6. Comparison of 1990 First Half NHIS Estimates and 1990 Census Results

	Average of 1st and 2nd Quarter Ratios of NHIS Estimate to 1990 Census				1990 Census
	Ave Per	Prin Per	Adj Prin	GLS	
Total Households	1.0297	1.0219	1.0305	1.0343	91947410
Hhlds, Black Hhldr	1.0791	1.0495	1.0710	1.0783	9976161
Hhlds, NonBlack Hhldr	1.0237	1.0185	1.0256	1.0290	81971249
Hhlds, Hispanic Hhldr	1.0733	1.0684	1.0779	1.0737	6001718
Family Households	1.0763	1.0651	1.0677	1.0753	64517947
Married-Couple Hhlds	1.0959	1.0843	1.0843	1.0970	50708322
Own Children Pres	1.0833	1.0787	1.0787	1.0732	23494726
No Own Children	1.1069	1.0891	1.0891	1.1176	27213596
Other Fmly Hhlds	1.0044	0.9948	1.0068	0.9956	13809625
Male Householder	0.8950	0.8990	0.9517	0.9357	3143582
Female Householder	1.0366	1.0231	1.0231	1.0133	10666043
Own Chldrn Pres	1.0023	1.0049	1.0049	0.9600	6028409
No Own Chldrn	1.0812	1.0468	1.0468	1.0825	4637634
Non-Family Households	0.9201	0.9201	0.9430	0.9378	27429463
Single-Person	1.0101	1.0101	1.0347	1.0248	22580463
Male Hhldr	0.9980	0.9980	1.0585	1.0701	9206811
Female Hhldr	1.0184	1.0184	1.0184	0.9937	13373609
Hhldr 65+	1.0047	1.0047	0.9901	1.0055	8824845
Multi-Person	0.5011	0.5011	0.5157	0.5326	4849043

Source: National Center for Health Statistics, National Health Interview Survey, 1990