

ALTERNATIVE ENUMERATION METHODS AND RESULTS

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Introduction

Detection of omissions and other kinds of errors that contribute to the differential net undercount is one of the main activities of the research project called the Ethnographic Evaluation of the Behavioral Causes of Undercount. Finding cases and patterns of omission and error in the census enumerations is a step which must be taken first in order to find out what demographic, social and behavioral characteristics of neighborhoods, households and people are associated with particular cases of omissions and errors or account for the observed higher or lower rates of error in the enumeration of a locality. Thus, the evidence and methodological bases for identifying errors and omissions in the census discussed in this paper underlie other studies.

We will describe the ethnographic evaluation method in brief, characterize its sample, discuss coding the "final match and resolution" for all records, and illustrate differences in population counts for small areas. We illustrate the comparison between two original sources, the Alternative Enumeration (AE) and the census forms, with the "resolved Census Day" population. More complete and detailed descriptions of exact enumeration methods used at appear in the individual ethnographic coverage reports available from the Center for Survey Methods Research, the division of the Census Bureau which designed the research.

The Method in Brief

Field research for the ethnographic evaluation studies were formally divided into four distinct sequential phases: 1) selection and geocoding of the exact site, 2) listing housing units by address, 3) enumeration of occupants in households and behavioral observations for 6 weeks, and 4) resolution of discrepancies on the match report between the AE and census. At each site, each researcher designed an appropriate strategy based on guidelines written by Census Bureau staff.

The researcher's first field step was to select an area containing about 100 contiguous housing units with population characteristics corresponding to one of the replicate cells in a sample design (Brownrigg and Martin 1989). Sample areas were deliberately selected in places where researchers believed conditions presented identified barriers and difficulties for censusing. Sample areas were configured as a cluster in a block subsample, or of one whole census block or contiguous whole census blocks.

The Ethnographic Sample

The ethnographic sample was purposefully situated in areas where minority race and ethnic groups and/or undocumented resident aliens were living in 1990. The objective was to discover causes for the differential undercount by documenting cases of omission and erroneous enumeration found in the census and by reflecting on approaches and problems experienced by the independent alternative enumerators. Ethnographic sites, therefore, were places where identified barriers to census

coverage existed. All ethnographic sites were potentially "hard" or "difficult" to enumerate. Residents are in population groups for which differential undercount prior to 1990 either had been documented (Blacks and Hispanics) or were suspected (American Indians, new immigrant Asian Americans and undocumented immigrants of any national origin). Evidence for the differential undercount of the Black population was found once again in the 1990 Census by Demographic Analysis and by the Post Enumeration Survey (PES), and evidence for the differential undercount of the Hispanic origin, Asian American and American Indian populations was found by the PES.

The Alternative Enumerations

Researchers were explicitly trained on Census Bureau methods and procedures for identifying and listing housing units. Guidelines on geography and physical space issued to them deals exclusively with Census Bureau address listing conventions, symbols on TIGER maps and instructions to listing enumerators. Researchers received advice about how to find hidden or less readily apparent housing units. The method of listing housing units and addresses was comparable to the List/Enumerate methods, one of several sources used by the Census Bureau to compile its Address Control File and Address Registers. Many of the researchers enjoyed the advantage of prior familiarity with the particular areas they enumerated and they all had at least 6 weeks to complete the listing, enumeration and behavioral observation phase.

Researchers made a list of all housing units -- occupied, vacant or boarded up and other living quarters within the boundaries of the sample area. They assigned to each housing unit a map spot number which was noted on a map of the area. Within three months after Census Day, the researchers began their enumeration of the population within each of their delimited sample areas. They developed and submitted a complete "Alternative Enumeration" list of all housing and people living in each ethnographic sample area during their period of observation.

The AEs recorded the same information for persons required on a 100% basis in the decennial census. Researchers replicated the information reported on short forms, that is, address of each housing unit, names of all persons observed in each occupied housing unit, relationship of each person in the household to the first person listed, and the basic demographics of each person: sex, age, race, marital status, Hispanic origin. In addition, on AEs were noted national or ethnic origins to clarify race and Hispanic origin information. Simultaneously, they recorded logs of systematic behavioral observations about aspects of the neighborhood, housing units, households and people in the sample area that might have prevented a complete count. The Alternative Enumerations and the behavioral logs were keyed by the Census Bureau.

Census Data

The census enumeration data used in this research project were keyed directly from the census forms, thus no census records contained any automated edits, imputations or substitutions. The census enumeration keyed directly from census forms represents a raw, unedited slice of the

census-in-process. The census file matched to the Alternative Enumerations is an immediate product of mail back and face-to-face enumeration which is not yet the final census count. In some census operations and procedures, data quality is compromised resulting in "head count" type records.

Discrete address elements written on census forms or address labels or from the Address Control File were keyed. In this regard, the census enumeration keyed and matched to the AEs differed from the Address Control File where addresses run on in long character variables. In keying information from census forms, we preserved demographically undefined person records (as to age or sex or race etc.) for several reasons: 1) blanks could be skipped in specifying matching variables, 2) blanks can be studied to compare item response between matched records, 3) strings of item nonresponse, for example, no demographics at all, indicate poor quality records and 4) blanks can be filled to test imputation models.

Matching

An appraisal of whether or not records from two different sources "match," (that is, refer to the same people or housing units) relies on similar information appearing in both records to link them. This is true whether the method of matching is assisted by a computer program, by matching clerks, or by field researchers.

In 1990 we combined an automated matching program and clerical review to produce match reports. The automated and clerical matching both keep together the set of persons enumerated together as households. A software program was developed specifically for the project, which first links the AE and the census versions of housing units/ households. Next, it matches person records within households on the AE with person records within households on the census on the basis of name and demographic data and arrays of names within each household set. The result of this process was a match report that displayed all matched and non matched housing units and the individual records associated within each housing unit/ household set. The matching system applies a number of rules developed to match the 1988 pilot for these studies called the "Household" or "Computer Assisted Clerical Matching" (CACM) system. Match reports produced by Census Bureau staff, however, were considered drafts to be verified in further fieldwork.

Final Match and Resolution Phase

The "resolution" phase is an innovation which distinguishes the 1990 ethnographic evaluation studies methodologically from the earlier "participant observer studies" in the 1986 Test of Adjustment Related Operations (TARO) and the pilots in the 1988 Dress Rehearsal. All records from the Alternative Enumeration and the Census were coded by type of match or nonmatch and situation as of Census Day.

The researchers who conducted the Alternative Enumeration coded their determinations of "Final Match": whether or not records of individual persons matched or did not match and whether or not a housing unit (with or without a household's worth of person records listed at the housing unit/address) had a link on the opposite file. The researchers' codes confirmed or corrected links between housing units and matches between records of people or records of vacant housing. Participating ethnographers were asked to "resolve" Census Day residence status of persons and the status of the housing unit as of Census

Day (whether valid, and if valid whether occupied, vacant or boarded up) and to tag once again records of people who moved into or moved out of the site between Census Day and the AE. Finally, researchers had to code which records should and should not be included in the best reconstruction of the most complete list of housing units and residents in the sample area "as of Census Day". These codes identified AE and census omissions and errors.

The resolution codes function to confirm or disconfirm the eligibility of each housing unit or person to be included in the census of the sample area, given Census Bureau 1990 rules of residence and housing listing procedures.

"Resolution phase" fieldwork had the greatest variability among sites. At least one researcher returned to each field site to complete resolutions. The coding of all records at each site generated by the Alternative Enumeration or keyed from census forms was more time consuming and ethnographically challenging than anyone originally anticipated.

We identified five problems in the resolution stage: these are timing, preparation, access, evidence, and consistency.

1. Timing

The trail was cold for timely follow up. Schedule constraints on the availability census questionnaires delayed the delivery of match reports to December 1990. To resolve unmatched cases appearing on the census or to verify the Census Day status of their own unmatched AE cases, researchers began additional fieldwork nine months or more after Census Day and six months or more after their AE. One phenomenon believed related to undercount -- the presence of a segment of the population that changed residences frequently -- was especially difficult to document, given the delay. Some sites experienced very high residential turnover and were therefore difficult to resolve. For example, at two sites where college students and others rented, more than a third of the off campus apartments, mobile homes or houses changed occupants between Census Day and the AE. Names unfamiliar to the researchers often appeared on the census at the address of housing units listed as vacant at the time of the AE. The more stable residents of these neighborhoods had little knowledge of the transitory tenants (Bell 1991; Isberner 1992).

At many sites, high residential turnover accounted for the majority of all discrepancies and non-matches between the AE and the census. At other sites, residential mobility into and out of the sample areas complicated the identification of matches. At the sites in North Carolina, Oklahoma, San Diego and Houston, residents also moved among housing units (and in North Carolina moved mobile homes) within the ethnographic site during the 6 week observation (Lerch 1992; Moore 1992; Velasco nd; Rodriguez and Hagen 1992). In San Diego, new illegal housing units were constructed during the six week AE.

2. Preparation

Timing made it difficult to interpret poorly defined records. Sketchy or incomplete census information complicated the research. Preparation for the resolution fieldwork stage varied greatly among the researchers. During the Alternative Enumeration fieldwork, some researchers had created detailed field notes (Hamid 1992; Rynearson and Gosebrink 1992), genealogies of the larger families of kin relations (Moore 1992; Garcia 1992) or compiled administrative records regarding housing and occupants (Sung 1992; Strauss 1992; Rynearson and Gosebrink

1992). Behavioral logs were a required product, however, some researchers conducted the behavioral observations cursorily (or not at all) or created no special field note references while others made highly systematic (and informative) behavioral observations.

3. Access

The researchers' familiarity and personal access to the sites seemed to influence the efficacy of the resolution fieldwork as well as their original AE. Researchers who were crossing the street from their homes were in a more enviable position to investigate further and check fine points of ambiguous residence and Census Day situation than were the principal investigators of five sites who had moved out-of-state between the conclusion of the AE and the initiation of resolution phase fieldwork. For them, and for the two other researchers who moved temporarily to the site for the AE, resolution fieldwork was conducted as a one time, short term expedition. The tactics of moving temporarily into a site or hiring a local research assistant which had been useful in the enumeration stage of fieldwork attenuated access in the resolution phase. Most of the principal investigators had intermediate, continuing access to their site; questions arising from the resolution coding could be and were taken back repeatedly to judge against the situation apparent at the field site or to discuss with respondents.

4. Evidence

Generally speaking, it was difficult to find supporting data to confirm unmatched census records. Among some very mobile populations, there was no evidence available to either confirm or disconfirm unmatched census records. The several sites where very recent immigrants found temporary housing were difficult to resolve because new arrivals quickly moved on and were not known or noticed by neighbors (Sung 1992; Velasco nd).

During their resolution phase fieldwork at several of the sites, the researchers fairly confidently determined that unmatched records referred to people actually living within the site who had been residents in the site on Census Day. In many cases where the unmatched record came from the Alternative Enumeration, the person was still resident; the researcher could return to discuss and confirm whereabouts on Census Day. Confirmation was also based on researchers' written field notes dated to the period before and after Census Day associating the person with a housing unit and household context or their own systematic log of observations for the housing units (which recorded prior as well as AE-observed residents of each housing unit in the sample). If the unmatched person could not be located in the site, researchers might confirm records by talking to neighbors who remembered the person. These investigations were delicate because researchers were not allowed to reveal confidential information from the census source. They had to devise and ask more open ended questions intended to probe for and elicit a specific name they could check. For example, -- for whole household non-matches asking neighbors a question like -- "Do you remember the name of the family who lived here last April?" Or, for within household non-matches--"Was there anyone else, perhaps a young boy living here before I came by last spring?"

Each researcher faced a unique set of problems for determining final match and applying resolution codes. However, many of the researchers had the advantage that they personally knew or had once interviewed the people

to whom the records referred. They were able to interpret partial records better than a clerk or a computer ever could. They could recognize, for example, the reversal of first name and surname or orthographic variation in the spelling of foreign names in the census version and match it with their own record (Sung 1992). As technical representatives, we spent a good deal of time discussing by telephone the researchers' deliberations and strategies for assembling and weighing evidence to support their coding. Those principal investigators who had personally conducted the AE (rather than supervising assistants' enumerations) had a better understanding of the community and more contacts which proved useful for resolving the status of records. The dilemma of evidence in favor of or against a match or resolution was acute in the cases of the "NN's" as we called records without names or worse yet, without names or demographic characteristics. Records with poor data quality were more common in the census source.

5. Consistency

We developed consistency edits after we received and keyed the first batches of final match and resolution coding. Some situations reported to us by the ethnographers proved difficult to express in codes.

Some of the most experienced ethnographers had little prior background applying codes and were uncomfortable reducing complex situations to codes. The more qualitatively oriented researchers preferred to provide elaborate and exact accounts of events and circumstances. Technical representatives had to "debrief" some exact situations from researchers in order to suggest appropriate coding.

Several rounds of consistency edits were required at each site until on each record the array of discrete codes applied were internally consistent. Three programs were developed and modified to identify apparent inconsistencies in coding and cases were referred back for more fieldwork. The number of coding rounds per site varied from a minimum of 3 to a maximum of 18.

OUTCOME

After the final match and resolution codes are applied and edited for consistency, records can be sorted into categories. One sort of the coded Alternative Enumeration and census enumeration records yields what we call the "Resolved Census Day Population" or R population. Since the R pop is the best estimate of the population resulting from this ethnographic evaluation method, the R population can be used to measure coverage in the census enumeration. (It cannot be used to measure coverage on the Alternative Enumerations, however, since records are selected in reference to the situation as of Census Day, a time point generally 3 months earlier than some AE's.)

The Resolved Census Day population is not based on estimates or formulas as is the case for the dual system estimator used in the 1990 Post Enumeration Survey. The R population is a refined, coded list of who was resident within each sample area on Census Day, applying 1990 Census Bureau rules of residence. In the R population, some AE and some census records are included and some from each source are deliberately excluded.

The resolved or Census Day population may include the following kinds of individual records: 1) one record from each pair of records matched between the AE and census enumeration sources and confirmed as referring to a Census Day resident, 2) unmatched unique records from the census

source coded as confirmed Census Day residents, and 3) unmatched unique records from the AE source coded as confirmed Census Day residents. The record "selected" from each matched pair is appraised by the ethnographer (advised by the technical representative) as the more accurate, more complete or better defined with demographic data. The selected record may be from either the AE or the Census enumeration source. Unmatched unique records represent people missed by the Census.

Also interesting are the records excluded and how our match and resolution codes allow us to find them. Excluded from the R population as errors are records from the "raw" Census enumeration keyed from forms which, according to the ethnographers' coding, were not Census Day residents of the sample area. We exclude "uncertain" records which the ethnographers could neither confirm nor refute as to exact status as of April 1, 1992. Records identified as erroneous enumerations for some other reason than reference to Census Day status are excluded. Records of persons known to have moved in after Census Day 1990 ("movers") are not included in the R population, whether those records appear on the AE or, less commonly, on the census source, even if matched on both sources.

Records were excluded if they referred to people who could not be considered, under Census Bureau rules of residence, as residents of any housing unit within the sample area on Census Day. For example, at three sites, some Asian adult children who had moved away to other states or who had long ago established homes and families elsewhere were reported by their parents to the census as residents of their parents' home (Sung 1992; Strauss 1991; Shaw and Guthrie 1992).

Records were excluded from the final resolved population if the people or the housing units were not physically located in the sample area as defined by block geocodes and address ranges or if the housing unit (or household) did not exist. Thus, misgeocoded records were excluded. Duplicate or triplicate enumerations of the same people or housing were excluded.

Since the resolution field work represents a third pass in each sample area, coming a few months to a year after the original AE and the census, few cases of people omitted on both the census and the AE were, found and included. (The source of these cases is attributed to the follow up rather than to Alternative Enumeration.) What remains missing from the resolved population is any record for persons who were residents of the site as of Census Day but who were missed by the Census and who were missed by both the original Alternative Enumeration and the resolution follow up phase.

The resolved population is considered as the "true" population under this method. Resolved Census Day populations can be constructed on a site-by-site basis, population groups or across site types or subgroups.

R populations can be derived for either people (population) or for housing units (housing) or households (occupied housing). Net undercount or net overcount can be calculated by comparing the "raw" census count (site-by-site, for the ethnographic sample as a whole or for any subsample therein) to the comparably defined resolved or "true" population.

The resolved Census Day population (R pop) has fewer records with poor data quality, than do either of the source files from which it is derived, but the resolved population

in this evaluation method may still include some confirmed "head count" type records. Selecting the more accurate and complete record of each matched pair and flagging erroneous enumeration records which also have poor data definition improves the data definition of the resolved Census Day version of the sample population.

Measurement of Net Coverage

Net undercount or overcount of a specified population constructed from coded records in the ethnographic sample can be measured with the ratio $B/R - 1 = TCOVER$ (net undercount or overcount) where B represents the census count and R represents the resolved population.

Histogram 1 illustrates the distribution of net undercount or net overcount of population among the 29 sites of the ethnographic sample. Coverage estimated by this method ran from net undercount (negative values) to net overcount (positive values). The distribution of values of net coverage is close to a normal curve but with outliers. The ethnographic sample as a whole displays a slight census net undercount by this measure. The mean of all sites is -1.634; the median is -.6.

The mean net undercount or overcount in the census enumeration for records data defined as males at sites in the ethnographic sample is negative. The ethnographic sample as a whole registers a male undercount as we would expect from prior studies, since the sample population as a whole is predominantly composed of people who are members of minority race and ethnic groups among which high net male undercounts have been demonstrated.

Composition of Net Coverage

Charts I-IV illustrate the composition of the R population at four sites. Similar charts and analysis exist for all 29 sites. These sites illustrate different compositions of omissions, error and mobility that result in net undercount or net overcount. Three bar charts for each named site are shown. The top bar chart labeled "AE" depicts the frequency of population records collected by the original Alternative Enumeration by the categories described below and the center chart labeled "Census" depicts how records in the census source in these categories. The bar chart labeled "Resolved" pulls together records which constitute the true Census Day population as described above.

The categories labeled Matched Records, Unique Records, Errors, Uncertain Records and Movers in each chart need to be interpreted by context. **Matched Records** appear in all three bars. This is the frequency of AE or Census records which have a match on the opposite file and which were confirmed as correctly censused, Census Day residents. The R bar includes the selected half of those matched records.

Unique Records of nonmovers: These are unmatched records of persons who were 1) confirmed to have been Census Day residents and 2) who did not move between Census Day and the time of the Alternative Enumeration but who were omitted in the opposite file. The unique records shown in the top bar were found by the Alternative Enumeration. The unique records shown in the middle bar were found in the census. The R pop combines unique correct records from both sources.

Movers on the AE bar represent AE records of people who moved into the sample area after Census Day. Although these records may be correct enumerations for the AE time period, AE records coded in the mover category are excluded from the Resolved population because the records do not refer to people who were resident Census Day. On

the census bar, **Movers** are unmatched records of people who moved out of the sample area after Census Day. They were Census Day residents, but were no longer present by the time of the AE. On the resolved population bar, the **Movers** then are only those from the census source: unmatched outmovers confirmed to have been resident on Census Day.

Errors refer to records (matched or unmatched) of persons included in either the AE or census enumeration by a mistake such as duplicating another record in the same sample area or misgeocoding. Records coded as **Errors** appear in the AE and the Census bar charts but are excluded from the Resolved population.

Uncertain Records refer to (matched or unmatched) of persons whose Census Day residence in the sample area cannot be either confirmed or unconfirmed. Like records coded as errors, these may appear in the AE or Census bar but not in that of the Resolved population.

Chart I depicts results from our site in Houston, TX. At the Houston ethnographic site, a net population coverage of -12% was measured by this $R/B - 1 = TCOVER$ method, that negative indicating a 12% net UNDERcount.

Had the raw population count of the AE been compared to the raw census count at the Houston site, the incorrect impression of a higher than actual undercount would have registered. The apartment building at this site provided housing for undocumented immigrants entering from Central America. Residential mobility was high. A large number of the people observed in the AE (118) had moved in after Census Day and 48 Census records referred to people who could be confirmed as having been Census Day residents who moved out. Nine census records were identified as erroneous enumerations; 23 were coded as uncertain because these unmatched records either could not be confirmed or contained too little personal information and so could not be verified (Rodriguez and Hagen 1992). Even if an alternative resolved population were constructed that included all the uncertain, unconfirmable census records, a net undercount would register.

Chart II depicts results from the San Diego, CA site: a site overcounted by the census by +25% according to the ethnographic evaluation. Undocumented migrants from Mexico were its main population. The primary reason for the net overcount is the large number of census records coded as either errors or uncertain. Housing at this site was highly irregular (de la Puente 1992; Brownrigg 1991; Velasco nd) and a large number of census records were without names and without demographics shown at addresses where the ethnographer knew other people (defined on the AE) lived as of Census Day. The resolved population is calculated is slightly larger than the AE count but smaller than the census count (Velasco nd)

Chart III shows the Koreatown, Los Angeles, CA site, one of two Korean sites in the ethnographic sample where the Alternative Enumeration and the Census agree closely and confirmed, matched records are predominant. A slight net overcount of .6% was determined because a few of the unmatched census records were identified as errors and a few could not be confirmed (Kim 1992).

Chart IV shows the outcome of the ethnographic site in Harlem, New York. This outlier of net undercount was the urban concentration of Black population in the Harlem neighborhood of New York City. The net undercount of 47% at this site was determined by large number of people

missed by the census, therefore, a rough comparison between the AE count and the raw census count would produce a similar perspective. Through the resolution coding, the relatively high proportion of census records shown as erroneous enumerations increases the net undercount (Hamid 1992).

Conclusions

This paper has described how the ethnographic evaluation of the 1990 Decennial Census studies identifies errors and omissions in the census and demonstrates net coverage. While a dual system estimator could be applied and a variety of options could be selected to handle and impute the missing data, based on the results of this experimental project, we believe that careful resolution fieldwork is possible. Despite problems associated with data quality on the census, issues in matching decisions and the search for evidence to confirm unmatched records, we believe the method demonstrated could be streamlined and spread to a larger sample to serve as an exact evaluation of census coverage.

The ethnographic sites display strong variation in their demographic profiles and their net coverage. The census enumeration of some ethnographic sites contain large proportions of records which cannot be confirmed or which are definitely erroneous enumerations. These erroneous enumerations "bouy up" the census count to bring it closer to and, in several sites, to surpass the actual numbers of persons who can be confirmed as Census Day residents of the sample area.

The method of the 1990 ethnographic evaluation links records of persons, households and housing units identified and coded as either 1) correctly censused, 2) erroneous enumerated or 3) omitted to demographic, social, cultural and environmental characteristics. In future studies we examine how errors and omissions as well as net coverage correlate with the behavioral traits collected in the systematic observations. We are interested in correlations between site demography, as seen in the census enumeration, with the eventual net undercount or net overcount to flag "hot spots" of census coverage problems.

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CHART I

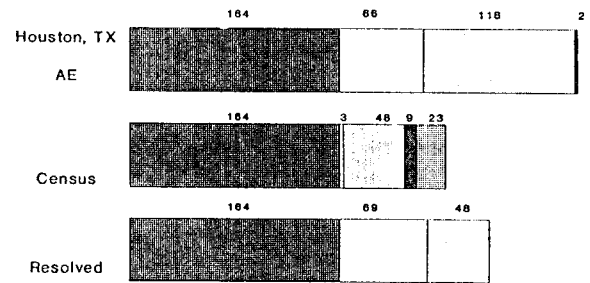


CHART II

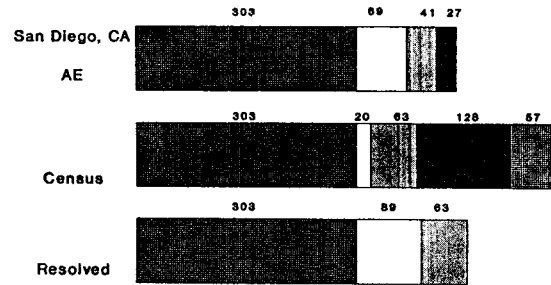


CHART III

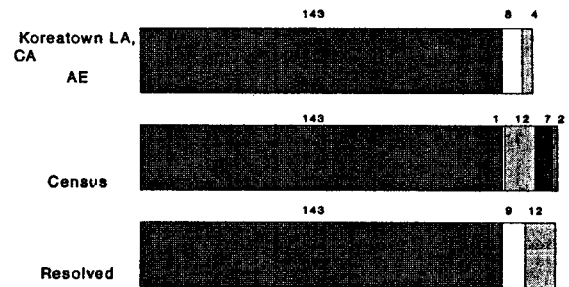
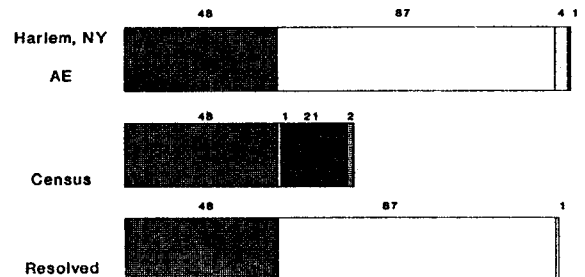
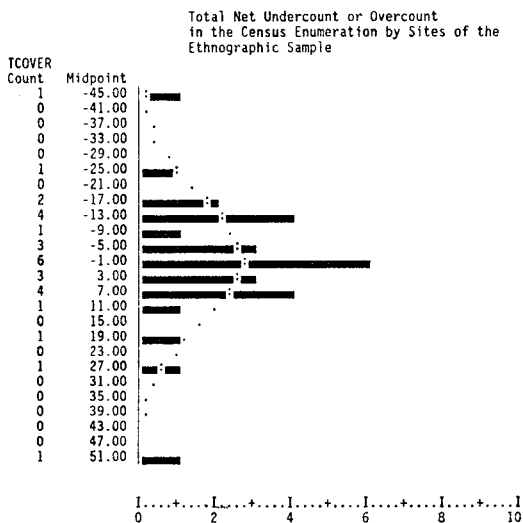


CHART IV



Matched Records
 Unique Records
 Movers
 Errors
 Uncertain Records

Histogram 1



Valid cases 29 Missing cases 0
Includes records with missing data on age or sex or both