

CONCEPTS AND PROCEDURES USED IN TABULATING 1970-CENSUS DATA FOR THE URBAN TRANSPORTATION PLANNING PACKAGE

Paul T. Manka, U.S. Bureau of the Census

Urban transportation planning is a continuing process that requires constant monitoring of urban growth. The changes produced by this growth require a periodic revision of transportation plans.

In response to the request from many urban transportation studies for 1970-census place-of-work data, the Federal Highway Administration (FHWA) submitted tabulation specifications to the Bureau of the Census for the compilation of both socioeconomic and journey-to-work data from the 15- and 20-percent-sample data (Appendix C in this paper explains the sample design) for traffic zones in standard metropolitan statistical areas (SMSA). The standardized tabulations contained in this 1970-census Urban Transportation Planning Package (UTPP) were designed to provide a common data base for transportation studies in the country and reduce processing costs for such tabulations.

This paper focuses on the concepts of the 1970 Census of Population and Housing as they relate to the UTPP, the procedures used to code the place-of-work data for the 15 percent sample, the processing steps involved in tabulating these data by traffic zone, and the limitations of these data for use in the transportation planning process.

PLACE-OF-WORK QUESTION: CONCEPTS AND CODING PROCEDURE

The place-of-work question, which is shown in Figure 1, was asked of all persons 14 years old and over in the 15 percent sample of the population. Working persons included all persons who responded to question 29a that they worked during the reference week March 22-28, 1970.

Place of work referred to the geographic location at which civilians and military personnel who were not on leave carried out their occupational or job activities. The 1960 census was the first census to include an inquiry on place of work. However, in that census, the identification of place of work was limited to county and city. For 1970, a more specific address (number and street name) was asked because the recent development of computerized

address coding guides (ACG) gave the census bureau the capability to code properly completed place-of-work responses to the census tract-block level.

Respondents and enumerators were given detailed instructions for answering the place-of-work question (Appendix A in this paper). The place-of-work coding operation involved approximately 250,000 enumeration districts (ED) containing data for approximately 40 million persons and 13.7 million housing units.

IMPLICATIONS OF PLACE-OF-WORK CODING PROCEDURES FOR TRANSPORTATION PLANNERS

As explained in Appendix A, the detailed place-of-work coding operation (i.e., place of work coded to census tract and block) was limited to those SMSA residents who reported place-of-work addresses that could be located within the ACG boundaries for their respective SMSA or within a commuter-shed SMSA. (A commuter shed is an area containing at least 2 contiguous SMSAs that in 1960 had at least 7.5 percent of the work force in 1 SMSA commuting from home to work in the adjoining SMSA.) In effect, the detailed place-of-work coding excluded those SMSA residents who

1. Did not report any place-of-work addresses,
2. Did not report their places of work in sufficient detail,
3. Reported place-of-work addresses outside the SMSA and not in a contiguous commuter-shed SMSA, or
4. Reported place-of-work addresses not contained in the place-of-work coding guide that the census coders used.

Given these exclusions, not every worker could be coded to census-block level. Figure 2 shows a typical ACG boundary in relation to the central city of an SMSA, its urbanized area, and the SMSA boundary. Since the place-of-work coding guide (which was prepared from the ACG) was the only tool that the census bureau had to assign a tract-block census code to a place-of-work address, those SMSA residents working in the SMSA outside of the ACG area were coded to zip code (ZC) and the Universal Area Code (UAC) only for place of work.

Because many urban transportation planners define their traffic zones in terms of groupings of blocks, they will have to allocate to their work-trip matrix both those workers who did not report places of work and those workers who were not coded to the block level. Because the extent of the geographic coverage of the place-of-work coding guide varied from one SMSA to another, the Users' Service Staff of the census bureau's Data User Services Office computed the percentages of work trips coded to the block level for each SMSA. This percentage was based on available census processing records and was calculated according to the following formula:

$$\frac{(\text{number of workers whose place-of-work responses were coded to tract-block level})}{(\text{number of workers residing in the SMSA})}$$

For commuter-shed SMSAs, the number of workers coded to block level included workers commuting from an adjoining SMSA, and that resulted in an inflation of this percentage. The actual percentage of workers coded to the tract-block level could not be known for these SMSAs until the 1970-census UTPP tabulations had begun. Therefore, this percentage is only intended to be used as a general indicator of the completeness of the census work-trip table from a transportation planner's viewpoint.

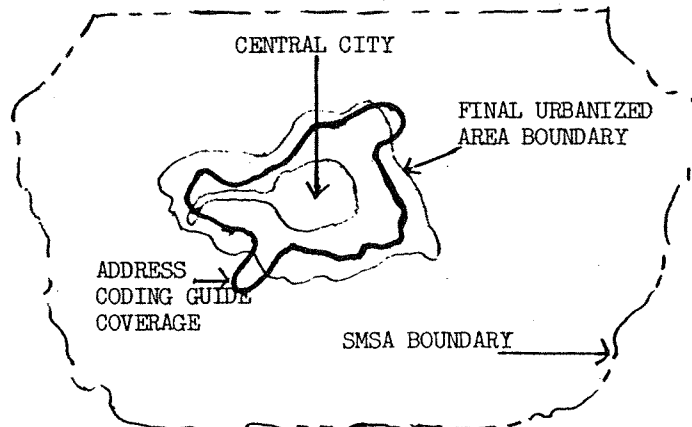
A percentage of 100 could be achieved if and only if all addresses within the SMSA were included within the place-of-work coding guide and all 15-percent-sample persons reported a complete place-of-work address. In reality, however, the percentage of SMSA residents whose place-of-work responses were coded to the block level ranged from 25 to 85 percent.

In summary, the percentage of workers coded to the tract-block level for a given SMSA provides a valuable indicator of the usability of the work trip table in the 1970-

Figure 1. Place-of-work question in the 1970 census.

<p>QUESTIONS 29 THROUGH 41 ARE FOR ALL PERSONS BORN BEFORE APRIL 1956 INCLUDING HOUSEWIVES, STUDENTS, OR DISABLED PERSONS AS WELL AS PART-TIME OR FULL-TIME WORKERS</p>		<p>29c.</p> <p>A ○ ○ ○ ○</p> <p>0 ○ ○ ○ ○ ○ 0</p> <p>1 ○ ○ ○ ○ ○ 1</p> <p>2 ○ ○ ○ ○ ○ 2</p> <p>3 ○ ○ ○ ○ ○ 3</p> <p>4 ○ Zip ○ ○ 4</p> <p>5 Code ○ ○ 5</p> <p>6 ○ ○ ○ ○ ○ 6</p> <p>7 ○ ○ ○ ○ ○ 7</p> <p>8 ○ ○ ○ ○ ○ 8</p> <p>9 ○ ○ ○ ○ ○ 9</p>
<p>29a. Did this person work at any time last week?</p> <p><input type="radio"/> Yes— Fill this circle if this person did full- or part-time work. (Count part-time work such as a Saturday job, delivering papers, or helping without pay in a family business or farm; and active duty in the Armed Forces.)</p> <p><input type="radio"/> No— Fill this circle if this person did not work, or did only own housework, school work, or volunteer work.</p> <p>Skip to 30</p>		
<p>b. How many hours did he work last week (at all jobs)? Subtract any time off and add overtime or extra hours worked.</p> <p><input type="radio"/> 1 to 14 hours <input type="radio"/> 40 hours</p> <p><input type="radio"/> 15 to 29 hours <input type="radio"/> 41 to 48 hours</p> <p><input type="radio"/> 30 to 34 hours <input type="radio"/> 49 to 59 hours</p> <p><input type="radio"/> 35 to 39 hours <input type="radio"/> 60 hours or more</p>	<p>29c.</p> <p>0 ○ ○ ○ ○ ○ 0</p> <p>1 ○ ○ ○ ○ ○ 1</p> <p>2 Street ○ ○ 2</p> <p>3 Code ○ ○ 3</p> <p>4 ○ ○ ○ ○ ○ 4</p> <p>5 ○ ○ ○ ○ ○ 5</p> <p>6 UAC ○ ○ 6</p> <p>7 ○ ○ ○ ○ ○ 7</p> <p>8 ○ ○ ○ ○ ○ 8</p> <p>9 ○ ○ ○ ○ ○ 9</p>	<p>Make no mark in this margin</p>
<p>c. Where did he work last week? If he worked in more than one place, print where he worked most last week. If he travels about in his work or if the place does not have a numbered address, see instruction sheet.</p> <p>(1) Address (Number and street name) _____</p> <p>(2) Name of city, town, village, etc. _____</p> <p>(3) Inside the limits of this city, town, village, etc.? <input type="radio"/> Yes <input type="radio"/> No</p> <p>(4) County _____</p> <p>(5) State _____ (6) ZIP Code _____</p>	<p>29c.</p> <p>0 ○ ○ ○ ○ ○ 0</p> <p>1 ○ ○ ○ ○ ○ 1</p> <p>2 House ○ ○ 2</p> <p>3 Number ○ ○ 3</p> <p>4 Only ○ ○ 4</p> <p>5 ○ ○ ○ ○ ○ 5</p> <p>6 ○ ○ ○ ○ ○ 6</p> <p>7 ○ ○ ○ ○ ○ 7</p> <p>8 ○ ○ ○ ○ ○ 8</p> <p>9 ○ ○ ○ ○ ○ 9</p>	

Figure 2. Place-of-work coding guide coverage.



census Urban Transportation Planning Package.

PROCESSING STEPS IN THE 1970-CENSUS URBAN TRANSPORTATION PLANNING PACKAGE

Before proceeding with the UTPP tabulation for a given SMSA, the Users' Service Staff had the local transportation planners specify approximately 10 to 15 areas outside of, but adjacent to, the SMSA as place-of-work destinations and identify them in terms of the census UAC scheme. This modification allowed place-of-work data to be tabulated for only those SMSA residents' external trips that are of interest to the local transportation planners. In the final data tabulation, employment data for both those SMSA residents who did not report places of work and those SMSA residents who reported places of work outside the SMSA in an unspecified UAC are reported in pseudo traffic zone 99998.

Eight computer programs involving 3 intermediate processing steps produce the final data tables for the transportation planning package.

Computer program 1 strips only those data that will be shown in the data tables from the 1970-census sample basic record tape (BRT) for residents of an SMSA. (Figure 3 shows the flow chart of processing programs.) This program produces 2 output tape files:

1. A stripped data file that contains the shortened basic records (this shortened BRT contains either 15- or 20-percent-sample data), and
2. A geocode file that contains a list of unduplicated census geographic codes (tract-block, ED, ZC, and UAC) appearing on each sample basic record regarding both household residence and place of work.

Computer program 1a produces a set of tallies that show the number of SMSA residents and the level to which their place-of-work responses have been coded for each listed UAC. Specifically, program 1a produces a printout that shows the number of workers

1. Who reside in the SMSA,
2. Whose place-of-work responses are coded to census tract-block level,
3. Whose place-of-work responses are coded to the ZC level,
4. Whose place-of-work responses are coded to a specified UAC only,
5. Whose places of work are outside the SMSA and are not in any specified UAC, and
6. Who did not report places of work.

Program 1a tallies are first compared with the corresponding place-of-work data shown in Table P-2, "Social Characteristics of the Population," in the PHC(1) census-tract report for that SMSA. Agreement of data from program 1a with Table P-2 data ensures that the stripped data file does, in fact, contain sample data for every worker residing in that SMSA. These worker-tally printouts are then sent with the census area-traffic zone equivalency printouts to the local planners. (Examples of both printouts are given in Appendix B in this paper.)

Computer program 2 takes the geocode file and sorts its geographic codes into the following sequence: state, SMSA, county, UAC, ZC, ED, and tract-block. The output from this program is then used to produce the census area-traffic zone equivalency printout, which is sent to the local transportation planners for the assignment of traffic zones.

Each line of the census area-traffic zone equivalency printout contains the county code, a maximum of 6 geographic codes with a space allocated for the assignment of the corresponding traffic zone code, and a serial number (Fig. 4, Appendix B). This serial number is the only means by which the locally assigned traffic zone codes can be linked to each census geocode.

While the census area-traffic zone equivalency printouts were being completed,

many local transportation planners raised the following questions:

1. Since the ZC, ED, and UAC may encompass many traffic zones, should we assign them traffic zone codes on the census area-traffic zone equivalency printout?
2. Why are some of the census tract-block numbers that are listed on the census area-traffic zone equivalency printout not shown on the 1970-census Metropolitan Map Series (MMS) for the urbanized area?
3. Why are some blocks containing population counts in the HC(3) block statistics report not listed on the census area-traffic zone equivalency printout?

In response to question 1, because not all place-of-work responses could be coded to tract-block level, both the ZC and UAC listed on the census area-traffic zone equivalency printout represent place-of-work data that must be shown in some fashion in the final data tabulation. Therefore, we have suggested that local transportation planners assign pseudo traffic zone numbers to such areas so that these data may be tabulated separately. We have found that this procedure facilitates analysis and possible allocation of these data to legitimate traffic zones. Also, because in most areas only the urbanized area and its immediate vicinity have census blocks identified, this procedure results in residential information for workers living in the rural portion of the SMSA being shown on the sample BRT at the lowest possible census geographic level, i.e., the enumeration district.

In response to question 2, there are 4 possible explanations for those tract-block codes that are listed in the census area-traffic zone equivalency printout and not shown on the published 1970 MMS for an urbanized area.

1. If the tract-block code is an impossible or nonexistent census tract-block combination, the error probably resulted from the place-of-work coding operation. As stated earlier, this coding operation used the locally prepared 1970 ACG to code place-of-work responses to the tract-block level. Consequently, any tract-block errors contained in the ACG would be reflected in the data coded to tract-block level. Generally, the processing records concerning such errors, which might have been discovered subsequent to the 1970 census, have been maintained by the local planning groups who revised and edited the 1970-census ACG.

2. Some of the MMS sheets were necessarily block-numbered in their entirety. This was done prior to the definition of the potential extent of the urbanized area that coincided with the final blocked area. Subsequently when the limits of these areas were defined, many of the rural block numbers were eliminated from the revised MMS sheets. These block numbers were deleted from the place-of-residence geocodes on the sample BRT, and the identified ED was retained as the lowest geographic code. However, the place-of-work codes on the sample BRT were not revised to reflect these changes.

3. Prior to the final publication of the MMS with the HC(3) block statistics report for an urbanized area, the original maps were revised by the Geography Division of the census bureau. As part of this process, nonexistent streets were deleted. Whenever a deleted street was a block boundary, the blocks adjoining this boundary would be merged to form one block on the revised map. This new block would then assume the lowest block number of the merged blocks; e.g., when blocks 120 and 123 were merged, the new block is shown on the revised metropolitan map as block 120. In a few cases, the coding for the ACG was not revised to reflect this change. Therefore, place-of-work data coded to block 123 on the sample BRT in some cases would be shown as block 123 on the census area-traffic zone equivalency printout, but block 123 would not be shown on the revised map.

4. Although all the revisions made to MMS sheets mentioned above were made to the appropriate place-of-residence geocodes on the sample BRT, some households in certain census tracts had either a nonexistent block code or some other inconsistency in its block coding. For such cases, we instructed the local transportation planners to allocate those households that had a pseudo block code 999 to a zone within that census tract, for we knew that such households were actually contained in that tract.

After receiving written notification regarding those blocks that the local transportation planners could not locate on the revised MMS sheets, the bureau's Geography Division has been able to determine the location of many of the unmapped blocks mentioned in points 2 and 3 above by referring to census processing records.

In regard to question 3, many transportation planners mistakenly thought that the census area-traffic zone equivalency printout is a complete listing of all tract-ED or tract-block codes for their SMSA. This is not true because as mentioned earlier the data input used to produce these census area-traffic zone equivalency printouts are the basic record tapes that contain individual household and person data from the sample portion of the 1970 Census of Population and Housing. The housing unit, including all its occupants, was the sampling unit in this census. Therefore, those census blocks or EDs that either had no sample households or did not contain a coded place-of-work destination could not be included in the census area-traffic zone equivalency listing produced from the sample BRT. (Appendix C gives a detailed discussion regarding the sampling procedure and accuracy of these sample data.)

After local transportation planners have resolved all of the problems regarding geocoding discrepancies on the census area-traffic zone equivalency printout, they complete their assignments of traffic zone codes to the census area-traffic zone equivalency printouts and then return them to the census bureau. When the printouts containing these locally assigned traffic zones are received, the zones listed on each line are punched into cards with the corresponding serial number.

Computer program 3 matches the serial number of each punchcard with the census area-traffic zone equivalency file and creates a new reference file that associates a traffic zone to each census area. A printout of this reference file is then sent to the sponsor for final verification of the traffic zone assignments.

After final approval is received from the sponsor, computer program 4 uses the reference file created in the previous program and writes the appropriate traffic zone identification for both residence and place of work on each household and person record contained on the shortened BRT. The output of this program is a new stripped BRT file with traffic zone identification only on each record. Computer program 5 tallies the data on the short BRT by traffic zone; program 6 produces both a printout and a data tape file; and program 7 copies the data file as well as the FHWA display program onto a computer tape that is sent to the local transportation planners. (The display program is discussed in the 1970-Census Urban Transportation Planning Package: Summary Tape Technical Documentation, which is reprinted in the appendix to this report.)

As of the end of July 1973, data tabulations were completed for 50 SMSAs and in progress for 63 SMSAs located in 33 states. Partially because the runs of the traffic zone package had to be carried out in such a way as not to interfere with the ongoing census publication tabulations and other decennial processing operations, the average length of time to complete the 1970-census UTPP data tabulations for a given SMSA was approximately 6 months from the receipt of funds. However, approximately 3 months of this time was used by the local transportation planning groups to complete and review the census area-traffic zone equivalency printout.

Census bureau policy states that, if a secondary or subsequent request is received for the traffic zone data tabulation for a given SMSA, the latter requester will be referred to the initial sponsor. If the initial customer cannot supply a copy of the data, the bureau will then provide the copy and prorate the original cost accordingly between the parties. After a 6-month period has expired following initial delivery of the tabulations, they may be made available by the bureau to requesters at cost of reproduction.

DATA CONTAINED IN THE 1970-CENSUS URBAN TRANSPORTATION PLANNING PACKAGE

The data provided in the UTPP tabulations are divided into 4 parts. (Detailed data items are listed in the 1970-Census Urban Transportation Planning Package: Summary Tape Technical Documentation, which is reprinted in the appendix to this report.)

1. Part I has 26 tables that contain socioeconomic and demographic data. Data regarding age, race, sex, school enrollment, employment, and income are given for both persons and heads of households. In addition, data regarding household size, household income, type of structure, and number of automobiles available are given for housing units. Part I tables are produced for each traffic zone of residence in the SMSA. Many of the data given in these tables have already been released by the bureau in either published or computer tape form for census tracts and larger geographic areas. This special tabulation was designed for traffic zones, which in many cases are smaller than the smallest census geographic areas for which these data are published.

Since by law (Title 13, U.S. Code) the census bureau cannot issue any statistics that might identify or indirectly disclose the identity or characteristics of an individual, no other information except total population will be given in these tables for a given traffic zone of residence containing fewer than 33 persons (weighted estimate). Therefore, when a particular traffic zone contains fewer than 33 persons, only the total population will be given in Table 1A-2 and the remainder of the tables will have zeros in each cell. A test of this disclosure rule on actual package output indicates that only a very small number of residence zones (about 5 percent) may be affected by this confidentiality regulation (1).

2. Part II contains 12 tables that give detailed cross tabulations of some of the socioeconomic variables contained in Part I and a 3-way cross tabulation of 2 socioeconomic variables and means of transportation to work. Because the remaining parts of the package vary in length according to the number of zones, Part II data are placed first in the computer file and in the data printout. There is only one set of Part II tabulations per urbanized area in an SMSA.

3. Part III contains 4 tables that give labor force status, occupation, industry, and class of worker for persons age 16 years old and over by zone of work within the SMSA. Until 1970, the estimates provided in these tables were usually obtained from secondary sources. This is the first time that the census bureau has compiled employment characteristics by zone of work. Therefore, users of these data should exercise caution in their analyses. The weights used for the zone-of-work employment data were based on the demographic characteristics of the residential area of the workers and were not designed for weighting employment data at the work site. As a result, it is possible that these employment data may be inaccurate. The data are given for pseudo traffic zones (i.e., ZC and UAC), and local planners may have to exert considerable effort to allocate them to the appropriate zone of work. Therefore, whenever possible, these employment figures should be verified by data from other sources, such as state and local agencies.

4. Part IV contains the work-trip table that gives the number of workers making trips from a given zone of residence to a zone of work by the modes of transportation. The utility of such tables for a given SMSA is affected, of course, by the accuracy of the place-of-work responses and by the percentage of place-of-work responses that could be coded to the tract-block level. The categories "other" and "worked at home" (means of transportation categories) were combined into "other" in this table in order to meet the bureau's confidentiality requirements. Work trips were coded to pseudo zone 99998 if they were made to areas outside of the SMSA that were not specified by the local planners and if they did not have place of work reported.

ACCURACY OF THE TRAFFIC ZONE DATA

The data input used for the 1970-census UTPP is the sample records from the 1970 Census of Population and Housing. Appendix C of this paper gives for each table in the package the sample base and, hence, the weighting that applies to the items contained in each data table. Even complete-count items such as age, race, sex, etc., are tabulated from the 20-percent-sample questionnaires. As a result, only weighted estimates of the total population for these variables appear in the final data tabulations, and these may differ slightly from the corresponding complete counts.

Although the sample design of the 1970 census and the ratio estimation procedures

employed in collecting and weighting the sample data are discussed in detail in Appendix C of this paper, their key concepts are briefly reviewed here.

The statistics based on sample data are estimates made through the use of ratio-estimation procedures, applied separately for the 15 and 20 percent samples. The first step in carrying through these ratio estimates was to establish the areas within which separate ratios were to be prepared. These are referred to as sample weighting areas. A single set of weighting areas, containing a minimum population size of 2,500, was defined for use with both the 15 and 20 percent samples. These weighting areas were established by a computer operation and were defined to conform, as nearly as possible, to areas for which tabulations are produced.

In general, sample estimates for a tract may be expected to agree with complete counts whenever the tract is a weighting area. However, tracts are not weighting areas if the population is less than 2,500 persons, if the tract is a part of more than one county subdivision or place, or if the census procedure is not the same in all parts of the tract. In these situations part of a tract may be combined with other partial or complete tracts to make up a weighting area. Consequently, sample estimates for an individual tract in the combination may not agree with complete counts of population or housing units. Separate ratio-estimation processes were used for both persons and for housing units, and a unique weight was assigned to each household and every sample person, i.e., each person or household in the 20 percent sample does not necessarily have a weight of 5.

Many traffic zones are smaller than sample weighting areas, and the sampling variability for statistics compiled for such traffic zones will be greater than that for a geographic area comprising one or more complete sample weighting areas. In brief, this is due both to the nature of the smaller sample for each zone and the fact that the sample data weights were not designed for weighting subareas of the sample weighting areas. Data given in Table 1 illustrate the sample-weighting-area concept as it applies to census tracts in Sacramento, California.

In tracts 0008 through 0012, the discrepancy between the sample and the complete-count data is noticeable because each tract contained fewer than 2,500 persons and they were combined to form a single sample weighting area. However, if the sample data for these tracts are aggregated, they agree with the aggregated 100 percent data for these tracts.

From this discussion, we can conclude that the transportation planner, in order to maximize the reliability of these sample data, should try to minimize the number of zones within a given sample weighting area and to avoid combining data from several sample weighting areas into a single traffic zone.

Given the considerations stated above, the zone-of-residence data contained in Parts I and II of the traffic zone tabulation constitute an excellent primary source of data for the transportation planning process. Such data can be used to validate similar data developed from the local information system and to check and calibrate the home-to-work trip generation equation. General improvement in the accuracy of coding place-of-work responses to small geographic areas, viz., tract-block geographic levels, is needed to make the data shown in Parts III and IV of the 1970-census UTPP more useful to local transportation planners. Both the Federal Highway Administration and the Bureau of the Census seek recommendations from local planners on how to improve the utility of such place-of-work data for urban transportation planning.

REFERENCE

1. U.S. Census Bureau Urban Transportation Planning Package. Federal Highway Administration, FHWA Notice, April 18, 1972.

Figure 3. Processing stages of census data in the transportation package.

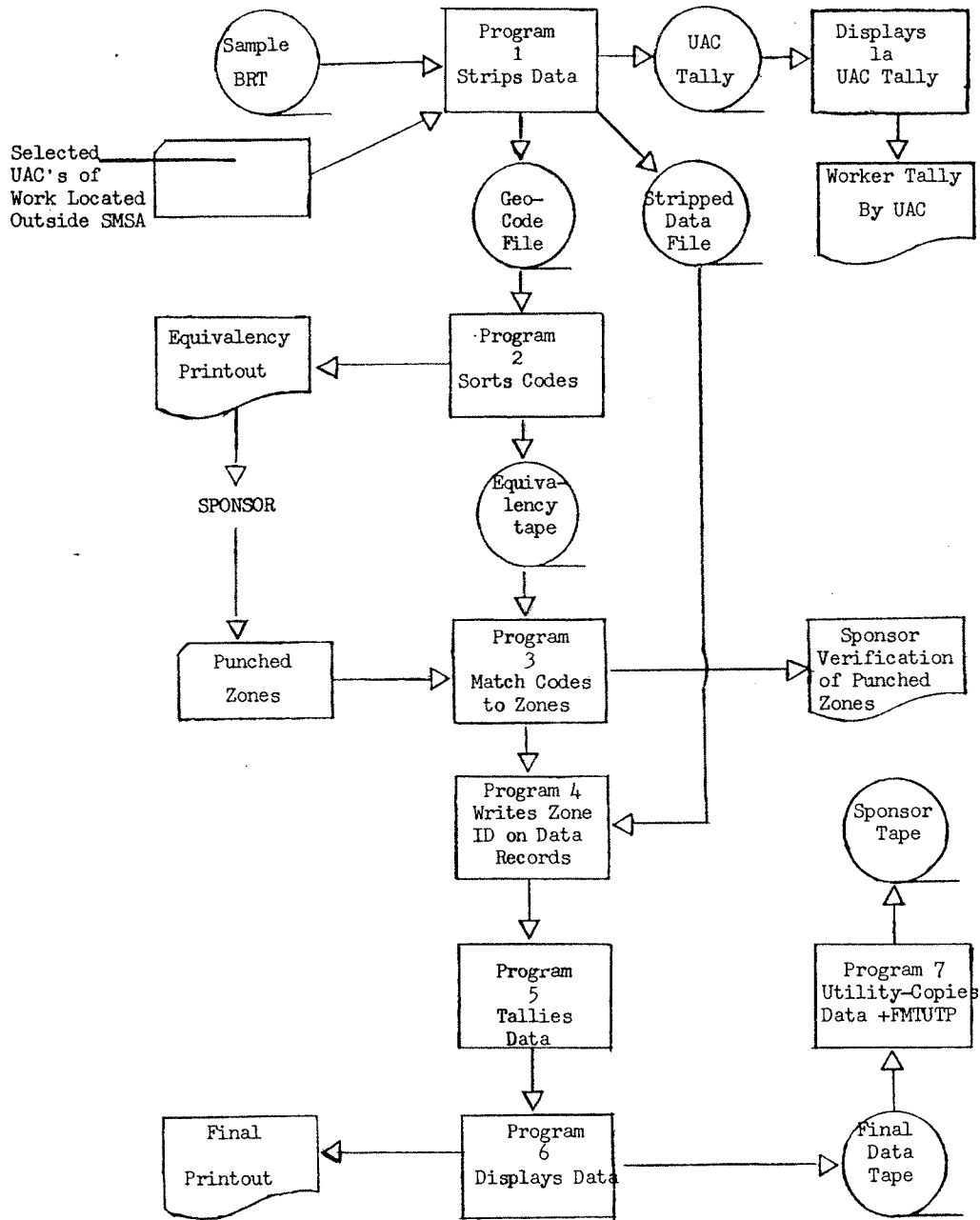


Table 1. Comparison of complete population and housing unit counts and sample weighted estimates.

Tract	Population		Housing	
	Complete (Table P-1)	Sample (Table P-2)	Complete (Table H-1)	Sample (Table H-2)
0008	377	374	321	328
0009	121	101	99	98
0010	120	78	82	68
0011	1,081	1,251	800	812
0012	2,955	2,850	2,294	2,290
Total	4,654	4,654	3,596	3,596

Source: PHC(1) 178 census tract report.

APPENDIX A: INSTRUCTIONS AND CODING PROCEDURES FOR PLACE-OF-WORK AND MEANS-OF-TRANSPORTATION INFORMATION

Respondents and enumerators were given detailed instructions for answering the place-of-work question. Some of the particular situations covered by these instructions are given below.

1. Persons who worked at more than one job are reported at the location of the job at which they worked the greatest number of hours during the reference week.
2. Salesmen, deliverymen, and others who worked in several places each week or traveled are reported as working at the address at which they began work each day or at the address of the central headquarters to which they were responsible.
3. For cases in which daily work was not begun at a central place each day, the place reported is the address at which the person worked most hours during the reference week. If the employer operated in more than one location or branch (such as a grocery store chain or public school system), the exact location or branch where the person worked is entered.
4. When the number or street name cannot be given, the name of the building or the name of the company for which the person worked is asked.
5. For persons who worked offshore or as an officer or crew member on a vessel and who did not report to a central headquarters, the words "at sea" are entered on line 1 and the remainder of question 29c is left blank.
6. If the person worked in a foreign country or a U.S. possession during the reference week, the name of the country or possession is entered on line 5 and the rest of the question is left blank.

Coding Procedures for Place of Work

The entries for question 29c were manually coded by clerks in the census bureau's Jeffersonville, Indiana, processing center. The place-of-work codes were entered by using the Film Optical Sensing Device for Input to Computer (FOSDIC) to mark circles in the first 2 or all 3 coding boxes printed next to question 29 on each person-page of the 15-percent-sample questionnaire. The code boxes and the purposes for which they were primarily used are shown in Figure 1.

All work addresses were first classified into 2 major categories according to the residence of the person reporting. Specific coding procedures were prescribed for groups within each major category. The major categories and the groups within them were as follows:

1. Persons residing in EDs not located within the limits of an SMSA were assigned to group A; and
2. Persons residing in EDs located within the limits of an SMSA were assigned to Group A if they worked outside the SMSA, to group B if they worked inside the SMSA and within that portion of the SMSA covered by the ACG, and to group C if they worked inside the SMSA but outside the area covered by the ACG.

The FOSDIC clerical coding procedure for persons in group A involved placing 00000 in the upper box and the UAC in the middle box and leaving the lower box blank (Fig. 1). The 5-digit UAC identified state, county, SMSA, central cities, other places of 20,000 or more in 1960 or at a subsequent special census, and selected minor civil divisions. For persons in group B, the zip code for workplace was entered in the upper box, the ACG street code indicating the name of the street was entered in the middle box, and the structure or house number of the workplace was entered in the lower box. For persons in group C, the ZC and the UAC were entered in the upper and middle boxes respectively and the lower box was left blank.

The place-of-work coding pattern for groups A, B, and C is given in Table 2. When

Table 2. Place-of-work coding.

Place-of-Work Coding Group	Place of Residence			Place of Work		
	Inside SMSA			Inside SMSA		
	Inside ACG Area	Outside ACG Area	Outside SMSA	Inside ACG Area	Outside ACG Area	Outside SMSA
A (00000/UAC)	X	X	X X X	X	X	X ^a X ^a X
B (ZC/street code/house no.)	X	X		X X		
C (ZC/UAC)	X	X			X X	

^aIf the place-of-work is located in another SMSA that is a commuter shed SMSA, the response is coded according to either group B or group C procedures.

Figure 4. Census area-traffic zone equivalency printout.

COUNTY	TRAFFIC ZONES FOR SMSA												STATE			PAGE	SERIAL	
	UAC	ZONE	UAC	ZONE	UAC	ZONE	UAC	ZONE	UAC	ZONE	UAC	ZONE	UAC	ZONE	UAC			ZONE
028	83022	*1003	*															000018
031	83024	*1006	*															000026
043	83031	*1007	*															000034

COUNTY	TRAFFIC ZONES FOR SMSA												STATE			PAGE	SERIAL	
	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	ZIP			ZONE
043	87004	*1007	*	87041	*1007	*	87048	*1007	*	87104	*1007	*	87107	*1007	*	87124	*1007	000042

COUNTY	TRACT	TRAFFIC ZONES FOR SMSA												O200 STATE			PAGE	SERIAL
		ED	ZONE	ED	ZONE	ED	ZONE	ED	ZONE	ED	ZONE	ED	ZONE	ED	ZONE	ED		
001	000701	0222	*8221	*														000232
001	000702	03228	*8312	*														000240
001	0008	0337	*8441	*														000257
001	0037	0281	*7301	*														000265
001	0038	0001	*3001	*	0002	*3002	*	0003	*3003	*								000273
001	0039	0342	*3004	*	0343	*3005	*											000281
001	0040	0234	*3421	*														000299
001	004701	0300	*6402	*														000307
001	004702	0315	*5503	*														000315
001	0048	0339	*3006	*	0340	*3007	*	0341	*3008	*								000323

COUNTY	TRACT	TRAFFIC ZONES FOR SMSA												O200 STATE			PAGE	SERIAL	
		BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	BLOCK			ZONE
001	000101	101	*7443	*	102	*7443	*	103	*7443	*	104	*7443	*	105	*7443	*	106	*7443	000331
001	000101	108	*7443	*	109	*7443	*	111	*7443	*	112	*7443	*	113	*7443	*	114	*7443	000349
001	000101	115	*7443	*	116	*7443	*	117	*7443	*	118	*7443	*	119	*7443	*	120	*7443	000356
001	000101	121	*7443	*	122	*7443	*	123	*7443	*	124	*7443	*	125	*7443	*	126	*7443	000364
001	000101	127	*7443	*	128	*7443	*	129	*7443	*	130	*7443	*	131	*7443	*	132	*7443	000372
001	000101	201	*7443	*	202	*7443	*	203	*7443	*	204	*7443	*	205	*7443	*	206	*7435	000380
001	000101	207	*7435	*	208	*7435	*	209	*7435	*	210	*7435	*	211	*7435	*	212	*7431	000398
001	000101	214	*7431	*	215	*7431	*	216	*7431	*	217	*7431	*	218	*7431	*	219	*7431	000406
001	000101	220	*7431	*	221	*7431	*	222	*7431	*	223	*7431	*	224	*7431	*	225	*7431	000414
001	000101	226	*7431	*	227	*7431	*	228	*7431	*	229	*7431	*	230	*7431	*	231	*7431	000422
001	000101	301	*7432	*	302	*7432	*	303	*7432	*	304	*7432	*	305	*7432	*	306	*7432	000430
001	000101	307	*7432	*	308	*7432	*	309	*7432	*	310	*7432	*	311	*7432	*	312	*7432	000448
001	000101	313	*7434	*	314	*7434	*	315	*7434	*	316	*7434	*	317	*7434	*	318	*7434	000456
001	000101	319	*7434	*	320	*7434	*	321	*7442	*	325	*7441	*	327	*7441	*			000463
001	000102	101	*7453	*	114	*7454	*	118	*7454	*	119	*7454	*	120	*7454	*	121	*7454	000471
001	000102	133	*7454	*	134	*7454	*	135	*7454	*	137	*7454	*	138	*7454	*	139	*7454	000489
001	000102	201	*7451	*	203	*7451	*	204	*7451	*	205	*7451	*	206	*7451	*	207	*7451	000497
001	000102	208	*7451	*	209	*7451	*	210	*7451	*	214	*7451	*	215	*7451	*	216	*7451	000505
001	000102	219	*7452	*	301	*7452	*	302	*7452	*	303	*7452	*	304	*7452	*	305	*7452	000513
001	000102	306	*7452	*	307	*7452	*	308	*7463	*	309	*7463	*	310	*7463	*	311	*7463	000521
001	000102	312	*7463	*	313	*7463	*	314	*7463	*	315	*7463	*	316	*7463	*	317	*7463	000539
001	000102	318	*7463	*	319	*7463	*	322	*7463	*	323	*7463	*	324	*7463	*	325	*7463	000547
001	000102	326	*7463	*	327	*7463	*	328	*7463	*	330	*7464	*	331	*7464	*	401	*7464	000554
001	000102	402	*7464	*	403	*7464	*	404	*7464	*	405	*7464	*	406	*7464	*	407	*7464	000562
001	000102	408	*7464	*	409	*7464	*	410	*7464	*	411	*7464	*	412	*7464	*	413	*7464	000570
001	000102	416	*7464	*	417	*7464	*	418	*7464	*	419	*7464	*	420	*7464	*	421	*7461	000588
001	000102	422	*7461	*	423	*7461	*	424	*7461	*	425	*7461	*	426	*7461	*	427	*7461	000596

an SMSA resident reported a place-of-work address in an adjoining SMSA that was part of a commuter shed, his response was coded according to either group-B or group-C procedures. A commuter shed is an area containing at least 2 contiguous SMSAs that in 1960 had at least 7.5 percent of the work force in one SMSA commuting from homes into the adjoining SMSA. When place-of-work coding began, the commuter-shed definition was applied to any SMSA that received 7.5 percent of its work force from one or more adjoining SMSAs or had at least 7.5 percent of its employed workers commuting to adjoining SMSAs to work. In March 1971, because of time and budget strictures, this definition was narrowed to include only those SMSAs receiving workers.

The coding clerks were provided, as needed, with ACGs, telephone directories, national zip code directories, and lists for assigning UAC numbers for places of work shown as military installations, colleges or universities, or place names. If the information contained in the response to question 29c was insufficient to allow coding by reference to one or more directories or if the entries were blank, the coder referred to question 33a (For whom did he work?) to see whether an employer's name was listed there. If there was an entry, the clerk looked for this name in appropriate telephone directories to secure an address that could be coded. The clerks followed a decision logic chart. Doubtful cases or cases that could not be coded on the basis of information available to the clerks were referred to technical assistants for resolution.

Before any computer processing was begun on the data described above, the records for the worker were edited according to the following criteria:

1. The worker is in the 15 percent sample;
2. The worker's data record has an employment status recode that indicates that he is in fact a civilian or a member of the armed forces "at work";
3. The worker resided within an SMSA or selected non-SMSA counties; and
4. Clerical coding of the worker's place-of-work address is sufficient—i.e., a coded entry is in the zip code, street, and house number field.

Criteria 1 and 2 eliminated those person records that by definition did not have place-of-work data. Those worker records meeting criteria 1 and 2 but not qualifying on residence or containing sufficient address information as described above were assumed to be clerically coded to a place of work based on the UAC or ZC/UAC.

For those sample basic records meeting all of the criteria shown above, a worker's "finder" record was created. This computer file was matched to the ACG files for the appropriate SMSA on the basis of the coded ZC, street, and house number. Census geographic information obtained from this match was added to the worker's sample basic record, i.e., UAC, tract code, block number, and central business district indicator for his place-of-work response. If a match was not made, the worker codes were allocated by using the following priority:

1. Odd/even house number failure,
2. House number out of range,
3. Zip code and street match only,
4. Zip code match only, and
5. Complete mismatch.

Since the match was made as far as possible before an allocation occurred, the allocation was based on the area of match. For example, if a match for only ZC and street name was made, a line for that street from the ACG was randomly selected within that ZC, the place-of-work codes were assigned from this line (i.e., UAC, tract code, block number, and CBD), and an allocation code 3 was assigned to that record. Allocation code 5 occurred most frequently for those persons with missing digits in the zip code field. Such cases were first automatically recoded to 00000 and then distributed at random among "good" zip codes over the entire area (SMSA or commuter shed). Since there was no "not reported" category for these records, all the finder records were given legitimate place-of-work codes resulting either from a complete match or an allocation.

Coding Procedures for Means of Transportation to Work

Another important variable in the urban transportation planning process is the means of transportation to work. Question 29d was asked of all persons 14 years old and over in the 15 percent sample of the population who were reported working during the reference week:

- d. How did he get to work last week? Fill one circle for chief means used on the last day he worked at the address given in 29c.
- | | |
|---|---|
| <input type="radio"/> Driver, private auto | <input type="radio"/> Taxicab |
| <input type="radio"/> Passenger, private auto | <input type="radio"/> Walked only |
| <input type="radio"/> Bus or streetcar | <input type="radio"/> Worked at home |
| <input type="radio"/> Subway or elevated | <input type="radio"/> Other means—Specify → |
| <input type="radio"/> Railroad | |

After completing question 29d, skip to question 33.

In completing this question, the respondents were asked to indicate the chief means of travel or types of conveyance used in traveling to and from work on the last day they worked at the addresses given in entries for item 29c (place of work). The "chief means" referred to the means of transportation covering the greatest distance if more than one means was used. "Worked at home" was entered for persons who worked on a farm where they lived or in an office or shop in their homes. If none of the means seemed appropriate, "other means" was checked and the type of transportation (such as truck, pickup truck, or bicycle) was specified.

A similar question was asked in 1960. However, the data for 1960 and 1970 are not entirely comparable because the 1960 data on means of transportation to work referred to the "last week" rather than to the "last day." Also a distinction was made in 1970 between the driver and the passenger of an automobile.

There was no manual office coding of this item. However, if the specified other means could be interpreted as one of the means listed (for instance, a company-operated station wagon used to pick up employees could be classified as a bus), the entry was changed by edit clerks in the field offices. Remaining entries for other means were tabulated as such, but the written-in entries were not coded or separately tabulated.

Nonresponses were allocated by the computer. The general procedure for allocating nonresponses was to assign an entry that was consistent with entries for other persons with similar characteristics who had reported means of transportation to work.

Number of Automobiles Available

Question H23 was asked for all of those occupied housing units covered in the 15 percent sample. This question was identical to the corresponding 1960 item.

- H23. How many passenger automobiles are owned or regularly used by members of your household?

Count company cars kept at home.

- None
- 1 automobile
- 2 automobiles
- 3 automobiles or more

The automobiles reported for 1970 were passenger cars, including station wagons, that were owned or regularly used and ordinarily kept at home. Company cars were included if they were used regularly and kept at home, and rented or leased vehicles were reported if the contract was for a month or more. The cars of all members of the household were counted, including those belonging to lodgers or other nonrelatives living in the unit. The following vehicles were excluded: taxicabs, pickups or larger

trucks, dismantled or dilapidated cars in an early stage of being junked, or immobile cars used only as a source of power for some piece of machinery.

An occupied housing unit that had no response recorded for this question was allocated the response recorded for the preceding occupied housing unit. The allocation rate for this item at the U.S. level was approximately 3.7 percent.

Acknowledgment

Much of the material in this appendix was taken from Chapter 8, "Processing the Data," in 1970 Census of Population and Housing: Procedural History.

APPENDIX B: EXAMPLES OF CENSUS AREA-TRAFFIC ZONE EQUIVALENCY AND WORKER-TALLY PRINTOUTS

Census Area-Traffic Zone

A section of a census area-traffic zone equivalency printout with assigned zones for the Albuquerque, New Mexico, SMSA is shown in Figure 4. Transportation planners assigned a traffic zone code to each census area shown in this printout.

Worker Tally

The worker-tally printout (Table 3) lists the number of workers residing in the Albuquerque SMSA as distributed by the coded census geographic level for each reported place-of-work address. Data are shown for the total SMSA and separately for each UAC on the printout.

The first column lists the 5-digit UAC, the second column lists the total number of workers, the third column lists the number of workers coded to block level, the fourth column lists the number of workers coded to ZC level, the fifth column lists the number of workers coded to UAC level only, and the sixth column lists the number of workers not working in the SMSA and not reporting places of work.

The first row lists the distribution of the total number of workers residing in the SMSA, and the second row lists the distribution of workers residing in the SMSA but not working in the SMSA or any of the other listed UACs. The remaining rows list the distribution of workers for that UAC, and the last row lists the number of workers residing in the SMSA and not reporting places of work.

Since the place-of-work question was asked of only 15 percent of all households, the numbers shown on this printout have been expanded by a variable weight for each worker's household to the complete count (100 percent) level; e.g., a raw total of 15 workers would be weighted such that they might be shown as 100 workers. Therefore, the total number of workers shown for an SMSA is comparable to the numbers shown in Table P-2 in the PHC(1) Census-tract report for that SMSA.

APPENDIX C: SAMPLING AND ESTIMATION PROCEDURES

This appendix describes the 1970-census sampling and estimation procedures and their implications for the use of statistics tabulated by traffic zones. Also included is a discussion of the sampling variability of the statistics included in this report and a method of approximating their standard errors.

Sample Design

For persons living in housing units at the time of the 1970 census, the housing unit, including all its occupants, was the sampling unit. For persons living in group quarters identified in advance of the census, the sampling unit was the person. In nonmail areas, the enumerators canvassed their assigned area and listed all housing units in address registers sequentially in the order in which they first visited the units whether or not they completed the interviews. Every fifth line of the address register was designated as a sample line, and the housing units listed on those lines were included in the sample. Each enumerator was given a random line on which he or she was to start listing, and the order of canvassing was indicated in advance, although the instructions allowed some latitude in the order of visiting addresses. In mail areas, the list of housing units was prepared prior to the census day either by employing commercial mailing lists corrected through the cooperation of the Postal Service or by listing the units in a process similar to that used in nonmail areas. As in other areas, every fifth housing unit of these lists was designated to be in the sample. In group quarters, all persons were listed, and every fifth person was selected for the sample.

This 20 percent sample was subdivided into a 15 percent and a 5 percent sample by designating every fourth 20-percent-sample unit as a member of the 5 percent sample. The remaining sample units became the 15 percent sample. Two types of sample questionnaires were used, one for the 5-percent-sample and one for the 15-percent-sample unit. Some questions were included on both the 5-percent-sample and 15-percent-sample forms and, therefore, appear for a sample of 20 percent of the units in the census. Other items appeared on either the 15 percent or the 5 percent questionnaires.

An item collected on one sample rate may have been tabulated on a smaller basis. (The rate for tabulation is given in Table 7.) Only 20-percent- and 15-percent-sample statistics are included in the traffic zone tabulations.

Although the sampling procedure did not automatically ensure an exact 20 percent sample of persons or housing units in each locality, the sample design was unbiased if carried through according to instructions; generally for large areas the deviation from 20 percent was found to be quite small. Biases may have arisen when enumerators failed to follow the listings and sampling instructions exactly. Quality control procedures were used throughout the census process, however. Where there was clear evidence that the sampling procedures were not properly followed, the work was returned to the field for resampling. No attempt at sampling was made for the relatively small number of persons and housing units (in most states, less than 1 percent) added to the enumeration from the post-census Postal Service check, the various supplemental forms, and the special check of vacant units. The ratio-estimation procedure described below adjusts the sample data to reflect these classes of population and housing units.

Ratio Estimation

The statistics based on 1970-census sample data are estimates made through the use of ratio-estimation procedures, applied separately for the 15 and 20 percent samples. The first step in carrying through the ratio estimates was to establish the areas within which separate ratios were to be prepared. These are referred to as "weighting areas." A single set of weighting areas, containing a minimum population size of 2,500, was defined for use with the 15 and 20 percent samples. Weighting areas were established by the computer and were defined to conform, as nearly as possible, to areas for which tabulations are produced. In general, sample estimates for a tract may be expected to agree with complete counts whenever the tract was a weighting area. However, tracts were not weighting areas if the population was less than 2,500 persons, if the tract was a part of more than one county subdivision or place, or if the census procedure was not the same in all parts of the tract. In these situations, part of a tract may have been combined with other partial or complete tracts to make up a weighting area, and sample estimates for an individual tract in the combination may not agree with complete counts for the tract. Similarly, a traffic zone is generally a part or a combination of

parts of a weighting area so that statistics tabulated by traffic zone are somewhat less reliable than those tabulated by weighting areas. The increase in sampling variability is reflected by the standard errors presented at the end of this discussion.

Separate ratio-estimation processes were used for persons and for housing units. The ratio-estimation process for persons operated in 3 stages (Table 4). The first stage used 19 household-type groups (the first of which was empty by definition), the second stage used 2 groups (head of household and not head of household), and the third stage used 24 age-sex-race groups:

The ratio-estimation process for housing operated in 2 stages for occupied housing units and in 1 stage for vacant units (Table 5). The first stage for occupied units used 18 household-type groups (the first of which was empty by definition), and the second stage for occupied units used 4 groups (owner- and renter-occupied units by race). The single stage for vacant units used 3 groups: year-round for sale, year-round for rent, and other.

At each stage, for each of the groups, the ratio of the complete count to the weighted sample count in the group was computed and applied to the weight of each sample person or housing unit in the group. For population, this operation was performed for each of the 19 groups in the first stage, then for the 2 groups in the second stage, and finally for the 24 groups in the third stage. For occupied housing units, this was performed first for the 18 groups in the first stage and then for the 4 groups in the second stage.

As a rule, the weighted sample counts within each of the groups in the final stage should agree with the complete counts for the weighting areas. Close, although not exact, consistency can be expected for the groups in the preceding stages. There are some exceptions to this general rule, however. As indicated above, there may be differences between the complete counts and sample estimates when the tabulation area is not made up of whole weighting areas as in the case of traffic zones. As a result, sample estimates for traffic zones may not agree with complete counts when the traffic zone did not form a weighting area. Furthermore, so that the reliability would be increased, a separate ratio was not computed in a ratio-estimation group whenever certain criteria pertaining to the complete counts and the magnitude of the weight were not met. For example, for the 15- and 20-percent-population sample, the complete count of persons in a group had to exceed 85 persons and the ratio of the complete count to the unweighted sample count could not exceed 20. Where these criteria were not met, groups were combined in a specific order until the conditions were met. Where this occurred, consistency between the weighted sample and the complete counts would apply as indicated above for the combined group but not necessarily for each of the groups in the combination.

Each sample person or housing unit was assigned an integral weight to avoid the complications involved in rounding in the final tables. If, for example, the final weight for a group was 5.2, one-fifth of the persons or housing units in the group (selected at random) were assigned a weight of 6 and the remaining four-fifths a weight of 5.

The estimates realize some of the gains in sampling efficiency that would have resulted had the persons and housing units been stratified into the groups before sampling. The net effect is a reduction in both the sampling error and possible bias of most statistics below what would be obtained by weighting the results of the sample by a uniform factor (e.g., by weighting the 20 percent sample results by a uniform factor of 5). The reduction in sampling error will be trivial for some items and substantial for others. A by-product of this estimation procedure is that estimates for the urbanized area from this sample are, in general, consistent with the complete count for the groups used in the estimation procedure. However, this consistency will not be fully evident for tabulations by individual traffic zones in this report.

Sampling Variability

The estimates from sample tabulations are subject to sampling variability. The standard errors of these estimates can be approximated by using the data given in Tables 6, 7, and 8. The chances are about 2 out of 3 that the difference (due to sam-

Table 3. Worker-tally printout.

UAC ^a	Number of Workers	Workers Coded to			Workers Not in SMSA
		Blocks	ZC	UAC	
1	112,563	72,223	27,068	5,653	7,619
2	1,694	0	0	0	1,694
85001	11,451	11,433	7	11	0
85002	75,424	54,016	17,619	3,789	0
85003	16,582	6,774	9,302	506	0
85022	70	0	0	70	0
85024	89	0	0	89	0
85031	345	0	67	278	0
85034	33	0	7	26	0
85035	322	0	12	310	0
85036	47	0	0	47	0
85038	20	0	0	20	0
85040	49	0	26	23	0
85042	512	0	28	484	0
99999	5,925	0	0	0	5,925

^a85001 = Albuquerque central business district; 85002 = remainder of Albuquerque city; 85003 = remainder of Bernalillo County (remainder of Albuquerque, New Mexico, SMSA); and 85022-85042 = county that is adjacent to the Albuquerque, New Mexico, SMSA.

Table 4. Ratio-estimation stages for persons.

Stage	Group	Description
1	1-6	Male head with own children under 18 1- to 6-or-more-person households
	7-12	Male head without own children under 18 1- to 6-or-more-person households
	13-18	Female head 1- to 6-or-more-person households
2	19	Group-quarters persons
	20	Head of household
	21	Not head of household (including persons in group quarters)
3		Male Negro
	22	Under 5 years
	23	5 to 13
	24	14 to 24
	25	25 to 44
	26	45 to 64
	27	65 and older
	28-33	Male, not Negro Same age groups as for male Negro
	34-39	Female Negro Same age groups as for male Negro
	40-45	Female, not Negro Same age groups as for male Negro

Table 5. Ratio-estimation stages for houses.

Housing Unit	Stage	Group	Description
Occupied	1	1-6	Male head with own children under 18 1- to 6-or-more-person households
		7-12	Male head without own children under 18 1- to 6-or-more-person households
		13-18	Female head 1- to 6-or-more-person households
	2		Owner occupied
		19	Negro
		20	Not Negro
			Renter occupied
		21	Negro
		22	Not Negro
Vacant	1	23	Year-round for sale
		24	Year-round for rent
		25	Other

Table 6. Approximate standard error of estimated number based on 20 percent sample.

Estimated Number	Type 1 Statistic ^a	Type 2 Statistic ^b
25	10	10
50	15	15
100	20	20
200	30	30
500	45	45
1,000	60	60
1,500	75	75
2,000	85	90
2,500	95	100
5,000	130	135
10,000	150	185
15,000	150	220
20,000	110	240
25,000	...	255
35,000	...	265
50,000	...	245
60,000	...	195
70,000	...	65

Note: Range of 2 chances out of 3.

^aCounts of housing units, households, families, or other data that ordinarily appear once in a given housing unit.

^bCounts of persons.

Table 7. Approximate standard error of estimated percentage based on 20 percent sample.

Estimated Percentage	Base of Percentage								
	200	500	1,000	2,500	7,500	10,000	20,000	25,000	70,000
2 or 98	2.0	1.3	0.9	0.6	0.3	0.3	0.2	0.2	0.1
5 or 95	3.1	2.0	1.4	0.9	0.5	0.4	0.3	0.3	0.2
10 or 90	4.2	2.7	1.9	1.2	0.7	0.6	0.4	0.4	0.2
25 or 75	6.1	3.9	2.7	1.7	1.0	0.9	0.6	0.5	0.3
50	7.1	4.5	3.2	2.0	1.2	1.0	0.7	0.6	0.4

Note: Range of 2 chances out of 3.

Table 8. Factor to be applied to standard error.

Tabulation Number ^a	Tabulation Rate (percent)	Type of Statistic ^b	Factor	Tabulation Number ^a	Tabulation Rate (percent)	Type of Statistic ^b	Factor
IA-1	20	2	1.0	ID-7	15	1	1.2
IA-2	20	2	2.6	ID-8	20	1	1.1
IA-3	15	2	1.3	ID-9	20	1	1.1
IA-4	20	2	1.0	ID-10	15	1	1.2
IA-5	20	2	1.2	IIA-1	15	1	1.0
IA-6	20	2	1.2	IIA-2	20	1	1.0
IA-7	20	2	1.2	IIA-3	20	1	0.9
IB-1	20	1	1.2	IIA-4	15	1	1.2
IB-2	20	1	1.2	IIA-5	15	1	1.0
IB-3	20	1	1.2	IIA-6	20	1	1.0
IC-1	20	1	0.7	IIB-1	15	1	1.2
IC-2	20	1	0.8	IIB-2	15	1	1.2
IC-3	15	1	1.4	IIB-3	15	1	1.2
IC-4	20	1	1.2	IIB-4	15	1	1.2
IC-5	20	1	1.2	IIB-5	15	1	1.2
IC-6	20	1	1.2	IIB-6	15	1	1.2
ID-1	20	1	0.3	III-1	15	2	1.4
ID-2	20	1	1.4	III-2	15	2	1.6
ID-3	20	1	0.9	III-3	15	2	1.7
ID-4	20	1	1.1	III-4	15	2	1.7
ID-5	20	1	1.0	IV	15	2	1.8
ID-6	20	1	1.2				

^a See 1970-Census Urban Transportation Planning Package: Summary Tape Documentation, reprinted in the appendix to this report.

^b See Table 6.

pling variability) between the sample estimate and the figure that would have been obtained from a complete count of the population is less than the standard error. The chances are about 19 out of 20 that the difference is less than twice the standard error and about 99 out of 100 that it is less than $2\frac{1}{2}$ times the standard error. The amount by which the estimated standard error must be multiplied to obtain other odds deemed more appropriate can be found in most statistical textbooks. The sampling errors may be obtained by using the factors given in Table 8 in conjunction with data given in Table 6 for absolute numbers and in Table 7 for percentages. In addition to sampling errors, these tables reflect the effect of simple response variance, but not of bias arising in the collection, processing, and estimation steps or of the correlated error enumerators introduced. Estimates of the magnitude of some of these factors in the total error will be published at a later date.

Table 6 gives approximate standard errors of estimated numbers for most statistics based on the 20 percent sample. In the determination of the figures for this table, some aspects of the sample design, the estimation process, and the population of the area over which the data have been compiled are ignored. Table 7 gives standard errors of most percentages based on the 20 percent sample. Linear interpolation in Tables 6 and 7 will provide approximate results that are satisfactory for most purposes. Table 8 provides a factor by which the standard errors given in Tables 6 or 7 should be multiplied to adjust for the combined effect of the sample size (i.e., whether a 20 percent or 15 percent sample), the sample design, and the estimation procedure.

In Table 8, the tabulation number is the number that identifies the particular data in the Summary Tape Technical Documentation (reprinted in the appendix to this report). For example, to find the standard error on 150 housing units with 1 automobile available for a traffic zone of residence under tabulation number ID-10, interpolate in Table 6 for an approximate standard error of 25 (type 1 statistic) on a total of 150 housing units. The factor for items under tabulation number ID-10 is given in Table 8 as 1.2. Therefore, the standard error is approximately $25 \times 1.2 = 30$. To estimate the standard error for a percentage having a given characteristic, locate in Table 8 the factor applying to the tabulation number and multiply this factor by the standard error found in Table 7. The standard errors estimated from these tables are not directly applicable to differences between 2 sample estimates. To estimate the standard error of a difference, the tables are to be used somewhat differently in the 3 following situations.

1. For a difference between the sample figure and one based on a complete count (e.g., arising from comparisons between 1970 sample statistics and complete-count statistics for 1960 or 1950), the standard error is identical with the standard error of the 1970 estimate alone.
2. For a difference between 2 sample figures (that is, one from 1970 and the other from 1960 or both from the same census year), the standard error is approximately the square root of the sum of the squares of the standard errors of each estimate considered separately. This formula will represent the actual standard error accurately for the difference between estimates of the same characteristic in 2 different areas or for the difference between separate and uncorrelated characteristics in the same area. If, however, there is a high positive correlation between the 2 characteristics, the formula will overestimate the true standard error. The approximate standard error for the 1970 sample figure is derived directly from Tables 6, 7, and 8. The standard error of a 25 percent 1960 sample figure may be obtained from the relevant 1960 census report or an approximate value may be obtained by multiplying the appropriate value in Table 6 or 7 by 0.9.
3. For a difference between 2 sample estimates, one of which represents a subclass of the other, the tables can be used directly, and the difference is considered as the sample estimate.

Acknowledgment

This appendix was prepared by the Statistical Methods Division, Bureau of the Census.