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Selected Characteristics of Travel to Work in the San Francisco-Oakland SMSA: 1975

INTRODUCTION

This report is one of a series of publications of final data for selected standard metropolitan statistical areas (SMSA's), from the Travel-to-Work Supplement to the Annual Housing Survey (AHS), initiated in 1975 under the sponsorship of the U.S. Department of Transportation (DOT). The AHS is conducted for the U.S. Department of Housing and Urban Development. The data in this report are based on interviews of households in the San Francisco-Oakland SMSA completed during the period from April 1975 through March 1976. Preliminary data from the Travel-to-Work Supplement, covering the first 4 months of the period, were previously published in Series P-23, No. 68, "Selected Characteristics of Travel to Work in 21 Metropolitan Areas: 1975."

MAJOR COMMUTING FLOWS

The largest commuting flow in the SMSA in 1975, about 535,000 workers, was comprised of persons who both lived and worked in the suburbs (table 1). In comparison, about 138,000 workers who lived in the suburbs commuted into San Francisco, and 77,000 commuted into Oakland. Approximately 219,000 of the workers who lived in San Francisco also worked there, while 22,000 workers lived in the city and worked in the suburbs. Among Oakland residents, 63,000 worked in Oakland, 32,000 in the suburbs, and 12,000 commuted into San Francisco. About 1 percent of the workers living in each central city worked outside the SMSA, compared with 5 percent of those living in the suburbs.

MEANS OF TRANSPORTATION TO WORK

Of the more than 1.2 million workers living in the San Francisco-Oakland SMSA in 1975, the survey results show that the majority (61 percent) usually drove to work alone (table 2). The proportion who used public transportation to get to work (16 percent) was slightly larger than the proportion who used carpools (14 percent), while 5 percent walked, 2 percent worked at home, and 2 percent used other means. Workers who lived in the suburbs were more likely to drive alone to work (68 percent) than residents of the central cities (45 percent), while workers who lived in the central cities were more likely to use public transportation (30 percent) than suburban residents (9 percent).

SELECTED CHARACTERISTICS OF COMMUTERS BY MEANS OF TRANSPORTATION

Sex. A greater proportion of men than women drove alone to work in 1975, while women were more likely than men to use public transportation (table 3). The difference between male and female workers in the rate of carpooling was not significant.

Race. Black workers showed a higher incidence of using public transportation (21 percent) than White[1] workers (15 percent). However, the differences in the proportions of Blacks and Whites who either drove alone or traveled in carpools were not significant (table 3).

Household relationship. Female household heads were less likely to either drive alone or carpool to work, and more likely to use public transportation than male household heads in 1975 (table 3). Comparing working wives with female household heads, the data indicate that the wives were more likely to carpool and less likely to use public transit than female heads of households. Twenty-six percent of the female heads used public transportation compared with 16 percent of the working wives.

Earnings. Comparing the three most widely used means of transportation, workers who drove alone to work had the highest median earnings ($11,324), followed by those in carpools ($10,378), and users of public transit ($9,024).

[1] The racial category "White and other races" is referred to as "White" in the text for convenience.

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TRAVEL DISTANCE AND TRAVEL TIME TO WORK

Travel distance by means of transportation. Among all workers in the metropolitan area, the average commuting trip was 10 miles in 1975 (table 4). Workers who used carpools to get to work reported traveling farther (13 miles), on the average, than workers who drove alone (10 miles) or rode public transportation (10 miles).

Travel time by means of transportation. The average commuting trip in the SMSA took 23 minutes in 1975 (table 5). Workers who drove alone reported an average of 20 minutes to get to work, compared with 25 minutes for those who carpooled. Public transportation users spent an average of 37 minutes getting to work.

BACKGROUND AND STRUCTURE OF THE SURVEY

The Travel-to-Work Supplement to the Annual Housing Survey. The travel-to-work data presented in this report are based on information collected by personal interview during the period from April 1975 through March 1976, as part of the enumeration for the Annual Housing Survey Group II SMSA sample. In all, the occupants of 14,523 sample households in the San Francisco-Oakland SMSA were eligible to answer the inquiries contained in the Travel-to-Work Supplement. The interviews resulted in responses from 25,776 workers 14 years old or over. A facsimile of the Travel-to-Work Supplement can be found in appendix B.

The Travel-to-Work Supplement was also included for the 1975 Annual Housing Survey National sample, and the 1976-77 and 1977-78 SMSA samples. Each of the SMSA samples contained about 140,000 households spread over 20 SMSA's; for operational reasons the 1975-76 enumeration covered 21 areas. Therefore, the 3-year cycle of SMSA samples resulted in coverage of about 420,000 metropolitan households in 60 SMSA's. (See list of SMSA's by Survey Group.) Each of the survey groups of SMSA's contained four very large SMSA's with approximately 15,000 sample housing units equally divided between the central city and the SMSA balance. Each remaining SMSA contained about 5,000 sample housing units distributed in proportion to the actual distribution of housing units between the central city and the SMSA balance. The survey coverage relates to each SMSA as defined for the 1970 census. A more detailed description of the survey design and sampling procedures can be found in appendix A.

Related travel-to-work data. In addition to this report, several other data products are or will be available from each of the three SMSA survey groups covered by the Travel-to-Work Supplement. These products include other published reports, unpublished tables, microdata tapes, and summary tapes of census tract-to-census tract commuter flows for each

List of SMSA's by Survey Group

SURVEY GROUP I (1977 to 1978)	SURVEY GROUP II (1975 to 1976)	SURVEY GROUP III (1976 to 1977)
Albany-Schenectady-Troy, N.Y.	Atlanta, Ga.*	Allentown-Bethlehem-Easton, Pa.-N.J.
Anaheim-Santa Ana-Garden Grove, Calif.	Chicago, Ill.*	Baltimore, Md.
Boston, Mass.*	Cincinnati, Ohio-Ky.-Ind.	Birmingham, Ala.
Dallas, Tex.	Colorado Springs, Colo.	Buffalo, N.Y.
Detroit, Mich.*	Columbus, Ohio	Cleveland, Ohio
Fort Worth, Tex.	Hartford, Conn.	Denver, Colo.
Los Angeles-Long Beach, Calif.*	Kansas City, Mo.-Kans.	Grand Rapids, Mich.
Madison, Wis.†	Miami, Fla.	Honolulu, Hawaii
Memphis, Tenn.-Ark.	Milwaukee, Wis.	Houston, Tex.*
Minneapolis-St. Paul, Minn.	New Orleans, La.	Indianapolis, Ind.
Newark, N.J.	Newport News-Hampton, Va.	Las Vegas, Nev.
Orlando, Fla.	Paterson-Clifton-Passaic, N.J.	Louisville, Ky.-Ind.
Phoenix, Ariz.	Philadelphia, Pa.-N.J.*	New York, N.Y.*
Pittsburgh, Pa.	Portland, Oreg.-Wash.	Oklahoma City, Okla.
Saginaw, Mich.	Rochester, N.Y.	Omaha, Nebr.-Iowa
Salt Lake City, Utah	San Antonio, Tex.	Providence-Pawtucket-Warwick, R.I.-Mass.
Spokane, Wash.	San Bernardino-Riverside-Ontario, Calif.	Raleigh, N.C.
Tacoma, Wash.	San Diego, Calif.	Sacramento, Calif.
Washington, D.C.-Md.-Va.*	San Francisco-Oakland, Calif.*	St. Louis, Mo.-Ill.*
Wichita, Kans.	Springfield-Chicopee-Holyoke, Mass.-Conn.	Seattle-Everett, Wash.*

* Sample size of 15,000 housing units; all others are 5,000 housing units.
† Included with Group II for the first (1975-76) enumeration.

SMSA. Data for the SMSA's in Survey Group II are currently available in all forms. Data for the SMSA's in Survey Group III are presently only available in **Current Population Reports,** Series P-23, No. 72, "Selected Characteristics of Travel to Work in 20 Metropolitan Areas: 1976." No data for the SMSA's in Survey Group I have yet been released.

Data from the 1975 National Travel-to-Work Supplement are currently available in **Current Population Reports,** Series P-23, No. 99, "The Journey to Work in the United States: 1975" and in the form of unpublished tables. As in the SMSA samples, the unpublished National tables cross-classify commuters and characteristics of the commuting trip by the socioeconomic characteristics obtainable from the Annual Housing Survey, which include age, sex, race, household relationship, and earnings. Information concerning these unpublished data may be obtained by writing to the Chief, Population Division, U.S. Bureau of the Census, Washington, D.C. 20233.

Table 1. Place of Residence, by Place of Work, for the San Francisco-Oakland SMSA

(Workers 14 years old and over. Numbers in thousands. SMSA as of the 1970 census. For explanation of symbols, see text)

Place of residence	All workers	Reported a fixed place of work							No fixed place of work	Place of work not reported
			Inside the SMSA					Outside the SMSA		
				Inside central cities			Outside central cities			
		Total	Total	Total	San Francisco city	Oakland city				
SMSA	1,278	1,148	1,102	513	370	144	589	46	120	10
Central cities	392	355	352	298	232	67	54	3	32	4
San Francisco city	273	248	245	223	219	4	22	2	22	2
Oakland city	119	108	107	75	12	63	32	1	10	2
Outside central cities	887	792	750	215	138	77	535	42	88	7
PERCENT DISTRIBUTION										
SMSA	[100.0]	100.0	96.0	44.7	32.2	12.5	51.3	4.0	[9.4]	[0.8]
Central cities	[100.0]	100.0	99.0	83.9	65.2	18.8	15.1	1.0	[8.2]	[1.0]
San Francisco city	[100.0]	100.0	99.0	90.1	88.5	1.6	9.0	1.0	[8.2]	[0.8]
Oakland city	[100.0]	100.0	99.1	69.8	11.5	58.3	29.3	0.9	[8.3]	[1.4]
Outside central cities	[100.0]	100.0	94.6	27.2	17.4	9.7	67.5	5.4	[9.9]	[0.7]

Note: Percents in brackets, [ ], are of all workers.

Table 2. Principal Means of Transportation to Work, by Place of Residence, for the San Francisco-Oakland SMSA

(Workers 14 years old and over. Numbers in thousands. SMSA as of the 1970 census. For explanation of symbols, see text)

Means of transportation	SMSA			Percent distribution		
				SMSA		
	Total	Inside central city (cities)	Outside central city (cities)	Total	Inside central city (cities)	Outside central city (cities)
All workers	1,278	392	887	100.0	100.0	100.0
Auto or truck	961	225	736	75.2	57.4	83.0
Drives alone	778	175	603	60.9	44.7	68.0
Carpool	183	49	133	14.3	12.6	15.0
Public transportation	201	119	82	15.7	30.4	9.2
Bus or streetcar	157	109	48	12.3	27.9	5.4
Subway or elevated	8	5	3	0.7	1.3	0.4
Railroad	34	4	30	2.6	1.0	3.3
Taxicab	1	1	-	0.1	0.2	-
Walks only	60	33	27	4.7	8.4	3.0
Other means	27	5	22	2.1	1.2	2.5
Bicycle	14	2	12	1.1	0.5	1.4
Motorcycle	8	2	6	0.6	0.5	0.7
All other means	5	1	4	0.4	0.3	0.5
Works at home	30	11	19	2.3	2.7	2.2

Table 3. Principal Means of Transportation to Work, by Selected Characteristics of Commuters, for the San Francisco-Oakland SMSA

(Workers 14 years old and over. SMSA as of the 1970 census. For explanation of symbols, see text)

Characteristics	All workers (thousands)	Percent by means of transportation						
			Auto or truck		Public transportation	Walks only	Other means	Works at home
		Total	Drives alone	Carpool				
All workers	1,278	100.0	60.9	14.3	15.7	4.7	2.1	2.3
SEX								
Male	761	100.0	64.6	13.9	12.4	4.2	2.9	1.9
Female	517	100.0	55.3	14.8	20.5	5.4	1.0	2.9
RACE								
White and other	1,168	100.0	61.0	14.3	15.2	4.9	2.3	2.4
Black	110	100.0	59.9	14.5	20.6	2.8	0.5	1.7
HOUSEHOLD RELATIONSHIP								
Head	801	100.0	64.6	12.8	14.7	4.1	1.9	1.9
Male	643	100.0	66.7	14.0	11.9	3.5	2.1	1.9
Female	158	100.0	56.2	8.1	26.1	6.5	1.1	2.1
Wife of head	262	100.0	57.7	18.5	15.6	4.4	0.5	3.4
Other member	215	100.0	50.9	14.7	19.6	7.3	5.0	2.6
EARNINGS								
Without earnings or not reported	169	100.0	56.2	12.0	13.9	6.3	2.4	9.0
With earnings	1,110	100.0	61.6	14.6	16.0	4.4	2.1	1.3
$1 to 5,999	289	100.0	52.9	14.4	18.2	8.0	3.3	3.4
$6,000 to 9,999	241	100.0	58.1	15.0	19.6	5.4	1.2	0.5
$10,000 to 14,999	279	100.0	65.8	15.5	13.8	2.7	1.7	0.5
$15,000 to 24,999	238	100.0	70.0	13.7	12.0	1.8	1.9	0.5
$25,000 or more	62	100.0	64.9	13.8	16.2	1.9	1.8	1.6
Median earnings	$10,416	...	$11,324	$10,378	$9,024	$6,374	$8,238	$3,126
Mean earnings	$11,101	...	$11,794	$10,988	$10,224	$7,141	$9,038	$7,168

Table 4. Principal Means of Transportation, by Distance to Work, for the San Francisco-Oakland SMSA

(Workers 14 years old and over. SMSA as of the 1970 census. For explanation of symbols, see text)

Means of transportation	Total[1] (thousands)	Percent distribution by distance to work (miles)									Median	Mean
		Total	Less than 1	1 to 2	3 to 4	5 to 9	10 to 14	15 to 24	25 to 49	50 or more		
All workers[1]	1,128	100.0	7.7	13.3	15.5	24.1	13.0	16.8	9.1	0.5	7.3	9.8
Drives alone	688	100.0	4.3	13.4	16.1	26.0	13.7	17.0	8.9	0.6	7.6	10.1
Carpool	170	100.0	2.6	8.9	12.7	22.2	15.4	22.5	14.9	0.8	10.6	12.7
Public transportation[2]	191	100.0	1.9	12.7	20.7	27.1	12.5	17.0	8.1	-	7.2	9.5
Bus or streetcar	149	100.0	2.2	15.7	25.1	28.9	10.8	13.3	3.8	-	5.7	7.6
Subway or elevated	8	100.0	3.6	2.4	15.7	33.7	22.9	18.1	4.8	-	8.7	9.8
Railroad	32	100.0	-	1.2	1.5	17.0	17.6	34.0	28.7	-	18.2	18.1
Walks only	56	100.0	80.6	18.8	0.7	-	-	-	-	-	0.1	0.2
Other means	23	100.0	15.0	34.3	12.9	16.7	9.9	9.0	2.1	-	2.6	5.6

[1] Excludes workers with no fixed place of work and workers who worked at home.
[2] Includes workers using taxicabs.

Table 5. Principal Means of Transportation, by Travel Time to Work, for the San Francisco-Oakland SMSA

(Workers 14 years old and over. SMSA as of the 1970 census. For explanation of symbols, see text)

Means of transportation	Total[1] (thousands)	Percent distribution by travel time to work (minutes)									Median	Mean
		Total	Less than 10	10 to 14	15 to 24	25 to 29	30 to 34	35 to 49	50 to 59	60 or more		
All workers[1]	1,128	100.0	14.3	15.2	31.5	5.5	13.8	12.4	1.2	6.1	21.0	23.0
Drives alone	688	100.0	16.7	18.1	35.2	5.5	12.1	9.0	0.6	2.8	18.8	19.6
Carpool	170	100.0	8.7	13.5	31.3	6.6	16.7	16.2	2.0	5.1	23.4	24.9
Public transportation[2]	191	100.0	1.0	3.2	20.7	5.6	21.1	25.4	2.9	20.1	34.1	37.2
Bus or streetcar	149	100.0	1.3	3.7	23.0	6.4	22.5	24.0	2.8	16.2	33.0	35.1
Subway or elevated	8	100.0	1.2	2.4	22.9	3.6	24.1	32.5	1.2	12.0	33.8	35.7
Railroad	32	100.0	-	0.3	9.0	2.2	14.2	30.6	3.4	40.4	46.5	48.1
Walks only	56	100.0	45.5	22.4	23.6	2.0	4.6	1.4	0.2	0.4	10.5	11.0
Other means	23	100.0	18.9	24.0	27.5	3.9	8.2	4.3	1.7	11.2	17.1	22.7

[1] Excludes workers with no fixed place of work and workers who worked at home.
[2] Includes workers using taxicabs.

Appendix A—Source and Reliability of the Estimates

SAMPLE DESIGN

The DOT Travel-to-Work Supplement and The Annual Housing Survey

The DOT Travel-to-Work Supplement data are based on interviews completed during the period April 1975 through March 1976 in 21 SMSA's as part of the enumeration for the Year II Annual Housing Survey (AHS) sponsored by the Department of Housing and Urban Development. Under the sponsorship of the Department of Transportation (DOT), the 1975 AHS-SMSA questionnaire included a supplementary group of questions pertaining to travel-to-work. In the four largest SMSA's, the survey sample consisted of about 15,000 housing units, and for the remaining 17 SMSA's, the survey was based on a sample of about 5,000 housing units.

In this SMSA, 14,523 housing units were eligible for interview in AHS. Of these sample units, 861 interviews were not obtained because, for occupied sample units, the occupants were not at home after repeated visits or were unavailable for some other reason; or for vacant units, no informed respondent could be found after repeated visits. In addition to units eligible for interview, 934 units were visited but found not to be eligible for interview because they were condemned, unfit, demolished, converted to group quarters use, etc. Within the interviewed households of this SMSA there were 26,135 persons 14 years and older. Of these, 359 persons did not respond to the DOT Travel-to-Work Supplement.

Selection of the AHS-SMSA sample. The sample for the SMSA's which are 100 percent permit-issuing was selected from two sample frames—units enumerated in the 1970 Census of Population and Housing in areas under the jurisdiction of permit-issuing offices (the permit-issuing universe) and units constructed in permit-issuing areas since the 1970 census (the new construction universe). In addition, the sample for those SMSA's which are not 100 percent permit-issuing included a sample selected from a third frame—those units located in areas not under the jurisdiction of permit-issuing offices (the nonpermit universe). This SMSA is 100 percent permit-issuing. A more detailed description of the selection of the sample can be found in the AHS Series H-170 reports for 1975.

ESTIMATION

The estimation procedure for the DOT Travel-to-Work Supplement utilized the AHS-SMSA housing inventory estimation procedure modified for the DOT Supplement as described below.

AHS-SMSA Housing Inventory Estimation Procedure

Initially the basic weight (i.e., the inverse of the probability of selection) for each interviewed sample housing unit was adjusted to account for the noninterviews previously mentioned. The noninterview adjustment factor was equal to the following ratio:

$$\frac{\text{Weighted count of interviewed housing units} + \text{Weighted count of noninterviewed housing units}}{\text{Weighted count of interviewed housing units}}$$

Within each sector (central city and balance) of each SMSA, a noninterview factor was computed separately for 56 noninterview cells.

A ratio estimation procedure was then employed for all sample housing units from the permit-issuing universe. This factor was computed separately for all sample housing units within the 54 noninterview cells pertaining to the permit-issuing universe. The ratio estimate factor for each cell was equal to the following:

$$\frac{\text{1970 census count of housing units from permit-issuing universe in a cell}}{\text{AHS sample estimate of 1970 housing units from the cell}}$$

DOT Supplement Adjustments. For the DOT Supplement, the weight resulting from the AHS-SMSA estimation procedure described above was adjusted to account for persons in households that were interviewed for AHS-SMSA who did not respond to the travel-to-work section of the questionnaire. This noninterview adjustment factor was calculated separately for each sector of each SMSA. Within each sector of each SMSA, a noninterview factor was computed separately for sex, age, and marital status categories.

The final adjustment for persons interviewed for the DOT Supplement was an additional ratio estimation procedure. This procedure was designed to adjust the AHS-SMSA sample estimate of persons 14 years and older in each SMSA to an independently derived current estimate of that same population group. In SMSA's where there was no evidence of differential undercoverage of persons within the sectors, the sample estimate of persons 14+ in the SMSA was adjusted to an independently derived estimate of persons 14+ in the SMSA. For SMSA's where there was evidence of differential

undercoverage within the sector, this ratio estimation was performed separately by central city and balance of the SMSA. The factor used for the ratio estimation procedure was calculated as follows:

$$\frac{\text{Independent estimate of persons 14+ in the SMSA (or sector)}}{\text{Sample estimate of persons 14+ in the SMSA (or sector)}}$$

The numerator of this ratio was based on the Census Bureau's estimates of population 14+ as of October 1, 1975. The denominator of this ratio was obtained from the weighted estimate of persons interviewed for the DOT Supplement, using the existing weight after the DOT Supplement noninterview adjustment had been applied. For this SMSA, one person ratio estimate factor was calculated for the whole SMSA.

The weight that resulted from the application of this final adjustment was the tabulation weight utilized to produce final tabulations.

The effect of this person ratio estimation, as well as the overall estimation procedure, was to reduce the sampling error for most statistics below what would have been obtained by simply weighting the results of the sample by the inverse of the probability of selection. Since the population 14 years and older of the sample differed somewhat by chance from the actual population in each city, SMSA balance, or SMSA as a whole, it can be expected that the sample estimates will be improved when the sample population is brought into agreement with known independent estimates of the actual population.

RELIABILITY OF THE DATA

There are two types of possible errors associated with data from sample surveys: sampling and nonsampling errors. The following is a description of the sampling and nonsampling errors associated with the DOT Travel-to-Work Supplement.

Nonsampling Errors

In general, nonsampling errors can be attributed to many sources: inability to obtain information about all cases, definitional difficulties, differences in the interpretation of questions, inability or unwillingness to provide correct information on the part of respondents, mistakes in recording or coding the data, and other errors of collection, response, processing, coverage, and estimation for missing data.

The DOT Travel-to-Work Supplement. One possible source of bias in the DOT Travel-to-Work Supplement data is proxy interviewing. That is, responses for a particular worker may have been given by someone else who is not as knowledgeable as the worker himself. For example, the person available for the interview may not know how long it takes the reference person (worker) to travel to work or whether or not the principal means of transportation to work is satisfactory to the worker. Although it is known that biases due to proxy interviewing, as well as other nonsampling errors, could exist in the DOT Travel-to-Work Supplement, their magnitude is unknown.

Reinterview program. No reinterview program was undertaken for the DOT Travel-to-Work Supplement. However, for the 1975 AHS-SMSA sample a study was conducted to obtain a measurement of some of the components of the nonsampling error associated with the AHS estimates. Results of this study may be a useful indicator of the accuracy to be expected in the travel-to-work data which was collected as a supplement to the AHS-SMSA data. A detailed description can be found in the AHS Series H-170 reports for 1975.

Coverage errors. With respect to errors of coverage and estimation for missing data, it is believed that the AHS new construction sample had deficiencies with regard to the representation of both conventional new construction and new mobile homes (and trailers) in permit-issuing areas. Although it is not known exactly, an estimated 7,200 conventional new construction units and 2,300 new mobile homes in permit-issuing areas in this SMSA were missed by the 1975 AHS-SMSA survey. It is felt that deficiencies also exist in non-permit-issuing areas. The 1975 AHS sample has been estimated to miss as much as 2 percent of all housing units in these areas.

Therefore, all persons 14 years or older who live in the above "missing" housing units or who live in enumerated housing units but were not detected by the enumerators had no chance for enumeration in the DOT Travel-to-Work Supplement. The person ratio estimation corrects for these deficiencies with respect to the count of persons 14+ in each SMSA. However, biases associated with estimates of travel-to-work characteristics of these people may still remain.

Rounding errors. With respect to errors associated with processing, the rounding of estimates introduces another source of error in the data, the severity of which depends on the statistic being measured. The effect of rounding is significant relative to the sampling error only for small percentages and medians derived from relatively large bases (e.g., median number of workers per household or median distance traveled to work).

This means that confidence intervals formed from the standard errors given may be distorted, and this should be taken into account when considering the results of the survey.

Sampling errors. The particular sample used for this survey is one of a large number of possible samples of the same size that could have been selected using the same sample design. Even if the same schedules, instructions, and enumerators were used, estimates from each of the different samples would differ from each other. The variability between estimates from all possible samples is defined as the sampling error. One common measure of this sampling error is the standard error which measures the precision with which an estimate from a sample approximates the average result of all possible samples.

In addition, the standard error as calculated for this survey also partially measures the variation in the estimates due to some nonsampling errors, but it does not measure, as such, any systematic biases in the data. Therefore, the accuracy of the estimates depends on both the sampling and

nonsampling error, measured by the standard error, biases, and some additional nonsampling errors not measured by the standard error.

The sample estimate and its estimated standard error enable the user to construct interval estimates in which the interval includes the average result of all possible samples with a known probability. For example, if all possible samples were selected, each of these surveyed under essentially the same general conditions, and an estimate and its estimated standard error were calculated from each sample, then:

1. Approximately 68 percent of the intervals from one standard error below the estimate to one standard error above the estimate would include the average result of all possible samples.
2. Approximately 90 percent of the intervals from 1.6 standard errors below the estimate to 1.6 standard errors above the estimate would include the average result of all possible samples.
3. Approximately 95 percent of the intervals from two standard errors below the estimate to two standard errors above the estimate would include the average result of all possible samples.

For very small estimates the lower limit of the confidence interval may be negative. In this case, a better approximation to the true interval estimate can be achieved by restricting the interval estimate to positive values, that is, by changing the lower limit of the interval estimate to zero.

The average result of all possible samples either is or is not contained in any particular computed interval. However, for a particular sample, one can say with specified confidence that the average result of all possible samples is included in the constructed interval.

All the statements of comparison appearing in the text are significant at a 1.6 standard error level or better, and most are significant at a level of more than 2.0 standard errors. This means that for most differences cited in the text, the estimated difference is greater than twice the standard error of the difference. Statements of comparison qualified in some way (e.g., by use of the phrase, "some evidence") have a level of significance between 1.6 and 2.0 standard errors.

The figures presented in the tables below are approximations to the standard errors of various estimates for this SMSA. In order to derive standard errors that would be applicable to a wide variety of items and also could be prepared at a moderate cost, a number of approximations were required. As a result, the tables of standard errors provide an indication of the order of magnitude of the standard errors rather than precise standard errors for any specific item.

Tables A-1 through A-4 present the standard errors applicable to estimates of travel-to-work characteristics of persons 14 years and older who were employed at the time of the 1975-76 AHS-SMSA survey. Standard errors for estimates not shown in the tables can be obtained by linear interpolation. Included in these tables are estimates of standard errors for estimates of zero and zero percent. These estimates of standard errors are considered to be overestimates of the true standard errors.

Illustration of the Use of the Standard Error Tables

Table 3 of the report indicates that there were 517,000 female workers in this SMSA in 1975-76. Interpolation in table A-1 of the appendix shows that the standard error of an estimate of this size is approximately 6,560. Consequently, the 68-percent confidence interval, as shown by these data, is from 510,440 to 423,560. Therefore, a conclusion that the average estimate, derived from all possible samples, of female workers lies within a range computed in this way would be correct for roughly 68 percent of all possible samples. Similarly, we could conclude that the average estimate, derived from all possible samples, lies within the interval from 506,500 to 527,500 workers with 90-percent confidence and within the interval from 503,880 to 530,120 with 95-percent confidence.

Table 3 also shows that of the 517,000 female workers, 20.5 percent commuted by means of public transportation. Interpolation in table A-2 of the appendix shows that the standard error of the percent is approximately 0.5 percentage points. Consequently, the 68-percent confidence interval, as shown by these data, is from 20.0 to 21.0 percent; the 90-percent confidence interval is from 19.7 to 21.3 percent; and the 95-percent confidence interval is from 19.5 to 21.5 percent.

Standard errors of differences. The standard errors shown are not directly applicable to differences between two sample estimates. The standard error of a difference between estimates is approximately equal to the square root of the sum of the squares of the standard error of each estimate considered separately. This formula is quite accurate for the difference between estimates of the same characteristic in two different areas or the difference between separate and uncorrelated characteristics in the same area. However, if there is a high positive correlation between the two characteristics, the formula will overestimate the true standard error; whereas if there is a high negative correlation, the formula will underestimate the true standard error.

Illustration of the Computation of the Standard Error of a Difference

In 1975, 12.4 percent of the male workers in this SMSA commuted by means of public transportation. Thus, the apparent difference, as shown by these data, between the percentage of public transportation use by males and females is 8.1 percent. Table A-2 of the apppendix shows the standard error of 12.4 percent on a base of 761,000 is approximately 0.3, while the standard error of 20.5 percent is approximately 0.5 percent. Therefore, the standard error of the estimated difference of 8.1 percent is about

$$0.6 = \sqrt{(0.3)^2 + (0.5)^2}$$

Consequently, the 68-percent confidence interval for the 8.1 percent difference is from 7.5 to 8.7 percent. Therefore, a conclusion that the average estimate of this difference, derived from all possible samples, lies within a range computed in this way would be correct for roughly 68 percent of all possible samples. Similarly, the 90-percent confidence interval is from 7.1 to 9.1 percent, and the 95-percent confidence interval is from 6.9 to 9.3 percent. Thus, we can conclude with 95-percent confidence that the percentage of female workers who used public transportation in 1975 is greater than the percentage of male workers, since the 95-percent confidence interval does not include zero or negative values.

Standard error of a median. The sampling variability of an estimated median depends upon the form of the distribution as well as the size of its base. An approximate method for measuring the reliability of a median is to determine an interval about the estimated median, such that there is a stated degree of confidence that the median based on a complete census lies within the interval. The following procedure can be used to estimate the 68-percent confidence limits on sample data:

1. Determine, using the appropriate standard error table, the standard error of the estimate of 50 percent from the distribution.
2. Add to and subtract from 50 percent the standard error determined in step 1.
3. Using the distribution of the characteristic, calculate the confidence interval corresponding to the two points established in step 2.

A two-standard-error confidence interval may be determined by finding the values corresponding to 50 percent plus and minus twice the standard error determined in step 1.

Illustration of the Computation of a Confidence Interval for a Median

Table 5 of this report indicates that the median travel time to work for commuters who drove alone in 1975-76 was 18.8 minutes.

1. Using table A-2 of the appendix, the standard error of 50 percent on a base of 688,000 is found to be about 0.6 percent.
2. A 95-percent confidence interval on a 50 percent item is obtained by adding to and subtracting from 50 percent twice the standard error found in step 1. This yields percent limits 48.8 and 51.2.
3. The median interval is 15 to 24 minutes (14.5 to 24.5). It can be seen that 34.8 percent of the persons fall in the intervals below the median interval, while 35.2 percent fall in the median interval itself. Thus, the lower limit on the estimate is found to be about

$$14.5 + (24.5 - 14.5)\left(\frac{48.8-34.8}{35.2}\right) = 18.5$$

Similarly, the upper limit is found by linear interpolation to be about

$$14.5 + (24.5 - 14.5)\left(\frac{51.2-34.8}{35.2}\right) = 19.2$$

Thus, the 95-percent confidence interval on the estimated median is from 18.5 to 19.2 minutes.

Standard error of an arithmetic mean. The standard error of an arithmetic mean can be approximated by the following formula:

$$\sigma_{\bar{x}} = \sqrt{\frac{b}{y} S^2}$$

where y is the size of the base, and b is a parameter which equals 106.2 for this SMSA, 84.0 for the central city, and 119.5 for the balance.

The variance, S^2, is given by

$$S^2 = \sum_{i=1}^{c} P_i \bar{X}_i^{\,2} - \left(\sum_{i=1}^{c} P_i \bar{X}_i\right)^2$$

where c is the number of groups; i indicates a specific group, thus taking on values 1 through c; P_i is the estimated proportion with the characteristic in group i; Z_{i-1} and Z_i are the lower and upper interval boundaries, respectively, for group i; and $\bar{x}_i = \frac{Z_{i-1} + Z_i}{2}$, which is assumed to be the most representative value for the characteristic for persons in group i. Group c is open-ended, i.e., no upper interval boundary exists. For this group an approximate average value is

$$\bar{x}_c = \frac{3}{2} Z_{c-1}$$

Illustration of the Computation of the Standard Error of an Arithmetic Mean

Table 5 of the report shows that the mean travel time for persons driving alone in 1975-76 was 19.6 minutes. The values of P_i and $\bar{X}_i$ for each group are shown below:

Class Interval	P_i	$\bar{X}_i$
Less than 10 min.	.167	4.5
10 to 14 min.	.181	12.0
15 to 24 min.	.352	19.5
25 to 29 min.	.055	27.0
30 to 34 min.	.121	32.0
35 to 49 min.	.090	42.0
50 to 59 min.	.006	54.5
60 min. or more	.028	90.0

The variance S^2 is equal to

$$S^2 = \sum_{i=1}^{8} P_i \bar{X}_i^{\,2} - \left(\sum_{i=1}^{8} P_i \bar{X}_i \right)^2 = 256.7$$

The b parameter is equal to 106.2. Thus the standard error on 19.6 minutes, $\sigma_{\bar{x}}$ is calculated to be

$$\sigma_{\bar{x}} = \sqrt{\frac{106.2}{688{,}000}\left(256.7\right)} = 0.2 \text{ minutes.}$$

Consequently, the 68-percent confidence interval is estimated to be from 19.4 to 19.8 minutes, the 90-percent confidence interval is from 19.3 to 19.9 minutes, and the 95-percent confidence interval is from 19.2 to 20.0 minutes.

Table A-1. Standard Errors for Estimated Number of Workers in the San Francisco-Oakland, Calif. SMSA, in the Central City of the SMSA, and in the Balance of the SMSA

(68 chances out of 100)

Size of estimate	Standard error			Size of estimate	Standard error		
	SMSA	In central city	Not in central city		SMSA	In central city	Not in central city
0	110	80	120	75,000	2,780	2,390	2,920
100	110	90	120	100,000	3,190	2,710	3,350
200	150	130	150	150,000	3,870	3,200	4,030
500	230	200	240	250,000	4,880	3,800	5,030
700	270	240	290	500,000	6,500	3,970	6,440
1,000	330	290	350	800,000	7,560	130	6,990
2,500	510	460	550	1,000,000	7,920	-	6,820
5,000	730	650	770	1,600,000	7,650	-	2,130
10,000	1,030	910	1,090	2,000,000	6,180	-	-
25,000	1,620	1,430	1,710	2,250,000	4,300	-	-
50,000	2,280	1,980	2,410				

Table A-2. Standard Errors for Estimated Percentage of Workers in the San Francisco-Oakland, Calif. SMSA

Base of percentage	Estimated percentage					
	0 or 100	1 or 99	5 or 95	10 or 90	25 or 75	50
100	51.5	51.5	51.5	51.5	51.5	51.5
200	34.7	34.7	34.7	34.7	34.7	36.4
500	17.5	17.5	17.5	17.5	20.0	23.0
700	13.2	13.2	13.2	13.2	16.9	19.5
1,000	9.6	9.6	9.6	9.8	14.1	16.3
2,500	4.1	4.1	4.5	6.2	8.9	10.3
5,000	2.1	2.1	3.2	4.4	6.3	7.3
10,000	1.1	1.1	2.2	3.1	4.5	5.2
25,000	0.4	0.6	1.4	2.0	2.8	3.3
50,000	0.2	0.5	1.0	1.4	2.0	2.3
75,000	0.14	0.4	0.8	1.1	1.6	1.9
100,000	0.11	0.3	0.7	1.0	1.4	1.6
150,000	0.07	0.3	0.6	0.8	1.2	1.3
250,000	0.04	0.2	0.4	0.6	0.9	1.0
500,000	0.02	0.15	0.3	0.4	0.6	0.7
800,000	0.01	0.11	0.3	0.3	0.5	0.6
1,000,000	0.01	0.10	0.2	0.3	0.4	0.5
1,600,000	0.01	0.08	0.2	0.2	0.4	0.4
2,000,000	0.01	0.07	0.2	0.2	0.3	0.4
2,250,000	0.01	0.07	0.15	0.2	0.3	0.3

Table A-3. Standard Errors for Estimated Percentage of Workers in the Central Cities of the SMSA

Base of percentage	Estimated percentage					
	0 or 100	1 or 99	5 or 95	10 or 90	25 or 75	50
100	45.6	45.6	45.6	45.6	45.6	45.8
200	29.6	29.6	29.6	29.6	29.6	32.4
500	14.4	14.4	14.4	14.4	17.7	20.5
700	10.7	10.7	10.7	10.7	15.0	17.3
1,000	7.7	7.7	7.7	8.7	12.5	14.5
2,500	3.2	3.2	4.0	5.5	7.9	9.2
5,000	1.7	1.7	2.8	3.9	5.6	6.5
10,000	0.8	0.9	2.0	2.7	4.0	4.6
25,000	0.3	0.6	1.3	1.7	2.5	2.9
50,000	0.2	0.4	0.9	1.2	1.8	2.0
75,000	0.11	0.3	0.7	1.0	1.4	1.7
100,000	0.08	0.3	0.6	0.9	1.3	1.4
150,000	0.06	0.2	0.5	0.7	1.0	1.2
200,000	0.04	0.2	0.4	0.6	0.9	1.0
250,000	0.03	0.2	0.4	0.5	0.8	0.9
500,000	0.02	0.13	0.3	0.4	0.6	0.6
800,000	0.01	0.10	0.2	0.3	0.4	0.5

Table A-4. Standard Errors for Estimated Percentage of Workers in the Balance of the SMSA

Base of percentage	Estimated percentage					
	0 or 100	1 or 99	5 or 95	10 or 90	25 or 75	50
100	54.4	54.4	54.4	54.4	54.4	54.7
200	37.4	37.4	37.4	37.4	37.4	38.6
500	19.3	19.3	19.3	19.3	21.2	24.4
700	14.6	14.6	14.6	14.6	17.9	20.7
1,000	10.7	10.7	10.7	10.7	15.0	17.3
2,500	4.6	4.6	4.8	6.6	9.5	10.9
5,000	2.3	2.3	3.4	4.6	6.7	7.7
10,000	1.2	1.2	2.4	3.3	4.7	5.5
25,000	0.5	0.7	1.5	2.1	3.0	3.5
50,000	0.2	0.5	1.1	1.5	2.1	2.4
75,000	0.2	0.4	0.9	1.2	1.7	2.0
100,000	0.12	0.3	0.8	1.0	1.5	1.7
150,000	0.08	0.3	0.6	0.8	1.2	1.4
250,000	0.05	0.2	0.5	0.7	0.9	1.1
500,000	0.02	0.2	0.3	0.5	0.7	0.8
800,000	0.01	0.12	0.3	0.4	0.5	0.6
1,000,000	0.01	0.11	0.2	0.3	0.5	0.5
1,600,000	0.01	0.09	0.2	0.3	0.4	0.4

Appendix B—Facsimile of the Travel-to-Work Supplement

Line number of person (240) | Line number of respondent (241)

If last worker in this household, mark this box ☐

7a. What is . . .'s principal means of transportation to work?

(242)
1 ☐ Truck . . . . .
2 ☐ Car or carpool → ▼

(243)
1 ☐ Drives alone – *Skip to 8a*
2 ☐ Shares driving . . . . . } *Skip to 7c*
3 ☐ Drives others . . . . . } *Skip to 7c*
4 ☐ Rides with someone else } *Skip to 7c*
5 ☐ Walks only – *Skip to 8a*
6 ☐ Works at home – *Skip to 12a*
7 ☐ Railroad
8 ☐ Subway or elevated
9 ☐ Bus or streetcar
10 ☐ Taxicab
11 ☐ Motorcycle
13 ☐ Bicycle
12 ☐ Other means – *Specify* _____

b. Does . . . usually ALSO use a car for part of the trip to work?

(244) 1 ☐ Yes 2 ☐ No – *Skip to 8a*

c. How many people, including . . . , usually ride in the car to work?

(245) _____ Number

8a. Does . . . usually WORK at the same location each day?

(246) 1 ☐ Yes – *Skip to 8c* 2 ☐ No

b. Does . . . usually REPORT to the same location to begin work each day?

(247) 3 ☐ Yes 4 ☐ No – *Skip to 12a*

c. Where is . . .'s usual place of work?

(1) Company or business establishment name

(2) Address *(Number and street)*
Note – If address (number and street name) are not known, enter building name, shopping center name, or other physical location description.

(3) Names of nearest intersecting streets

(4) Name of city, town, village, borough, etc.
Place type →

(5) County

State | ZIP code

8d. Was . . .'s place of work inside the incorporated (legal) limits of (name of city, town, village, etc., listed in 8c(4)?

(248) 1 ☐ Yes 2 ☐ No 3 ☐ Don't know

9. What time does . . . usually leave for work?

(249) _____ Time

(250) 1 ☐ a.m.
2 ☐ p.m.

10. How long does it usually take . . . to get from home to work?

(251) _____ Minutes

11. What is . . .'s ONE-WAY distance from home to work?

(252) _____ Miles **OR** 0 ☐ Less than 1 mile

12a. In the last year, has . . . changed his principal means of transportation to work?

(253) 1 ☐ Yes 2 ☐ No – *Skip to 13*

b. What was . . .'s principal means of transportation to work (prior to the change)?

(254)
1 ☐ Truck . . . . .
2 ☐ Car or carpool → ▼

(255)
1 ☐ Drove alone
2 ☐ Shared driving
3 ☐ Drove others
4 ☐ Rode with someone else
5 ☐ Walked only
6 ☐ Worked at home
7 ☐ Railroad
8 ☐ Subway or elevated
9 ☐ Bus or streetcar
10 ☐ Taxicab
11 ☐ Motorcycle
13 ☐ Bicycle
12 ☐ Other means – *Specify* _____

13. If "Yes" marked in 12a – *ASK* Compared to . . .'s previous means of transportation to work (Given in 12b), how satisfied is . . . with his present means of transportation to work – much more, more, about the same, less or much less satisfied?

If "No" marked in 12a – *ASK* Compared to a year ago, how satisfied is . . . now with his principal means of transportation to work – much more, more, about the same, less or much less satisfied?

(256)
1 ☐ Much more satisfied
2 ☐ More satisfied
3 ☐ About the same satisfaction
4 ☐ Less satisfied
5 ☐ Much less satisfied
6 ☐ Don't know
7 ☐ Did not work last year

INTERVIEWER Be sure to transcribe items 6c, 7a, 7b, 10 and 11 for head of household to items 82a–e on page 19 of AHS-52 questionnaire.

Appendix C—Definitions and Explanations

Most of the terms used in this report are self-explanatory or can best be understood by reference to the appropriate questionnaire items. (See appendix B.) An explanation of other subjects is provided below.

Worker. For purposes of the Travel-to-Work Supplement, a worker is any member of a sample household 14 years old or over who had a regular part-time or full-time job the week prior to interview. A job is defined as a definite arrangement for regular work for pay every week or every month. This included persons who operated their own business, professional practice, or farm. A household member was also considered to be a worker if the person had a regular job, but was temporarily absent from work due to illness, vacation, layoff, etc.

Place of work. This is the actual geographic location at which the worker *usually* carried out their occupational or job activities. If the person was on a business trip, on vacation, taking classes, etc., the week prior to interview, the person's usual place-of-work location was obtained. Workers who had the type of job in which they worked at one location for a period of time and then changed work locations (e.g., a temporary office worker) were asked to report the location of the first place they worked the previous week. Persons who did not usually work at the same location each day were requested to give the location where they usually reported to begin work each day. Persons who neither worked at the same location nor began work at the same location each day were classified as having no fixed place of work.

No fixed place of work. Workers with no fixed place of work were those who did not usually work at the same location each day and did not usually report to a central location to begin work each day.

Means of transportation to work. Means of transportation refers to the principal mode used to get from home to work.. Workers who used different means of transportation on different days of the week were asked to specify the one used most often. Workers who used more than one means of transportation to get to work each day were asked to specify the one used for the longest distance during the work trip.

Automobile. The category "automobile" includes workers using cars, station wagons, company cars, and passenger vans.

Truck. The category "truck" includes workers using pick-up trucks, panel trucks, and other trucks of 1-ton capacity or less. Workers who used larger trucks to get to work are classified as using "other means."

Travel distance to work. The one-way, "door-to-door" distance in miles that the person reported usually traveling from home to work during the week prior to interview was counted as the travel distance to work. Respondents were instructed to report travel distance rounded to the nearest mile. However, some heaping of the responses did occur; i.e., persons were more likely to report distances of 5, 10, 15, 20, etc., miles than values between these figures.

Travel time to work. The total elapsed time in minutes that the person reported it usually took to get from home to work during the week prior to interview was counted as the travel time to work. The elapsed time included time spent waiting for public transportation and picking up members of carpools. Respondents were instructed to report travel time to the nearest minute. However, substantial heaping of the responses did occur; i.e., persons were much more likely to report travel times of 5, 10, 15, 20, 30, and 45 minutes than values between these figures. Some heaping also occurred at 25, 35, and 40 minutes, although not to the same extent. A large proportion of the heaping was presumably due to the daily variation in travel time to work experienced by most workers, plus the manner in which the question was asked ("How long does it *usually* take to get from home to work?").

Metropolitan areas. The term "metropolitan area" as used in this report refers to the 243 standard metropolitan statistical areas (SMSA's) used in the 1970 census. Changes in SMSA definition criteria, boundaries, and titles made after February 1971 are not reflected in the report.

Except in the New England States, a standard metropolitan statistical area was essentially defined in 1970 as a county or group of contiguous counties containing at least one city of 50,000 inhabitants or more (or "twin cities" with a combined population of at least 50,000). Contiguous counties were included in the SMSA definition if, according to certain criteria, they were socially and economically integrated with the central county. In the New England States, SMSA's consisted of towns and cities instead of counties. Each 1970 census SMSA included at least one central city; the complete title of an SMSA identified the central city or cities.

Central cities. Each 1970 census SMSA included at least one central city. They were determined essentially according to the following criteria:

1. The largest city in an SMSA is always a central city.
2. One or two additional cities may also be named central cities on the basis and in the order of the following criteria:
   a. The additional city or cities have at least 250,000 inhabitants.
   b. The additional city or cities have a population of one-third or more of that of the largest city and a minimum population of 25,000.

Suburbs or suburban area. That portion of metropolitan areas which is outside of central cities is referred to in the text and tables of this report as "suburbs," "suburban area," or "in SMSA's, outside central cities." The term "suburb" is used here for convenience since for some metropolitan areas the territory outside central cities extends beyond what might reasonably be considered suburban.

Race. Data in this report are provided separately for Black workers, and for White workers and workers of other races combined. Workers in the "White and other races" category are referred to as "White" in the text for convenience. The determination of the race of each worker was based on the observation or inquiry of the enumerator.

Household. A household consists of all the persons who occupy a housing unit. A house, an apartment or other group of rooms, or a single room is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters; that is, when the occupants do not live and eat with any other persons in the structure and there is either (1) direct access from the outside or through a common hall or (2) a kitchen or cooking equipment for the exclusive use of the occupants.

A household includes the related family members and all the unrelated persons, such as lodgers, foster children, wards or employees, who share the housing unit. A person living alone in a housing unit or a group of unrelated persons sharing a housing unit as partners is also counted as a household.

Head of household. In the 1975-76 Annual Housing Survey, one person in each sample household was designated as the "head." The head of household was defined as the person who was regarded as the head by the members of the household. A married woman was not classified as the head of household if her husband was living with her at the time of the survey.

In the past, the Census Bureau has designated a head of household to serve as the central reference person for the collection and tabulation of data for each member of the household (or family). However, the trend toward recognition of equal status and roles for adult family members makes the term "head" less relevant in the analysis of household and family data. As a result, the Bureau is currently developing new techniques for the enumeration and presentation of data which will eliminate the concept "head." Although the data in this report are based on this concept, methodology for future Census Bureau reports will reflect a gradual movement away from this traditional practice.

Earnings. Earnings are the total amount of money earned in the last 12 months by a person working as an employee for a private employer or an incorporated business (including a farm employer or branch of government). Earnings also include such items as piece-rate payments, commissions, tips, cash bonuses, and Armed Forces pay.

Symbols used in this report. A dash "-" means "rounds to or represents zero." Three dots "..." means "not applicable."

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