# Characteristics of Urban Transportation Demand: An Updated and Revised Handbook

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**In this paper, a selection of updated data on a wide variety of statistics pertaining to urban travel demand, and how they have been integrated into the UMTA report, *Characteristics of Urban Transportation Demand: An Update*, are discussed. This report presents a compilation of almost exclusively post-1970 data on travel demand for all major urban modes. It is designed to be used by transportation planners and analysts as a source of data to check the validity and reasonableness of local forecasts developed from either conventional or emerging planning and modeling techniques, or as a cross-check on the similarity of travel statistics from one locality to another. Certain data also may be used as default values for modeling purposes, when such information is not available locally or would require new or extensive data collection efforts. Another application is in examining how key statistics have changed over time and transferring these changes from one area to another. Much of the information contained in the report was obtained from reports, documents, and memoranda produced by or for each study area contacted. A main criterion of the study was that the information collected be based on surveys, measurements, counts, and so forth, and not be synthesized results from analytical modeling efforts. Many source documents have not been circulated widely, adding to the usefulness of the data contained in this report.**

In urban transportation planning, an analyst must often borrow a particular factor related to travel demand, especially when such estimates or factors are not available locally or, if available, are believed to be out of date. This situation is typically encountered when results are needed in a quick-response time frame (sometimes referred to as "yesterday"). Alternatively, after a fairly complex and laborious exercise of forecasting the volume of vehicle- or person-trips that may be made on a proposed system is completed, it may be useful to undertake a reasonability check by comparing such forecasts to actual volumes observed elsewhere. To help meet these needs, UMTA released the report *Characteristics of Urban Transportation Demand—A Handbook for Transportation Planners* (CUTD) in April 1978 *(1)*. A description of the overall objectives and use of the original CUTD Handbook was presented by Levinson *(2)*.

The original CUTD Handbook *(1)* drew heavily from facts contained in the comprehensive, large-scale, urban transportation planning studies that were conducted in many localities during the 1950s and 1960s. While providing a rich source of data that has not been duplicated, the information contained in these studies generally reflects travel behavior before 1970. Since these early studies, many changes have occurred in the nation's transportation system (e.g., fuel price increases, transit retrenchment, and expansion) and in the socioeconomic characteristics of travelers and households; for example, household sizes have generally declined over time and the availability of automobiles has continued to increase. It is therefore reasonable to expect that changes have also occurred in many of the travel demand factors presented previously.

In this paper, the results of a study to update and reorganize data on a wide variety of statistics related to urban travel demand characteristics *(3)* are described. Except for a paucity of recent data on urban truck travel, the CUTD Update *(3)* presents a compilation of almost exclusively post-1970 data on travel demand. It is designed to be used by transportation planners and analysts as a source of data to check the validity and reasonableness of local forecasts using either conventional or emerging planning and modeling techniques, or as a cross-check on the similarity of travel statistics in various localities. Certain data may also be used as default values for modeling purposes when such information is not available locally, or would require new or extensive data collection efforts. Another use for the CUTD Update *(3)* is in examining how key statistics have changed over time and transferring these changes from one area to another.

## DATA SOURCES

Since 1970, few urban areas have conducted comprehensive transportation studies of the type undertaken in the 1950s and 1960s. Many areas, however, have conducted small-scale data collection efforts either to update earlier data for model validation purposes or for some specialized (rather than area-wide) planning purposes. As might be expected, those localities that have available more recent data on travel demand statistics tend to be the larger metropolitan areas that are able to support an ongoing transportation planning staff. Thus, the updated travel demand data available for small- to medium-sized urban areas are not as voluminous as those in the 1978 CUTD Handbook *(1)*.

Much of the updated information on travel demand characteristics was obtained from reports, documents, and memoranda produced by or for each study area contacted. A main criterion was that the information collected be based on

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surveys, measurements, counts, and so forth, and not be synthesized results from analytical modeling efforts. Many of these source documents have not been circulated widely, which should add to the usefulness of the data contained in the CUTD Update *(3)*. One objective of the work undertaken was to summarize useful travel demand statistics that may not be readily available elsewhere. Therefore, little information was reproduced from many other widely circulated but potentially relevant publications *(4–9)*.

## ORGANIZATION AND USE OF THE UPDATED CUTD REPORT *(3)*

As an aid to using and locating data within the CUTD Update *(3)*, tables were grouped into the following nine sections in a sequence consistent with the traditional cooperative, comprehensive, and continuing (3C) transportation planning process:

A. Socioeconomic Characteristics for Study Areas,
B. Trip Generation–Person and Vehicle Trips,
C. Trip Length and VMT Data,
D. Mode Choice and Automobile Occupancies,
E. Temporal Distribution of Travel,
F. CBD Characteristics and Travel Statistics,
G. Truck Travel,
H. Transit Usage Statistics, and
I. Highway and HOV Usage Statistics.

Presented in the following is an overall description of the types of data that can be found in Sections A–I, along with selected tables that highlight the updated travel demand data that have been collected.

### Section A: Socioeconomic Characteristics for Study Areas

Section A of the CUTD Update *(3)* contains data on population, land areas, and densities for cities, urbanized areas, and standard metropolitan statistical areas (SMSAs) along with vehicle availability statistics from the 1980 Census for major urbanized areas in the United States. Users of the CUTD Update *(3)* can refer to this information to determine which other cities are most comparable to their own locality in terms of area, density, and vehicle availability. Vehicle availability can be viewed as a proxy for the amount of transit available or the relative income level of the study population. The attractiveness of these data is that the geographical boundaries are defined according to a consistent set of census definitions. This is rarely the case for the geographical areas traditionally used in regional transportation planning studies.

Once one or more comparable cities have been identified, the user should refer next to the table that presents key socioeconomic statistics about many of the study areas for which data are presented in subsequent tables of the report. In particular, this table identifies for these study areas: *(a)* the year the information was collected, *(b)* the size (i.e., population) or boundaries for the study area examined, and *(c)* the socioeconomic characteristics of the study area. Generally (but with some exceptions), information on study areas from this table can then be matched with information on study areas in any other table for which the study area name, year, and study area description are the same.

In addition to these factors, certain travel demand data can be expected to change over time. Even though the inclusion of data before 1970 has been minimized, there is a time span of at least 15 years between the earliest and latest entries. An even longer time span exists if comparisons are made to data contained in the original CUTD Handbook *(1)*. Consequently, to assist users in transferring data between two points in time, selected key socioeconomic characteristics taken from the 1960, 1970, and 1980 censuses are presented *(9)*. For example, it is evident that the work force has expanded as a result of population growth and the increase in the number of women who work outside the home. Automobile ownership levels have increased, bringing about increases in the percentage of commuter trips made by automobile at the expense of mass transit modes. An understanding of the implications of these types of trends for travel demand should assist users of the CUTD Update *(3)* in examining or transferring data between different points in time.

Certain tables in the CUTD Update *(3)* also present summary statistics on average nationwide travel demand characteristics from the 1969 and 1983 Nationwide Personal Transportation Study (NPTS) reports. These statistics are useful in highlighting how a given travel factor may have changed over time. The NPTS results can also be used as a reference point to determine how similar factors from a particular study area compare to a nationwide estimate. Users should note, however, that differences in definitions, questionnaire designs, and relatively small sample sizes associated with the 1983 NPTS may not always yield a true comparison.

### Section B: Trip Generation—Person and Vehicle Trips

Section B of the CUTD Update *(3)* presents data on total person and vehicle trip rates for selected study areas in the United States. Trip rates are further cross-classified by pertinent factors such as number of automobiles per household, income, size of household, and trip purpose. Depending on local practice, certain trip purpose factors are presented according to the home-based and nonhome-based convention, which classifies trips according to both the origin and the destination purpose, whereas other tables use only destination purpose to assign trip purpose. In some instances, transit trip rates are also presented.

Given information on population and average trip rates for either an entire area or disaggregated by a particular market segment, it is possible to compute an approximate estimate of the total number of trips made in an area. Caution must be exercised regarding the basic definition of trips; for example, do they include walking or only motorized modes, trips by trucks, trips by persons of all ages, and are they linked or unlinked (particularly for transit)?

Table 1 presents motorized trip generation rates per person and per household for selected study areas. For each study area, Table 1 indicates (as do all tables) the year and study area description (either the population or a common term for the

TABLE 1 TRIP GENERATION: PER PERSON, PER HOUSEHOLD

| Study Area | Year | Study Area Description | Person Trips per: Person | Household | Persons per Household | Persons per Vehicle | Vehicles per Household |
|---|---|---|---|---|---|---|---|
| Atlanta | 1972 | 1,640,000 | 2.49 | 7.20 | 2.9 | 2.1 | 1.38 |
| Baltimore | 1977 | T.P.A. | 2.9 | 8.3 | 2.8 | --- | --- |
| Buffalo | 1973 | 1,234,000 | 2.5 | 7.5 | 3.0 | 2.5 | 1.2 |
| Chicago | 1979 | City | 1.6 | 4.6 | 2.9 | --- | --- |
| Chicago | 1979 | SMSA | 2.4 | 7.2 | 3.0 | --- | --- |
| Dallas | 1984 | T.P.A. | 3.40 | 8.68 | 2.6 | 1.4 | 1.84 |
| Denver | 1971 | T.P.A. | 2.83 | 8.76 | 3.10 | 2.21 | 1.40 |
| Fresno/Clovis | 1972 | 295,000 | 3.00 | 8.25 | 2.74 | 2.27 | 1.21 |
| Los Angeles | 1976 | 6 County | 2.99 | 8.15 | 2.8 | 1.8 | 1.6 |
| Louisville | 1975 | Urban Area | 2.19 | 6.34 | 2.90 | 1.91 | 1.52 |
| Philadelphia | 1977 | SMSA (+) | 2.45 | 7.66 | 2.5 | 2.45 | 1.27 |
| Phoenix | 1980 | T.P.A. | 2.44 | 6.58 | 2.7 | --- | --- |
| Portland | 1977 | SMSA | 3.67 | 8.66 | 2.4 | --- | --- |
| Rochester | 1974 | 735,000 | 2.56 | 8.03 | 3.14 | 2.75 | --- |
| Sacramento | 1978 | 3 County | 3.39 | 9.34 | 2.6 | 1.6 | 1.6 |
| San Diego | 1977 | County | 3.5 | 9.8 | 2.8 | 1.71 | 1.64 |
| San Francisco | 80/81 | CMSA (-) | 3.40 | 8.71 | 2.56 | 1.52 | 1.70 |
| Washington, DC | 1968 | 2,714,000 | 2.17 | --- | --- | 2.58 | --- |

SOURCE: Reports from individual study areas.

TABLE 2 PERSON-TRIPS GENERATED PER HOUSEHOLD BY AUTOMOBILE OWNERSHIP

| Study Area | Year | Study Area Description | Autos per Household 0 | 1 | 2 | 3+ | All Households |
|---|---|---|---|---|---|---|---|
| Buffalo | 1973 | 1,234,000 | 1.6 | 6.9 | 11.5 | 16.9 | 7.5 |
| Chicago[a] | 1979 | City | 1.9 | 5.3 | 7.7 | 9.5 | 4.6 |
| Chicago[a] | 1979 | SMSA | 1.7 | 6.4 | 10.7 | 12.7 | 7.2 |
| Fresno | 1971 | 295,000 | 1.3 | 6.7 | -----12.0----- | | 8.2 |
| Los Angeles | 1976 | 6 County | 2.0 | 5.8 | -----11.0----- | | 8.1 |
| Milwaukee | 1972 | 7 County | 1.9 | 7.0 | 11.5 | 16.0 | 7.9 |
| Minneapolis/St. Paul | 1982 | 7 County | 1.8 | 6.5 | 11.1 | 16.4 | 9.1 |
| Portland | 1977 | SMSA | 3.0 | 6.8 | -----11.5----- | | 8.7 |
| Rochester | 1974 | 735,000 | 2.2 | 7.1 | 11.1 | 14.0 | 8.0 |
| San Diego[b] | 1977 | County | 3.0 | 6.6 | -----13.0----- | | 9.8 |
| San Francisco | 80/81 | CMSA (-) | 4.0 | 6.3 | 10.1 | 13.4 | 8.7 |

Key to Notes

a — Shown are person trips per occupied dwelling unit.
b — Person trips not including motorcycle, bicycle, walking.

SOURCE: Reports from individual study areas.

geographic boundary, or, if neither are available, the local transportation planning area) that applies to the data item listed. Many travel demand factors can differ simply because of differences in study area sizes. For example, as given in Table 1 for Chicago, the number of person-trips made per household in the city of Chicago compared to the larger SMSA varies considerably because of differences in automobile availability, income, and household composition.

Table 2 shows how person-trip rates per household increase with the number of automobiles owned per household (which implicitly would also reflect increases in the number of individuals per household). For the cities shown, households with no automobiles average about 2 person-trips/day, increasing to about 10.5 person-trips/day for households with 2 automobiles. From Table 3, the vast majority of trips made are home based, although over time it appears that the percentage of trips that are home based has declined. Work trips still represent the largest category of home-based trips.

As given in Table 4, a much higher percentage of transit trips represents home-based trip purposes. This difference is largely due to the increased likelihood of individuals using transit for work and school trips, offset partially by the decreased likelihood of their using transit for home-based trips made for shopping, social, and recreational purposes.

### Section C: Trip Length and VMT Data

Section C of the CUTD Update *(3)* represents the output of the trip distribution phase of travel demand analyses. Data are reported on average trip length characteristics for all trips and disaggregated by trip purpose and by mode. Where possible, trip lengths are reported in miles or minutes, or both. For example, Table 5 presents average trip lengths by trip purpose expressed in miles and minutes. (Differences in the definitions of trips and whether or not trip times include line-haul as well as access or transfer times can affect the transferability of the data.) As is typically observed, home-based work trips are the longest—measured in terms of either miles or minutes. Average trip lengths for home-based nonwork and nonhome-based trips, while shorter than for work trips, are more nearly equal to each other.

Categorized by motorized modes, the longest trips are made on commuter rail, followed by rapid transit, automobile, bus, and taxi. Table 6 also presents a comparison of average trip length from individual cities to average trip length reported in

TABLE 3 HOME-BASED PERSON-TRIPS BY TRIP PURPOSE

| Study Area | Year | Study Area Description | Home-Based Trips as % of All Trips | Percent of Home-Based Trips to & from: Work | School | Shop | Soc/Rec | Other | Total Home-Based Trips per HH |
|---|---|---|---|---|---|---|---|---|---|
| Dallas | 1984 | T.P.A. | 74.7 | 36.1 | --- | --- | --- | 63.9 | 6.4 |
| Denver | 1982 | Urbanized Area | 79.2 | 31.8 | --- | 21.5 | --- | 46.7 | --- |
| Detroit | 1980 | 7 County | 74.1 | 27.4 | --- | --- | --- | 72.6 | 5.5 |
| Detroit | 1965 | 4,042,000 | 77.6 | 20.8 | 17.0 | 19.8 | 22.2 | 22.0 | 6.6 |
| Detroit | 1953 | 2,969,000 | 87.0 | 41.6 | 6.3 | 13.9 | 20.1 | 18.1 | 4.7 |
| El Paso | 1970 | 363,000 | 75.6 | 26.0 | 14.0 | 19.0 | 17.0 | 24.0 | 6.6 |
| Fresno | 1971 | 245,000 | 69.3 | 24.8 | --- | 18.3 | --- | 56.9 | 5.9 |
| Louisville | 1975 | Urban Area | 80.7 | 33.0 | --- | 21.6 | 21.2 | 24.2 | --- |
| Philadelphia | 1977 | SMSA (+) | 78.0 | 29.5 | --- | --- | --- | 70.5 | --- |
| Philadelphia | 1960 | 4,007,000 | 85.4 | 34.8 | 6.6 | 12.7 | 17.1 | 28.8 | 3.9 |
| Phoenix | 1980 | T.P.A. | 79.2 | 32.4 | 11.4 | 20.5 | --- | 35.7 | --- |
| San Diego | 1977 | County | 71.0 | 22.3 | --- | 18.2 | --- | 59.5 | 7.0 |
| San Francisco | 80/81 | CMSA (-) | 73.2 | 29.6 | 14.9 | --- | 19.8 | 35.7 | 6.4 |
| Washington, DC | 1968 | 2,714,000 | 87.2 | 28.0 | 8.0 | 23.4 | 17.7 | 22.9 | 6.3 |

SOURCE: Reports from individual study areas.

TABLE 4 TRANSIT PERSON-TRIPS BY TRIP PURPOSE

| Study Area | Year | Study Area Description | Mode | Trip Definition | Home-Based Transit Trips: Work | School | Shop | Soc/Rec | Other | Nonhome-Based | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Atlanta | 1980 | 7 County | Rapid Rail | Linked | 50.4 | 19.5 | 1.8 | 7.2[b] | 9.7 | 11.4 | 100 |
| Atlanta | 1980 | 7 County | Bus | Linked | 50.0 | 16.3 | 4.8 | 9.8[b] | 7.8 | 11.3 | 100 |
| Atlanta | 1980 | 7 County | All | Linked | 50.1 | 17.4 | 3.7 | 8.9[b] | 8.5 | 11.4 | 100 |
| Boston | 1978 | 79 Cities | Bus | Unlinked | 48.5 | 18.3 | 8.1 | 4.4 | 10.4 | 10.4 | 100 |
| Boston | 1978 | 79 Cities | Rapid Rail | Unlinked | 53.6 | 12.6 | --- | --- | 17.5 | 16.3 | 100 |
| Cincinnati | 1978 | T.P.A. | Bus | Linked | 40.1 | 17.6 | --- | --- | 24.8 | 17.5 | 100 |
| Detroit | 1980 | 7 County | Bus | Unlinked | 36.7 | --- | --- | --- | 50.0 | 13.3 | 100 |
| Denver | 1978 | 4 County | Bus | Unlinked | 49.9 | 15.6 | 8.4 | 4.5 | 7.6 | 14.0 | 100 |
| Indianapolis | 1973 | T.P.A. | Bus | Unlinked | 58.2 | 13.6 | 11.9 | --- | 16.3 | --- | 100 |
| Minn./St. Paul | 1982 | 7 County | Bus | Linked | 36.8 | a | --- | 41.4 | --- | 21.8 | 100 |
| Philadelphia | 1977 | SMSA (+) | All | Linked | 55.4 | --- | --- | --- | 34.0 | 10.6 | 100 |
| Portland | 1977 | SMSA | Bus | Linked | 31.9 | 18.9 | --- | 9.9 | 22.1 | 17.2 | 100 |
| San Diego | 1977 | County | All | Unlinked | 35.0 | 24.4 | 10.8 | ----19.4---- | | 10.4 | 100 |
| San Francisco | 80/81 | CMSA (-) | Bus | Linked | 36.9 | 22.6 | 15.2 | 8.0 | c | 17.3 | 100 |

Key to Notes

a -- School bus trips not included.
b -- Personal business.
c -- Included in "shop."

SOURCE: Reports from individual study areas.

TABLE 5 AVERAGE PERSON-TRIP LENGTH BY TRIP PURPOSE

| Study Area | Year | Study Area Description | Home-Based Work: Miles | Minutes | Home-Based Nonwork: Miles | Minutes | Nonhome-Based: Miles | Minutes | All Trips: Miles | Minutes |
|---|---|---|---|---|---|---|---|---|---|---|
| Baltimore | 1977 | T.P.A. | 6.6 | --- | 4.0 | --- | 4.9 | --- | 4.9 | --- |
| Dallas | 1984 | T.P.A. | 10.1 | --- | 5.3 | --- | 6.5 | --- | 6.9 | --- |
| Indianapolis | 1970 | T.P.A. | --- | 19.0 | --- | 12.9 | --- | 14.2 | --- | 14.5 |
| Minn./St. Paul | 1982 | 7 County | 8.1 | --- | 5.0 | --- | 5.4 | --- | 5.7 | 17 |
| Philadelphia | 1977 | SMSA (+) | --- | 22.1 | --- | 16.6 | --- | 15.0 | --- | 17.5 |
| Phoenix | 1980 | T.P.A. | --- | 18.9 | --- | 12.8 | --- | 13.0 | --- | 14.4 |
| Portland | 1977 | SMSA | 6.6 | --- | 4.1 | --- | 4.1 | --- | 5.0 | --- |
| San Diego | 1977 | County | 8.9 | 14.3 | 4.9 | 8.4 | 4.9 | 8.3 | 5.5 | 9.3 |
| San Francisco | 80/81 | CMSA (-) | --- | 26.6 | --- | 17.6 | --- | 16.7 | --- | 19.3 |
| Seattle | 1977 | T.P.A. | --- | 22.1 | --- | --- | --- | 15.4 | --- | --- |
| Tucson | 1977 | T.P.A. | --- | 17.7 | --- | 12.3 | --- | 10.9 | --- | 13.0 |

SOURCE: Reports from individual study areas.

TABLE 6 AVERAGE TRIP LENGTH BY MODE

| Study Area | Year | Study Area Description | Auto | All Transit | Commuter Rail | Rapid Transit | Bus |
|---|---|---|---|---|---|---|---|
| Baltimore | 1977 | T.P.A. | 5.0 | 4.1 | --- | --- | 4.1 |
| Chicago | 1970 | 7,593,000 | 5.0 | --- | 18.5 | 7.9 | 3.9 |
| Chicago | 1979 | SMSA | 4.5[a] | 6.4 | --- | --- | --- |
| Denver | 1982 | Urbanized Area | 5.3 | 4.7 | --- | --- | 4.7 |
| Minn./St. Paul | 1982 | 7 County | 5.9 | 5.0 | --- | --- | 5.0 |
| New York | 1983 | City | --- | --- | 22.1 | 7.0 | 2.4 |
| Philadelphia | 1977 | SMSA (+) | 6.2 | 4.9 | 18.4 | 4.8/7.5[b] | 2.6[c] |
| Portland | 1977 | SMSA | 4.9 | 6.0 | --- | --- | 6.0 |
| San Diego | 1977 | County (-) | 5.5 | --- | --- | --- | 3.2 |
| Washington, DC | 1980 | SMSA (-) | 7.5 | --- | --- | --- | --- |
| **NPTS** | 1983 | USA | 7.6 | --- | 19.4 | 10.6 | 6.1 |

Key to Notes

a — Measured in airline miles.
b -- For Subway Elevated/PATCO High Speed.
c — Includes surface trolley.

SOURCE: Reports from individual study areas.

TABLE 7 AVERAGE DAILY PERSON-TRIPS BY MODE

| Study Area | Year | Study Area Description | Total Trips (000's) | Percent of Person Trips by Mode: Auto Driver | Auto Passenger | Transit | Truck | Walk | Other | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Atlanta | 1972 | 1,640,000 | 4,087 | 61.2 | 28.4 | 10.4 | --- | --- | --- | a |
| Baltimore | 1977 | T.P.A. | 3,408 | --------89.3-------- | | 10.7 | --- | --- | --- | |
| Chicago | 1979 | City | --- | 50.6 | 18.4 | 29.7 | --- | --- | 1.3 | |
| Chicago | 1979 | SMSA | --- | 65.0 | 21.5 | 10.4 | --- | --- | 3.1 | |
| Denver | 1982 | Urbanized Area | 6,025 | 58.0 | 20.0 | 2.5 | 19.5 | --- | --- | b |
| Los Angeles | 1976 | 6 County | --- | 59.7 | 22.0 | 3.1 | --- | 11.9 | 2.6 | |
| Louisville | 1978 | 835,000 | 1,858 | --------92.3-------- | | 7.7 | --- | --- | --- | |
| Milwaukee | 1972 | 7 County | 4,505 | 64.3 | 27.2 | 8.0 | --- | --- | 0.5 | |
| Minn./St. Paul | 1982 | 7 County | --- | 68.8 | 20.4 | 3.8 | --- | --- | 7.0 | b |
| Philadelphia | 1977 | 5,123,900 | 12,690 | --------92.0-------- | | 8.0 | --- | --- | --- | |
| Portland | 1977 | SMSA | 3,550 | 60.7 | 22.8 | 7.1 | --- | 7.9 | 1.5 | b |
| Sacramento | 1978 | 3 County (-) | --- | 57.7 | 23.7 | 4.3 | 0.5 | 9.3 | 4.5 | b |
| San Diego | 1977 | County (-) | --- | 59.1 | 22.6 | 4.1 | 0.6 | 10.1 | 3.5 | b |
| San Francisco | 80/81 | CMSA (-) | 17,168 | 60.0 | 18.2 | 6.4 | --- | 11.4 | 4.0 | |
| **NPTS** | 1969 | USA | 145,146,000 | --------85.1-------- | | 8.3 | 5.6 | --- | 1.0 | b |
| **NPTS** | 1983 | USA | 205,811,000 | --------81.5-------- | | 5.6 | 11.6 | --- | 1.3 | b |

Key to Notes

a -- Does not include trips by motorcycle, bicycle, walking.
b -- Transit includes school bus trips.

SOURCE: Reports from individual study areas.

the 1983 NPTS *(10)*. In general, NPTS trip lengths are longer because the total linked length of a particular O-D trip is reported even though more than one mode may be used for the trip in question. Following the convention of the Bureau of the Census, when more than one mode is used, the mode with the longest unlinked trip segment measured according to distance is the one reported. Thus, a 2-mi bus trip followed by an 8-mi trip on rapid transit appears in the data as a 10-mi-long rapid transit trip.

### Section D: Mode Choice and Automobile Occupancies

In Section D of the CUTD Update *(3)*, information is provided on total person and vehicle trips by mode (as well as vehicle type for vehicle trips) and by trip purpose. Because mode shares are sensitive to the size of the geographic area under consideration, one table shows modal shares for journey-to-work trips based on the consistent urbanized area definition used in the 1980 census of population. Also presented in Section D are average automobile occupancies by time of day and by trip purpose, separately. Again, trip purpose is defined according to the home-based and nonhome-based trip-end convention as well as by the purpose at the destination end.

Table 7 lists the number of total daily trips made for various study areas along with modal shares (which if multiplied together produces the average number of daily trips made by each mode). Also presented for comparative purposes is equivalent trip information from the 1969 and 1983 NPTS surveys. If statistically valid, the NPTS data suggest that the total number of daily trips made increased by 42 percent between 1969 and 1983, whereas the share of public transit trips declined by 24 percent, from 3.4 to 2.6 percent *(11)*. (Table 7

TABLE 8 AUTOMOBILE OCCUPANCY BY TRIP PURPOSE

| Study Area | Year | Study Area Description | Home-Based Work | Home-Based Nonwork | Nonhome-Based | Total |
|---|---|---|---|---|---|---|
| Dallas | 1984 | T.P.A. | 1.13 | 1.55 | 1.39 | 1.36 |
| Honolulu | 1981 | County | 1.20 | 1.65 | 1.54 | 1.52 |
| Kansas City | 1970 | 8 County | 1.11 | 1.61 | 1.56 | 1.51 |
| Los Angeles | 1976 | 6 County | 1.15 | 1.71 | 1.65 | 1.54 |
| Minn./St. Paul | 1982 | 7 County | 1.15 | 1.40 | 1.24 | 1.31 |
| Portland | 1977 | SMSA | 1.13 | 1.56 | 1.65 | 1.50 |
| Sacramento | 1978 | 3 County(-) | 1.06 | 1.54 | 1.75 | 1.50 |
| San Diego | 1977 | County (-) | 1.08 | 1.63 | 1.58 | 1.50 |
| San Francisco | 1980 | 9 County | 1.07 | 1.52 | 1.51 | 1.41 |
| Tucson | 1977 | T.P.A. | 1.18 | 1.55 | 1.37 | 1.42 |

SOURCE: Reports from individual study areas.

shows modal shares for public transit and school bus combined.) However, over this period the absolute number of transit trips made nationwide increased by over 8 percent, according to NPTS data.

Table 8 presents average automobile occupancy data by trip purpose. The lowest occupancies are home-based work trips, reflecting the greater propensities of individuals to commute to work in single-occupant automobiles. Both home-based nonwork and nonhome-based trip purposes have similar but significantly higher occupancies, indicative of the underlying shopping and recreational trip activities that are being undertaken.

### Section E: Temporal Distribution of Travel

Section E of the CUTD Update *(3)* presents statistics on the temporal distribution of person and transit trips over the course of an average weekday. Factors are also provided so that the relative magnitude of person-trips taken on weekdays versus weekend days by mode and by trip purpose can be compared or computed from other available data. Based on the hourly distribution of trips made on four rapid transit systems and vehicle driver-transit trips made in San Francisco, transit trips exhibit sharper peaks compared to those for the automobile.

### Section F: CBD Characteristics and Travel Statistics

Section F of the CUTD Update *(3)* presents statistics concerning person, vehicle, and truck travel as related to the central business districts (CBDs) of urban areas. However, there are multiple definitions of the geographic boundaries of a CBD that can have a major influence on the interpretation of the statistics presented. Although the CBD area as defined by the Bureau of the Census can be easily ascertained, few areas choose to use this definition, as it encompasses too small an area of interest. Where possible, the local acronym for the central area (e.g., Boston proper) has been used in place of the term "CBD"; however, only the lack of a local convention prevents wider use of this approach. Although many of the data pertain to CBDs, the term might better be translated to mean central, built-up areas of cities.

Also presented in this section of the CUTD Update *(3)* are summaries of cordon counts for persons and vehicular trips taken over an entire day (or nearly so) and during the peak hour. These data tend to be based on actual counts rather than on samples. Comparisons of cordon counts over time are possible when the geographic boundaries are the same. Although rare, the inclusion of an artery or expressway with much through traffic can distort the comparability of the cordon data. Similarly, because of the traditionally high peaking characteristics of transit trips to the CBD, peak mode shares based on two-way flows artificially reduce the importance of transit trips compared to measurements based on the one-way peak direction.

Table 9 presents the peak-hour percent of person trips by transit and nontransit modes crossing the CBD cordon for cities of various sizes and, in some instances, over time for the same city. Generally, high concentrations of transit trips to the CBD are associated with large cities (New York, Chicago), high-CBD employment, and cities with dense, downtown-oriented rapid transit systems. Some large but nonrail cities (e.g., Houston) have, as a result, relatively low transit mode shares destined to the CBD. In the case of Houston, however, the share of transit trips to the CBD in the peak hour has increased with the overall growth of the central core. Conversely, from the early 1970s to the early 1980s, there has actually been a decline in the proportion of transit trips being made in New York and Chicago.

### Section G: Truck Travel

Section G of the CUTD Update *(3)* contains data concerning truck travel. Following the basic outline of the entire handbook, statistics are presented for average truck trip rates per day, average trip length, percentage of trips that are made by trucks, trip rates by trip purpose, and hourly variation of truck trips for all trips and by facility type. Many of the data are drawn from studies conducted in the 1960 because few studies of this kind have been undertaken since that time.

### Section H: Transit Usage Statistics

Section H of the CUTD Update *(3)* presents statistics on the usage characteristics of transit facilities. Annual ridership data and selected productivity statistics (e.g., person-trips per revenue-car-mile operated) are reported on all commuter rail, rapid rail, light rail, and streetcar transit systems except for those cities that only recently began partial service, and for major bus systems. Peak-hour volumes on selected lines are reported for various rapid rail, light rail, and streetcar systems. Modes of access at the systemwide level and by selected stations and terminals are also provided. From the data collected, it is clear

TABLE 9 PEAK-HOUR PERSON-TRIPS BY TRANSIT TO CENTRAL BUSINESS DISTRICTS

| City Rank 1980 Census | Study Area | 1980 City Population (000s) | Year of Count | Peak-Hour One-Way Persons (000s) | Peak-Hour Percent Auto/Other | Peak-Hour Percent Transit |
|---|---|---|---|---|---|---|
| 1 | New York | 7,072 | 1971 | 805 | 8 | 92 |
| | | | 1974 | 738 | 10 | 90 |
| | | | 1982 | 748 | 12 | 88 |
| 2 | Chicago | 3,005 | 1971 | 210 | 19 | 81 |
| | | | 1974 | 200 | 18 | 82 |
| | | | 1983 | 152 | 23 | 77 |
| 3 | Los Angeles | 2,967 | 1970 | 99 | 69 | 31 |
| | | | 1974 | 93 | 63 | 37 |
| | | | 1980 | 88 | 64 | 36 |
| 5 | Houston | 1,595 | 1971 | 55 | 86 | 14 |
| | | | 1980 | 66 | 82 | 18 |
| 6 | Detroit | 1,203 | 1974 | 39 | 67 | 35 |
| 7 | Dallas | 904 | 1971 | 50 | 72 | 28 |
| | | | 1983 | 88 | 71 | 29 |
| 11 | San Antonio | 786 | 1979 | 21 | 73 | 27 |
| 15 | Washington, DC | 638 | 1983 | 169 | 68 | 32 |

SOURCE: Reports from individual study areas.

TABLE 10 COMMUTER RAIL RIDERSHIP STATISTICS

| Study Area | Annual Ridership | Passengers per Revenue Car Mile | Passenger Miles per Revenue Car Mile | Implied Average Trip Length (Miles) |
|---|---|---|---|---|
| Boston (1987) | 14,649,000 | 1.7 | 29.6 | 17.2 |
| Chicago (1987) | 66,505,000 | 3.0 | 63.5 | 21.2 |
| New Jersey (FY1987) | 43,773,000 | 1.2[a] | 28.2[a] | 23.4[a] |
| New York (1987) | | | | |
| Metro-North | 53,802,000 | 1.7 | 46.3 | 27.5 |
| LIRR | 74,938,000 | 1.4 | 38.7 | 27.5 |
| Philadelphia (FY1987) | 22,933,000 | 2.2 | 29.6 | 13.5 |
| Pittsburgh (FY1987) | 236,000 | 0.9 | 15.5 | 17.2 |
| San Francisco (FY1987) | 5,422,000 | 2.3 | 54.9 | 23.7 |
| Washington (FY1987) | | | | |
| Baltimore (Amtrak) | 713,000 | -- | -- | -- |
| Baltimore (CSX) | 337,000 | 1.4 | 30.0 | 21.8 |
| Martinsburg (CSX) | 772,000 | -- | -- | -- |

a -- NJT District only (i.e., less NEC Adj. and NY)

SOURCE: Individual rail systems or transportation agencies, except where noted.

that access modes at outlying stations in the morning differ considerably from access modes at center city stations on the return trip in the evening. Thus, access mode shares can be expected to vary significantly, depending on whether they are given as a.m. in-bound only, systemwide, or by station or terminal. The distribution of access modes at stations and terminals is heavily dependent on parking availability and cost, feeder bus service, and neighborhood characteristics.

In Table 10 annual ridership statistics for all areas in the United States currently served by commuter rail are summarized. The CUTD Update *(3)* provides additional details for various commuter rail line and branch segments. Because average trip lengths on commuter rail are relatively long (about 25 mi), passengers per revenue-car-mile average only about 1.9 with a range between 0.9 and 3.0. However, differences in operating procedures (e.g., pertaining to carrying passengers on trains moving in the reverse-haul direction), may lead to artificial differences in how revenue-car-miles are computed, potentially affecting precise comparison between systems.

On rapid rail systems in the United States, unlinked trips per vehicle-mile-traveled (VMT) have a weighted average of 5.0 using the data in Table 11. This number contrasts with the weighted average of 7.6 for streetcar and light rail transit lines and about 4.4 for large bus transit systems *(3)*. Expressed on the basis of linked trips per VMT, these statistics would be lower.

TABLE 11 RAIL RAPID TRANSIT: RIDERSHIP AND SYSTEM PROFILES (1986)

| Study Area | System | Directional Route Miles (One-Way) | Number of Stations | Maximum Revenue Vehicles in Service | Annual Revenue VMT (000s) | Annual Unlinked Rides (000s) | Unlinked Rides per Station (Avg. Weekday[a]) | Unlinked Rides per VMT |
|---|---|---|---|---|---|---|---|---|
| Atlanta | (MARTA) | 51.5 | 25 | 115 | 11,741 | 65,548 | 8,740 | 5.6 |
| Baltimore | (MTA) | 14.4 | 9 | 42 | 1,792 | 11,567 | 4,280 | 6.5 |
| Boston | (MBTA) | 76.6 | 50 | 252 | 17,543 | 143,747 | 9,580 | 8.2 |
| Chicago | (CTA) | 191.0 | 143 | 925 | 46,401 | 145,348 | 3,390 | 3.1 |
| Cleveland | (RTA) | 38.2 | 18 | 35 | 2,065 | 5,671 | 1,050 | 2.7 |
| Lindenwold | (PATCO) | 30.5 | 12 | 90 | 3,829 | 10,367 | 2,880 | 2.7 |
| Miami | (DCTA) | 39.7 | 20 | 66 | 4,442 | 7,668 | 1,280 | 1.7 |
| New Jersey | (PATH) | 27.6 | 13 | 241 | 11,344 | 53,794 | 13,790 | 4.7 |
| New York City | (NYCTA) | 481.2 | 463 | 4,889 | 290,493 | 1,591,526 | 11,460 | 5.5 |
| Philadelphia | (SEPTA) | 80.4 | 74 | 283 | 15,572 | 88,357 | 3,980 | 5.7 |
| San Francisco | (BART) | 142.0 | 34 | 321 | 30,490 | 63,959 | 6,270 | 2.1 |
| Washington | (WMATA) | 139.1 | 64 | 446 | 26,859 | 145,149 | 7,560 | 5.4 |

Key to Notes

a -- Average weekday trips computed by dividing annual trips by 300. Note that this statistic may be deceptively high for systems with relatively large numbers of rail-to-rail transfers.

SOURCE: U.S. Department for Transportation, National Urban Mass Transportation Statistics, 1986 Section 15 Annual Report (UMTA-VA-06-0127-88-1), June 1988; computations by Charles River Associates.

TABLE 12 PEAK-HOUR VEHICLE VOLUMES ON URBAN FREEWAYS AND EXPRESSWAYS

| Study Area | Facility | No. of Lanes | Year | Average Daily Traffic (2-Way) | Peak Directional Volumes: Vehicles (One-Way) | Peak Directional Volumes: % of ADT |
|---|---|---|---|---|---|---|
| Atlanta, GA | I-20 E. of CBD @ Moreland Ave. | 8 | 1984 | 99,900 | 7,794 | 7.8 |
| | I-85 N. of I-75 @ Monroe Dr. | 8 | 1984 | 95,300 | 6,765 | 7.1 |
| Boston, MA | S.E. Expwy. @ Southampton St. | 6-8 | 1982 | 143,300 | 6,860 | 4.8 |
| | I-95 -- East of 128 N. of Middlesex | 8 | 1984 | 125,050 | 7,282 | 5.8 |
| Denver, CO | I-25 South of I-70 | 8 | 1983 | 175,000 | 7,500 | 4.3 |
| | US 6 West of Federal Blvd. | 6 | 1985 | 112,000 | 5,835 | 5.2 |
| Detroit, MI | Jeffers Fwy. (I-96) & Warren | 8 | 1980 | 67,600 | 6,270 | 9.3 |
| | Lodge @ East Grand Blvd. | 6 | 1981 | 111,450 | 4,660 | 4.2 |
| Houston, TX | I-10 - East of Taylor St. | 10 | 1985 | 151,000 | 7,600 | 5.0 |
| | I-610 - @ Ship Channel | 10 | 1985 | 103,200 | 5,540 | 5.4 |
| Milwaukee, WI | N-S Fwy @ Wisconsin | 8 | 1984 | 118,080 | 5,370 | 4.5 |
| | Airport Fwy @ 68th | 6 | 1984 | 81,020 | 3,940 | 4.9 |
| New York City, NY | Holland Tunnel | 4 | 1982 | 73,200 | 2,700 | 3.7 |
| | Lincoln Tunnel | 6 | 1982 | 110,700 | 5,150 | 4.7 |
| San Francisco, CA | Oakland-Bay Bridge (I-80) | 10 | 1984 | 223,000 | 8,898 | 4.0 |
| Washington, DC | Anacostia Fwy (Howard Road) | 6 | 1984 | 121,700 | --- | 5.0 |

SOURCE: Reports from individual study areas.

### Section I: Highway and HOV Usage Statistics

Section I of the CUTD Update *(3)* presents statistics on the usage characteristics of major highways and high-occupancy vehicle (HOV) facilities located on freeways. Flows on the network are a key output of any demand modeling project. For comparative purposes, average daily traffic (ADT) and percentage of ADT occurring in the peak hour as measured at maximum load points are provided for selected freeway facilities (Table 12). For HOV sites, peak-hour volumes on the general-purpose and HOV lanes by carpool or bus are given as measured approximately 1 year after implementation and as most recently available (typically, for the years 1982–1985). Information is not presented on changes in travel volumes due to the introduction of HOV treatment *(12)*; rather, the statistics presented are most useful for comparison with other forecasts.

## CONCLUSIONS

In this paper, an overview of the various types of data on urban travel demand characteristics that have been assembled and incorporated into the newly revised CUTD Update *(3)* has been presented. The CUTD Update *(3)* is designed to provide a handy reference for analysts who need to borrow particular statistics not otherwise available locally, or who would like to compare forecasts of travel demand to actual volumes

experienced elsewhere. At various points, potential pitfalls in accomplishing this task have been described. Overall, the CUTD Update *(3)* is viewed as an addition to the literature on urban travel behavior that will be progressively updated as more data become available. In this way it should continue to be a useful reference to urban transportation planners.

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