Understanding Commuting and Grocery Shopping Using The American Time Use Survey

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Abstract: The American Time Use Survey (ATUS) allows researchers to examine individuals' travel time for a variety of trips; however, using the data poses particular challenges. With today's lifestyles, the commute may be a straightforward trip from home to work, or it also may involve stopping to drop children at a childcare center, going through the drive-through for a quick breakfast, or running other errands. In the ATUS coding lexicon, every stop a respondent makes breaks up the commute so that each part of the trip is coded according to its destination (childcare services, eating places, work, etc). This implies that parts of a respondent's daily commute may be hidden in other travel categories. A similar challenge is encountered when analyzing grocery shopping, where stops on the way to/from a grocery store influence the ATUS trip classification, complicating estimation of total time for grocery shopping travel. This paper uses 2003 ATUS data to examine different ways that commute time can be calculated, including whether trips should be combined. We discuss problems involved with different methods for both commute time and grocery shopping travel time.

Commuting

Many researchers may be interested in the American commute to work to answer a variety of research questions. For example, more time spent traveling to work could mean less time for exercise or preparing home-cooked meals. Could longer commutes be a factor in rising rates of obesity in the U.S.? The American Time Use Survey (ATUS) provides data on commute times, but there may be problems with using the ATUS data, depending on the research focus.

The ATUS activity lexicon includes commuting to/from work. The first two digits (TUTIER1CODE) of the 6-digit activity code will be 17, for traveling; the second two digits (TUTIER2CODE) will be 05, travel related to work; and the last two digits (TUTIER3CODE) will be 01, commuting to/from work (U.S. BLS 2003). For ATUS 2003 data, adding up all commute time and dividing by the number of commuting observations[1] gives an average daily commute trip of 21.7 minutes, with a median commute trip of 15 minutes, a minimum of 1 minute and a maximum of 9 hours. Only 6,244 people are making these commutes, meaning each person is commuting for approximately 39 minutes per day, or 19.5 minutes each way. The majority of commutes (85.3%) are by car, either as driver or passenger. A small percentage (6.3%) walk for at least a part of the commute, 2.2% take the bus and 1.8% the subway or train. Only 0.3% ride a bicycle and 0.2% take a taxi or limousine.

Such a simple estimation of commute time gives accurate estimates for individuals who have a straightforward commute from home to his/her workplace. However, for individuals who make a stop while traveling to work, estimating commute using ATUS commute codes may pose a challenge. In the ATUS, coding of every travel activity is based on its destination. If an individual stops for a cup of coffee on the way to work, his/her travel will be coded as travel

[1] For 2003, total commute time (using TUACTDUR) is 243,361 for 11,270 commuting observations.

related to eating and drinking.[2] If he/she drops household children at childcare or school, the code for travel related to caring for and helping household children[3] will be used. Similar coding occurs for any errand-related travel that transpires as a person is on his/her way to work. Only the last leg of this travel to work, after which the person arrives at his/her workplace, will be coded as the commute. Hence, analyzing only activities coded as commutes may underestimate the actual commute of a respondent.

Evaluation of the commute from work to home may also be challenging. The only exception to ATUS destination-based coding is travel from some location to home. In that case, travel is not coded as traveling to home but instead is based on where the person is coming from. When an individual leaves the workplace, if he/she heads straight home, this travel will be coded as commuting from work. However, if the individual leaves work and makes a stop on the way home, the travel to that stop is coded with respect to that destination, and then travel from that destination to home is also coded as travel related to the location of the stop. For example, if someone leaves work and stops to pick up dinner on the way home, travel to the restaurant will be coded as travel related to eating and drinking, as will the travel from the restaurant to home. In this case, the person will appear not to have commuted home from work at all.

Other than examining each person's commute individually, a prohibitively time consuming process, a general method for calculating a person's commute must first decide how to define commute. When travel to or from work regularly includes stops to drop off or pick up children or to get a cup of coffee or a meal, many would agree that these stops, or at least the travel to these locations, should be included as part of that person's commute. Hence, one possible commute definition may be that a person's commute begins when he/she leaves home

[2] TUTIER1CODE=17, TUTIER2CODE=11, TUTIER3CODE=01
[3] TUTIER1CODE=17, TUTIER2CODE=03, TUTIER3CODE=01

and ends with arrival at work, and similarly, on the way home the commute begins when he/she leaves work and ends with arrival at home. To focus just on time spent traveling the route to or from work, the time spent on any activity at the stop location would not be included in the commute calculation. Alternatively, if the researcher only wants to know how long it takes someone to get to work from the time he/she leaves home, then the time spent at each stop would be included. One problem that can arise from these commute definitions methods is that on the reference day a person has an unusually high number of stops or stays a long time at any one stop, such that this commute will overestimate the average commute. For example, someone may have arranged to leave work early because of a doctor's appointment, after which he/she then runs a number of errands before arriving home at approximately the normal time of day. If the total time (or travel time) from when the person leaves work until he/she arrives home is used to calculate commute time, a four or more hour commute could be the result when clearly this is not a normal situation. However, because the ATUS data are based on one day in this person's life, it may be difficult to differentiate stops that the respondent makes on a "normal" basis versus an atypical commute. Some approaches to screening travel based on the number or duration of stops are discussed below.

After deciding on a commute definition, a set of additional issues must be addressed. The first is related to travel mode. Bose and Sharp (2005) discovered that a number of travel activities in the ATUS do not have a travel mode associated with them but rather a place.[4] In order to compare ATUS travel with travel behavior captured in the National Household Travel Survey (NHTS), Bose and Sharp (2005) recoded as missing all activity location (TEWHERE) observations that listed a place instead of a travel mode, along with activity location observations

[4] TEWHERE is coded from 1 to 11 rather than from 12 to 21. For definitions of TEWHERE variables, see ICPSR 2005.

listed as "unspecified place" or "unspecified mode of transportation." We found that of 87,945 travel observations (ATUS 2003), 3,601 (about 4%)[5] were coded with a place rather than a travel mode. However, this location coding for travel could reflect time spent waiting due to a change in travel modes, such as walking to the bus stop and waiting for the bus. Therefore, we followed Bose and Sharp (2005) and recoded travel modes, but included the time spent waiting in our calculation of commute times.

Further, some ATUS respondents reported having an accident or breakdown or driving for pleasure (rather than to reach a destination) [6]. In the 2003 ATUS, 1,183 travel observations (1.4%) for 679 people are reported as such travel activities. Counting this travel as part of a commute could overestimate actual time spent commuting, and we excluded such activities from commute evaluation.[7]

After commute definition, travel mode, and "breakdown" travel issues are addressed, respondents who commute can be selected. First, individuals who did not work[8] during the reported time period are excluded. Using ATUS 2003 data, 13,083 (63%) out of 20,720 respondents reported no work activity during their day, which leaves 7,637 respondents (37%). We define commuting as travel from home to the workplace, or vice versa, so individuals who worked, but not at their workplace (TEWHERE=2) are excluded (1,376 individuals, about 18% of those who worked). These could be individuals who, on the activity day, were working somewhere other than what they define as their workplace. For example, that day, an individual may have traveled to a work retreat held at a hotel meeting room, with a location code of "other"

[5] Bose and Sharp (2005 p. 10) found "between three and four percent of all activities with travel-related codes without an associated mode code."
[6] TUTIER1CODE=17, TUTIER2CODE=99, TUTIER1CODE=99
[7] Unfortunately this travel category also includes paying toll booth or parking lot/garage attendants which probably should be considered part of the commute.
[8] TUTIER1CODE=05, TUTIER2CODE=01, TUTIER3CODE=01 (working at main job) or TUTIER1CODE=05, TUTIER2CODE=01, TUTIER3CODE=02 (working at other job)

or “restaurant.” Travel to these other locations, even though the individual worked there, did not correspond with our definition of a commute. For the ATUS 2003 data 6,261 individuals reported coming to their workplace and working there.

Further, we excluded 167 individuals who did not report any activities at home for their reference day (2.2% of those who worked). These individuals may have actually spent time at home, although the location code (TEWHERE) may not indicate this. In the ATUS, the location code for any personal care activity is recorded as negative one (-1) no matter where the activity takes place. If all of the activities an individual engages in at home are considered personal care activities, then this person will not appear to spend any time at home. Because we calculate commute time based on when a person leaves home or arrives at home, if none of the respondent’s activities are classified as being at home, this respondent is not counted in the commute estimation. We considered changing the location of all or selected personal care activities to home (change TEWHERE=-1 to TEWHERE=1), however, none of our re-coding algorithms allowed accurate differentiation of home-based activities from stops during travel (e.g., a stop to use the restroom).

An additional 173 people (2.3% of those who worked) alternate between activities at home and the workplace without traveling between locations. These individuals are also excluded. Some of these individuals appear to be making a distinction between “home” and a workplace which is also at home. For other individuals the time spent going from home to, for example, the attached shop, is not significant enough to be recorded as an activity.

Another 21 respondents were excluded because the only travel they reported was work-related travel (which neither we nor ATUS classify as a commute), or they were not counted as

commuters due to other assorted reasons. Thus, we analyze commute time for 5,900 respondents (ATUS 2003).

To calculate an individual's commute we begin the commute when the person leaves his/her home and end the commute when he/she arrives at work[9]. The same method is used for the commute from work to home, beginning when he/she leaves work and ending when he/she arrives home[10]. Because we are focusing on travel time, the time spent in an activity at each stop is excluded. This allows individuals to make an unlimited number of stops on the way to or from work. All of the travel time both to and from work is added together and divided by the number of "commutes." Usually, there are two commutes, one from home to work and one to home from work, but occasionally an individual commutes back and forth several times in a day, for example, traveling home for lunch. An individual may travel straight to work but stop several places on the way home. This method calculates an average commute time that includes both of these periods of travel. Results (using ATUS 2003 data) per trip per person show a mean commute time of 30.8 minutes (std. dev. 25.5 minutes) with the shortest mean commute time of one minute and the longest 350 minutes. The median of average commute time is 25 minutes. This 30.8 minute average and median of 25 minutes are approximately 10 minutes per trip longer than the 21.7 minute average and median of 15 minutes calculated using only ATUS-coded commutes.

In addition to the average commute time, we also evaluate the minimum time spent commuting as well as the maximum time. Researchers who are interested in examining the least amount of time necessary to travel to the workplace would want to know the minimum commute. Those who are considering how much time Americans spend running errands or transporting

[9] A change from TEWHERE=1 to TEWHERE=2, including all travel in between.
[10] A change from TEWHERE=2 to TEWHERE=1, including all travel in between.

children or stopping to eat as they travel to or from work will want to examine the maximum commute time. When examining only the minimum commute times, we find a minimum of one minute, a maximum of 350 minutes, a median of 20 minutes, and an average minimum commute time of 26.8 minutes (std. dev. 24.3 minutes). An analysis of maximum commute times again shows a minimum of one minute and a maximum of 350 minutes, with an average maximum commute time of 34.9 minutes (std. dev. 29.4 minutes). The median maximum commute is 30 minutes. An examination of daily commute time shows a minimum of one minute, a maximum of 395 minutes, a mean of 50 minutes (std. dev. 40 minutes) and a median of 40 minutes. Although this average of 50 minutes of commuting per day is longer than the 39 minutes calculated when only considering ATUS-coded commutes, the median daily commute of 40 minutes is close.

Researchers may want to put some limits on the maximum commute time. One way to do this would be to limit the amount of time an individual can spend commuting. However, this may delete individuals who really do have long commutes. We examined a number of individual cases where someone appeared to commute for four hours, one way. Sometimes this was due to a large number of stops while traveling, but in several cases the person was actually commuting for four hours. We did not examine these lengthy commutes further, but these individuals may be victims of urban sprawl, or this lengthy commute could be due to some abnormality such as weather, an accident, or construction delays. Researchers may want to scrutinize individual outliers who have a commute time considered excessive to judge whether this lengthy commute is legitimate. An alternative screening method could focus on the travel mode. For example,

although commuting by plane could be possible, a lengthy commute that includes air travel may actually reflect work-related travel, not commuting[11].

Another way to limit maximum commute time is to examine the number of segments or legs involved in a commute. Based on the concerns of the researcher, if someone makes more than four stops, for example, either on the way to or from work, then this travel would not be considered a commute. For travel from home to work, only the travel coded as commuting to work (the last leg of a multi-stop trip) could be included. However, if a person leaves work and stops multiple times on the way home, none of that travel will be coded as a commute in ATUS, making it difficult to decide which legs of that trip to include as the commute. In this case, the best choice may be to delete all of this travel from the commute calculation. In addition, if the researcher wants to reduce commute time by limiting the number travel segments, there is a need to distinguish a trip containing multiple destinations from a trip containing multiple travel modes. A trip that includes waiting for the bus, traveling on the bus, waiting for the subway, traveling by subway, and then driving home from the subway station is obviously a legitimate multi-mode commute. Compare this trip to one that includes driving to a childcare center to drop off a child, driving to a school to drop off a child, driving to the bank to make a deposit, driving to Starbucks for a coffee and then driving to work. Both trips contain five travel segments, although the latter also contains four stops. Both would appear to be someone's commute. In future research we will separate multi-leg trips due to various travel modes from those due to numerous stops. This should allow researchers to limit the number of stops that are considered part of a reasonable commute while not impacting legitimate multi-travel-mode commutes.

[11] TUTIER1CODE=17, TUTIER2CODE=05, TUTIER3CODE=02 rather than TUTIER1CODE=17, TUTIER2CODE=05, TUTIER3CODE=01

In the 2003 ATUS data, the number of legs in a commute (based on both mode changes and/or stops) ranges from one to twenty. Of 10,079 commutes, 98.8% will be incorporated if trips containing five legs or less are included. Almost two thirds of commutes (66.6%) have straightforward one segment commutes, 18.9% include one stop or use two travel modes, 8.1% contain two stops or three travel modes, and 3.7% have three stops or four travel modes. Only 1.5% contain four stops or five travel modes.

We calculate travel time for each of 9,955 commute trips for commutes with five or fewer segments (5,856 commuters). Results (using ATUS 2003 data) per trip per person show a mean commute time of 29.8 minutes (std. dev. 24 minutes) with the shortest average commute time of one minute and the longest 350 minutes. The median of average commute time is 25 minutes. When examining only the minimum commute times, we find a minimum of one minute, a maximum of 350 minutes, a median of 20 minutes, and an average minimum commute time of 26.2 minutes (std. dev. 23.1 minutes). An analysis of maximum commute times again shows a minimum of one minute and a maximum of 350 minutes, with an average maximum commute time of 33.5 minutes (std. dev. 27.3 minutes). The median maximum commute is 30 minutes. An examination of daily commute time shows a minimum of one minute, a maximum of 395 minutes, a mean of 48.2 minutes (std. dev. 37.8 minutes) and a median of 40 minutes. Obviously, these numbers are close to those calculated when not eliminating commutes with more than five legs because 98.8% of commutes are included.

Other data sources also consider how much time Americans spend commuting. The U.S. Department of Transportation, Bureau of Transportation Statistics found an annual (they also calculate average commute time for each month) average one-way commute time for 2003 of 26.8 minutes (BTS 2007). Slightly lower than the 30.8 or 29.8 minutes we calculate using 2003

ATUS data. The U.S. Census Bureau calculates average travel time to work (for those who did not work at home) using the American Community Survey. Their estimate for 2003 is 24.3 minutes for the whole U.S., ranging, by state, from 15.2 minutes in South Dakota to 30.4 minutes in New York (U.S. Census Bureau 2007a). Although the Census Bureau's national average of 24.3 minutes is shorter than the ATUS averages of 30.8 and 29.8, the New York state average of 30.4 minutes is comparable. Perhaps the ATUS data is weighted more towards metropolitan areas that may have longer commutes. According to the U.S. Census Bureau data, several American cities have commutes of 29 minutes or more: New York City's average commute is 38.3 minutes, Chicago 33.2 minutes, Philadelphia 29.4 minutes, and Los Angeles, Miami, and Baltimore all 29 minutes (U.S. Census Bureau 2007b).

Another consideration when a person stops while traveling to/from work would be the length of time spent at one stop. Researchers may want to reconsider a commute that involves a stop for a time period considered "too long." Excluding long stops is an attempt to allocate travel according to its intended purpose. Bose and Sharp (2005) suggest any stop longer than 10 minutes is too long, however, we believe that 15 minute stops should still be considered as part of the commute (after examination of a random sample of cases with stops included as part of a commute). However, excluding long stops does bring up cases that are not easy to define. If an individual leaves work and goes out to dinner, which takes an hour, and then travels home, the travel might be considered travel for dining rather than part of the commute. But, if an individual leaves work and stops briefly for dinner, say at a fast food restaurant which only takes 15 minutes, and then travels home, this travel might be counted as part of the commute. Since the only difference is the amount of time the individual spent eating should these be categorized the same way or differently? In addition, excluding travel associated with long stops by developing a

uniform algorithm (rule) to exclude travel associated with long stops may be difficult due to the variety of situations that could be involved. If an individual travels to the gym, works out for over an hour, and then travels to work, should both legs of this trip be excluded (perhaps resulting in no commute at all), or should only the travel to the gym be excluded, or should both trips be included as a legitimate part of this person's commute? The length of time considered a legitimate stop should be left up to the researcher based on the reason s/he is calculating commute time. We have not addressed this issue at this time, thus all travel considered as a commute according to our definition is included, even if it contains a long stop.

Grocery shopping

As we begin to understand the possible health consequences of the increase in consumption of food away from home in the U.S., researchers may want to consider the time constraints that have led to less preparation of food at home. The American Time Use Survey facilitates analysis of time spent on preparing food at home including time spent grocery shopping. The 2003 ATUS data show 16.9% of respondents went grocery shopping[12] on the reference day, 92% at a grocery store, 5% at another store, and 0.6% at home (online shopping?). The average time spent on a grocery shopping activity (ATUS 2003) was 40.7 minutes (std. dev. 30.6 minutes), with a minimum of one minute and a maximum of 375 minutes. The median time spent grocery shopping was 30 minutes. The average amount of time a person spent grocery shopping in the reference day was 43.8 minutes. If, according to the Food Marketing Institute, the average shopper makes 2.1 trips per week to a grocery store (Gordon 2007), this would indicate that grocery shopping takes approximately 92 minutes per week, not including travel time.

[12] TUTIER1CODE=07, TUTIER2CODE=01, TUTIER3CODE=01 (consumer purchases, shopping, grocery shopping) and TUTIER1CODE=07, TUTIER2CODE=01, TUTIER3CODE=05 (consumer purchases, shopping, waiting in line to purchase groceries)

Estimating travel time for grocery shopping using ATUS data involves many of the issues discussed regarding commuting. Only the travel segment that ends at the grocery store will be coded as grocery shopping travel, as will travel from the grocery store that ends at home. Using only the activities coded as travel for grocery shopping[13] in the 2003 ATUS, we find that on the reported day 16.4% of respondents traveled to grocery shop, 93.8% by car, as either driver or passenger, and 5.4% by walking. Very few traveled to grocery shop using the bus (0.24%), a bicycle (0.15%), a taxi (0.09%), the subway or train (0.06%), or an airplane (0.03%). A small percentage (0.12%) used an "other" mode of transportation to shop for groceries. Using the 2003 ATUS data, the average time spent on a one-way grocery shopping trip (travel only) is 12.5 minutes (std. dev. 13.2 minutes). This indicates that consumers shop relatively close to home, however, multiple stop trips are not included in this calculation. Individuals may have traveled much longer to the grocery store but only, on average, 12.5 minutes from the last destination. The minimum grocery shopping travel time is one minute, the maximum is 340 minutes, and the median is 10 minutes. The daily average grocery shopping travel time per person is 22.7 minutes. Adding together grocery shopping and the associated round-trip travel we find that an average grocery shopping "trip" involves 65.7 minutes. Calculated per person, in the reference day a consumer, on average, spends 66.5 minutes traveling to the store and grocery shopping. Again, assuming 2.1 grocery shopping trips per week, this works out to 138-140 minutes or 2.3 hours per week.

It will depend on the research question whether other segments of a multiple stop trip should be counted as time spent traveling for grocery shopping. If the researcher wants to know the total time spent shopping and/or running errands, s/he may want to include all legs of a multi-stop trip. If concern is for the minimum amount of time it takes to get groceries, then only the

[13] TUTIER1CODE=17, TUTIER2CODE=07, TUTIER3CODE=01

travel leg that is directly associated with arrival at or departure from the grocery store would be included.

Another issue that is difficult to address using ATUS data is understanding the purpose of the trip. Someone could stop to grab a bite to eat before going to the grocery store, and in ATUS, such a trip will be coded as two travel activities, the first for eating and the second for grocery shopping, although the purpose of this trip was grocery shopping. Alternatively, someone could go out to dinner and then run into the grocery store for one or two items on the way home. Again, this will be coded as two trips in ATUS, one for eating and the second for grocery shopping. Depending on the research question, the researcher may want to classify the trips of these two individuals differently. One way to determine the probable purpose of a multi-stop trip may be by considering the length of time spent at each of the two activities. If eating time is short relative to grocery shopping, one might classify the whole trip as grocery shopping, with the opposite classification if eating time is longer than time spent getting groceries.

Another reason to study grocery shopping travel is to look at food access. Research on food deserts (lack of access to full-service supermarkets) uses geographic distance to determine how far people must travel for groceries (Blanchard and Lyson 2006). Distance to a grocery store could also be measured using travel time, which arguably may be a better measure than miles because it takes an area's topography, such as mountains and rivers, into account. ATUS travel activity data can also help us understand other implications of grocery shopping behavior, such as whether consumers shop for groceries as part of their commute or other activities. Research that analyzes the impact of environmental factors on nutrition often defines an individual's neighborhood of influence as the area surrounding his/her home. If individuals are grocery shopping as part of their commutes or other travel, defining the relevant neighborhood as only

the area surrounding their homes does not reflect the true area of influence (Ball, Timperio and Crawford 2006). Using 2003 ATUS data we found that 644 people (10.9% of commuters) shop for groceries as part of their commutes. Future research will include a more in depth analysis of these and other grocery shopping travel issues.

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