The Use of Three Surveys for Long Distance Travel Estimates in California

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ABSTRACT
Information on long distance travel is crucial for interregional and statewide travel forecasting. While long distance trips may account for a small percentage of total trips within a state, they produce an inordinate share of the statewide vehicle-miles of travel (VMT). For example, based on the daily diary information from the recent California Statewide Household Travel Survey (CSHTS), trips to locations more than 50 miles from travelers’ residences comprised about two percent of the total daily trip making, yet produced about 30 percent of the statewide VMT.

While typical, one-day travel diaries can provide some useful information regarding long distance travel, they are an inefficient source of information for the detailed analysis of long distance travel. Since long distance travel is a relatively rare occurrence for most households–the average person makes approximately nine long distance round trips per year–most household will not report any long distance travel in a survey collecting travel data for a single travel day. In fact, only five percent of households participating in the CSHTS reported any long distance trips in their daily diaries.

This paper describes how three recent surveys performed in California have been used to provide an overall picture of long distance travel within the state. The three surveys are the 2011 Harris On-Line Panel Long Distance survey performed for the California High Speed Rail Authority (CAHSRA) and the 2012-2013 California Statewide Household Travel Survey Daily Diary and Long Distance Travel Recall Surveys performed for the California Department of Transportation (Caltrans).
INTRODUCTION
A major update of the California High Speed Rail Ridership and Revenue Model (CHSR3M) was initiated in late 2012. The Version 2 CHSR3M development effort has taken advantage of the daily diary and long distance recall data collected for the 2012-2013 California Statewide Household Travel Survey (CSHTS) performed for the California Department of Transportation (Caltrans). The raw (unexpanded) data have been used for estimation of the discrete choice models for trip frequency, destination choice, and mode choice comprising the CHSR3M.

The Version 2 CHSR3M will also take advantage of the expanded long distance survey data to estimate control totals for model calibration <1>. The CSHTS used a design that has been used in other recent surveys (e.g. the Utah statewide survey and Front Range Travel Counts survey in Colorado) where long distance travel is collected using both daily diary and long distance recall surveys. Information from both the daily diary and long distance surveys have been used to estimate overall daily long distance trip making within the state. In addition, information collected as part of the 2011 Harris On-Line Panel Long Distance travel survey performed for the California High Speed Rail Authority (CAHSRA) have been used to supplement the long distance recall data from the CSHTS.

For the Version 2 CHSR3M, long distance trips have been defined as any trip made to a Traffic Analysis Zone (TAZ) 50 miles or more from the respondent’s home TAZ. All distances have been calculated as straight line distances between TAZ centroids for consistency with the modeling process. Only intrastate long distance travel is considered for the CHSR3M.

Four long distance trip purposes have been defined:
- **Business** travel includes all travel to locations other than a traveler’s normal place of work for business purposes.
- **Commute** travel includes all travel to a person’s regular place of work. Note that a person might work from home three or more days per week but travel to an assigned office more than 50 miles from their home one or two days per week. Such travel would also be considered commute travel.
- **Recreation** travel includes all trips made for recreation, vacations, leisure or entertainment.
- **Other** travel includes all trips made for other purposes including school, visiting friends or relatives, medical, personal business, weddings and funerals.

The following section provides brief overviews of each of the three surveys. It is followed by a description of how data from each of the surveys were combined and used to provide an overall picture of long distance travel made by California residents within the state. Finally, summaries of the findings are presented.

BACKGROUND ON THE THREE TRAVEL SURVEYS

**2012-2013 CSHTS Daily Diary Survey**
The CSHTS daily diary survey was a comprehensive household travel survey that collected daily travel from all members of each respondent household. The survey collected travel information from 42,431 California households using a daily travel diary as the primary collection tool. Multiple data collection methods were employed including computer aided telephone collection, on-line data entry by respondents, and mail-back of survey forms. A stratified sampling procedure was used to ensure that the numbers of surveys collected from each county exceeded specified minimum numbers.

Travel data were collected for each member of a respondent household during the travel day appointed for the household. The travel diary was designed to collect information necessary to calibrate and validate trip-based or activity-based travel models. The data included characteristics of each respondent household, the household members, the vehicles owned by the household, the places visited, activities performed at those places, and modes of travel between places visited. Over 3,600 households declined to report household income and were dropped from the database used for the analysis of long distance travel. The remaining 38,787 households with all socioeconomic data reported were used to estimate long distance travel behavior for the diary day.
A one-day travel diary is not an ideal instrument for collecting long distance travel data. Even with a sample the size of the CSHTS, over 100,000 persons in the 38,787 households, a single day diary collects long distance travel data for a limited number of travelers and households. Each person makes an average of 0.045 long distance trips on an average day. Thus, a survey of 100,000 persons would collect only about 4,500 long distance trips.

A second issue with using the daily diary for the analysis of long distance travel data is that it is difficult or impossible to determine long distance trip purposes for many of the reported trips. Since daily diaries are designed to collect information for only the assigned travel day, it is often impossible to determine the true purpose for long distance travel. For example, a person may travel for a business meeting scheduled for the day following the assigned travel day. That traveler’s final trip (or tour) on the assigned travel day may end at a hotel leaving the true purpose of the trip unreported.

Nevertheless, the strength of the daily diary survey for the analysis of long distance travel is that it provides a good mechanism for identifying all long distance travel completed by members of respondent households on the assigned travel day. Thus, it is a very strong tool for validating overall long distance travel estimated using data from long distance recall surveys.

Long distance trips were estimated from the daily diary data using a process similar to determining tours for tour-based travel models:

- A TOUR was defined by listing all PLACES visited between two stops at the HOME location;
- For each TOUR, the PLACE farthest from the HOME location (based on straight line distances) was determined;
  - If the farthest place visited was 50 miles or more from the HOME location, the location was identified as the long distance DESTINATION;
  - Each long distance DESTINATION determined from the above three steps defined two, one-way long distance trips;
  - For trips that began or ended the travel day at a location other than HOME, the trip was counted as a single one-way long distance trip if the non-HOME location was 50 miles or more from HOME;
- Long distance trips that included a stop outside the State of California were not counted as long distance trips, even if the TOUR defining the long distance trip included a stop within California that was 50 or more miles from HOME.

This process was defined to avoid double-counting long distance trips from the daily diary and to be as consistent as possible with the long distance travel data reported in the recall surveys. The goal of the process was to “link out” intermediate stops for incidentals such as gas or food. In some cases, the process incorrectly identified the true long distance destination. For example, suppose a person traveled to a specific location for a business meeting and made a noontime visit to a restaurant farther from HOME than the location of the business meeting. The restaurant location would have been identified as the long distance trip DESTINATION.

The above analysis process identified 3,210 long distance trips completed by 3,199 persons (i.e. 11 persons made more than one long distance trip on their diary day). A significant portion, 53 percent, of the long distance travel involved overnight stays, so those travelers were credited with completing one-half of a long distance round trip. Therefore, the 3,210 long distance trips accounted for 4,713 one-way trips, or the equivalent of 2,358 long distance round trips. Since multiple household members traveled together to a significant number of the identified long distance locations, 1,201 of the long distance person trips were consolidated into larger group trips. Thus, the survey identified long distance trips to 2,009 “unique” locations. Long distance trips were identified for 1,965, or five percent, of the 38,787 households included in the CSHTS data used for the analysis.

The surveyed long distance trips were expanded to represent long distance travel for all California households <1>. The expansion factors were based on geographic and demographic characteristics of the surveyed households as compared to those characteristics for all households in California. Over 1.5
million, one-way long distance trips were estimated to be made by California residents on an average day. Based on expanded results from the CSHTS data, the long distance trips account for approximately two percent of all intrastate trips made by California residents.

The 1.5 million daily one-way long distance trips equate to an average of 8.2 annual intrastate long distance round trips per capita for California residents. In comparison, an NPTS Brief from 2006 estimated the national average of 9.4 annual long distance round trip rate per capita; for the Pacific Region the annual average was 8.7 long distance round trips per capita. (This “NPTS Brief” provides summary statistics of long distance travel derived from the 2001 National Household Travel Survey, commonly referred to as the 2001 NHTS. All other briefs associated with the 2001 NHTS appear to be titled “NHTS Brief.”) When interstate and international long distance trips reported in the CSHTS daily diary are included in the analysis, the average round trip rate is 8.6 annual long distance trips per capita which is almost identical to the value reported in the NPTS Brief for the Pacific Region.

Summary of Findings Regarding Usefulness of CSHTS Daily Diary Data for Long Distance Travel Analysis

The CSHTS Daily Diary data provide a good basis for determining the overall amount of intrastate long distance travel made by California residents. However, even though the CSHTS dataset includes information from 38,787 households, long distance trip making is such a rare phenomenon that making estimates of variations in trip rates by geographic region of the state or different socioeconomic strata is risky. In addition, since the diary covered only one day of travel, it is not possible to reliably determine the purposes of the long distance trips reported in the diary.

2012-2013 CSHTS Long Distance Travel Recall Survey

With the knowledge that the understanding of long distance travel is critical to the analysis and planning for many upcoming projects in California, the CSHTS included a supplemental survey to collect more long distance travel data than would be available from the CSHTS Daily Diary survey. The Long Distance Travel Log (LDTL) was an optional survey that requested long distance travel performed by the members of the respondent during the eight weeks preceding the assigned travel day. The longer survey period (56 days, as compared to one day for the daily diary) greatly increased the amount of long distance travel data available for analysis.

The LDTL was designed to reduce respondent burden by requesting information deemed relevant for most planning studies: trip origin and destination, trip purpose, group size (total and household members) and the main mode of travel used on the trip. Respondents were instructed to record this information for all long distance trips completed during the eight week reporting period to places 50 miles or more from their home. One recall survey form with spaces for up to eight long distance trips was provided for each household member. Respondents were instructed to record outbound and return trips separately and to record details for trips in excess of eight on a separate sheet of paper.

Completion of the LDTL was not required for a survey collected via the daily diary to be considered to be complete. As a result, long distance travel data was provided by only about one-half of CSHTS respondent households. The differential response rate dictated the calculation of separate expansion factors for estimating long distance travel characteristics for the full population of California. However, even though the LDTL was optional, data for a much greater number of long distance trips were collected via the LDTL than were collected via the daily diaries. The LDTL included 32,641 long distance person trips completed by 22,555 individuals from 12,183 households. Another 9,834 households completed the LDTL, but indicated either no long distance trips or long distance trips only to non-California locations. Approximately nine times as many trips to unique locations, 18,023, were identified in the LDTL as were identified in the daily diary. This occurred in spite of the fact that the LDTL was completed by only half of the CSHTS households. The larger number of trips to unique locations resulted in a much richer database for analyzing and understanding long distance travel in California.
When the 32,641 long distance person trips reported in the LDTL were initially expanded to represent the entire population of California, approximately 680,000 daily one-way long distance trips, or an average of 3.6 annual long distance round trips per capita were estimated. This estimate was significantly lower than 8.2 annual long distance trips per capita calculated using the data derived from the CSHTS daily diary.

Summary of Findings Regarding Usefulness of CSHTS Long Distance Recall Survey Data for Long Distance Travel Analysis

The LDTL provided a rich database for determining long distance trip purposes and the destination and main mode choice characteristics intrastate long distance travel made by California residents. Since discrete choice models of trip frequency, destination choice, and mode choice were being developed for the CAHSR3M, the unexpanded trip data could be used to estimate model forms and coefficients. Thus, the fact that the total amount of long distance travel based on the LDTL was less than one-half the amount of travel estimated using the daily diary did not preclude the use of the LDTL data for model estimation. However, procedures to adjust the LDTL data to reflect all intrastate long distance travel had to be developed for the data to be useful for final calibration of the CAHSR3M.

The initial analysis of the LDTL data revealed several survey design issues that had to be addressed:

- The LDTL didn’t include a “repetition frequency” question, which would have allowed respondents who made multiple long distance trips to the same location via the same travel mode to quickly report the trips. An analysis of the responses along with the number of LDTLs with exactly eight trips suggested that respondent fatigue coupled with a lack of understanding of the need for respondents to report all long distance travel was an important issue.
- The LDTL required respondents to remember and report travel completed as much as eight prior to their assigned travel day. The recall survey was subject to memory lapses resulting in underreporting of long distance trips.
- Many respondents failed to record both directions of travel. On average, for every outbound trip, only 0.65 of a return trip was recorded.
- Since completion of only the CSHTS Daily Diary was required for a survey to be considered to be complete, only about one-half of the respondent households completed the LDTL. Household and total daily trip making characteristics for households completing and households failing to complete the LDTL were different.

Since the data from the LDTL were the primary data for the estimate of total long distance travel made by California residents, each of issues outlined above had to be addressed before reasonable estimates of travel could be produced.

2011 Harris On-Line Panel Long Distance Survey

This survey was performed in May and June 2011, for the CAHSRA in an effort to collect information for corroborating trip rates and shares of trips by trip purpose forecast using the CAHSR3M. The survey was designed, pilot tested, performed, and summarized over a two month period in order to meet a schedule imposed on the production of ridership forecasts for the CAHSRA 2012 Business Plan <3>. The survey design <4> was similar to the CSHTS long distance recall survey in that travel over the previous eight week period was requested. However, there were several distinct differences:

- Survey respondents were drawn from an established on-line panel that responds to selected surveys in order to accrue credit for awards and prizes.
- Demographic information on the panelists such as age, sex, household size, and household income, was obtained from panelists’ on-line panel registration information. Worker status of the survey respondents was also collected.
- Due to the need to limit response time for the survey, only the destination city or zip code, rather than detailed address information was requested for each trip.
Also due to the need to limit the response time for the on-line survey, respondents were requested to provide a repeat frequency for multiple trips made to the same destination for the same purpose and using the same mode during the eight week recall period. This shortcut resulted in the finding that many long distance trips are repeated on a regular basis.

- The survey collected long distance travel information only for the panel member rather than for all household members. This allowed survey respondents to provide information about their own long distance travel during a single internet session without requiring interviews of other household members.
- The survey panel included only adult household members.
- The survey was conducted over a two month time period rather than over a complete year.

The two month time period covered by the survey (essentially April and May 2011) represented an “average” time of year when most employed residents were working and most students were in school. More long distance trips would be expected during the summer months for vacation travel, and fewer long distance trips would be expected during the winter months. The survey time frame included a major holiday weekend (Memorial Day) that is normally associated with recreational weekend travel. The inclusion of one major holiday weekend was appropriate for the two-month survey time frame since almost any two-month time period during the calendar year includes one such major holiday weekend.

The 2011 Harris Panel survey collected useful long distance travel information for 11,986 California residents. These residents reported making over 25,000 one-way long distance trips during the two month survey recall period. This total included over 11,200 one-way long distance trips to unique locations. Each unique trip was factored by the reported repeat frequency over the previous two months. The average trip repetition frequency reported by the Harris Panel survey respondents was 2.23 repetitions for each trip. The repeat frequency varied significantly by trip purpose (commute trips had the highest repeat frequency) and trip length (shorter trips had higher repeat frequencies than longer trips). Based on the reported trips coupled with repeat frequencies and adjustments for household members accompanying the survey respondents on trips, 5.1 average annual long distance intrastate round trips per capita were estimated.

Summary of Findings Regarding Usefulness of 2011 Harris Panel Long Distance Survey Data for Long Distance Travel Analysis

The 2011 Harris Panel survey was designed to collect long distance travel characteristics of adult California residents. The original intent of the survey was to validate long distance trip making forecast using the Version 1 CAHSR M. With limited time and resources available, and with the knowledge that a more comprehensive statewide household survey would not be ready for another 12 months, the Harris Panel survey was used as a stop-gap measure to corroborate long distance trip frequency, shares of trips by trip purpose, average trip lengths, travel group sizes, and mode shares.

The following issues impact the usefulness of the 2011 Harris Panel survey data for long distance travel analysis:

- The survey was not a random sample of California residents since respondents were drawn from an established on-line panel that responds to selected surveys in order to accrue credit for awards and prizes.
- Long distance trip information was collected for only the respondents, not all members of the respondents’ households. While adjustments were made for household members accompanying respondents on their reported trips, trips made by other household members independently of the survey respondents were not recorded.
- The survey did not collect detailed origin and destination location information.

The 2011 Harris Panel survey data provides important information that is missing from the LDTL and can be used for long distance travel analysis: an estimate of repeat frequency for long distance trips. The following section describes how this information was combined with the data collected via the 2012-2013 CSHTS Long Distance Recall survey to improve estimates of total intrastate long distance travel made by California residents.
METHODS FOR ADJUSTING THE 2012-2013 CSHTS LONG DISTANCE RECALL SURVEY

The previous section provided background on the three sets of survey data available for estimating total intrastate long distance travel made by California residents. Issues were identified with each of the surveys that limited the usefulness of the data for the estimates of total travel. However, by combining information from each of the surveys, a reasonable estimate of the total travel can be made:

- The 2012-2013 CSHTS Daily Diary data provide a reasonable estimate of the total average daily intrastate long distance trips made by California residents. The estimated amount of daily long distance trip making corresponds closely with the estimate of long distance trip making from the NPTS Brief. The estimate can be used to adjust for underreporting of long distance trips in the 2012-2013 CSHTS Long Distance Recall survey.

- The 2012-2013 CSHTS Long Distance Recall survey data provide the most complete data regarding long distance trips by trip purpose, long distance trip travel flows, and long distance trip mode shares.
- The 2011 Harris Panel survey data provides important information regarding the repeat frequency for long distance trips. This information can be used to adjust reported trips by trip purpose and trip length in the 2012-2013 CSHTS Long Distance Recall survey.

Three basic steps comprised the process used to adjust the 2012-2013 CSHTS Long Distance Recall survey:
- Only information from one direction of travel was used for the analysis. This removed the issue that 35 percent of respondents reported information only for outbound trips, and a much smaller number reported information only for return trips. For total intrastate long distance trip making, symmetry of travel was assumed. This step was a simple, straightforward adjustment.
- An imputation procedure was developed to account for repeat frequency. This procedure randomly assigned repeat frequencies from the 2011 Harris Survey on LDTL data based on trip purpose, trip distance, and traveler socioeconomic data.
- Distance-based adjustment factors based on the 2012-2013 CSHTS Daily Diary data were applied to adjust for remaining differences between overall trip rates from the adjusted LDTL data.

Imputation of Repeat Trips

The average trip repetition frequency from the LDTL, which didn’t include a trip repetition frequency question, was 1.2 repetitions for each trip. This information was estimated by summarizing the numbers of long distance trips in the LDTL made by each respondent to the same location, for the same trip purpose, and by the same mode. In comparison, the average trip repetition frequency summarized from the 2011 Harris Panel survey, which did include a question regarding trip repetition frequency, was 2.2 repetitions for each trip.

In order to adjust for the underreporting of repeat trips in the LDTL data, a procedure was implemented to replace the trip repetition frequency information summarized from the LDTL data with an imputed trip repetition frequency derived from the data reported by the Harris Panel survey. The 2011 Harris Panel data showed that trip repetition frequency was correlated with trip purpose (commute trips have the highest repetition frequency) and trip length (shorter trips have the higher repetition frequency than longer trips). In addition, for the commute trip purpose it was clear that household income was important for estimating trip repetition frequency. Double counting of reported repeat trips in the LDTL data was averted by removing the reported repeat trips so that only “unique” long distance trips were included in the database. The imputation process was then completed by randomly assigning a repeat frequency rate from the Harris Survey data based on the trip purpose, trip length and, in the case of commute trips, income group of the respondent.

Table 1 shows the impact of the trip repetition frequency imputation process. The reported repetition frequency summarizes the reported repeat trips form the LDTL, and the imputed repetition frequency data summarizes the results of the imputation process. The imputed repetition frequency rates...
are substantially higher for commute trips than for the other trip purposes. The expanded data in the last two columns show the results for each of the categories before and after the implementation of the imputation process. The imputation process increased the number of trips for all trip purposes with the biggest impact on the commute trip purpose. The average repetition frequency reported for commute trips in the LDTL survey was two repeats per unique trip, whereas the average repetition frequency reported for commute trips in the Harris Survey was 15 repeats per unique trip. The imputation process increased the number of commute trips from 23,250, or three percent of total long distance trips, to 87,285, or 15 percent of total long distance trips.

**TABLE 1  Impact of Trip Repetition Frequency Imputation on Long Distance Trips**

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>Distance Range (mi)</th>
<th>Income Range(s)</th>
<th>Reported Repetition Frequency (LDTL)</th>
<th>Imputed Repetition Frequency (Harris)</th>
<th>Expanded Daily Long Distance Trips Before Imputing</th>
<th>Expanded Daily Long Distance Trips After Imputing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commute</td>
<td>50-75</td>
<td>Medium, High</td>
<td>2.5</td>
<td>24.5</td>
<td>11,200</td>
<td>115,130</td>
</tr>
<tr>
<td></td>
<td>50-300</td>
<td>Low</td>
<td>1.2</td>
<td>6.2</td>
<td>1,190</td>
<td>5,040</td>
</tr>
<tr>
<td></td>
<td>75-300</td>
<td>Medium</td>
<td>1.6</td>
<td>18.2</td>
<td>2,660</td>
<td>31,970</td>
</tr>
<tr>
<td></td>
<td>75-300</td>
<td>High</td>
<td>1.9</td>
<td>6.0</td>
<td>6,560</td>
<td>20,960</td>
</tr>
<tr>
<td></td>
<td>Over 300</td>
<td>All</td>
<td>1.4</td>
<td>1.4</td>
<td>1,640</td>
<td>1,470</td>
</tr>
<tr>
<td></td>
<td>All (Average)</td>
<td>All</td>
<td>2.0</td>
<td>15.0</td>
<td>23,250</td>
<td>174,570</td>
</tr>
<tr>
<td>Percent of Total Long Distance Trips</td>
<td></td>
<td></td>
<td>3%</td>
<td>15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>50-75</td>
<td>All</td>
<td>1.2</td>
<td>2.2</td>
<td>23,790</td>
<td>44,890</td>
</tr>
<tr>
<td></td>
<td>75-100</td>
<td>All</td>
<td>1.2</td>
<td>1.9</td>
<td>13,740</td>
<td>21,080</td>
</tr>
<tr>
<td></td>
<td>100-150</td>
<td>All</td>
<td>1.1</td>
<td>1.8</td>
<td>12,170</td>
<td>18,810</td>
</tr>
<tr>
<td></td>
<td>150-300</td>
<td>All</td>
<td>1.1</td>
<td>1.7</td>
<td>8,980</td>
<td>13,490</td>
</tr>
<tr>
<td></td>
<td>Over 300</td>
<td>All</td>
<td>1.1</td>
<td>1.6</td>
<td>11,370</td>
<td>16,080</td>
</tr>
<tr>
<td></td>
<td>All (Average)</td>
<td>All</td>
<td>1.2</td>
<td>1.9</td>
<td>70,050</td>
<td>114,350</td>
</tr>
<tr>
<td>Percent of Total Long Distance Trips</td>
<td></td>
<td></td>
<td>10%</td>
<td>11%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation &amp; Other</td>
<td>50-75</td>
<td>All</td>
<td>1.2</td>
<td>1.9</td>
<td>190,560</td>
<td>318,920</td>
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<tr>
<td></td>
<td>75-100</td>
<td>All</td>
<td>1.2</td>
<td>1.7</td>
<td>126,370</td>
<td>185,510</td>
</tr>
<tr>
<td></td>
<td>100-150</td>
<td>All</td>
<td>1.1</td>
<td>1.5</td>
<td>120,410</td>
<td>164,590</td>
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<tr>
<td></td>
<td>150-300</td>
<td>All</td>
<td>1.1</td>
<td>1.4</td>
<td>92,440</td>
<td>119,760</td>
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<tr>
<td></td>
<td>Over 300</td>
<td>All</td>
<td>1.1</td>
<td>1.2</td>
<td>60,900</td>
<td>68,890</td>
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<tr>
<td></td>
<td>All (Average)</td>
<td>All</td>
<td>1.1</td>
<td>1.6</td>
<td>590,680</td>
<td>857,670</td>
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<tr>
<td>Percent of Total Long Distance Trips</td>
<td></td>
<td></td>
<td>86%</td>
<td>75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Purposes</td>
<td></td>
<td></td>
<td>683,980</td>
<td>1,146,590</td>
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<td></td>
</tr>
</tbody>
</table>

**Correction for Missing Trips**

After the imputation process was implemented, the adjusted trips were expanded to represent the total intrastate long distance trip making by California residents. The adjusted, expanded trips summed to approximately 1.15 million daily intrastate long distance one-way trips, or an average of 6.1 annual long distance round trips per capita. This annual round trip rate per capita was still significantly lower than the
1.5 million daily long distance trip, or 8.2 annual round trips per capita, calculated from the CSHTS daily diary data.

The cause of the difference was surmised to be a result of underreporting of trips for the various reasons described previously – the provision of only eight spaces on the LDTL forms for long distance trips, forgotten trips due to the eight week recall period, and differences between the respondents reporting long distance travel and respondents who elected to not complete the long distance recall survey.

It was not feasible to determine adjustments for each component of underreporting. However, when the expanded, adjusted LDTL dataset and the expanded long distance trips from the CSHTS Daily were tabulated and compared by trip distance, it was clear that most of the trips missing from the imputed/expanded LDTL dataset were shorter trips, particularly trips between 100 and 150 miles. For the trip lengths more than 200 miles, almost identical number of trips were estimated for the two expanded datasets. This finding appeared to be logical since shorter trips may be more likely to be forgotten, especially if they were made more than a month prior to the reporting date.

Adjustment factors stratified by 25 mile groupings were calculated. Trips between 50 and 75 miles were increased by 41 percent with decreasing adjustment factors for increasing distances up to 275 miles in length. No adjustment factors were applied for trips over 275 miles in length. The adjustment factors applied to correct for missing trips can be summarized:

- For trips between 50 and 75 miles in length – adjustment factor = 1.41
- 75 to 100 miles = 1.38
- 100 to 125 miles = 1.36
- 125 to 150 miles = 1.34
- 150 to 175 miles = 1.31
- 175 to 200 miles = 1.27
- 200 to 225 miles = 1.22
- 225 to 250 miles = 1.14
- 250 to 275 miles = 1.06
- For trips over 275 miles in length – adjustment factor = 1.00 (no adjustment)

The results of the trip distance adjustment factors are displayed in Figure 1. As shown, the application of the adjustment factors that varied by distance range improved the match between the adjusted and expanded LDTL trips and the estimated trips from the daily diary data. After both sets of adjustment factors were applied, the adjusted and expanded LDTL trips summed to approximately 1.5 million daily intrastate, long distance one-way trips, or an average of 8.2 annual long distance round trips per capita. This value matched the 8.2 annual intrastate, long distance round trips per capita estimated from the expanded CSHTS daily diary data.

**SUMMARY OF THE ADJUSTED 2012-2013 CSHTS LONG DISTANCE RECALL SURVEY RESULTS**

This section provides some brief summaries of the expanded CSHTS long distance recall survey results. As noted in the introduction, the data have been used for the estimation and calibration of the Version 2 CHSR’M. Additional summaries and uses of the data can be found on the CAHSRA website <1>.

**Long Distance Trip Frequency**

Following the adjustment of the 2012-2013 CSHTS Long Distance Recall survey expansion, 1.536 million daily intrastate long distance round trips have been estimated to be made by California residents. That level of trip making represents an average of 8.2 annual long distance round trips per capita. The numbers and shares of trips by trip purpose are:
Figure 1  Expanded long distance trips by distance range.

- 150,200 business trips (10 percent of total);
- 242,090 commute trips (16 percent);
- 512,610 recreational trips (33 percent); and
- 630,830 distance trips for other purposes (41 percent).

The annual intrastate long distance average trip rate of 8.2 round trips per capita compares reasonably to the 9.4 annual long distance round trip rate per capita reported in the NPTS Brief from 2006 <2>. The reported long distance trip rate included all long distance trips, not just intrastate trips. For the Pacific Region, the NPTS Brief reported an annual average of 8.7 long distance round trips per capita. When interstate and international long distance trips reported in the CSHTS daily diary are included in the analysis, the average annual long distance round trip rate is 8.6 trips per capita.

Table 2 shows the variation in average long distance trip rates per capita by geographic region of the state. The average trip rates are generally higher in rural areas of the state and lower in urban areas. Average trip rates for the four largest urban areas of the state vary from 7.2 to 8.4 annual long distance round trips per capita. In contrast, average annual round trip rates per capita in more rural areas of the state are generally greater than ten trips per capita.
**TABLE 2  Average Annual Intrastate Round Trips per Capita by Geographic Region**

<table>
<thead>
<tr>
<th>Home Region</th>
<th>Annual Average Round Trips per Capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern California (SCAG) Region</td>
<td>7.2</td>
</tr>
<tr>
<td>Bay Area (MTC) Region</td>
<td>8.4</td>
</tr>
<tr>
<td>San Diego (SANDAG) Region</td>
<td>7.8</td>
</tr>
<tr>
<td>Sacramento (SACOG) Region</td>
<td>7.5</td>
</tr>
<tr>
<td>San Joaquin Valley Counties</td>
<td>11.6</td>
</tr>
<tr>
<td>Rest of State</td>
<td>10.1</td>
</tr>
<tr>
<td>Statewide</td>
<td>8.2</td>
</tr>
</tbody>
</table>

**Long Distance Average Trip Lengths**

Figure 2 shows the trip length frequency distributions of trips by purpose within California. The shares of commute trips decrease most rapidly with increasing trip distance while the other three trip purposes show similar decreases in shares with increasing trip distances. The trip length frequency distributions for the business, recreation, and other trip purposes show a slight “hump” in shares in the 300 to 375 mile distance range. That slight increase in trips in that distance range reflects travel between the major metropolitan areas in northern California, the San Francisco and Sacramento areas, and the major metropolitan areas in southern California, the Los Angeles and San Diego areas.

The average straight line distance between origin and destination locations for all long distance trips within California has been estimated to be 110 miles. Long distance trips lengths vary by trip purpose with commute trips being the shortest, 78 miles and business trips being the longest, 118 miles. Average long distance trip rates for recreational and other trip purposes are both approximately 115 miles.

Average straight line trip distances vary by region within the state. However, unlike the variation in trip rates by region, there is no clear pattern regarding the variation in average trip distances by region.

Figure 3 shows the trip length frequency distributions by main travel mode within California. As would be expected, the shares of trips by auto and bus decrease rapidly with increasing distance. Shares of trips by rail also decrease rapidly with increasing distance but then show a hump in the 175 to 225 mile range. This pattern probably reflects two different types of rail travel: commuter rail within the San Francisco, Los Angeles, and San Diego regions and intercity rail travel between urban areas such as Sacramento and San Francisco or San Diego and Los Angeles. The trip length frequency distribution for air travel reflects travel between metropolitan areas in northern and southern California.
Figure 2 Long Distance Trip Length Distribution by Purpose
Figure 3  Long Distance Trip Length Distribution by Mode

Long Distance Mode Shares
Table 3 summarizes long distance mode shares by trip purpose. As would be expected, auto is the dominant mode for all trip purposes. It’s interesting to note that bus mode shares are similar to those for rail.

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>Main Travel Mode</th>
<th>Auto</th>
<th>Bus</th>
<th>Rail</th>
<th>Airplane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td></td>
<td>91.5%</td>
<td>0.9%</td>
<td>1.4%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Commute</td>
<td></td>
<td>97.9%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Recreation</td>
<td></td>
<td>97.3%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>96.1%</td>
<td>1.3%</td>
<td>1.1%</td>
<td>1.4%</td>
</tr>
<tr>
<td>All Purposes</td>
<td></td>
<td>96.3%</td>
<td>1.1%</td>
<td>1.0%</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

Figure 4 summarizes long distance mode shares by trip distance range. The figure also shows the dominance of the auto mode for all distance ranges. However, the figure also demonstrates that air travel captures significant portions of the travel market in the 300 to 500 mile distance range.
CONCLUSIONS
This paper has demonstrated the difficulties associated with collecting long distance travel data. Typical household travel survey techniques employing daily travel diaries and an assigned travel day are generally inadequate for collecting data on long distance travel due to the low incidence of long distance trip making. In California, the travel data collected via the use of a one day diary by over 100,000 people in almost 40,000 households yielded only about 4,000 long distance trips. Even if sufficient data can be collected, a standard one-day travel diary survey will not provide good information since many long distance trips span more than one day. Thus, without special probing, the purpose for the long distance trip is frequently missed using a one-day diary.

Long distance trip recall diaries are generally required to collect information on long distance travel. Nevertheless, the recall diaries must be well designed to ensure that information on long distance travel is not systematically missed. The provision of adequate spaces to record long distance trips and the provision of a shortcut method for reporting multiple trips to the same destination for the same purpose and using the same travel mode are of particular importance.

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REFERENCES
<1> California High Speed Rail Ridership and Revenue Model Version 2.0 Model – Processing of California Household Travel Survey Data for Model Calibration & Validation, California High Speed Rail Authority, http://www.hsr.ca.gov/docs/, forthcoming.