INSTITUTE OF TRANSPORTATION STUDIES

Research Report – UCD-ITS-RR-13-03

Did Free Wi-Fi Make a Difference to Amtrak's Capitol Corridor Service? An Evaluation of the Impact on Riders and Ridership

February 2013

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Did Free Wi-Fi Make a Difference to Amtrak's Capitol Corridor Service? An Evaluation of the Impact on Riders and Ridership

Report to the

Capitol Corridor Joint Powers Authority

on the AmtrakConnect Wi-Fi Service

by

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February 2013

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EXECUTIVE SUMMARY

On November 28, 2011, Amtrak launched the free Wi-Fi service named "AmtrakConnect", on all trains traveling the California Capitol Corridor (CC) route. The Capitol Corridor Joint Powers Authority (CCJPA) teamed with the University of California, Davis, to evaluate the impact of the new Wi-Fi service on passengers' travel behavior. The primary goal of this study was to evaluate the changes in ridership associated with the availability of free Wi-Fi. To do this, we developed descriptive statistics, and we estimated both a discrete choice model to predict the propensity to use AmtrakConnect and a multiple regression model with which to estimate the impact of the service on passengers' trip frequency in 2012.

Survey design and data collection

A four-page survey was designed and distributed to passengers on board the California Capitol Corridor trains (a tabulated copy of the survey is provided in Appendix A). It contained three sections:

- *Part A:* Current and past use of Capitol Corridor trains;
- *Part B:* Experience and opinions regarding the free Wi-Fi;
- *Part C:* Socio-demographic traits.

The survey was distributed to the riders of most Capitol Corridor trains running during the three weekdays of March 6-8, 2012. A total of 1627 surveys were returned by passengers, and after cleaning the data, the final working sample included 1576 completed surveys. The "average" characteristics of a respondent to this survey are: male, 43 years old, college graduate, lives in a household with 2.8 members and 1.4 cars, has an annual household income of $75,000 - $99,999, and has made an average of about two CC trips per month during 2011.

Descriptive analysis

We examined several variables that are relevant to passengers' choice to use Wi-Fi and their expected frequency in 2012. Some key findings from this part of the research include:

- Passengers in general, and frequent passengers in particular, tend to have stable travel patterns (the more frequently a passenger traveled in 2011, the more likely he/she was to indicate a similar high frequency in 2012).
- On average, commuters reported higher expected trip frequencies in 2012 than in 2011 (however, the sample necessarily does not include those who discontinued riding in 2011).
- Those who are salaried, hourly-wage or contract workers expect to ride Capitol Corridor more frequently in 2012.
- Commuters are the category with the highest share of passengers who accessed the internet during their trip.
- Commuters and those traveling for other work/school purposes were overall the most frequent users of the Wi-Fi connection.

- Even among passengers who have broadband internet access (in particular for those having limited data plans), there is a greater tendency to use the Capitol Corridor Wi-Fi than their 3G/4G plan.
- Wi-Fi connectivity has a positive impact on the expected travel frequency during 2012, especially for new riders.

Wi-Fi choice model

A discrete choice model was estimated to predict the choice to use the free Wi-Fi service. The results from this part of the research showed that passengers are more likely to use the service if they:

- are traveling for commuting purposes;
- have a professional or technical job;
- carry a tablet or laptop with them during the trip; or
- rate it more important for CCJPA to offer the free Wi-Fi.

However, passengers are less likely to use AmtrakConnect if they:

- have access to cellular broadband internet (e.g., 3G or 4G service);
- regard streaming media as an important internet feature;
- are older; or
- do not usually carry Wi-Fi-enabled devices with them on board.

Calculation of trips added due to Wi-Fi

The survey distribution process effectively sampled *trips* rather than passengers, meaning that passengers who travel more often had a higher probability of being sampled for the study. In reality, however, we need to estimate the impacts of Wi-Fi for the total population of *passengers* that use the Capitol Corridor trains. Accordingly, we weighted the cases inversely proportionally to their trip frequency, to yield an equal probability of being sampled for each case. In the weighted sample, lower-frequency CC passengers were assigned a larger weight, to represent their greater proportion in the population relative to that of higher-frequency travelers. Using the weighted sample, two approaches were applied to estimate the impact of Wi-Fi on CC ridership.

Method 1: Descriptive statistics

Method 1 used descriptive statistics to compare the aggregate number of trips in 2012 to the aggregate number of trips in 2011 for those respondents who acknowledged an impact of Wi-Fi on their trip frequency. The responses to several questions from the survey were examined to identify seven (roughly concentric) groups for which we have slight (group 7) to extreme (group 1) confidence that Wi-Fi influenced a change in trip frequency in 2012. The questions that were used for this analysis were:

- *B16:* respondent chose Wi-Fi as a factor affecting a change in frequency;

- *B17:* respondent stated that he/she would have used Capitol Corridor less often or more often if the free Wi-Fi service were not offered; and
- *B14-A1:* difference in trip frequency category between 2012 (prospective) and 2011 (retrospective).

The estimated net increase in trips due to the free Wi-Fi ranged from 0.7% (group 1) to 8.9% (group 7). We believe that group 5 offers the most appropriate balance between liberal and conservative inclusion criteria (specifically, respondents in this group (1) chose "Free Wi-Fi" as a factor changing their trip frequency; and either (2) changed their frequency by at least one category between 2011 and 2012; or (3) indicated that they would use Capitol Corridor less or more frequently without Wi-Fi), and for that definition of the "Wi-Fi-influenced" group there was approximately a ***2.9%* increase** in round trips on Capitol Corridor from 2011 to 2012 using this method.

Method 1 also allows us to estimate the number of new *riders* (not just *trips*) influenced by Wi-Fi. Altogether, 31.5% of the sample were new riders (indicating that they did not ride Capitol Corridor at all in 2011 but rode it at least once in 2012). As an upper bound, some 35.9% of the new riders, or 11.3% of the sample as a whole, could liberally be considered "Wi-Fi-influenced" (group 7). However, since the new riders in general tend to be concentrated in lower-frequency categories (Table 5-5), the Wi-Fi-influenced new riders' share of *trips* is (at most) a more modest 3.6% of the 2012 sample total.

Method 2: Linear regression model for 2012 frequency

Method 2 used linear regression to develop a model that allows estimation of the impact of Wi-Fi on 2012 frequency. This method is driven by the difference between the predicted number of 2012 trips in the presence of Wi-Fi services, and the counterfactual predicted number of 2012 trips in the absence of Wi-Fi. The model includes trip frequency in 2011, trip purpose, station-to-station distance, employment and two reasons for changing trip frequency (free Wi-Fi and job location change) as explanatory variables.

Three segments of passengers were examined within the model: new riders, lower-frequency continuing riders and higher-frequency continuing riders. The model showed that the free Wi-Fi influenced an increase in trip frequency that was greater for lower-frequency continuing riders than for higher-frequency continuing riders (who might associate higher satisfaction with their trip due to Wi-Fi, but did not increase their trip frequency very significantly, probably because they had already "maxed out" their need for travel with Capitol Corridor). Overall, however, new riders were the segment whose trip frequency was most affected by the availability of free Wi-Fi. Based on the model, an estimated ***2.7%* increase** in round trips between 2011 and 2012 could be attributed to Wi-Fi. The following table summarizes the impact of Wi-Fi among the different groups of travelers:

Impact of free Wi-Fi on (projected) 2012 ridership

	Impact of Wi-Fi on trips in 2012	**Percent of total impact**
Pooled data (N=1447)	2.7%	100%
New riders (N=445)	8.6%	29.6%
Lower-frequency continuing riders (N=825)	6.2%	42.8%
Higher-frequency continuing riders (N=177)	1.0%	27.6%

The results of both methods are similar. However, Method 1 is more liberal in attributing a frequency change to Wi-Fi, whereas Method 2 isolates the impact of Wi-Fi on the trip frequency in 2012 by controlling for other factors to the extent possible. Therefore, Method 1 might somewhat overstate the amount of increase that "properly belongs" to Wi-Fi, whereas Method 2 is more conservative. Hence, we are more confident in the results estimated using Method 2.

Prior to the installation of AmtrakConnect on Capitol Corridor, CCJPA indicated that a 1-2% increase in round trips in a year would be sufficient to justify the free Wi-Fi business model. Our research has shown with reasonable confidence that the results have met, and most likely exceeded, this requirement.

1. Introduction

In recent years, the world has become increasingly connected by information and communication technologies (ICTs). This greater connectivity has influenced the way we conduct both our personal and professional lives. Being more connected offers us the opportunity to be more productive, as well as the potential to be more distracted, in all elements of our lives.

Travel is one prominent element of most individuals' daily lives. We travel to and from places for work, recreation, and many other important personal reasons. For some, the time spent traveling may be viewed as time taken away from engaging in other, more preferable, activities such as social, work, or family activities. Advances in technology, however, are making it more possible to conduct such activities while traveling. Passengers can use cell phones, laptops, and other electronic devices to do work or connect with friends, family, or colleagues during a trip. These devices continue to enhance travelers' productivity, while technology and transportation continue to improve the level of connectivity available.

Many electronic devices used today are internet-enabled. Such a device may be equipped with mobile broadband internet access (e.g., 3G or 4G), typically purchased through a monthly payment plan. In addition to or in lieu of mobile broadband internet access, many devices may have an ability to connect to an available source of wireless internet (i.e., Wi-Fi).

Therefore, many transit companies around the world are introducing Wi-Fi connections on their services, and offering them to their passengers either free or at a cost, to increase the popularity of their services through increased opportunities to multitask and to allow passengers to be connected through their internet-enabled devices. In this project, we examine the free model implemented by the Capitol Corridor Joint Powers Authority (CCJPA) in the fall of 2011.

After adding free Wi-Fi connectivity on its Acela Express (Northeast Corridor) and Cascades (Pacific Northwest) services, Amtrak launched free Wi-Fi service on the California Capitol Corridor on November 28, 2011. The 170-mile Capitol Corridor (CC) provides intercity rail service to eight Northern California counties: Placer, Sacramento, Yolo, Solano, Contra Costa, Alameda, San Francisco and Santa Clara (including feeder bus routes operated by California Thruway Services). It is the major public transportation option available on the transportation corridor between Sacramento/the California Central Valley and the San Francisco Bay. The Capitol Corridor currently serves 17 stations[1] (Figure 1-1). On all trains serving this corridor, passengers can now connect to the web for business, personal or entertainment purposes,[2] accessing the free wireless internet connection from their own devices.

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[1] There were 16 stations when we conducted the survey; the Santa Clara/University station has been opened since then.

[2] To date, entertainment options are partially limited by some restrictions on video streaming and access to VOIP services enforced to conserve bandwidth.

Since 2003, CCJPA has been investigating a variety of technologies and business models for adding Wi-Fi on its trains. By 2008, a system was chosen, and the next years were focused on securing funding and other logistics to start providing the service. CCJPA decided to implement the free model (i.e., offer free Wi-Fi) on their trains. The business model predicted that a 1% to 2% inducement in ridership would offset capital and operating costs.

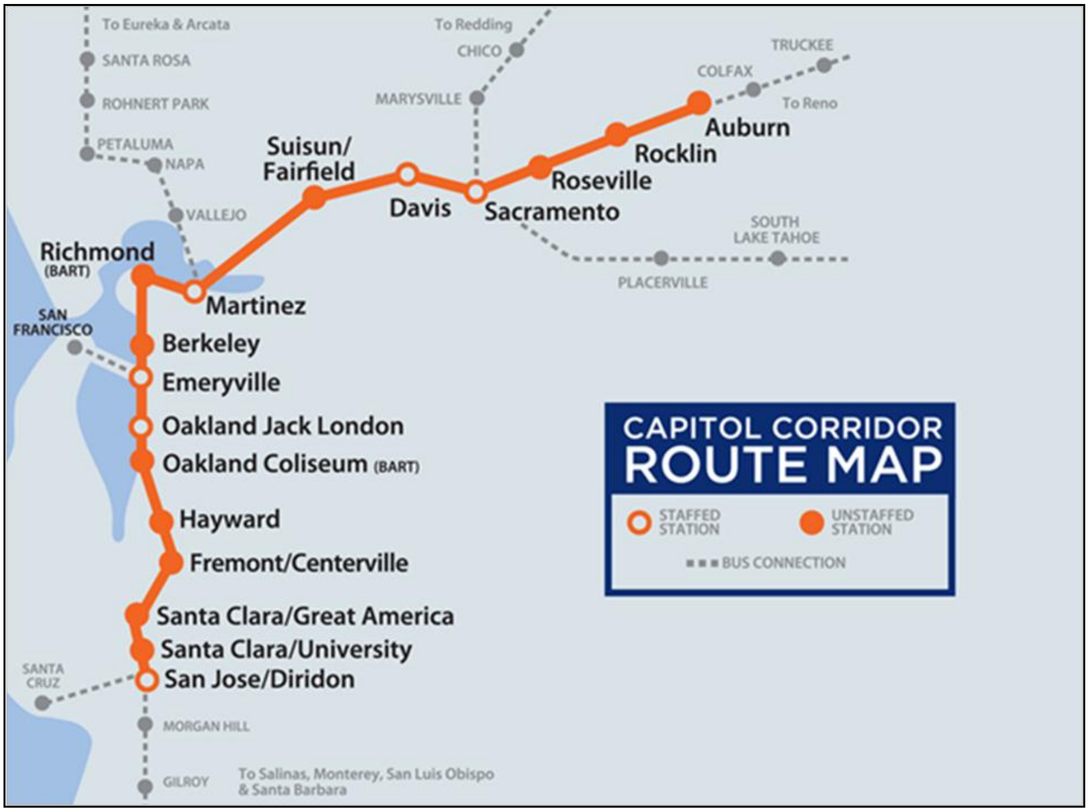

Figure 1-1 Route of Capitol Corridor
(Source: http://www.capitolcorridor.org/route_and_schedules/, accessed February 11, 2013)

CCJPA teamed with the University of California, Davis (UC Davis) to evaluate the impact on ridership of the new Wi-Fi service. The primary goals of our study were (1) to assess riders' reactions to the Wi-Fi service on board; (2) to develop a model of the choice to use the free AmtrakConnect Wi-Fi; and (3) to estimate the change in ridership due to the addition of free Wi-Fi. To achieve these goals, we designed a short survey and distributed it to weekday Capitol Corridor passengers in March 2012, about three-and-a-half months after free Wi-Fi had been introduced on trains. This report describes the analysis of that survey. In the following section we review some previous research pertinent to the present study. Section 3 describes the survey and sampling process, while Section 4 discusses the need to weight the sample and presents the weighting methodology. Section 5 describes some key findings related to passengers' evaluation of the Wi-Fi service, and Section 6 presents a model of the choice to use the service. Section 7 estimates the impact of free Wi-Fi on ridership, both by a descriptive analysis and by a model of 2012 trip frequency. Section 8 concludes with a summary and suggestions for future research.

2. Literature Review

2.1 Role of ICT during travel

A number of studies have addressed the interactions between Information and Communication Technology (ICT) and travel behavior (Salomon, 1986; Mokhtarian, 2009; Choo and Mokhtarian, 2005) and found that ICT had a more complex impact on travel behavior than originally assumed. ICT nowadays is not only used at home or at certain locations, to substitute for making a trip. In addition, mobile devices, such as laptops, cell phones, and other wireless internet-enabled devices provide increased opportunities for performing activities "anywhere", in particular during journeys (Aguilera and Guillot, 2010). This can enable more effective use of otherwise "wasted" travel time (Lyons and Urry, 2005; Schwieterman et al., 2009), which thereby reduces the disutility of travel and encourages greater mobility (Kenyon and Lyons, 2007).

Accordingly, a growing number of studies have investigated the role of ICT during travel. In a survey of rail travelers in Norway in 2008, most travelers stated that the use of ICT while travelling by train made the time spent on board pass more quickly. In the same study, about one third of the commuters and business travelers claimed that they made good use of the time spent on board (Gripsrud and Hjorthol, 2012). Lyons et al. (2007) analyzed a survey of 26,221 rail passengers in Great Britain and found that business travelers obtained slightly more benefit from using electronic devices than leisure travelers, and first class passengers were more likely than other passengers to agree that electronic devices had improved their travel time use. Analysis from a survey of Chicago Transit Authority (CTA) train riders indicated that use of ICT is a significant predictor of whether an individual would consider it was a better use of time and/or money to ride transit in Chicago than to drive (Frei and Mahmassani, 2011).

2.2 Multi-tasking on board

Some studies have specifically examined the phenomenon of rider productivity during travel (i.e., travel multi-tasking), and cited internet use during travel as one of the opportunities for greater productivity by travelers (Bissel, 2007; Jain and Lyons, 2008). Early speculation along these lines has now been augmented by a growing number of empirical examinations of multi-tasking behaviors by travelers and of the impact of multi-tasking on the perceived value of travel time. For example, results from the 2010 autumn National Passenger Survey in Great Britain identify various activities passengers undertake on the train, and these include "text messages/phone calls" for work and personal reasons, "checking emails," and "internet browsing," with personal "text messages/phone calls" and "checking emails" being the most popular among ICTs (Susilo et al. 2010). A survey of Irish Rail passengers not only identified laptops and mobile phones as popular ICTs used for multi-tasking on board, but also learned of a demand for Wi-Fi among passengers, as "approximately two thirds of respondents said that if wi-fi internet access was available they would use it once or more every week" (Connolly et al. 2009, p. 12). Researchers in the Netherlands examined activity-travel data to identify the variation in travel multi-tasking activities by travel mode. With regard to ICTs and wireless internet in particular, they found that the probability of internet use increased with increasing travel time. Train riders were the most prominent internet users during travel (as opposed to car drivers or car, bus, tram, or metro passengers) (Ettema et al., 2010). Banerjee and Kanafani (2008) investigated the value of wireless internet connection on trains and indicated that wireless internet connection increases the possibilities to work on transit, and the combination of work with travel increases the perceived utility of the trip and thus reduces the valuation of travel time (VOTT) savings, i.e. the amount travelers would be willing to pay to reduce their travel time.

Ettema and his colleagues revisited this topic to examine the influence of travel multi-tasking "on public transport users' subjective well-being" (Ettema et al., 2012, p.1). They looked closely at ICTs, "including internet, gaming, email/SMS/phone") (Ettema et al., 2012, p. 218) and found that they had "no effect [on] satisfaction" (Ettema et al., 2012, p. 221). Conversely, other studies that primarily focused on mobile internet connections and ICTs have shown that being connected while traveling is an important factor that adds to the value of travel time for riders (Banerjee and Kanafani, 2008; Schweitermann et al., 2009; Frei and Mahmassani, 2011; Gripsrud and Hjorthol, 2012). Results like this have encouraged transit companies across the world to explore ways to enhance the travel experience by allowing passengers to have more opportunities for productivity while traveling.

2.3 General perceptions of Wi-Fi by transit riders

A research group for media and ICT in Belgium reviewed a large scale survey of 1324 regular train riders to study and forecast the demand for internet technologies on trains. The survey included attitudinal statements that offered "insight into the factors that will accelerate or slow down the adoption rate" among train riders. The researchers found that, in general, riders had positive reactions to the hypothetical adoption of Wi-Fi on trains, since their responses reflected a "higher weight of positive motivations" to use the internet onboard (Evens et al., 2010, p. 15). The most popular desired uses of Wi-Fi on trains were revealed to be internet browsing and writing/reading e-mail. The most important qualities of the Wi-Fi service cited by riders included, but were not limited to, cost (cited as the quality of highest importance to riders), reliability, speed, safety, accessibility, continuity, and ease of use.

Zhang et al. (2006) explored the impact of Wireless Internet Service (WIS) on Dutch business travelers on trains. The results showed that with WIS, respondents perceived their travel time to become more useful and more pleasant, and the usefulness of travel time increased the quality and efficiency of their work during their business trips. Leonard (2007) described the benefits of installing Wi-Fi internet access for passengers and suggested passengers' travel experience could be enhanced. Connolly et al. (2009) examined the potential benefit for Wi-Fi internet access while traveling by public transit through multinomial logit (MNL) modeling, and demonstrated that males and passengers with longer trips associated a greater benefit with the provision of Wi-Fi internet access.

2.4 Implementation of Wi-Fi

As mentioned, a number of transit companies have implemented or plan to implement some form of Wi-Fi on their services in order to increase connectivity for customers during their trip. According to an earlier survey conducted by the CCJPA in July 2005 to assess the possible market for wireless internet connection on the Capitol Corridor, 36.1% of the 1092 respondents declared that they would increase the number of trips by train if the service was introduced (Kanafani et al., 2006).

Another passenger survey was conducted on the Alameda County (AC) Transit Transbay service a few months after Wi-Fi had been introduced to that service. Out of 725 total respondents, 46% had used the Wi-Fi service on board and 41% of those (i.e. about 19% of all respondents) reported that they had increased their use of the Transbay service because of the availability of Wi-Fi. Among Wi-Fi users, 39% (i.e. about 18% of all respondents) said that the availability of Wi-Fi was a major factor in their starting to use the Transbay service (Twichell et al., 2008), which indicates that Wi-Fi also helps create new riders.

Similar studies have been conducted internationally. In 2011, Russian Railways conducted marketing research to examine perceptions of adding wireless internet on board their trains. In general, passengers were enthusiastic about the prospect, with 72% of business passengers saying “they would prefer to travel by train than go by car or plane if they could have access to the internet on trains” (Tamarkin and Oserov, 2012). Similarly to other European countries, in Italy Wi-Fi internet services have been introduced on board high-speed trains by the two main railway operators. Maccagni (2012) reports on the results from the introduction of Wi-Fi services by the railway operator Nuovo Trasporto Viaggiatori (NTV), which has introduced a multimedia system on board the “Italo” high speed trains. This system offers free web browsing, media on demand (e.g., movies and digital newspapers), and live TV to all train passengers. When the free system was launched in 2012, it proved difficult to accommodate demand from passengers. Not only did more passengers use the system than it could handle, but the users also required an excessive amount of bandwidth for streaming videos and other media. This high level of usage caused problems with system functionality, which NTV continues to investigate (Maccagni, 2012).

Finnish transport company VR Group began offering an internet connection for passengers in 2010, and has since noted the highest use of the internet during commuting hours with approximately 50% of business class passengers using it throughout the day (Uusitalo, 2012). In Denmark, Danske Statsbaner (DSB or Danish State Railways) offers Wi-Fi for a price on its trains. A passenger survey revealed that almost half of the passengers would ride the train more frequently if the Wi-Fi service were offered for free (Kiltholm, 2012). Irish Rail initially implemented a free Wi-Fi service, but recently tested charging for the service and not only did passengers express anger about this change, but usage also dropped by 90% (O’Kelley, 2012). Such research and results have demonstrated the desirability of connectivity during travel, particularly for transit passengers. This desirability motivated the implementation of free Wi-Fi by CCJPA on board the Capitol Corridor.

3. Data Collection and Preparation

3.1 Survey design

In designing the survey, the researchers gave priority to keeping the survey simple and of minimal length so as to achieve the greatest number of complete responses from riders of the Capitol Corridor. Accordingly, we restricted the length to four 8½” x 11” pages, which were printed (in blue ink, for greater appeal) on both sides of a (white) 17” x 11” sheet that was then folded in half in booklet style. Questions were designed to help measure the change in ridership (if any) due to the addition of free Wi-Fi, as well as to gain an understanding of the overall perception of the AmtrakConnect Wi-Fi. A facsimile of the survey is provided in Appendix A, together with tabulations of the responses.

The beginning of the survey included the Capitol Corridor logo and route map prior to the screening question “Are you 18 or older?” and then followed with three parts.

Part A, “Your Travel on the Capitol Corridor”, was intended to understand the type of Capitol Corridor passenger responding to the survey. Questions included the rider’s trip frequency in 2011, time and location of boarding and destination stops for the present trip, general purpose of the trip, and available alternate ways of making the trip.

Part B, “Free Wi-Fi Access on the Capitol Corridor”, began with a brief explanation of the newly available service. This part explored the experience and opinions regarding free Wi-Fi on board the Capitol Corridor train: familiarity with the service, whether the users accessed the service or not, and their evaluation of the service. This section also asked for passengers’ expected frequency of trips on the Capitol Corridor trains during 2012 and the possible reason for the frequency change.

Finally, *Part C, “Background Information”,* included questions aiming to identify key socio-demographic traits of the sample, such as gender, age, occupation, employment, education, auto ownership, number of vehicles in the household, household size, and income.

3.2 Data collection

Paper copies of the survey were distributed to riders on the Capitol Corridor on the three working days of March 6-8, 2012. We focused on weekdays because regular commuters and business travelers are an important component of the CC ridership. There are 32 trains (in both directions) per weekday on this route between Sacramento and Oakland, and 14 of these daily trains offer extended service to the southern terminal station in San Jose (according to the schedule operated in March 2012). About 70% of the train runs during these three working days were covered by the data collection for this project. This allowed representing most operating times, including peak and off-peak periods, and both directions. Table 3-1 shows the trains that were surveyed.

Surveys were offered to every passenger on board by staff from UC Davis and CCJPA. Passengers were briefly introduced to the aims of the survey, asked whether they were willing to participate, and requested to fill in the survey before the end of their trip. Completed questionnaires were collected on board.

Table 3-1 Trains surveyed, March 6-8, 2012

March 6, 2012			
Train #	**Boarding station**	**Boarding time**	**Destination**
529	Davis	7:55 AM	Oakland Coliseum
528	Oakland Coliseum	10:04 AM	Rocklin
543	Rocklin	2:15 PM	Davis
543	Davis	3:50 PM	Emeryville
542	Emeryville	5:45 PM	Davis
533	Davis	9:35 AM	Oakland–Jack London
530	Oakland–Jack London	12:15 PM	Davis
547	Davis	5:55 PM	Oakland Coliseum
546	Oakland Coliseum	8:10 PM	Davis
537	Sacramento	12:10 PM	Oakland–Jack London
542	San Jose	4:20 PM	Sacramento
544	San Jose	5:50 PM	Oakland–Jack London
March 7, 2012			
Train #	**Boarding station**	**Boarding time**	**Destination**
525	Davis	6:35 AM	Oakland Coliseum
526	Oakland Coliseum	8:55 AM	Suisun–Fairfield
535	Davis	10:25 AM	Fremont–Centerville
532	Fremont–Centerville	12:49 PM	Davis
541	Davis	2:25 PM	Oakland–Jack London
540	Oakland–Jack London	4:50 PM	Davis
527	Davis	7:15 AM	Fremont–Centerville
528	Fremont–Centerville	9:38 AM	Davis
537	Davis	12:25 PM	Oakland–Jack London
534	Oakland–Jack London	2:50 PM	Davis
545	Davis	4:55 PM	Oakland–Jack London
544	Oakland–Jack London	6:55 PM	Davis
546	San Jose	7:15 PM	Oakland–Jack London
536	Oakland Jack–London	3:30 PM	Auburn
March 8, 2012			
Train	**Boarding station**	**Boarding time**	**Destination**
531	Davis	8:45 AM	Oakland Coliseum
528	Oakland Coliseum	10:04 AM	Davis
541	Davis	2:25 PM	Emeryville
538	Emeryville	4:20 PM	Davis
538	San Jose	3:00 PM	Richmond

We estimate that we handed out just under 2000 surveys, and collected 1627 of them completed to some degree. Discussions with CCJPA indicated that we had sufficiently covered a typical week's worth of passengers[3]: CC's total daily average of about 5000 trips comprises about 2500 passengers, many of whom will repeat from one day to the next. Since not all trains were surveyed, not all passengers were approached. Among those who were, we estimate that on the first day, about 50% of passengers who were offered surveys declined them (since most passengers make a round trip, i.e. two one-way trips, in a single day, then many or most of those declining on one occasion would be offered the survey on two occasions that day, and may have accepted the other time). Declination rates would be higher on the next two days because of repeat passengers (neither they nor we wanted them to complete the survey more than once). Thus, although an exact response rate cannot be determined, our best estimate is that the response rate was about 40% of those eligible (i.e. among those approached, but excluding repeat riders after the first approach to them).

After data cleaning, 51 surveys were excluded from the 1627 cases as either ineligible (10 completed by passengers under 18 years old), too incomplete (16), frivolous (3), or having major inconsistencies (in 22 cases[4], the respondents indicated in question B16 that they did not expect to change their frequency in 2012 compared with that in 2011, but the difference between their reported 2011 frequency (question A1) and 2012 frequency (B14) was three categories or more).

With respect to the latter group, there are three natural ways to treat these inconsistencies: (1) accept the B16 answer as correct and recode the 2012 frequency to equal the 2011 frequency (assuming that the retrospective report of the latter is more reliable than the prospective estimate of the former); (2) accept the A1 and B14 answers as correct and disregard the B16 answer; and (3) discard those 22 cases as possibly frivolous or at least unreliable. We tended to discount approach (2), on the assumption that it was unlikely for a serious respondent to incorrectly answer a direct question about a change in frequency (and also, incidentally, we would be unable to identify the reason for the observed change in frequency, which is vital to determining the influence of Wi-Fi). We explored the other two approaches and obtained almost the same results except for an impact that was 1.3 percentage points larger for new riders with approach (1) in the regression model in Section 7.3. To be conservative, we adopted approach (3) and excluded those 22 cases from the remainder of the analysis. Therefore, 1576 cases were used in the final analysis.

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[3] CCJPA had conducted one of its periodic ridership satisfaction surveys on January 7-11, 2012 (about two months prior to our data collection). A comparison of the two sets of data on the weekday ridership distributions for gender, age, trip purpose (share of commuters), frequency, on-board possession of Wi-Fi enabled devices, and propensity to ride CC more often because of Wi-Fi showed a high level of consistency between the two samples, before we applied the frequency weighting correction described in Section 4.

[4] In the preliminary analysis, we did not identify these 22 cases, and 1598 cases were used.

3.3 Imputing trip frequencies and identifying frequency change status

After various consistency checks and after recoding the data as needed for consistency, some more data preparation was needed before weighting the sample and developing the model of trip frequency. To do so, several assumptions had to be made. Firstly, the approximate number of trips for both 2011 and 2012 was defined for each respondent, based on answers to the following questions:

A1. *"Last year (2011), on average, how often did you use the Capitol Corridor service? (anywhere between the Auburn station and the San Jose/Diridon station). Count a round trip as one time rather than two."*

B14. *"This year (2012), how often do you expect to use Capitol Corridor (not counting the present trip)?"*

CC trip frequencies in both 2011 (question A1) and 2012 (question B14) were measured with six response categories[5] in the survey: "Not at all" ("not counting the present trip" in 2012), "Less than once a month", "1-3 times a month", "1-2 times a week", "3-4 times a week", and "5 or more times a week".

Reporting frequencies only in terms of categories was obviously easier for the respondent. However, we needed a specific number of 2012 trips for the calculation of weights (see Section 4) and for calculating the number of trips added due to the free Wi-Fi service. Further, using only the ordered categories did not produce a satisfactory model, as mentioned in Section 7.3. Therefore, we transformed the categorical frequency variables to a continuous scale, as is frequently done in cases such as this.

Table 3-2 Assumptions for total average trips

Trip frequency category	Assumed number of round trips in one year
Not at all	0 (2011); 1[6] (2012)
Less than once a month	6 (if not otherwise specified by respondent)
1-3 times a month	24
1-2 times a week	72
3-4 times a week	168
5 or more times a week	240

Specifically, we assumed that "Not at all" represents zero trips in 2011 and one (the current) trip in 2012. With respect to the category "Less than once a month", for 2011 the respondent was given a blank in which to write the exact number of trips, whereas for 2012 (due to space constraints and because the question was prospective rather than retrospective), no blank was provided. Thus, if this category were checked only for 2012, it was translated to 6 trips a year.

[5] For answers of "less than once a month", question A1 asked "how many times in 2011", with a blank to be filled in.

[6] The one trip during our distribution of the survey.

For 2011 we used the exact number of trips written in by respondents[7], and if they said "Less than once a month" for both years, then we used the same number for 2012 that they reported for 2011. The average numbers of trips in other categories were obtained by taking the midpoint of each category; for example, "1-3 times a month" represents 24 trips a year. We assumed that respondents use Capitol Corridor for about 48 weeks per year (to allow for vacations, holidays, and personal leave), so that the last three categories respectively correspond to 72, 168 and 240 trips a year, which are shown in Table 3-2.

Although using the midpoint of each category is reasonable in the absence of any other information, in some cases we had other information, which required an adjustment of the value assigned to a given individual's response. Question B16 of the survey asked, "Compared to your frequency in 2011 (question A1), which of the following factors (if any) are changing the frequency with which you expect to use Capitol Corridor in 2012? Please check all that apply". The responses offered were, "job location change", "home location change", "change in preferences", "change in auto ownership", "free Wi-Fi", and "other: ______" as well as "I do not expect my frequency to change". In some cases, respondents checked one or more reasons for a frequency "change" but reported the same trip frequency category for 2012 as for 2011. We presumed that in those cases the frequency changed within category, even if we did not know in which direction and by how much. For all reasons except Wi-Fi, we cannot ascertain the direction for this change. Therefore, for these cases, we left 2011 and 2012 frequencies unchanged (unless Wi-Fi was also checked)[8]. If Wi-Fi was given as a reason, however, we can infer the direction of change from a separate question in the survey (B17) which asked, "What impact does the availability of free Wi-Fi have on your frequency of using Capitol Corridor in 2012?"

Among the 111[9] (unweighted) respondents who indicated Wi-Fi as a reason for their frequency change, 51 (45.9%) reported a higher trip frequency category for 2012 than for 2011, 8 reported a lower one, and 3 were missing the frequency category for either 2011 or 2012[10]. The

[7] If the respondent checked "Less than once a month" but did not fill in the exact number of trips, we assumed it was 6 trips.

[8] For 63 cases (weighted) in the final model, 2011 and 2012 frequency categories were equal, and "job location change" was given as a reason but Wi-Fi was not.

[9] There were 23 additional cases who gave Wi-Fi as a reason for change. However, they (1) showed no change in frequency category, and (2) to B17 responded that "Without free Wi-Fi, I would still use Capitol Corridor as often…" (or were missing B17, in two cases). With (usually) two indications that either no frequency change occurred, or if it did, Wi-Fi was not a reason for it, we recoded the B16 answer to "uncheck" the Wi-Fi reason. If any other reasons for a frequency change were given in B16 (7 cases) we left them "checked" (inferring that the stability in frequency category reflected a change within category), and if no other reasons were given (16 cases) we "checked" the "I do not expect my frequency to change" response for B16.

[10] These three cases (together with the other 36 cases missing either of the two frequencies) were excluded from the frequency model of Section 6, but are included in the descriptive statistics where possible.

other 49 reported the same trip frequency category for 2012 as for 2011, but for question B17, 47 (96%) of those 49 respondents indicated that without free Wi-Fi, they would use the Capitol Corridor less often than their reported expected frequency in 2012 (and thus are considered to be increasing their frequency due to Wi-Fi), whereas only two respondents would use Capitol Corridor more without Wi-Fi. Thus, there are 49 change-within-category cases for which the direction of change could be determined from B17. To represent a within-category change, we arbitrarily took the difference between the 25th percentile of the frequency range for that category, and the 75th percentile of the range. For example, the category "1-3 times a month" is assumed to represent 12-36 times a year, for which the 25th percentile is 18 trips and the 75th percentile is 30 trips. For cases assumed to be increasing their frequency within that category we coded the 2011 frequency at 18 trips a year and the 2012 frequency at 30 trips (for a within-category increase of 12 trips), and for cases assumed to be decreasing their frequency we reversed those two numbers (for a decrease of 12 trips). The assumed values are shown in Table 3-3.

Table 3-3 Assumed total trip differences

	Trip difference 2012-2011	
Trip frequency category	**Assumed 75th percentile (trips per year)**	**Assumed 25th percentile (trips per year)**
Not at all	N/A	N/A
Less than once a month[11] (1-11 times a year)	8.5	3.5
1-3 times a month (12-36 times a year)	30	18
1-2 times a week (48-96 times a year)	84	60
3-4 times a week (144-192 times a year)	180	156
5 or more times a week (216-264 times a year)	252	228

[11] If the respondent filled in the exact number in A1, we assume 2012 trips increased (or decreased) by 5 from the exact number of trips in 2011, or assume 1 trip in 2012 if that is greater than "2011 trips minus 5".

4. Weighting the Sample

4.1 The need for weighting and calculation of weights

During the data collection, we distributed surveys to Capitol Corridor passengers during most operating times and in both directions on the three working days (Tuesday – Thursday) of March 6-8, 2012. Using this approach yielded a somewhat[12] random sample of *person-trips*, but a far less random sample of *passengers* that use the Capitol Corridor train services. To see this, imagine the list of *all* passengers riding CC during 2012. In our three-day sampling period, we are much more likely to intercept *high-frequency* riders on that comprehensive list, than *low-frequency* riders. There will be many lower-frequency riders who will be taking the train only outside that three-day period, and who therefore were not sampled at all, whereas a sizable proportion of the high-frequency riders will be on the train sometime during that period. Accordingly, our resulting sample overrepresents higher-frequency passengers and underrepresents lower-frequency passengers.

However, when we evaluate the impact of Wi-Fi on ridership, we would like to examine it based on a random sample of passengers rather than person-trips, especially when we would like to evaluate the impact on various segments of the population of riders. To produce a representative sample of passengers, we needed to weight the sample so as to mimic the conditions of a simple random sample, in which each member of the population has an equal probability of being sampled. Thus, we needed to deflate the weight of higher-frequency passengers and inflate the weight of lower-frequency passengers.

Since we conducted our sampling in 2012, the weights should be calculated based on respondents' indicated 2012 trip frequency obtained from question B14: "This year (2012), how often do you expect to use the Capitol Corridor (not counting the present trip)?" with the responses comprising the six frequency categories presented in Section 3.2. Each of those 2012 trip frequency categories should receive a weight inversely proportional to its probability of being sampled, so that those with a higher probability will have their weight reduced and those with a lower probability will have their weight increased. As there are 35 missing responses to B14, only 1541 cases are used in the calculation of weights.

Before calculating the weights for each category j, we need to calculate P_j, the probability that a respondent in that frequency category was sampled. As a slight simplification, we assumed we covered all passengers traveling on the three days we sampled. Therefore, the probability that we surveyed passengers in the higher two categories ("3-4 times a week" and "5 or more times a week") is 1 since they took the train at least once within the three days.

P_j for the "1-2 times a week" frequency category is calculated by taking the average of the probabilities that we sampled passengers who travel once a week and twice a week. If

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[12] It is only "somewhat" random because we did not take a true random sample of train runs across the year, plus there are the usual biases generated by those who declined to respond.

passengers travel on the Capitol Corridor only once a week, there is a 20% (one day out of five) chance that they will be on board on any given weekday[13]. Since we covered three weekdays in our sampling, there is a 60% chance ($P_j = 0.6$) that we sampled those passengers traveling once a week on the Capitol Corridor. For those who travel twice a week, there are ten possible combinations of two (out of five) weekdays. Among those ten outcomes, the only one for which a passenger would not be sampled is if she took the Capitol Corridor on a Monday and Friday that week. Thus, since there are nine out of ten equally-likely situations in which we would have intercepted an individual traveling twice a week on the Capitol Corridor, the probability of sampling such an individual is 0.9. Accordingly, for the category "1-2 times a week," $P_j = (0.6+0.9)/2 = 0.75$.

Whereas for the higher frequencies of once a week or more we assumed this represented a regular schedule with fairly uniform spacing of trips, for the 2012 lower-frequency categories "Less than once a month" and "1-3 times a month" we allowed for the possibility that rides could be clustered, resulting in multiple trips by a such a passenger during the survey week. In that case, we have:

$$P_j = \sum_{i=0}^{5} P_{|i} P_{i(j)} \quad , \tag{1}$$

where $P_{|i}$ = Pr[being sampled | a passenger rode i times in the survey week], and

$P_{i(j)}$ = Pr[a passenger in category j rode i times in the survey week], $i = 0, 1, \ldots 5$.

$P_{i(j)}$ is determined using the hypergeometric distribution. We assume 48 weeks a year, so there are 240 workdays a year:

$$P_{i(j)} = \frac{\binom{5}{i}\binom{235}{F_j - i}}{\binom{240}{F_j}}, \; i = 0, 1, \ldots 5, \tag{2}$$

where F_j = the average number of 2012 trips taken by each respondent in category j (shown in Table 1). However, since F_j for the "Less than once a month" category is non-integer, we compute $P_{i(j)}$ for the adjacent two integers $F_j = 4$[14] and $F_j = 5$ first, and then take the weighted average of the two outcomes.

Based on the previous discussion, $P_{|i}$, the probability of being sampled given that a passenger rode i times in the survey week, is simply 0 for $i = 0$, 0.6 for $i = 1$, 0.9 for $i = 2$, and 1.0 for $i \geq 3$. To calculate the weights (W_j), we first computed I_j as the inverse of P_j for each

[13] Note the additional simplifications, (1) that passengers riding once a week "on average" never ride more than once a week, and (2) that "a week" means the five days of the typical workweek. In general, the approach described here is oriented toward making the sample more representative of the population of *weekday* CC passengers. For these calculations we also (3) implicitly assume 100% response among those invited to take the survey, which is a restrictive assumption to the extent that response rates differ by frequency category.

[14] In this case, equation (2) does not apply for $i = 5$, and $P_{5(j)}$ is defined to be 0 (if only 4 trips were taken in the entire year, then 5 trips could not be taken in the survey week).

category, then we normalized I_j so that the sum of weighted cases, $\sum_j W_j T_j^{12}$, would equal the total number of original cases in the sample, $\sum_j T_j^{12}$. The weight for each category j can be expressed as equation (3):

$$W_j = I_j \frac{\sum_j T_j^{12}}{\sum_j (T_j^{12} I_j)} , \tag{3}$$

where T_j^{12}= the (unweighted) number of cases in the 2012 frequency category j; and $I_j = 1/P_j$.

After calculating the weights for the six categories applying the method above, however, we found that the cases in the lowest frequency category ("Not at all", which was initially assigned F_j = 1, representing the current trip, and had a sampling probability P_j = 1/240) were consequently weighted too heavily and caused nonsensical results (e.g., when the weights were applied, the new values indicated an overall decrease in trips from 2011 to 2012). Such outcomes are common when developing weights, and a standard remedy is to combine two (or more) categories (Little, 1993; Brick and Kalton, 1996). Therefore, we collapsed the lowest two categories and calculated a new average F_j for this combined category. The final weights for each category are listed in Table 4-1, together with the unweighted and weighted sample sizes for each category.

Comparing the two distributions shows that (to the extent the sample represents the population), for example, only 22% of all weekday trips are made by one-time and less-than-once-a-month riders, but 78% of all weekday passengers fall into that category. At the other frequency extreme, it can be said that 27% of the trips are made by only 5% of the riders.

Table 4-1 Calculation of weights for each 2012 frequency category (N = 1541)

Trip frequency category	**Assumed average number of trips in 2012 (F_j)**	**Probability of being sampled (P_j)**	**Unweighted number of cases (T_j^{12})**	**Weight (W_j)**	**Weighted number of cases ($T_j^{12} \times W_j$)**
Not at all & Less than once a month	4.06	0.05	337 (21.9%)	3.563271	1201 (77.9%)
1-3 times a month	24	0.27	235 (15.2%)	0.656266	154 (10.0%)
1-2 times a week	72	0.75	218 (14.1%)	0.238023	52 (3.4%)
3-4 times a week	168	1.00	337 (21.9%)	0.178517	60 (3.9%)
5 or more times a week	240	1.00	414 (26.9%)	0.178517	74 (4.8%)

The confidence to be placed in the weighting process increases when comparing its outcome to externally available information. Between June 2011 and May 2012, Capitol Corridor observed a 5.7% increase in ridership (Allison, 2012). As is later shown in Table 7-1, the total net adjusted increase in trips from 2011 to 2012 for the weighted sample is 4.6%, which, given the data from

Capitol Corridor, is much more reasonable than the 14.4% increase found for the unweighted sample.

4.2 Selected characteristics of the sample

Table 4-2 presents the weighted and unweighted sample statistics for some selected characteristics. In the weighted sample, males comprise 53.4% of the respondents who reported their gender. Every age group constitutes a similar share of 15% to 20% except the groups "65 to 74" (10.4%) and "75 or older" (3.1%). Nearly half of the respondents (41.0%) are in professional / technical occupations and one third (32.9%) are salaried workers. More than a third of the respondents have graduate degree(s), and nearly a quarter have an annual household income higher than $125,000. These traits might be partially a result of some response biases in completing the survey, but they are also consistent with the expected population of users of this service[15]. Nearly one third of the respondents traveled for social/entertainment/recreation purpose (32.9%). The "average" characteristics of a respondent to the survey are: male, around 43 years old, college graduate, in a household with 2.8 members, 1.4 cars, having an annual household income of $75,000 - $99,999, and with an average trip frequency in 2011 of about 2 trips a month.

Table 4-2 Selected characteristics of the sample

Characteristic (sample size)	**N (%) or ave. (s.d.)**	
	Weighted sample (N=1541)	**Unweighted sample** (N=1576)
Gender	N=1511	N=1539
Female	704 (46.59%)	636 (41.33%)
Age	N=1532	N=1551
18 to 24	290 (18.93%)	170 (10.96%)
25 to 34	296 (19.32%)	327 (21.08%)
35 to 44	232 (15.14%)	331 (21.34%)
45 to 54	272 (17.75%)	337 (21.73%)
55 to 64	235 (15.34%)	275 (17.73%)
65 to 74	159 (10.38%)	85 (5.48%)
75 or older	48 (3.13%)	26 (1.68%)
Occupation	N=1526	N=1554
Homemaker	104 (6.82%)	48 (3.09%)
Manager / administrator	221 (14.48%)	258 (16.60%)
Service / repair	60 (3.93%)	41 (2.64%)
Professional / technical	626 (41.02%)	776 (49.94%)
Sales / marketing	68 (4.46%)	61 (3.93%)

[15] Capitol Corridor trains are priced at a relatively high level for public transportation services in the area (e.g., $26 for a 71-mile (114.2-km) one-way trip from Sacramento to Richmond). They offer air conditioning, onboard café/ bar services, and spacious seats with tables and electric plugs at every seat, which allow easy use of ICT devices. Both the price and the amenities tend to attract higher-income working categories of travelers. In addition, this corridor includes the California State capitol (Sacramento), Silicon Valley, and two large campuses of the University of California (Berkeley and Davis), which significantly contribute to the ridership of the CC service.

Clerical / administrative support	43 (2.82%)	62 (3.99%)
Student	272 (17.82%)	221 (14.22%)
Production / construction	51 (3.34%)	38 (2.45%)
Other	81 (5.31%)	49 (3.15%)
Employment	N=1514	N=1543
Self-employed	219 (14.46%)	134 (8.68%)
Salaried	498 (32.89%)	823 (53.34%)
Hourly wage	255 (16.84%)	254 (16.46%)
Contract worker	55 (3.63%)	58 (3.76%)
Non-working student	118 (7.79%)	90 (5.83%)
Retired	204 (13.47%)	94 (6.09%)
Not currently working	149 (9.84%)	79 (5.12%)
Other	16 (1.06%)	11 (0.71%)
Educational level	N=1525	N=1547
Some grade/high school	44 (2.89%)	24 (1.55%)
High school diploma	149 (9.77%)	99 (6.40%)
Some college/technical school	378 (24.85%)	340 (21.98%)
Four-year college degree	366 (24.00%)	385 (24.89%)
Some graduate school	95 (6.16%)	120 (7.76%)
Graduate degree(s)	493 (32.33%)	579 (37.43%)
Annual household income	N=1379	N=1403
Less than $25,000	233 (16.90%)	139 (9.91%)
$25,000 to $49,999	263 (19.07%)	198 (14.11%)
$50,000 to $74,999	214 (15.52%)	204 (14.54%)
$75,000 to $99,999	146 (10.59%)	178 (12.69%)
$100,000 to $124,999	196 (14.14%)	218 (15.54%)
$125,000 or more	328 (23.79%)	466 (33.21%)
Household size	N=1501 2.75 (1.58)	N=1541 2.80 (1.42)
Number of household operational vehicles	N=1482 1.97 (1.38)	N=1528 2.03 (1.25)
Trip purpose	N=1540	N=1573
Commuting	352 (22.86%)	1023 (65.03%)
Other work/school-related	276 (17.92%)	139 (8.84%)
Personal business	364 (23.64%)	174 (11.06%)
Social/entertainment/recreation	506 (32.86%)	221 (14.05%)
Other	42 (2.73%)	16 (1.02%)
Average number of trips in 2011	N=1536 25.1 (57.7)	N=1571 102 (96.2)
Average number of expected trips in 2012	N=1541 26.2 (58.7)	N=1541 116 (95.1)

In comparing the weighted and unweighted sample statistics, it can be seen that many sociodemographic features are similar, but the weighted sample has higher shares of (–signifying that lower-frequency riders are more likely to be–) women; people younger than 25 or older than 64; students; self-employed or retired/not working; less well-educated; lower-income; and owning fewer vehicles. As expected, the weighted sample also has a far lower share of commute trips: the appropriate interpretation (assuming the necessary simplifications are approximately correct) is, “65% of all (weekday) trips on CC are commute trips, but only 23% of all passengers (from the imaginary list of all weekday passengers riding CC in 2012) commute on CC.” A final notable difference is that the 2011 average number of trips is far (about four times) higher in the unweighted sample, which is also not surprising in view of the strong (0.837) correlation between the 2011 and 2012 trip frequencies.

Unless otherwise specified the following analyses are based on the weighted sample; however, for comparative purposes we also include the descriptive analysis and the model results for the unweighted sample in Appendix B.

5. Descriptive Analysis

5.1 Crosstabulations relevant to the Wi-Fi choice model of Section 6

Numerous crosstabulations were produced from the data. The crosstabs presented in this section reflect the topics to be further explored in the model of the choice to use the free Wi-Fi. In particular, internet access is examined by trip purpose to determine the types of passengers that are internet users and hence likely to benefit from the new service. In addition, internet access is analyzed by cellular broadband internet access to measure the extent to which the 3G/4G internet option impacts passengers' usage of the free Wi-Fi service. The final crosstab examines how age impacts the respondents' opinions about the importance of CCJPA offering free Wi-Fi on board. Some crosstabs exclude missing data, or only involve a subset of the data.

- Trip purpose (survey question A6) *Internet access (question B5)

"Internet access" represents whether the internet was accessed by any means while traveling on the Capitol Corridor since free Wi-Fi was added. Regarding "trip purpose", note that the two separate responses of *shopping* and *social* / *entertainment* / *recreation* are combined, since the two options are somewhat similar and neither of them were frequently reported purposes. The table shows that across trip purpose categories, half of the respondents with the *social* / *entertainment* / *recreation* / *shopping* purpose accessed the internet since November 28, 2011 – when free Wi-Fi was launched on Capitol Corridor – and over 60% of riders traveling for any of the other purposes did the same.

Table 5-1 Trip purpose by Internet access on the Capitol Corridor (N=1531)

			Internet access		Total
			No	Yes	
Trip purpose	Commuting	Count	74	277	351
		% within purpose	21.1%	78.9%	100.0%
	Other work- or school-related purpose	Count	94	182	276
		% within purpose	34.1%	65.9%	100.0%
	Personal business	Count	141	222	363
		% within purpose	38.8%	61.2%	100.0%
	Social / entertainment / recreation / shopping	Count	254	245	499
		% within purpose	50.9%	49.1%	100.0%
	Other	Count	15	27	42
		% within purpose	35.7%	64.3%	100.0%
Total		Count	578	953	1531
		% within purpose	37.8%	62.2%	100.0%

The group among which the largest portion has accessed the internet was commuters, likely both because they are the passengers that may have the greatest need for connectivity and productivity during any single trip, and also because the repetitiveness of the trip may further generate a need to pass the time in some constructive way. From the entire dataset, the 953 cases that have accessed the internet were selected to create the next crosstab, with missing data reducing the total to 935.

- Trip purpose (A6) * Means to access the internet (B6)

Since we are working with a smaller subset of the data in this crosstab, one more category was absorbed into another. Shopping is still included with the social/entertainment/recreation category; in addition, the "other work- or school-related purpose" category was combined with the commuting category to create a more general "work or school trip" category. These results show that riders traveling for work purposes are the most frequent users of the free Wi-Fi. The crosstabulation of trip purpose versus means of accessing the internet on the Capitol Corridor showed this group connecting to some form of internet more frequently than others on Capitol Corridor, so it logically follows that they would also use the free Wi-Fi more frequently. This crosstab also demonstrates that the majority of internet users on Capitol Corridor use the free Wi-Fi (note that many use both Wi-Fi and 3G or 4G internet). This is likely due to the fact that riders with a 3G or 4G service pay a fee for the service and that fee may increase with more frequent use.

Table 5-2 Trip purpose by Means used to access the internet when traveling on CC (N=935)

			Means of accessing the internet*			**Total**
			3G/4G	**Wi-Fi**	**Not sure**	
Trip purpose	**All work- or school-related**	Count	230	376	7	450
		% within purpose	49.0%	83.4%	1.6%	100.0%
	Personal business	Count	97	125	11	215
		% within purpose	45.1%	58.1%	5.1%	100.0%
	Social / entertainment / recreation / shopping	Count	104	177	5	245
		% within purpose	42.4%	72.2%	2.0%	100.0%
	Other	Count	11	16	4	27
		% within purpose	40.7%	59.3%	14.8%	100.0%
Total		Count	432	694	27	935
		% within purpose	46.1%	74.0%	2.9%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for each purpose. The numbers in the "Total" column are the total number of individuals reporting each purpose, not the total number of responses.

- Service plan (B4) * Means to access the internet (B6)

The crosstab of cellular broadband internet access versus means used to access the internet contains only the respondents who indicated that they have accessed the internet on Capitol Corridor since the addition of free Wi-Fi. This crosstab shows that, as expected, a greater majority of riders without cellular broadband internet (3G/4G) access use the free Wi-Fi than those that do have 3G or 4G access. It also shows that, across categories of cellular broadband internet access, more passengers use the Wi-Fi than the 3G/4G plan, possibly because it is more reliable and less "spotty" than mobile internet. The opportunity to use free Wi-Fi may also serve as a method of avoiding overage charges for individuals that pay a monthly fee for limited (by megabytes) 3G/4G access.

Table 5-3 Cellular broadband internet access by Means used to access the internet (N=934)

			Means of accessing the internet*			Total
			3G/4G	Wi-Fi	Not sure	
Cellular broadband internet access	**No**	Count	3	150	2	153
		% within cellular internet	2.0%	98.0%	1.3%	100.0%
		% within means	0.7%	21.6%	7.1%	16.3%
	Yes	Count	429	532	22	769
		% within cellular internet	55.9%	69.3%	2.9%	100.0%
		% within means	99.3%	76.8%	78.6%	82.1%
	Not sure	Count	0	11	4	15
		% within cellular internet	0.0%	73.3%	26.7%	100.0%
		% within means	0.0%	1.6%	14.3%	1.6%
Total		Count	432	693	28	934
		% within cellular internet	46.1%	74.0%	3.0%	100.0%
		% within means	100.0%	100.0%	100.0%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for the "no" and "yes" responses to the cellular broadband question. The numbers in the "Total" column are the total number of individuals reporting each row response, not the total number of responses.

- Age (C2)*Importance (B10)

Crosstab 5-4 presents the crosstabulations for the perceived importance of free Wi-Fi across different age groups. The specific question posed to riders read, "In general, how important do you think it is for the Capitol Corridor to offer free Wi-Fi?" The responses in each answer category are examined by age group.

The results demonstrate that the majority of the entire sample finds it extremely important for Capitol Corridor to offer free Wi-Fi on its trains. This majority holds within each age group under 75. A majority of individuals in age groups over 65 answered that it was at least fairly important to offer the free Wi-Fi. The age groups with the greatest majority (about two-thirds) finding the Wi-Fi to be extremely important are those between the ages of 35-44. The next largest majority choosing “extremely important” is in the 25-34 age group. This indicates that the young-to-mature-adult groups are those that really believe, more so than the youngest group and older groups, that free Wi-Fi is an important amenity for Capitol Corridor to offer.

Table 5-4 Age by Importance of offering free Wi-Fi on Capitol Corridor (N=1525)

			Importance				Total
			Not at all important	Somewhat important	Fairly important	Extremely important	
Age	18 to 24	Count	4	54	88	144	290
		% within age	1.4%	18.6%	30.3%	49.7%	100.0%
	25 to 34	Count	4	34	80	178	296
		% within age	1.4%	11.5%	27.0%	60.1%	100.0%
	35 to 44	Count	2	13	61	156	232
		% within age	0.9%	5.6%	26.3%	67.2%	100.0%
	45 to 54	Count	13	34	72	153	272
		% within age	4.8%	12.5%	26.5%	56.2%	100.0%
	55 to 64	Count	9	26	70	124	229
		% within age	3.9%	11.4%	30.6%	54.1%	100.0%
	65 to 74	Count	8	37	49	64	158
		% within age	5.1%	23.4%	31.0%	40.5%	100.0%
	75 or older	Count	12	9	23	4	48
		% within age	25.0%	18.8%	47.9%	8.3%	100.0%
Total		Count	52	207	443	824	1526
		% within age	3.4%	13.6%	29.0%	54.0%	100.0%

5.2 Crosstabulations relevant to the frequency model of Section 7

5.2.1 Frequency (B14) against conventional predictors of train ridership

Aside from the characteristics related to Wi-Fi, some conventional characteristics in the survey have interesting and relatively strong correlations with the 2012 trip frequency. Crosstabulations of the expected trip frequency in 2012 with various conventional characteristics are shown in Table 5-5.

- Expected 2012 frequency (B14) * Trip frequency in 2011 (A1)

As shown in Table 5-5, CC trip frequencies appear to be relatively stable for the continuing riders: more than 78% of the 2011 passengers who traveled less than once a month or 3 or more times a week remained in the same category for both years. By contrast, only around 43.6% of the passengers traveling 1-3 times a month plan to keep the same frequency in 2012 and about 58.1% of those who traveled 1-2 times a week.

Table 5-5 Crosstabulation of expected trip frequency in 2012 with conventional factors

Numbers in parentheses are row percentages		Expected trip frequency in 2012						
		Not at all (aside from sampled trip)	*Less than once a month*	*1–3 times a month*	*1–2 times a week*	*3–4 times a week*	*5 or more times a week*	*Total*
Frequency in 2011 N=1536	*Not at all*[1]	192 (39.5%)	264 (54.3%)	19 (3.9%)	3 (0.6%)	3 (0.6%)	5 (1.0%)	*486 (100%)*
	Less than once a month[2]	36 (5.6%)	577 (89.9%)	25 (3.9%)	2 (0.3%)	1 (0.2%)	1 (0.2%)	*642 (100%)*
	1–3 times a month[2]	21 (9.5%)	93 (42.3%)	96 (43.6%)	7 (3.2%)	2 (0.9%)	1 (0.5%)	*220 (100%)*
	1–2 times a week[3]	0 (0.0%)	11 (17.7%)	7 (11.3%)	36 (58.1%)	8 (12.9%)	0 (0.0%)	*62 (100%)*
	3–4 times a week[3]	0 (0.0%)	0 (0.0%)	3 (5.5%)	3 (5.5%)	43 (78.2%)	6 (10.9%)	*55 (100%)*
	5 or more times a week[3]	0 (0.0%)	4 (5.6%)	3 (4.2%)	0 (0.0%)	3 (4.2%)	61 (85.9%)	*71 (100%)*
	Total	*249 (16.2%)*	*949 (61.8%)*	*153 (10.0%)*	*51 (3.3%)*	*60 (3.9%)*	*74 (4.8%)*	*1536 (100%)*
Trip Purpose N=1540	*Commuting*	21 (6.0%)	103 (29.3%)	57 (16.2%)	42 (12.0%)	57 (16.2%)	71 (20.2%)	*352 (100%)*
	Other work- or school-related	32 (11.6%)	214 (77.5%)	24 (8.7%)	3 (1.1%)	1 (0.4%)	2 (0.7%)	*276 (100%)*
	Personal business	61 (16.7%)	267 (73.2%)	32 (8.8%)	3 (0.8%)	1 (0.3%)	1 (0.3%)	*364 (100%)*
	Social / entertainment / recreation	121 (23.9%)	342 (67.5%)	39 (7.7%)	3 (0.6%)	1 (0.2%)	1 (0.2%)	*506 (100%)*
	Other	14 (33.3%)	25 (59.5%)	3 (7.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	*42 (100%)*
	Total	*249 (16.2%)*	*951 (61.7%)*	*155 (10.1%)*	*51 (3.3%)*	*60 (3.9%)*	*75 (4.9%)*	*1541 (100%)*
Employment N=1514	*Self-employed*	43 (19.6%)	143 (65.3%)	25 (11.4%)	5 (2.3%)	2 (0.9%)	1 (0.5%)	*219 (100%)*
	Salaried	53 (10.6%)	271 (54.4%)	51 (10.2%)	30(6.0%)	44(8.8%)	49 (9.8%)	*498 (100%)*
	Hourly wage	53 (20.8%)	146 (57.3%)	27 (10.6%)	7 (2.7%)	7 (2.7%)	15 (5.9%)	*255 (100%)*
	Contract worker	4 (7.1%)	39 (69.9%)	5 (8.9%)	3 (5.4%)	2 (3.6%)	3 (5.4%)	*55 (100%)*
	Non-working student	14 (12.0%)	82 (70.1%)	13 (11.1%)	4 (3.4%)	2 (1.7%)	2 (1.7%)	*118 (100%)*
	Retired	36 (17.6%)	150 (73.5%)	16(7.8%)	1 (0.5%)	0 (0.0%)	1 (0.5%)	*204 (100%)*
	Not currently working	36 (24.2%)	96 (64.4%)	13 (8.7%)	2 (1.3%)	1 (0.7%)	1 (0.7%)	*149 (100%)*
	Other	4 (25.0%)	11 (68.8%)	1 (6.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	*16 (100%)*
	Total	*243 (16.1%)*	*938 (62.0%)*	*151 (10.0%)*	*52 (3.4%)*	*58 (3.8%)*	*72 (4.8%)*	*1514 (100%)*

Notes: Totals do not add perfectly across rows and columns due to rounding issues in the weighted sample; [1] New riders (in 2012); [2] Lower-frequency continuing riders; [3] Higher-frequency continuing riders

The 249 passengers who do not expect to use the CC at all in 2012 (except for the current trip) are viewed as "one-time" riders. The 486 passengers who reported no trips in 2011 are new riders who started to use Capitol Corridor in 2012. Aside from the 192 one-time riders in this group, the expected 2012 frequencies of the remainder are mainly (90%) focused on traveling less than once a month.

- Expected 2012 frequency (B14) * Trip purpose (A6)

Not surprisingly, commuters reported higher expected trip frequencies in 2012 than those traveling for any other purpose, with nearly half of them planning to travel once a week or more during 2012. By contrast, among those traveling for personal business or for social and entertainment purposes, almost all (99%) were expecting to travel on the Capitol Corridor three times a month or less.

- Expected 2012 frequency (B14) * Employment (C3)

Different employment types also show some interesting relationships with the expected frequency in 2012, which will be further examined for the model presented in the following section. Those who are salaried, hourly-wage, or contract workers expect to ride CC more frequently than others; for example, 34.8% of the salaried passengers plan to travel 1-2 times or more a week, followed by contract workers and hourly-wage workers. Among self-employed and non-working respondents, by contrast, more than 85% reported an expected frequency lower than 1-3 times a month.

5.2.2 Wi-Fi variables and other reasons for frequency changes

As mentioned in Section 3, we presented six reasons for a frequency change as well as an "other" option; respondents were invited to "check all that apply". After recoding the Wi-Fi responses for consistency, 9.8% of the passengers in the weighted sample chose "job location change" as one reason, and the percentages of other reasons chosen are: "home location change" (8.9%), "change in preferences" (6.3%), "change in auto ownership" (2.6%), "free Wi-Fi" (8.7%), and "other: ___" (10.6%). Nearly three-fifths (59.2%) of the passengers indicated that "I do not expect my frequency to change". Wi-Fi was deliberately placed late in the list to minimize any bias toward conforming to the presumably desired answer. As a result, the role of Wi-Fi may be slightly understated, as some respondents for whom it was a legitimate answer may have checked an earlier appropriate answer and then skipped directly to the next question.

Among the 133 passengers (8.7%) who gave free Wi-Fi as a reason for a trip frequency change, 110 (or 7.1%[16] of the 1541 cases in the weighted sample) exhibited an increase in their CC ridership frequency due to Wi-Fi[17]. This is considerably lower than the 20% found by the

[16] Since the two comparison studies did not weight their samples, we can mention that our unweighted counterpart is 6.4%. Thus, the weighting does not provide a reason for the discrepancy between our study and the other two.

[17] This increase is inferred from the difference between reported 2011 frequencies (question A1) and expected 2012 frequencies (B14), and is subject to respondents' errors in predicting and reporting their 2012 frequencies. The remaining 23 passengers show a *decrease* in their trip frequency and attributed the change to Wi-Fi (this group constitutes 10 passengers in the unweighted sample, three of whom chose other reasons for the change in frequency as well as Wi-Fi). Anecdotal information suggests that some passengers were concerned about possible health impacts of the electromagnetic radiation involved in providing the Wi-Fi service; others may have expected *other passengers'* use of the Wi-Fi service to pose a nuisance.

prospective survey of Kanafani et al. (2006) (which would not even have included new riders generated by the service) and the 19% found by AC Transit in its retrospective survey (Twichell et al., 2008)[18]. In the first instance, the reason may simply be that the higher number is subject to the optimism bias often associated with hypothetical questions. In the second instance, the reason may be that the AC Transit survey was clearly "all about Wi-Fi", and thus may have generated substantial unit non-response biases (those not interested in Wi-Fi may be less likely to respond) and response biases (those responding may be influenced to give the clearly more-desirable answer). In contrast, by design our survey was neutrally-titled "Capitol Corridor Passenger Survey", and the word "Wi-Fi" did not appear until Part B on page 2, inside the four-page leaflet. We also tried to minimize bias in the question wording by not presuming that frequency would specifically *increase*, hence using the neutral word "*changing*", and inferring the direction of change from the difference between reported 2011 frequencies (question A1) and expected 2012 frequencies (B14).

Table 5-6 Impact of Wi-Fi for different traveler segments (weighted)

Group	Wi-Fi influenced a frequency change (column percentages, by segment)[4]	Expected trip frequency in 2012 (row percentages)					
		Not at all	*Less than once a month*	*1–3 times a month*	*1–2 times a week*	*3–4 times a week*	*5 or more times a week*
NR[1] N=485	*No*	178	232	16	2	2	4
	434 (89.5%)	(41.0%)	(53.5%)	(3.7%)	(0.5%)	(0.5%)	(0.9%)
	Yes	14	32	3	0	1	1
	51 (10.5%)	(27.5%)	(62.7%)	(5.9%)	(0.0%)	(2.0%)	(2.0%)
LFR[2] N=864	*No*	50	613	114	8	2	1
	788 (91.2%)	(6.3%)	(77.8%)	(14.5%)	(1.0%)	(0.3%)	(0.1%)
	Yes	7	57	8	2	1	1
	76 (8.8%)	(9.2%)	(75.0%)	(10.5%)	(2.6%)	(1.3%)	(1.3%)
HFR[3] N=187	*No*	0	14	12	38	50	65
	179 (95.7%)	(0.0%)	(7.8%)	(6.7%)	(21.2%)	(27.9%)	(36.3%)
	Yes	0	0	1	1	4	2
	8 (4.3%)	(0.0%)	(0.0%)	(12.5%)	(12.5%)	(50.0%)	(25.0%)

[1] New riders (in 2012); [2] Lower-frequency continuing riders; [3] Higher-frequency continuing riders; [4] As mentioned in the text, there are 133 "Yes" cases in the weighted sample, but the numbers appear to sum to 135 here due to rounding.

Table 5-6 crosstabulates the expected trip frequency in 2012 and the role of Wi-Fi as a driver to change the trip frequency, for three traveler segments based on their 2011 frequency: new riders (those who did not ride in 2011), lower-frequency continuing riders (those who used CC less than once a week in 2011), and higher-frequency continuing riders (those using CC once a week

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[18] Based on combining information from several questions in the survey, in Section 7 we present seven different ways of defining the share of respondents who increased trip frequency because of Wi-Fi. The identification used here is the one we consider to best balance the various considerations, but the most liberal definition of the "increasers" group does, in fact, comprise about 20% of the respondents.

or more in 2011). Wi-Fi appears to have the largest positive impact on expected 2012 frequency for new riders: in that segment, 72.5% of those who reported Wi-Fi as influencing their 2012 frequency expect to use CC for more than just the current trip in 2012, compared with fewer than 60% of the new riders who did not see Wi-Fi the same way. As for the lower-frequency riders, 5.2% of those who cited Wi-Fi as an influence expect to use CC more often (at least once a week); in contrast, only 1.4% of the lower-frequency riders who did not choose Wi-Fi expect to travel at least once a week.

5.3 Other crosstabulations relevant to this research

In addition to the crosstabulations relevant to the models of the choice to use free Wi-Fi and the 2012 trip frequency, there are several other analyses whose results offer further insight on the internet use on board and the related trip experience of passengers. In the rest of this section, we interpret a number of such crosstabs.

5.3.1 Crosstabs involving means of accessing the internet (B6)

- Service plan (B4) * Means of accessing the internet on CC (B6)

Table 5-7 Service plan by Means used to access the internet when traveling on CC (N=764)

			Means of accessing the internet*			
			3G/4G	**Wi-Fi**	**Not sure**	**Total**
Service plan	**pay for each megabyte of data**	Count	9	5	0	14
		% within service plan	64.3%	35.7%	0.0%	100.0%
		% within means	2.1%	0.9%	0.0%	1.8%
	limited number of megabytes	Count	113	201	4	257
		% within service plan	44.0%	77.9%	1.6%	100.0%
		% within means	26.6%	37.8%	15.4%	33.4%
	unlimited number of megabytes	Count	272	277	8	418
		% within service plan	65.1%	66.1%	1.9%	100.0%
		% within means	64.0%	52.1%	30.8%	54.3%
	not sure	Count	30	44	14	76
		% within service plan	39.5%	57.9%	18.4%	100.0%
		% within means	7.1%	8.3%	53.8%	9.9%
Total		Count	425	532	26	764
		% within plan	55.2%	68.9%	3.4%	100.0%
		% within means	100.0%	100.0%	100.0%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for most service plan categories. The numbers in the "Total" column are the total number of individuals reporting each type of plan, not the total number of responses.

The crosstabulation of 3G/4G service plan versus the means used to access the internet when traveling on the Capitol Corridor revealed that passengers who pay for each megabyte were more likely to use 3G/4G than Wi-Fi. This may seem counterintuitive but, first, only 14 people fell into this category. Second, such individuals may be less technologically savvy, less wealthy and perhaps equipped with older smartphones/cell phones. Third, they may also comprise people who do not use the internet very much and therefore do not have the tools (e.g. a tablet or laptop) with them to access the internet through Wi-Fi.

On the other hand, those with a limited number of megabytes were much more likely to use Wi-Fi (78%) than their cellular broadband internet plan (44%), likely using the free service when available to avoid overage charges. But even among passengers who have an unlimited number of megabytes, about two-thirds (66%) used Wi-Fi, similar to the share using 3G/4G (65%). This indicates that the Wi-Fi may be a more convenient service even for passengers well-equipped with other options, perhaps due to the possible loss of their 3G/4G data signal at some points along the Capitol Corridor route.

- Awareness of free Wi-Fi (B9) * Means of accessing the internet on CC (B6)

Table 5-8 Awareness of free Wi-Fi by Means used to access the internet when traveling on CC (N=912)

			Means of accessing the internet*			
			3G/4G	**Wi-Fi**	**Not sure**	**Total**
Awareness of free Wi-Fi	**No**	Count	125	89	12	195
		% within awareness	63.8%	45.6%	6.2%	100.0%
		% within means	29.7%	13.1%	44.4%	21.5%
	Yes	Count	287	578	11	696
		% within awareness	41.2%	83.0%	1.6%	100.0%
		% within means	68.2%	85.0%	40.7%	76.1%
	Not sure	Count	9	13	4	22
		% within awareness	40.9%	59.1%	19.0%	100.0%
		% within means	2.1%	1.9%	14.8%	2.4%
Total		Count	421	680	27	912
		% within awareness	46.1%	74.5%	3.0%	100.0%
		% within means	100.0%	100.0%	100.0%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for each awareness response. The number in the "Total" column is the total number of individuals reporting each level of awareness, not the total number of responses.

Table 5-8 shows that more than four-fifths (83%) of those who were aware of the free Wi-Fi service "before today" had used it. Interestingly, nearly half (46%) of those who had *not* been aware of the service before the current trip had also used it, suggesting a high level of latent interest in the service.

- Usefulness of Wi-Fi (B12) * Means of accessing the internet on CC (B6)

Table 5-9 Usefulness of Wi-Fi by Means used to access the internet when traveling on CC (N=933)

			Means of accessing the internet*			
			3G/4G	**Wi-Fi**	**Not sure**	**Total**
Usefulness of Wi-Fi	**Not at all useful**	Count	33	10	1	35
		% within usefulness	94.3%	28.6%	2.9%	100.0%
		% within means	7.6%	1.4%	3.7%	3.8%
	Somewhat useful	Count	104	104	5	179
		% within usefulness	58.1%	58.1%	2.8%	100.0%
		% within means	24.1%	15.1%	18.5%	19.2%
	Fairly useful	Count	131	165	9	240
		% within usefulness	54.6%	68.8%	3.8%	100.0%
		% within means	30.3%	23.9%	33.3%	25.7%
	Extremely useful	Count	164	411	12	479
		% within usefulness	34.2%	85.8%	2.5%	100.0%
		% within means	38.0%	59.6%	44.4%	51.3%
Total		Count	432	690	27	933
		% within usefulness	46.3%	74.0%	2.9%	100.0%
		% within means	100.0%	100.0%	100.0%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for each level of perceived usefulness. The numbers in the "Total" column are the total number of individuals reporting each level of usefulness, not the total number of responses.

Not surprisingly, Table 5-9 shows that those who did not find the Wi-Fi service useful to them personally were far more likely to use 3G/4G (94%) to access the internet while traveling on the Capitol Corridor, than to use Wi-Fi (29%). Those who found it somewhat or fairly useful were naturally more likely to use it than the first group, but were also still likely to use 3G/4G as well. But among those who found free Wi-Fi to be extremely useful to them personally, 86% chose to use free Wi-Fi and only 34% used 3G/4G plans.

5.3.2 Crosstabulations relevant to impact of Wi-Fi on overall trip experience (B13)

- Trip purpose (A6) * Impact of Wi-Fi on overall trip experience (B13)

Table 5-10 Trip purpose by Impact of Wi-Fi on overall trip experience (N=1513)

			Impact on overall trip experience				Total
			Make it worse	**Makes it worse in some ways, and better in others**	**Has no effect**	**Makes it better**	
Trip purpose (Combined shopping and social/ entertainment)	**Commuting**	Count	6	22	70	252	350
		% within purpose	1.7%	6.3%	20.0%	72.0%	100.0%
	Other work- or school-related purpose	Count	0	10	29	233	272
		% within purpose	0.0%	3.7%	10.7%	85.7%	100.0%
	Personal business	Count	7	15	96	235	353
		% within purpose	2.0%	4.2%	27.2%	66.6%	100.0%
	Social / entertainment / recreation	Count	4	24	141	327	496
		% within purpose	0.8%	4.8%	28.4%	65.9%	100.0%
	Other	Count	0	0	4	38	42
		% within purpose	0.0%	0.0%	9.5%	90.5%	100.0%
Total		Count	17	71	340	1085	1513
		% within purpose	1.1%	4.7%	22.5%	71.7%	100.0%

The crosstabulation of trip purpose versus the impact of free Wi-Fi on the overall trip experience indicates that a majority of passengers indicated Wi-Fi made the trip experience better across trip purpose. The greatest percentage of passengers in trip purpose categories “other” and “other work- or school-related purpose” indicated a better trip experience due to the free Wi-Fi.

- Service plan (B4)* Impact of Wi-Fi on overall trip experience (B13)

Table 5-11 Service plan by Impact of Wi-Fi on overall trip experience (N=1024)

			Impact on overall trip experience				Total
			Make it worse	**Makes it worse in some ways, and better in others**	**Has no effect**	**Makes it better**	
Service plan	**pay for each megabyte of data**	Count	0	1	1	16	18
		% within plan	0.0%	5.6%	5.6%	88.9%	100.0%
	limited number of megabytes	Count	1	7	53	283	344
		% within plan	0.3%	2.0%	15.4%	82.3%	100.0%
	unlimited number of megabytes	Count	5	30	81	417	533
		% within plan	0.9%	5.6%	15.2%	78.2%	100.0%
	not sure	Count	0	7	20	97	124
		% within plan	0.0%	5.6%	16.1%	78.2%	100.0%
Total		Count	10	45	156	813	1024
		% within plan	1.0%	4.4%	15.2%	79.4%	100.0%

The crosstabulation of 3G/4G service plan versus the impact of the free Wi-Fi on the overall trip experience demonstrates that a majority of passengers indicated Wi-Fi made the trip experience better regardless of which service plan they have, but those with a limited plan had the greatest majority finding an improved trip experience due to free Wi-Fi.

6. Wi-Fi Choice Model[19]

6.1 Model specifications

Certain types of passengers may be more inclined than others to use the free AmtrakConnect Wi-Fi on board Capitol Corridor. To explore and define some of these differences and correlations, a logit model was estimated (using the Limdep/Nlogit software package) for the binary choice to use the free Wi-Fi or not. The model was estimated on the subset of cases who answered "Yes" to the question, "Have you accessed the internet while traveling on the Capitol Corridor since November 28, 2011?" In this subset of 1241 internet users, some used the free Wi-Fi (80.2%) and some did not (19.0%). To create this model, many variables were tested, and those with a P-value greater than 0.05 were not included, since this is widely used as "a limit in judging whether a deviation is to be considered significant or not" (Fisher, 1925). Cases with missing data on any prospective explanatory variables were eliminated, leaving 1173 cases used to estimate the model. The final model is presented in Table 6-1.

6.2 Model results and variable definitions

Table 6-1 presents all variables that proved to be significant in the binary logit model, as well as their coefficients, indicating their influence on the choice to use (or not use) the free AmtrakConnect Wi-Fi on board. The variables included in the model and their values are defined in greater detail in Table 6-2.

Table 6-1 Binary logit model of the choice to use the free Wi-Fi on board Capitol Corridor

Variable k	Coefficient β_k	Standard error	P-value	Mean of variable
Constant	2.058	0.657	0.002	
Commute trip	0.803	0.181	0.000	0.732
Tablet	0.471	0.229	0.040	0.194
Laptop	1.033	0.173	0.000	0.708
3G/4G access	-2.405	0.453	0.000	0.830
Wi-Fi importance	0.477	0.110	0.000	3.507
Streaming	-0.236	0.082	0.004	2.005
Professional/technical	0.429	0.177	0.016	0.534
Age	-0.023	0.065	0.001	41.733
No device	-2.260	0.613	0.000	0.020
Final LL = -457.631, $LL_{constant\ only}$ = -601.801, χ^2_{EL} = 710.861, χ^2_{MS} = 205.230, N = 1173, ρ^2_{EL}=0.437, adj-ρ^2_{EL}=0.425, ρ^2_{MS}=0.183, adj-ρ^2_{MS}=0.167				

[19] Section 6 was completed before the sample weighting was finalized. Since this section is relatively self-contained, all results reported here are based on the *unweighted* sample.

Table 6-2 Variable definitions

Variable	Survey question	Definition
Commute trip	A6	Dummy variable: =1 if primary trip purpose was "commuting to/from work or school", = 0 otherwise
Tablet	B2	Dummy variable: =1 if respondent generally has a tablet with him while traveling, = 0 otherwise
Laptop	B2	Dummy variable: =1 if respondent generally has a laptop with him while traveling, = 0 otherwise
3G/4G access	B3	Dummy variable: =1 if respondent has cellular broadband internet access, = 0 if not
Wi-Fi importance	B10	The respondent's perceived importance for Capitol Corridor to offer free Wi-Fi: 1 = not at all, 2 = somewhat, 3 = fairly, 4 = extremely
Streaming importance	B11	The respondent's perceived importance for the ability to stream audio or video on board: 1 = not at all, 2 = somewhat, 3 = fairly, 4 = extremely
Professional / technical	C3	Dummy variable: =1 if respondent has a job of a professional/technical nature, = 0 otherwise
Age	C2	The respondent's age. The age ranges were assigned the following values: 21, 30, 40, 50, 60, 70, and 78.
No device	B2	Dummy variable: =1 if respondent indicated that he generally has no Wi-Fi enabled device with him while traveling, =0 otherwise

The coefficient β_k can be interpreted as the change in the utility of using the free Wi-Fi for an individual with a unit increase in explanatory variable *k*. The coefficient of the highest magnitude does not necessarily indicate the most important or influential variable, since the explanatory variables are not consistent in scale. Therefore, in the analysis, the coefficients are interpreted based on sign and statistical significance, not on magnitude.

The ρ^2 values show that this model explains about 44% of the information in the data using the equally likely model as the benchmark (in which the choices to use the free Wi-Fi and the choice to not use the free Wi-Fi are equally likely), and about 17% of information in the data when the market share model is the benchmark (in which there is only a constant term, which simply reflects the percentage of respondents that chose to use Wi-Fi). This is well within the typical range of explanatory power for disaggregate choice models. Both χ^2 values have p-values less than 0.0001 and are hence statistically significant (Fisher, 1925). Therefore, the null hypothesis that there is no difference between the models can be rejected and it can be concluded that the binary logit model is a significantly better model than both the equally likely and the market share model.

The constant in the binary logit model is significant and positive, indicating that the average effect of unobserved variables supports using Wi-Fi. Both constraints against and factors encouraging riders to use of free Wi-Fi were identified. Constraints against riders using the free Wi-Fi are variables with negative coefficients, which include the following:

- *3G/4G access:* This indicates that if a passenger has access to cellular broadband internet (e.g., 3G or 4G service), she is less likely to use the free Wi-Fi service than if she does not. Recall that the sample on which this model was estimated included only internet users (only some of which used the free Wi-Fi, since some were able to access the internet via other methods). It can be assumed that the only other option for internet access on board besides 3G or 4G services is the free Wi-Fi. Therefore, the negative coefficient for this variable in the model is as expected, and it reflects the fact that passengers accessing the internet on board without 3G or 4G service are likely using the free AmtrakConnect Wi-Fi.

- *Streaming importance:* In order to maximize service availability to everyone, Capitol Corridor limits the bandwidth that can be used by passengers. To do so, it does not allow users of the free AmtrakConnect Wi-Fi to stream audio or video, since this uses a large amount of bandwidth. If passengers want to stream audio or video on board, they must use their own 3G or 4G service. The negative coefficient for this variable indicates that the more important this streaming capability is to a passenger, the less likely she is to use the free Wi-Fi. It is probable that if streaming capability is of significant importance to a respondent, that she will be using her internet connection primarily for such activities. Therefore, without further motivation to use the free Wi-Fi, the passenger simply does not access it.

- *Age:* The negative coefficient for this variable echoes the results in the crosstab of age and the perceived importance of offering free Wi-Fi on board Capitol Corridor. It must be recalled, however, that all respondents in the model estimation sample have used some form of internet on board at least once since the addition of free Wi-Fi. Thus, given that the older internet users are less likely than younger passengers to use the free Wi-Fi, they are evidently using a 3G/4G service or are unsure of their connection source. Those who use their 3G/4G service have likely spent time learning the technology and may be unwilling to change to the new free Wi-Fi. This may be due to a lack of enthusiasm for or understanding of the newer technologies among the older generations.

- *No device:* A value of 1 for this dummy variable indicates that the respondent generally has no Wi-Fi enabled devices with her while traveling. Since these people have still somehow accessed the internet at least once since Wi-Fi was introduced on board, this suggests that they probably did so via their 3G/4G service.

The variables with positive coefficients are qualities and characteristics of passengers that are more likely to use the free AmtrakConnect Wi-Fi:

- *Commute trip:* All trip purposes were tested via dummy variables, but only commuting was significant. A majority of passengers (65.3%) are commuters, and they are also most likely to use the free AmtrakConnect Wi-Fi. Commuters are likely preparing for the work day or completing projects on the way home during their commute trip on Capitol Corridor. Being connected with colleagues during the commute can be very beneficial and increase productivity. Greater productivity on board can also prevent commuters from having to work at home before or after their commute to work. Therefore, it logically follows that this variable has a positive coefficient, meaning that all else equal, a passenger traveling for his commute is more likely to use the free Wi-Fi on board than those traveling for other purposes.

- *Tablet:* All devices were tested via dummy variables, but only tablet and laptop were significant. A tablet, such as the iPad®, is typically Wi-Fi-enabled. It is also typically equipped with a 3G or 4G service. The presence of this variable in the model demonstrates that even with a 3G or 4G service, a passenger with a Wi-Fi-enabled device is still inclined to use the free Wi-Fi. Given that this is a dummy variable similar to the laptop variable, however, the smaller coefficient value indicates that it is less likely to be used to access the free Wi-Fi than a laptop is (because a tablet can also connect through 3G/4G, while a laptop primarily relies on Wi-Fi for internet connection while traveling).

- *Laptop:* Unlike a tablet, a laptop is not usually equipped with a 3G or 4G service. Mobile internet cards are an option, but are typically quite expensive. Laptops do, however, connect to Wi-Fi. Of Wi-Fi enabled devices, a laptop also typically has the largest screen and is most ergonomic due to the keyboard and upright screen. These qualities cause passengers with laptops to be more likely to use the free Wi-Fi on their laptops.

- *Wi-Fi importance:* The results from this variable are as logically expected. The positive coefficient for this variable indicates that passengers who find it more important for CCJPA to offer free Wi-Fi are also more likely to choose to use the free Wi-Fi.

- *Professional/technical:* All occupations were tested via dummy variables, but only professional/technical was significant. Those with a professional or technical job are more likely to be those who are commuting or traveling for work purposes. These individuals generally have jobs that require them to be connected on the go, so the free Wi-Fi is especially useful for them. The nature of their jobs and their daily lives make them more inclined to use the free Wi-Fi on board, which may explain the positive coefficient for this variable.

Other variables that were considered to possibly have an impact on the choice to use Wi-Fi but were insignificant (and therefore not included in the final model) are the following:

- *Travel companions:* A dummy variable was created for each answer option (traveling alone, traveling with family, traveling with friends, and traveling with colleagues). None of these variables were significant, indicating that the presence of any form of travel companion does not influence the individual to use or not use the free Wi-Fi. Perhaps this variable influences the use of internet at all (i.e., a travel companion may prevent someone from using the internet as they are already verbally communicating), but does not influence the use of the free Wi-Fi specifically.

- *Education level:* We hypothesized that a higher education level may be correlated with use of the free Wi-Fi (due to greater knowledge of such systems). The insignificance of education may reflect that its influence is captured by other variables that *are* in the model, such as professional/technical occupation, commuting purpose, and presence of laptop or tablet.

- *Income:* This variable is insignificant, perhaps partially due to the high number of missing responses (which were removed during model estimation) reducing the variability in the *non-missing* responses available to the model. It may also be that those with a lower income may have nearly equal portions of free Wi-Fi users via an inexpensive device and non-Wi-Fi users due to lack of device, whereas the higher income individuals may have nearly equal portions of individuals using expensive devices to access the free Wi-Fi and individuals using their expensive 3G/4G service rather than the free Wi-Fi. Alternatively, as with education, an influence of income may be captured via other variables in the model that differ by income.

- *Travel time on Capitol Corridor:* We hypothesized that a higher travel time would create a longer opportunity for free Wi-Fi use, and that there would hence be a positive correlation between travel time and use of the free Wi-Fi. However, this variable was surprisingly insignificant. This could be due to the fact that the Capitol Corridor is typically used for longer trips anyway, and it is unlikely that a trip would be short enough to prevent someone from using the internet service assuming they have the device(s) to do so. Here too, there could also be a correlation with variables already in the model, and a certain amount of endogeneity: those with longer trips may be more likely to equip themselves with a laptop or tablet, so the presence of those items is already mediating the influence of trip length.

The model can be used to predict the likelihood that any given passenger would use the Wi-Fi service, given how he measures on each of the explanatory variables.

7. Estimation of the Impact of Wi-Fi on Capitol Corridor Trips[20]

7.1 Overview of the two methods of analysis

Two methods were used to estimate the number of trips added due to the availability of Wi-Fi services. Method 1 uses descriptive statistics to compare the aggregate number of trips in 2012 against the aggregate number in 2011, distinguishing cases according to the impact of Wi-Fi on this trip difference. Specifically, we identify the "impact group" formed by those cases for whom Wi-Fi affected their trip frequency, compute the net change in trips from 2011 to 2012 separately for that group and for its complement (the "non-impact" group), and express the impact group's change as a percent of the 2011 baseline (i.e. the percent increase in overall trips due to Wi-Fi), and as a percent of the total change in trips across the entire sample (i.e. the percent of *new* trips that could be attributed to Wi-Fi). Seven roughly concentric "impact groups" are identified, differing in the degree of confidence in the impact of Wi-Fi on their trip frequency change. As explained in more detail in Section 7.2, these groups are defined on the basis of their responses to four questions in the survey: B16 (factors affecting frequency), B17 (direction of impact of Wi-Fi), and the difference between B14 and A1 (change in frequency category between 2011 and 2012).

In Method 2, we build a linear regression model of 2012 frequency, from which the influence of Wi-Fi can be estimated after accounting for (some) other influences on that frequency. This method is driven by the difference between the predicted number of 2012 trips when accounting for the presence of Wi-Fi services, and the counterfactual predicted number of 2012 trips in the absence of Wi-Fi.

The two approaches use two different benchmarks for comparison, both based on the computation of the number of 2012 trips (Method 1 uses the "actual", directly reported, number of trips while Method 2 uses the total number of trips predicted by the model, but these two numbers should be, and are, essentially the same for both methods). The two methods subtract different numbers of trips from that 2012 "baseline" to obtain the change in number of trips due to Wi-Fi: the 2011 reality is used for Method 1, whereas the 2012 counterfactual ("without Wi-Fi") number of trips is used for Method 2. In the latter case, the 2011 frequency is one variable used for estimating the 2012 counterfactual, but additional factors (besides Wi-Fi) influencing the 2012 frequency are also taken into account.

Overall, Method 1 is expected to overestimate the influence of Wi-Fi, because it attributes the entire change in trips for the "impact group" to Wi-Fi. Method 2, by contrast, is more conservative (and appropriate) in that it attempts to capture and account for other factors affecting trip frequency as well (such as job location changes), and only attributes to Wi-Fi the difference that remains after the effects of those other factors are also accounted for.

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[20] All calculations in Section 7 are based on the weighted sample. Appendix B contains the regression model and the computed impacts on ridership for the unweighted sample.

7.2 Method 1: Descriptive approach

7.2.1 Calculation of added trips from 2011 to 2012

Prior to the installation of free AmtrakConnect Wi-Fi on Capitol Corridor, CCJPA analysis indicated that a 1-2% increase in round trips in a year would be necessary to justify the free Wi-Fi business model. Using the data from the Wi-Fi survey, the number of trips that were added due to the free Wi-Fi service was estimated. To do so, several assumptions and data preparations were made (see Section 3.3). First, each of the 2011 and 2012 trip frequency categories was assigned an average number of trips per year (see Table 3-2). Second, for those who checked Wi-Fi as a reason for change but gave the same category in A1 and B14, we considered the frequency change within category by arbitrarily taking the difference between the 25th percentile of the frequency range and the 75th percentile of the range according to the answers in B17. The assumed values are shown in Table 3-3. Third, the sample was weighted using the methodology described in Section 4. For the purpose of calculating the total trips in 2011 and 2012, any missing responses were recoded as the mean number of trips across all responses for each year.

Incorporating the above assumptions, we computed the "trip difference" between 2012 and 2011 for each respondent. This variable was ultimately used to determine the number of added trips due to Wi-Fi. First, the total net number of added trips was calculated with the "trip difference," yielding the results shown in Table 7-1: an increase of 4.6% in the total number of round trips.[21]

Table 7-1 Total trip difference between 2011 and 2012 (N=1541)

Total round trips in 2011	38,660
Total round trips in 2012	40,439
Net increase in round trips from 2011 to 2012	1,779
Total percent increase in round trips from 2011 to 2012	4.6%

It is important to note that when using the unweighted sample, the same difference totaled 14.4%, which is quite high in absolute terms (especially compared to the external evidence mentioned at the end of Section 4.1) as well as relative to the weighted results. This unrealistic result for the unweighted sample is a pragmatic justification (in addition to the theoretical one) of the need for weighting the sample as described in Section 4.

Many respondents (535, or 34%) changed their trip frequency between 2011 and 2012, but not all changes were due to the addition of free Wi-Fi on board. A primary goal of our study is to determine the respondents who did increase (or decrease) their trip frequency on Capitol Corridor between 2011 and 2012 because free Wi-Fi was introduced on board. Several questions on the survey could be used to make this determination, but respondents' answers were not always consistent across questions. Therefore, there is some uncertainty in whether or not some respondents changed their frequency due to Wi-Fi, or not. Accordingly, we present several sets

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[21] If missing data on 2012 frequency were filled with the mean, the sample size would be 1576, and the numbers in Table 7-1 would be 39,308; 41,357; 2049; and 5.2%, respectively. However, to be conservative the 35 cases with missing data on that variable were excluded from the computation of weights and thence from the remainder of the analysis. They are also excluded here for consistency.

of criteria for deciding how a respondent could be classified, and conduct the analysis for several of those classifications in order to understand how the results differ.

In brief (to be elaborated below), we examined (1) individuals who indicated that they would use the Capitol Corridor more or less frequently without Wi-Fi (in question B17) and/or (2) those who indicated that Wi-Fi was a factor influencing a change in their trip frequency between 2011 and 2012 (in question B16). Additionally, we (3) compared their trip frequencies in 2011 (question A1) and 2012 (question B14) to identify individuals who increased or decreased their trip frequencies by at least one category. This information helped us to classify specifically the Wi-Fi-influenced (based on B16) respondents as either increasing or decreasing trip frequency from 2011 to 2012.

We developed a set of seven groups of increasers, as well as seven counterpart groups of decreasers. For each set of groups (both increasers and decreasers), the first group has the strictest requirements for inclusion. The requirements are progressively relaxed for each consecutive group. The final group has the least strict requirements for inclusion and also includes all the cases in the preceding groups. The process is visually described with Venn diagrams. To define these groups, we looked at responses to the following four questions for each case:

- *Part B, question 16:* "Compared to your frequency in 2011 (question A1), which of the following factors (if any) are changing the frequency with which you expect to use Capitol Corridor in 2012?" Multiple answers were offered to the respondents, namely job location change, home location change, change in preferences, change in auto ownership, free Wi-Fi, and "other: ____". The free Wi-Fi option was consciously placed just before "other" so as to minimize a bias toward that answer, since the question was preceded by a number of other questions focusing on Wi-Fi. As a result, however, it may somewhat *undercount* the number of cases for which Wi-Fi is a valid answer, since some respondents may have overlooked it in the list. Bias minimization was also the reason for choosing the neutral wording "changing the frequency" rather than "increasing" it; one could imagine some riders perceiving *others'* use of Wi-Fi to be an annoyance (or even, anecdotally, a health hazard), making them *less* inclined to ride the train. In fact, we do find a few people decreasing their trip frequency due to Wi-Fi, as detailed below. In any case, we identified the respondents selecting "Free Wi-Fi" as one of the factors changing their frequency. Those respondents are represented by one circle on the Venn diagrams (B16=f) for both increasers and decreasers.

- *Part B, question 17:* "What impact does the availability of free Wi-Fi have on your frequency of using Capitol Corridor in 2012?" Respondents who marked "Without free Wi-Fi, I would use Capitol Corridor little or not at all" or, "Without free Wi-Fi, I would use Capitol Corridor sometimes, but not as often as I indicated in question B14" were considered to have indicated they would use Capitol Corridor less without the free Wi-Fi. Those respondents are represented by one circle on the Venn diagrams (B17<3) for the increasers. The remaining responses provided were, "Without free Wi-Fi, I would still use Capitol Corridor as often as I indicated in question B14", and "Without free Wi-Fi, I would use Capitol Corridor more often than I indicated in question B14". Those respondents who selected the latter response are represented by one circle on the Venn diagrams (B17=4) for the decreasers.

- *Part A, question 1:* "Last year (2011), on average, how often did you use the Capitol Corridor service? (anywhere between the Auburn station and the San Jose/Diridion station). Count a round trip as one time rather than two." This question is compared to the next in order to determine whether an individual increased or decreased by one or more trip frequency categories from 2011 to 2012.

- *Part B, question 14:* "This year (2012), how often do you expect to use Capitol Corridor (not counting the present trip)?" If the respondent chose a higher frequency category here than in question A1, she was considered to have definitely increased her trip frequency, and this quality ("2011<2012" or "A1<B14", for short) represents the third and final circle of the Venn diagram used to define groups of increasers. Conversely, if she chose a lower frequency category here than in question A1, she was considered to have decreased her trip frequency, and this quality ("2011>2012") represents the third and final circle of the Venn diagram used to define groups of decreasers.

Examining the answers to these questions, we were able to decide whether a respondent falls into one or more of the categories shown in Table 7-2. Note that these categories are not mutually exclusive.

Table 7-2 Categories for Wi-Fi-influenced respondents*

Category	**Definition/qualifications**	**Increase or decrease**
B16=f	Respondents selected "Free Wi-Fi" as a factor affecting their trip frequency (question B16).	Applies to respondents that increased or decreased trip frequency.
A1<B14 (2011<2012)	Respondents *increased* trip frequency according to questions B14 and A1.	Indicates that respondents increased trip frequency.
B17<3	Respondents indicated they would use Capitol Corridor *less* without the free Wi-Fi (i.e., chose category 1 or 2 in question B17).	Indicates that respondents increased trip frequency.
A1>B14 (2011>2012)	Respondents *decreased* trip frequency according to questions B14 and A1.	Indicates that respondents decreased trip frequency.
B17=4	Respondents indicated they would use Capitol Corridor *more* without the free Wi-Fi (i.e., chose category 4 in question B17).	Indicates that respondents decreased trip frequency.

* Note that these categories are not exhaustive, meaning not all 1541 respondents fall into one of these categories. Only the respondents that fall into these categories are of concern in calculating net added trips *due to free Wi-Fi* using this method.

Based on these categories, subsets of cases were selected with varying degrees of confidence as to whether the respondent could be considered to have increased (or decreased) trip frequency due to the addition of free Wi-Fi on board. In order to select these groups, three key categories (for groups of increasers: B16=f, 2011<2012, and B17<3; for groups of decreasers: B16=f, 2011>2012, and B17=4) were arranged in a Venn diagram to create a visual representation of the groups, as shown in Figure 7-2 and Figure 7-3. Figure 7-1 presents the groups in order of decreasing degrees of confidence. The distance between groups in the figure is not significant –

this is simply to demonstrate the variability in confidence across groups. The group colors in Figure 7-1 correspond to the group colors in the Venn diagrams in Figures 7-2 and 7-3.

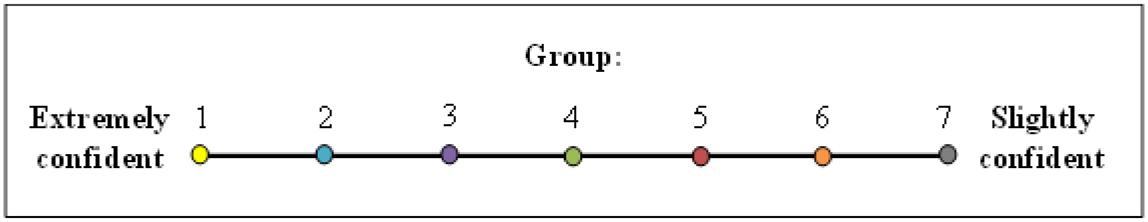

Figure 7-1 Varying levels of confidence that the groups in Figure 7-2 represent the riders influenced by the free Wi-Fi

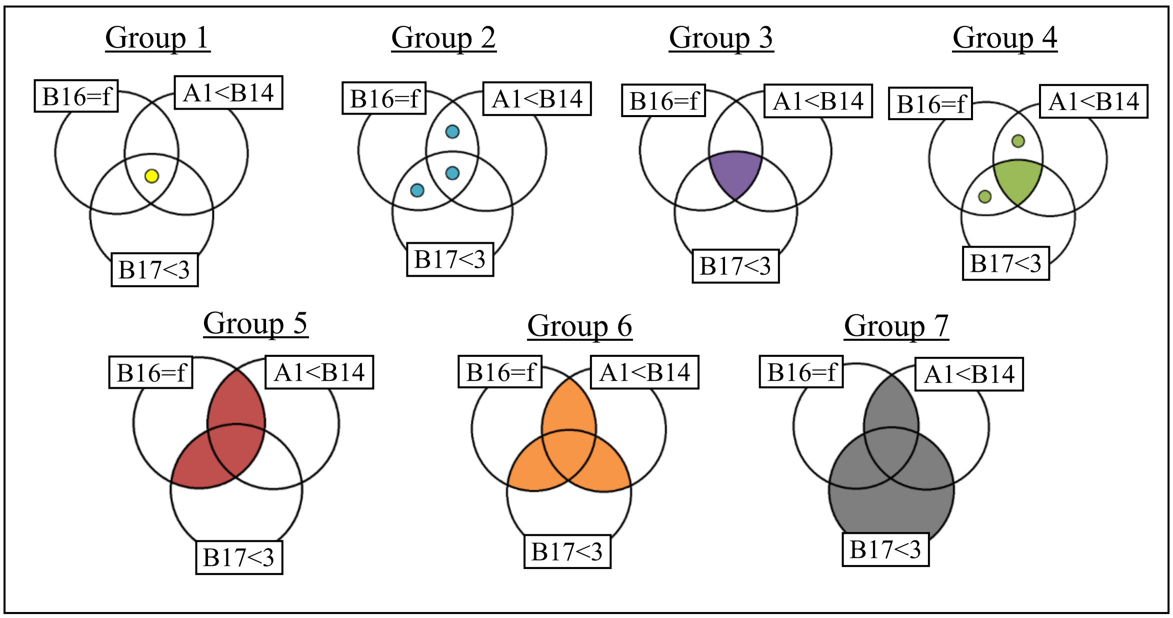

Figure 7-2 "Increase" groups defined by Venn diagrams

To avoid inclusion of individuals who decreased their trip frequency between 2011 and 2012 in the groups of increasers, each case within any circle of any Venn diagram in Figure 7-2 either has the same trip frequency category for 2011 and 2012, or a higher trip frequency category in 2012 than in 2011. The latter cases all fall into the large circle labeled "A1<B14". "B16=f" indicates that the free Wi-Fi was cited as a factor influencing a change in trip frequency; the small circles within groups 1, 2, and 4 represent cases for whom Wi-Fi was the ONLY factor influencing a trip frequency change. "B17<3" means the respondent stated that she would use Capitol Corridor less often without Wi-Fi. Group 1 has the most strict inclusion requirements and group 7 has the least strict inclusion requirements. These seven groups are not mutually exclusive (see Table 7-3 for summary representations of each group).

To explain the figures further, consider group 1 of Figure 7-2. The small yellow circle represents the group about which we can have (essentially) complete confidence that they increased their frequency due to Wi-Fi: they reported an increase in frequency (A1<B14), they cited Wi-Fi as a reason for their change in frequency (B16=f), and in fact as the *only* reason for that change (putting them in the small circle), and they indicated that without Wi-Fi they would

use Capitol Corridor less often (B17<3). The shaded areas showing group 4, on the other hand, represent those in the intersection of the three main conditions (B16=f, A1<B14, and B17<3), plus those who gave Wi-Fi as the only reason for a change in frequency as long as there is evidence either from 2012 trips > 2011 trips (B14>A1) or from B17 (i.e., an indication that the respondent would use Capitol Corridor less often without Wi-Fi) that the frequency change in question was an *increase* (the two small circles). We are less confident about the latter subgroup (the addition of which is what makes the difference between group 3 and group 4), because the A1<B14 (2012 frequency > 2011 frequency) and B17 answers seemingly conflict: for the cases that reported a 2012 frequency higher than 2011's (A1<B14), some indicated in question B17 that they would use Capitol Corridor as often (5 cases) or more often (1 case) without Wi-Fi (i.e., they are not in category "B17<3"), or conversely they are in "B17<3" (i.e., the respondent would use Capitol Corridor less often without Wi-Fi) but the trip frequency categories in 2011 and 2012 are equal. Group 5 includes group 4 plus more cases, obtained by relaxing the requirement that Wi-Fi be the *only* reason given for a frequency change, and so on.

None of the groups presented in Figure 7-2 contains the cases that *decreased* their trip frequencies due to the addition of free Wi-Fi. Therefore, to account for the (small) number of trips that were *lost* in 2012 due to the addition of free Wi-Fi, a similar method is used to determine the groups of decreasers at each level of confidence. The decrease groups have the same group numbers as the increase groups, but are defined with different specifications, as identified by the category labels on each circle in the Venn diagram. The center of all diagrams is white because no cases fall into all three categories "B16=f", "A1>B14", and "B17=4", meaning no cases selected Wi-Fi as a factor influencing trip frequency, had a lower trip frequency category in 2012 than in 2011, *and* indicated that they would use the Capitol Corridor more often without free Wi-Fi. For this reason, groups 2 and 4 decreasers contain the same cases, whereas group 3 contains no cases. Therefore, the degrees of confidence presented in Figure 7-1 cannot be entirely applied to the decrease groups. The purpose of defining the decrease groups is to properly calculate the *net* increase for each different way of identifying the respondents "affected by Wi-Fi", by including the trip changes for decreasers as well as increasers.

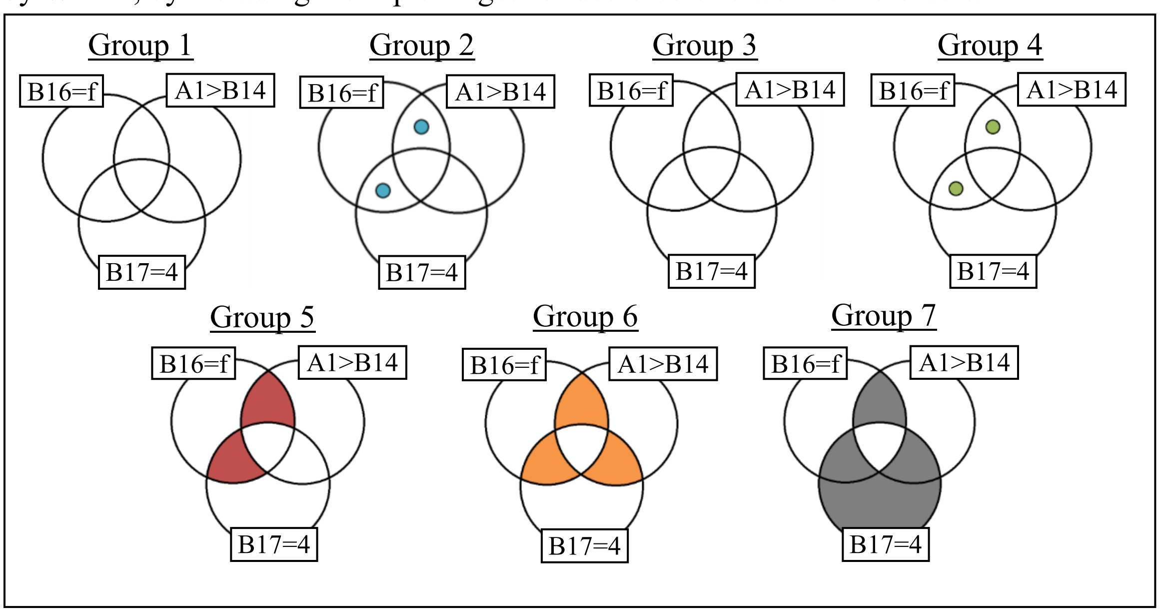

Figure 7-3 "Decrease" groups defined by Venn diagrams

Just as for the increase groups, decreaser group 1 has the most strict inclusion requirements and group 7 has the least strict inclusion requirements. All the decreaser group diagrams of Figure 7-3 exclude cases for which 2012 trips > 2011 trips. And just as for the increase groups, the seven decrease groups are not mutually exclusive.

The "trip difference" variable, as previously defined, was used to calculate the net increase of round trips from 2011 to 2012 for each group. Specifically, the increase in round trips for each increase group is presented in Table 7-3. The decrease in round trips for each group is presented in Table 7-4. The number of added or fewer round trips in the increase or decrease groups, respectively, becomes larger as the requirements are relaxed, since group 1 has the most strict inclusion requirements and group 7 has the least strict inclusion requirements. Any case present in Table 7-3 does not appear in Table 7-4, and vice versa. The percent net increase in round trips due to Wi-Fi under each definition of the increaser/decreaser groups is graphed in Figure 7-4.

Table 7-3 Increase in round trips due to Wi-Fi by group

<table>
<tr><th rowspan="2">Group</th><th rowspan="2">No. of cases</th><th rowspan="2">Increase in round trips from 2011 to 2012</th><th colspan="4">Group definitions</th></tr>
<tr><th>Respondents chose "Free Wi-Fi" as the ONLY factor changing their trip frequency</th><th>Respondents chose "Free Wi-Fi" as a factor changing their trip frequency</th><th>Respondents' trip frequency increased by at least one category from 2011 to 2012</th><th>Respondents indicated that they would use Capitol Corridor less frequently without Wi-Fi</th></tr>
<tr><td>1</td><td>21.51</td><td>291.64</td><td>x</td><td></td><td>x</td><td>x</td></tr>
<tr><td>2</td><td>62.98</td><td>641.82</td><td>x</td><td></td><td colspan="2">at least one of these is met</td></tr>
<tr><td>3</td><td>40.11</td><td>738.89</td><td></td><td>x</td><td>x</td><td>x</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">81.58</td><td rowspan="2">1089.07</td><td>OR x</td><td></td><td colspan="2">at least one of these is met</td></tr>
<tr><td></td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>5</td><td>110.65</td><td>1493.85</td><td></td><td>x</td><td colspan="2">at least one of these is met</td></tr>
<tr><td>6</td><td>244.69</td><td>2973.80</td><td></td><td colspan="3">at least two of these are met</td></tr>
<tr><td rowspan="2">7[22]</td><td rowspan="2">379.94</td><td rowspan="2">4024.61</td><td>OR</td><td></td><td></td><td>x</td></tr>
<tr><td></td><td colspan="3">at least two of these are met</td></tr>
</table>

[22] Section 3.3 described how we computed a within-category change in frequency for those who reported the same category in 2012 (B14) as for 2011 (A1), but only if they reported a change in frequency due to Wi-Fi in question B16. There we did not use B17 to infer a Wi-Fi-influenced frequency change, because the counterfactual nature of the question makes it more difficult for respondents to cognitively process and answer correctly. Here, however, our most liberal definition of "influenced by Wi-Fi" (group 7) includes those who reported the same frequency categories in A1 and B14 and did *not* check Wi-Fi as a reason for changing frequency in B16, but indicated in B17 that they would have made fewer trips without Wi-Fi. Therefore, for group 7 only, when we considered within-category frequency changes, we included those who did not check Wi-Fi as a reason in B16, but only if they indicated the hypothetical change without Wi-Fi in B17.

Table 7-4 Decrease in round trips due to Wi-Fi by group

<table>
<tr><th rowspan="2">Group</th><th rowspan="2">No. of cases</th><th rowspan="2">Decrease in round trips from 2011 to 2012</th><th colspan="4">Group definitions</th></tr>
<tr><th>Respondents chose “Free Wi-Fi” as the ONLY factor changing their trip frequency</th><th>Respondents chose “Free Wi-Fi” as a factor changing their trip frequency</th><th>Respondents’ trip frequency decreased by at least one category from 2011 to 2012</th><th>Respondents indicated that they would use Capitol Corridor more frequently without Wi-Fi</th></tr>
<tr><td>**1**</td><td>0</td><td>0</td><td>x</td><td></td><td>x</td><td>x</td></tr>
<tr><td>**2**</td><td>18.47</td><td>-316.56</td><td>x</td><td></td><td colspan="2">*at least one of these is met*</td></tr>
<tr><td>**3**</td><td>0</td><td>0</td><td></td><td>x</td><td>x</td><td>x</td></tr>
<tr><td rowspan="2">**4**</td><td rowspan="2">18.47</td><td rowspan="2">-316.56</td><td rowspan="2">OR x</td><td></td><td colspan="2">*at least one of these is met*</td></tr>
<tr><td>x</td><td>x</td><td>x</td></tr>
<tr><td>**5**</td><td>19.13</td><td>-357.98</td><td></td><td>x</td><td colspan="2">*at least one of these is met*</td></tr>
<tr><td>**6**</td><td>26.43</td><td>-499.11</td><td></td><td colspan="3">*at least two of these are met*</td></tr>
<tr><td rowspan="2">**7**[23]</td><td rowspan="2">33.69</td><td rowspan="2">-582.67</td><td rowspan="2">OR</td><td></td><td></td><td>x</td></tr>
<tr><td colspan="3">*at least two of these are met*</td></tr>
</table>

The decrease in trips for each group presented in Table 7-4 is subtracted from the increase for each group presented in Table 7-3. These values are used to calculate the net percent increases in Figure 7-4 for each group. These values represent the percent increase in total trips between 2011 and 2012 that could be attributed to Wi-Fi, based on the net increase in trips calculated for each group. For example, the 2.0% shown for group 4 is obtained from [1089.07-316.56]/38660 expressed as a percentage, where the three numbers in the expression are found in Table 7-3, Table 7-4 and Table 7-1, respectively.

There is a gradual increase in added trips from groups 1 through 5, but there is a large jump between groups 5 and 6. All of the increasers in groups 5 and below indicated that the free Wi-Fi was an influential factor in their trip frequency change, and in addition indicated that they would either use Capitol Corridor less without it *or* that their trip frequency increased by at least one category between 2011 and 2012 (or both). We believe that group 5 offers the most appropriate balance between liberal and conservative inclusion criteria, and accordingly find that there was approximately a 2.9% increase in round trips on Capitol Corridor from 2011 to 2012 that can be reasonably confidently attributed to the Wi-Fi service using this method.

[23] Decrease group 7 had the same considerations as increase group 7, with respect to inferring within-category frequency changes on the basis of question B17.

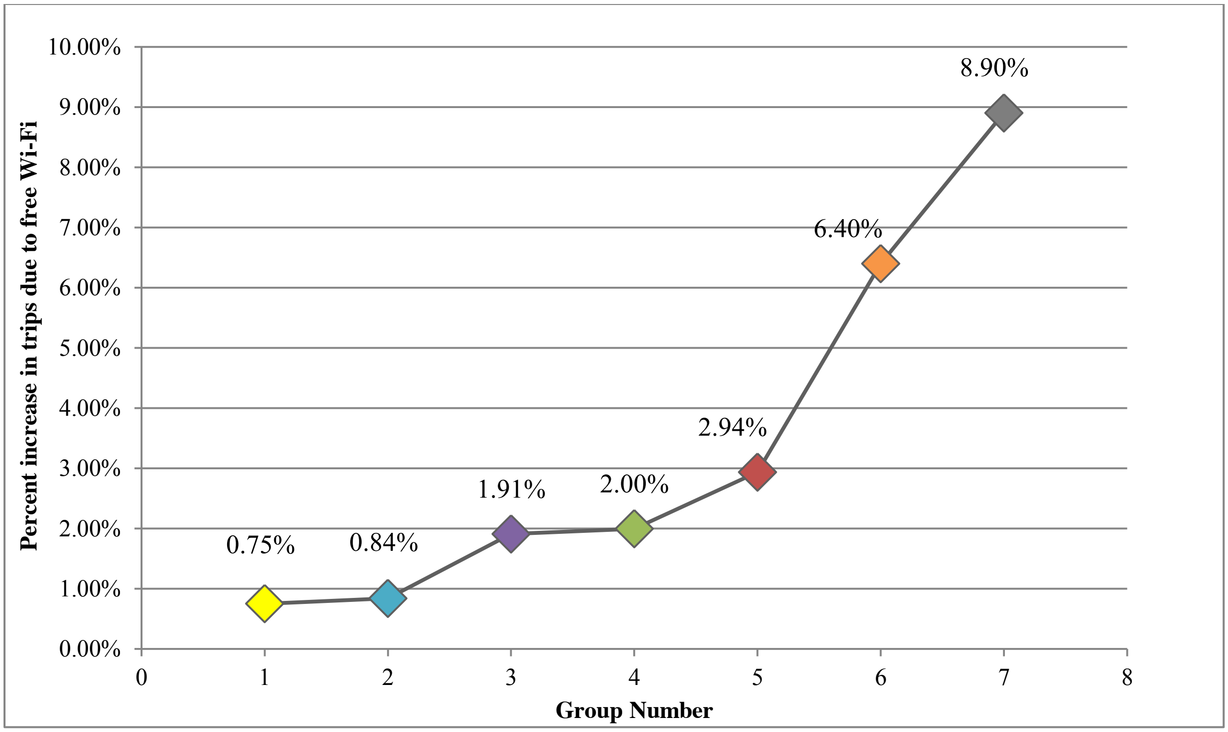

Figure 7-4 Percent increase in Capitol Corridor trips due to free Wi-Fi, by group

It may be noted that the increases for groups 6 and 7 are both greater than the 4.6% increase for the entire weighted sample shown in Table 7-1, meaning that the people outside of those two groups accounted for a net decrease in trips. Mathematically, this is because (1) the odds of *increasing* rather than *decreasing* trip frequency are in general much higher for those influenced by Wi-Fi, and (2) when the sample is weighted inversely proportional to individuals' 2012 frequencies, those who *decreased* their frequency from 2011 to 2012 will tend to have lower 2012 frequencies and thus be weighted more heavily than before. Thus, in the weighted group 6 and group 7 the heavier weight given to that group's few decreasers does not have much effect, whereas among those *outside* whose frequency changed, the weight of decreasers grows substantially. (3) Moreover, as noted in the footnotes to Tables 7-3 and 7-4, the calculations for group 7 assumed within-category frequency changes for more cases than did the calculations for the entire sample, and in general, such within-category changes are more often increases than decreases. Thus, the change in trips influenced by Wi-Fi will be especially larger for group 7.

7.2.2 Characteristics of individuals who increased trip frequency due to the free Wi-Fi

As noted, we consider that group 5 increasers well represent the individuals who increased their trip frequency due to free Wi-Fi. Accordingly, we examined the increasers in group 5 more closely to determine the types of individuals who were influenced to ride more frequently when the free Wi-Fi was added. To determine if certain qualities of the increasers in group 5 were significantly different from those who did not change their trip frequency due to the free Wi-Fi, chi-squared tests were conducted to compare the increasers in group 5 to those not falling into any of the first three categories of Table 7-4, as represented by the shaded area in Figure 7-5. For analysis purposes, the group represented in Figure 7-5 is referred to as group X (which also does not include the 10 decreasers in group 5, as they were specifically removed). The results of the chi-squared tests are presented in Table 7-5 through Table 7-8.

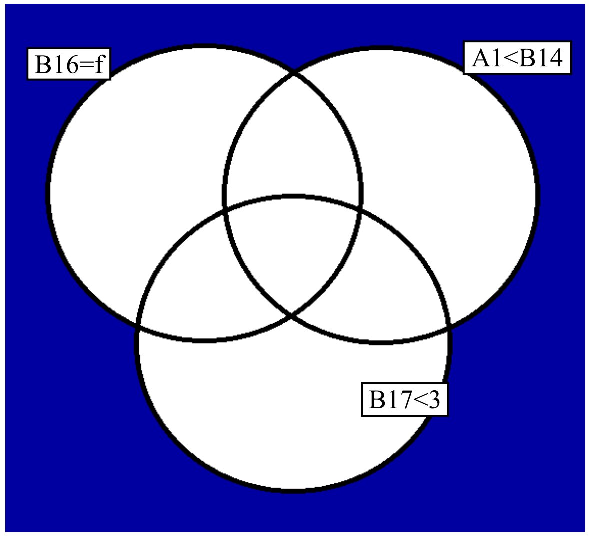

Figure 7-5 Dark area representing individuals that definitely did not increase trip frequency due to the free Wi-Fi, group X.

Table 7-5 Chi-squared test for trip purpose

		Trip Purpose				**Total**
		Commute	**Other work- or school-related purpose**	**Personal business**	**Social / entertainment / recreation & Other**	
Group X	Count	215	184	298	165	862
	%	24.9%	21.3%	34.6%	19.1%	100.0%
Group 5	Count	19	25	25	41	110
	%	17.3%	22.7%	22.7%	37.3%	100.0%
Pearson's chi-square: value =21.719, d.f. = 3, asymp. sig. = 0.000						

Table 7-6 Chi-squared test for age

		Age range					**Total**[1]
		18-24	**25-34**	**35-44**	**45-54**	**55+**	
Group X	Count	148	153	113	159	286	859
	%	17.2%	17.8%	13.2%	18.5%	33.3%	100.0%
Group 5	Count	26	18	27	25	12	108
	%	24.1%	16.7%	25.0%	23.1%	11.1%	100.0%
Pearson's chi-square: value = 28.271, d.f. = 4, asymp. sig. = 0.000							

[1]Blank cases excluded.

Table 7-7 Chi-squared test for occupation

		Occupation					Total[1]
		Manager / admin.	Professional / technical	Sales / market.	Student	Other	
Group X	Count	122	349	25	154	206	856
	%	14.3%	40.8%	2.9%	18.0%	24.1%	100.0%
Group 5	Count	21	50	13	13	9	106
	%	19.8%	47.2%	12.3%	12.3%	8.5%	100.0%
Pearson's chi-square: value = 35.757, d.f. = 4, asymp. sig. = 0.000							

[1]Blank cases excluded.

Table 7-8 Chi-squared test for employment status

		Employment					Total[1]
		Self-employed	Salaried	Hourly wage	Contract worker	Other[2]	
Group X	Count	94	283	141	24	307	849
	%	11.1%	33.3%	16.6%	2.8%	36.2%	100.0%
Group 5	Count	10	52	25	8	12	107
	%	9.3%	48.6%	23.4%	7.5%	11.2%	100.0%
Pearson's chi-square: value =32.936, d.f. = 4, asymp. sig. = 0.000							

[1]Blank cases excluded. [2] Includes "non-working student", "retired", "not currently working", and "other."

Using the previously stated standards for statistical significance, the chi-squared tests for trip purpose, age, and occupation demonstrate a significant difference between group 5 and group X for those characteristics (Fischer, 1925). Table 7-5 shows that there is a smaller share of commuters in group 5 than in group X. This is likely because, while commuters may be using the free Wi-Fi, they may already have been using the Capitol Corridor service as frequently as they could, and thus be less able to increase their trip frequency. There is, however, a slightly greater percent of individuals traveling for other school or work purposes and social/entertainment/ recreation/other purposes in group 5. These are likely individuals who have more flexible work and travel schedules who were encouraged to take Capitol Corridor more frequently with the introduction of free Wi-Fi, and hence they enjoy a greater opportunity for productivity and connectivity on board.

Table 7-6 shows that group X has a significantly greater share of older individuals than group 5, likely because older people are less likely to be influenced or intrigued by the free Wi-Fi, since (as also demonstrated in the choice model in Section 5) they are also less likely to use it. It is notable, however, that there is a significantly greater percent of group X respondents in the "other" category for occupation in Table 7-7. This category includes those who work in "production/construction," "service/repair," "clerical/administrative support," or as a "home-maker". Since these occupations tend to be location-specific, people holding them probably tend to finish work on the job, and therefore may be less interested in being connected and productive while traveling. Moreover, there is also a slightly lower percent of group 5 in the student category. Table 7-8 shows that Wi-Fi-influenced increasers are more likely to be salaried, hourly-wage and contract workers, whereas group X members are more likely to be self-employed and other (e.g. "non-working student", "retired", "not currently working").

7.2.3 New riders on Capitol Corridor due to free Wi-Fi

Section 7.2.1 focused on the quantification of new *trips* that could be attributed to the Wi-Fi service, but those results include both trips made by continuing riders who increase their trip frequency, and those made by entirely new riders (the new trips generated by these groups are separately estimated in Section 7.3). It is also of interest to analyze just the new *riders* – that is, to ask, how many entirely new passengers were attracted to Capitol Corridor because of free Wi-Fi?

In the weighted sample, 485 passengers are new riders (indicating that they did not ride Capitol Corridor at all in 2011 but rode it at least once in 2012), constituting 31.5% of the total sample of 1541. Among those, how many are "Wi-Fi-influenced"? Using the most liberal definition of "Wi-Fi-influenced", i.e. group 7, 174 are Wi-Fi-influenced new riders[24]. This group constitutes 35.9% of the new riders, and 11.3% of the total (2012) ridership represented by the sample. We cannot express these numbers in terms of increases over 2011, because our sample does not include 2011 passengers who discontinued riding in 2012, and thus our 2011 basis is biased downward and our estimates of increases over 2011 would accordingly be biased upward.[25] However, as a share of *2012* ridership, the influence of Wi-Fi in attracting new riders is impressive (it should also be noted, however, that these riders' share of *trips* is more modest, since, as shown in Table 5-5, the new riders tend to be concentrated in lower-frequency categories: the 174 Wi-Fi-influenced new riders expect to make 1479 trips in 2012, 3.6% of the sample total of 41,357).[26]

The trip purpose and age distributions of these respondents, compared to other new riders, continuing riders from group 7, and all other continuing riders, are presented in Figures 7-6 and 7-7.

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[24] For the other six groups, the numbers of new riders are as follows: group 6 (174), group 5 (51), group 4 (43), group 3 (35), group 2 (27), group 1 (19).

[25] For example, 1051 people in our sample are continuing riders from 2011, but it would not be correct to say that the population of riders increased by (485/1051)x100% = 46.% from 2011 to 2012, because the "true" population of 2011 riders includes an unknown (probably large, judging by the large shares of one-time and lower-frequency riders in the 2012 sample) number of people who stopped riding by the end of 2011. Thus, the denominator of the fraction should be (much) greater than 1051.

[26] For comparison, the 51 Wi-Fi-influenced new riders in group 5 expect to make 552 trips in 2012.

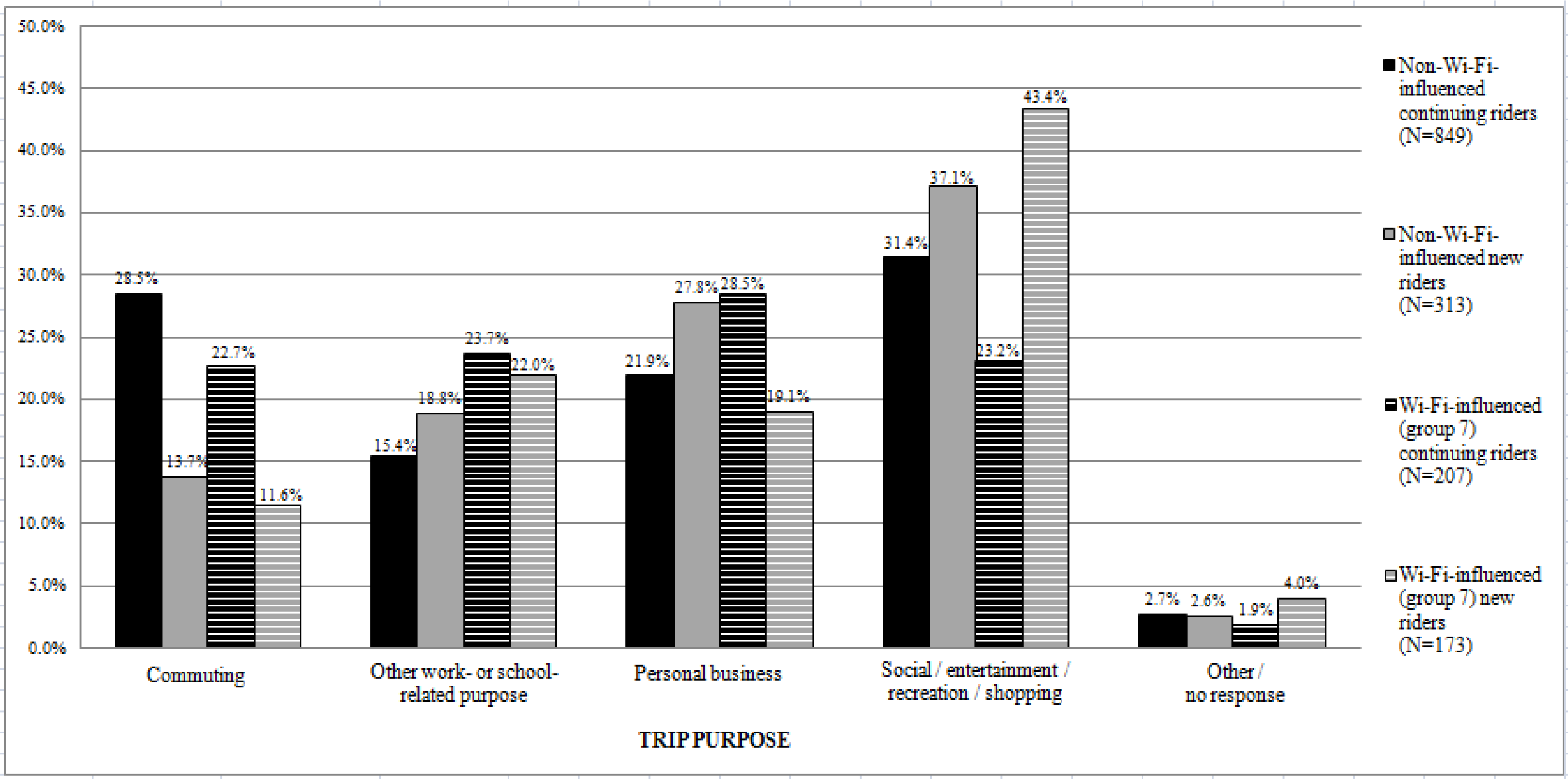

Figure 7-6 Trip purpose distribution of non-Wi-Fi-influenced continuing and new riders vs. Wi-Fi-influenced continuing and new riders

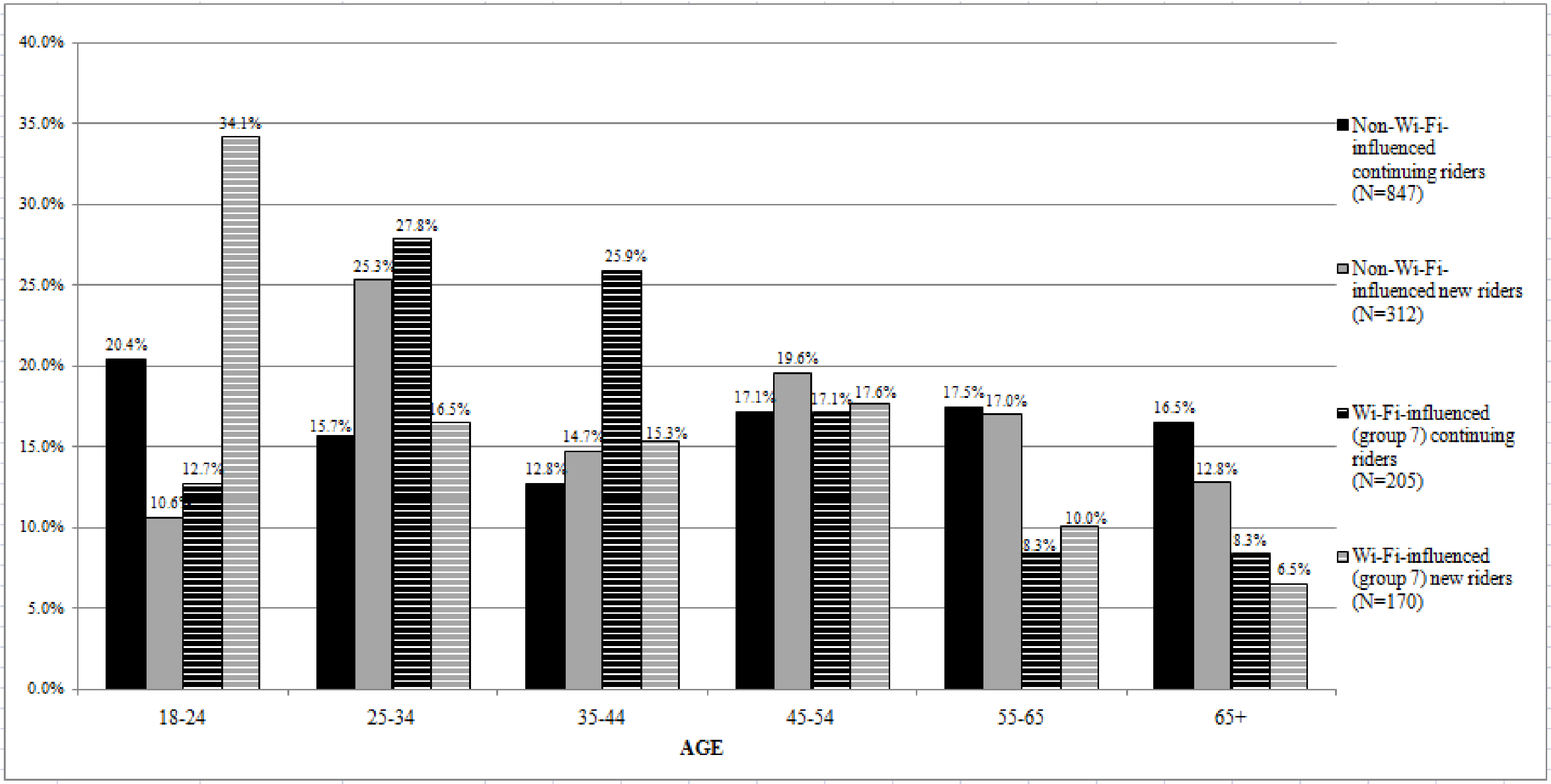

Figure 7-7 Age distribution of non-Wi-Fi-influenced continuing and new riders vs. Wi-Fi-influenced continuing and new riders[27]

[27] The differences in the sample sizes for each group in the two figures are due to missing data according to trip purpose or age.

The results in Figure 7-6 show that social/entertainment/recreation/shopping is the most prominent trip purpose across most respondent categories. However, it does not hold the majority among Wi-Fi-influenced continuing riders. In addition, the percentages of passengers traveling for social/entertainment/recreation/shopping purposes are greater in both groups of new riders than in the groups of continuing riders. Moreover, the percentages of Wi-Fi-influenced continuing riders with an "other work- or school-related" purpose or a personal business purpose are greater than those for the other three groups. The group with the greatest share of social/entertainment/recreation/shopping is the Wi-Fi-influenced new riders. This can be due to the fact that such trip purposes are more typical of some individuals who might be trying the experience of the trip and the new free Wi-Fi as advertised (and tend to be lower frequency passengers). The results suggest that Wi-Fi may be responsible for influencing such individuals to try the rail system for the first time.

As demonstrated in Figure 7-7, the Wi-Fi-influenced riders (both new and continuing) are also younger in general as compared to the non-Wi-Fi-influenced riders, probably because the younger group may be generally more interested in technology and therefore influenced by the free Wi-Fi service. Non-Wi-Fi-influenced new riders have the smallest portion of passengers in the lowest age group (18-24), whereas the Wi-Fi-influenced *new* riders have the *largest* portion of passengers in the lowest age group. In the next two age groups (25-44), however, the Wi-Fi-influenced continuing riders have larger shares of passengers than do the non-Wi-Fi-influenced continuing riders. Non-Wi-Fi-influenced new riders have higher shares than do Wi-Fi-influenced new riders for all age categories except for the 18-25-year-olds and 35-44 year-olds. The 18-25-year-old group has the largest share among Wi-Fi-influenced new riders, suggesting that youth seems to be correlated with both interest in the new Wi-Fi and interest in trying new things in general (i.e., Capitol Corridor and/or the free Wi-Fi).

7.3 Method 2: 2012 Frequency models

7.3.1 Model comparison and selection

Although it is helpful to see descriptive statistics on the relationships between the expected trip frequency in 2012 and other variables in the dataset individually, it is also desirable to better understand the impact of each factor on trip frequency while controlling for the impacts of the other factors. To do this, we estimate a model for the expected frequency.

For all model specifications, we used the survey question B14 "How often do you expect to use Capitol Corridor this year (2012)?" as the dependent variable, with the six possible response categories as described in Section 3.3. We first estimated an ordinal logit model, but since the predictive power of this model was low and its goodness of fit below expectations (one reason being that it could not account for changes within frequency category), we tested additional specifications. Ultimately, a multiple linear regression model on a transformation of the categorical dependent variable appeared to fit the data better. To estimate the linear regression model, we created a continuous dependent variable by using the midpoint of each frequency category, except where we used the 25^{th} or 75^{th} percentile of the range to account for a frequency change within category (as discussed in Section 3.2).

As described in Section 5.2, a number of potential explanatory variables are available for inclusion in the model, including average trips in 2011 (transformed in essentially the same way as for the 2012 trip frequency), trip purpose, station-to-station trip distance, reasons for changing frequency (including Wi-Fi among others), employment, and other socioeconomic variables. We experimented with a natural log and other nonlinear transformations of the dependent variable, but eventually chose the raw frequency as most appropriate. Accordingly, coefficients in the model can be directly interpreted as the average change in annual trips resulting from a unit increase in the associated explanatory variable.

We initially estimated a multiple regression model based on the pooled data. However, after considering the differences among the three segments shown in Table 5-6, we also estimated best models for each segment separately. Then, we combined those three specifications into a single model so that a composite R^2 measure could be computed. This was done by creating segment-specific versions of each variable. Specifically, we replaced a variable taking on the value "V_i" for person i with three variables: $V_{ni} = V_i$ if person i is a new rider and 0 else; $V_{lfi} = V_i$ if i is a lower-frequency rider and 0 else; and $V_{hfi} = V_i$ if i is a higher-frequency rider and 0 else. Including a full set of segment-specific variables in the model allows coefficients for each variable to differ across segment. Discarding insignificant variables led to the final segmented model shown in Table 7-9.

The adjusted R^2 of the segmented model (0.791) is higher than that for the pooled model (0.780, model not shown), confirming its superior fit. Even more importantly, the dramatic differences in estimated coefficients across segments provide strong post-hoc justification of the segmentation strategy. Finally, those differences also provide improved insight into the nature of each segment. Accordingly, the segmented model of Table 7-9 is our preferred model.

Table 7-9 Weighted segmented model of 2012 expected CC trip frequency* (N= 1447)

Variable name	**Model**								
	Unstandardized coefficient			*Standardized coefficient*			*P-value*		
Constant	15.657						0.002		
Lower-frequency rider (DV)	-13.913			-0.116			0.008		
Higher-frequency rider (DV)	-14.137			-0.078			0.076		
	New riders (V_n)			***Lower-frequency riders (V_{lf})***			***Higher-frequency riders (V_{hf})***		
	Unstandardized coefficient	*Standardized coefficient*	*P-value*	*Unstandardized coefficient*	*Standardized coefficient*	*P-value*	*Unstandardized coefficient*	*Standardized coefficient*	*P-value*
Conventional variables									
Trips in 2011	——	——	——	0.560	0.077	0.000	0.827	0.829	0.000
Commuting (DV)	21.437	0.073	0.000	12.482	0.057	0.000	——	——	——
Station-to-station distance (Miles)	-0.147	-0.103	0.010	——	——	——	——	——	——
Salaried (DV)	——	——	——	——	——	——	21.420	0.098	0.000
Hourly wage (DV)	——	——	——	——	——	——	24.898	0.090	0.000
Reasons for changing									
Job location change (DV)	19.520	0.055	0.000	——	——	——	-32.627	-0.067	0.000
Free Wi-Fi (DV)	7.585	0.021	0.091	5.837	0.022	0.074	39.271	0.047	0.000
R^2	0.793								
Adjusted R^2	0.791								
F	395.559								
Significance level of F	0.000								

* Dummy variables are identified as (DV) in the table.

7.3.2 Interpretation and discussion of the regression model

Seven variables plus the constant appear in the final preferred model, each with up to three segment-specific versions: five "conventional" variables and two reasons for changing frequency, including Wi-Fi.

It is possible to see even in the descriptive analysis of Section 5 that the trip frequency in 2011 has a strong impact on the trip frequency in 2012. This result remains after controlling for other explanatory factors, in that the coefficient of *Trips in 2011* is statistically significant and positive: for both lower-frequency riders and higher-frequency riders, the more trips passengers took in 2011, the more trips they expect to take in 2012. Conversely, for these two continuing-rider segments, it should be kept in mind that all the other coefficients represent effects of the corresponding variable *after controlling for the 2011 trip frequency*.

Commuting is the only trip purpose statistically significant in the segmented model, and is significant for both new riders and lower-frequency riders: commuters use the train more often than those traveling for personal/social and entertainment purposes (the base category). This is natural, as those traveling by train for the latter reasons usually do not have strong pressure to make frequent trips for these purposes. *Commuting* is not significant for higher-frequency riders, due to the significant correlation (0.319) between the *Commuting* and *Salaried* variables (see the discussion of the *Salaried* variable below). When we included *Commuting* in the model, none of the employment variables were significant, and the adjusted R^2 decreased as well. Accordingly, the specification shown in Table 5 was preferable.

Station-to-station distance is statistically significant, but only for new riders, and with a negative sign, meaning the longer the distance the fewer the trips. This is the result of an interaction with trip purpose: the average distance of new riders traveling for social/ entertainment purposes is longer than that of commuters, but their expected trip frequency is much lower. For example, the average distances for new riders are 86.9 miles for commute trips and 88.4 miles for social/entertainment trips, while the average numbers of expected 2012 trips for those purposes are 31.4 and 4.0, respectively.

In terms of employment, the indicators for *Salaried* and *Hourly wage* workers are statistically significant, for higher-frequency riders. The positive signs indicate that both types of workers tend to use the service more frequently than self-employed higher-frequency riders (the base employment group). Self-employed workers might have a stronger need to rely on their own vehicles for their mobility requirements, rather than using transit. Moreover, the significant correlation between *salaried* and *commuting* for higher-frequency riders (0.319, compared to only the insignificant relationship between *Self-employed* and *Commuting*) indicates that salaried higher-frequency riders were much more likely to be commuting (69.7%) than their self-employed counterparts (3.4%), so the *Salaried* variable reflects the expected relationship that commuters use the CC more frequently than those traveling for other purposes. Further, income is also typically positively associated with trip generation, and the salaried higher-frequency riders have higher annual incomes on average ($96,436) than self-employed higher-frequency riders ($82,087).

In cases where respondents gave more than one reason for changing frequency, we cannot directly tell the relative importance of each reason. Accordingly, dummy variables for each of those reasons were allowed to enter the model. If we had solely included an indicator for the Wi-Fi reason, its estimated coefficient could have partly reflected the influence of any other reasons for changing (35% of the 122 passengers[28] giving Wi-Fi as a reason also gave (an)other reason(s)), and thus could have been biased upward. However, only two variables indicating reasons for changing the expected frequency in 2012 are ultimately significant: "*Job location change*", and "*Free Wi-Fi*". *Job location change* has a positive impact on 2012 trips for new riders but a negative impact for the higher-frequency riders segment. Upon reflection, it is not surprising that a change in frequency for already higher-frequency riders would more likely be downward than upward (which makes the positive impact of Wi-Fi, discussed below, even more impressive).

The *Free Wi-Fi* variable exhibits moderately-to-strongly significant and positive coefficients across all three segments, indicating that free Wi-Fi plays a substantive role in increasing the trip frequency for both new riders and continuing riders. To obtain more specific measures of the impacts of Wi-Fi on the different segments, we conduct some calculations in Section 7.3.3.

7.3.3 Estimation of the impact of free Wi-Fi

Equation (4) is used to calculate the predicted value of the dependent variable from the results of the segmented model estimation:

$$\begin{aligned} Trips^{12}_{withwifi} = {} & 15.657 - 13.913 * D_{lf} - 14.137 * D_{hf} + 21.437 * Commuting_n + 19.52 \\ & * Job_{loc_n} - 0.147 * Station_{distace_n} + 7.585 * Dwifi_n + 0.560 * Trips^{11}_{lf} \\ & + 12.482 * Commuting_{lf} + 5.837 * Dwifi_{lf} + 0.827 * Trips^{11}_{hf} \\ & + 21.420 * Salaried_{hf} + 24.898 * Hourly\_wage_{hf} - 32.627 * Job\_loc_{hf} \\ & + 39.271 * Dwifi_{hf} \qquad (4) \end{aligned}$$

where *n* represents new riders, *lf* represents lower-frequency riders, and *hf* indicates higher-frequency riders.

After calculating the number of expected trips in 2012 with equation (3), we then turn all values for the Wi-Fi variables to 0s to switch off their effect, and recalculate the resulting number of trips to represent how many trips would have been made *without* the influence of Wi-Fi. The difference between those two numbers is an approximate measure of the impact of Wi-Fi on the estimated number of trips in 2012.

Results of the calculation are shown in Table 7-10. For the sample as a whole, the sum of the estimated trips considering the effects of Wi-Fi is 38,620, with 37,596 estimated trips if Wi-Fi had no influence. The difference (increase) in the estimated number of trips for 2012 due to Wi-Fi amounts to about 2.7% for the whole sample. As discussed earlier, based on the descriptive analysis, the effect of free Wi-Fi is expected to differ among the various segments (new riders, lower-frequency continuing riders and higher-frequency continuing riders). For this reason, we also calculate the impact of free Wi-Fi on each segment. New riders are estimated to make 8.6% more trips than if Wi-Fi had no impact. The estimated number of 2012 trips of lower-frequency continuing riders is 6.2% higher than it would be if Wi-Fi had no impact. By comparison, the estimated trips for the higher-frequency continuing riders are only 1.0% greater than if Wi-Fi had no impact.

[28] The difference from the 133 cases giving Wi-Fi as a reason that were mentioned in Section 5.2 is due to the exclusion of some cases with missing data in some explanatory variables.

Table 7-10 Impact of free Wi-Fi on (projected) 2012 ridership

	Sum of estimated trips with Wi-Fi in 2012	Sum of estimated trips without Wi-Fi in 2012	Impact of Wi-Fi on trips in 2012	Percent of total impact
Pooled data (N=1447)	38,620	37,596	2.7%	100%
New riders (N=445)	3,807	3,504	8.6%	29.6%
Lower-frequency continuing riders (N=825)	7,529	7,091	6.2%	42.8%
Higher-frequency continuing riders (N=177)	27,284	27,001	1.0%	27.6%

We can conclude that the new riders are the passengers who are most influenced by the availability of free Wi-Fi on board, which indicates that free Wi-Fi has a useful role in attracting new riders to use CC. The higher-frequency continuing riders are the least influenced, but because they travel more frequently as a baseline condition, the absolute number of new trips they contribute is large relative to the size of their group and to the degree of impact of Wi-Fi. However, it is reasonable that the "rate of impact" of Wi-Fi on lower-frequency riders is higher because they have more "room" to adjust the frequency with which they use the service, whereas many or most higher-frequency continuing riders may already be "maxed out" with respect to the frequency that is possible or desirable for them[29].

It is of interest at this point in the analysis to explicitly refer to the results from the unweighted sample for comparison. We calculated the impact of free Wi-Fi based on the results from a similar frequency model estimated on the unweighted sample; the details are presented in Tables B-18 and B-19 in Appendix B and the comparison of the impact of Wi-Fi is shown in Table 7-11 below. Although the impacts for lower-frequency riders and higher-frequency riders are roughly similar, the overall impact of Wi-Fi is estimated to be twice as high when weighting the sample as when not weighting it, and the impact of Wi-Fi on new riders becomes significant (and in fact, most prominent) after weighting the data. Thus, these results demonstrate how different the outcomes can be when sampling on a trip basis (i.e. for the unweighted sample) rather than on a passenger basis (the weighted sample).

[29] These travelers might still associate higher utility with the availability of free Wi-Fi, without being able to increase the frequency with which they travel on Capitol Corridor trains.

Table 7-11 Comparison of the impact of free Wi-Fi when the sample is weighted to when it is unweighted

	weighted sample	unweighted sample
Pooled data	2.7%	1.3%
New riders	8.6%	No sig. impact
Lower-frequency continuing riders	6.2%	5.4%
Higher-frequency continuing riders	1.0%	0.7%

7.4 Comparison of the two methods

In the descriptive analysis (Method 1), group 5 is considered to be the most appropriate group for calculating the impact of Wi-Fi. Not coincidentally, the cases in group 5 are identical to those who chose Wi-Fi as a reason for change in Method 2[30]. It is of interest to compare the results of the two methods, as shown in Table 7-12.

Table 7-12 Comparison of the results of the two methods

Method 1	**2011 → 2012 increase in round trips for Wi-Fi-influenced riders (group 5 increasers)**	**2011 → 2012 decrease in round trips for Wi-Fi-influenced riders (group 5 decreasers)**	**Total round trips in 2011 (full sample, N=1541)**	**Percent net 2011 → 2012 increase influenced by Wi-Fi**
	1493.85	357.98	38,660 [31]	2.9%
Method 2	**Sum of estimated trips with Wi-Fi in 2012 (full model estimation sample)**		**Sum of estimated trips without Wi-Fi in 2012 (model-predicted counterfactual, N=1447)**	**Impact of Wi-Fi on trips in 2012**
	38,620		37,596	2.7%

The results are similar from both Method 1 and Method 2. However, the estimates from Method 1 are still slightly higher, probably because Method 1 is more liberal in attributing a frequency change to Wi-Fi, whereas Method 2 isolates the impact of Wi-Fi on the trip frequency in 2012 by controlling for other factors to the extent possible. Method 1 includes multiple

[30] Method 1 utilizes all 109 cases in Group 5 whereas Method 2 loses two of those cases due to missing values on the variables in the model, but that small difference does not influence the final results.

[31] Method 1 uses the 1541 weighted cases for which 2012 frequency is available. For Method 2, however, cases with missing values on any of the explanatory variables were excluded from the frequency model, with a resulting sample size of 1447, which is the number used for the model-based calculations. So the total numbers of trips involved in the calculations are different for each method (e.g. 40,439 total trips in 2012 using the Method 1 sample of 1541 [Table 7-1], compared to 38,620 trips in 2012 using the Method 2 sample of 1447 [Table 7-10]), but when the results are represented as percentage increases over their respective bases, it is appropriate to compare them.

sources of the effect on trip frequency, as there are usually several factors combined together to cause a traveler to use Capitol Corridor. Therefore, Method 1 might somewhat overstate the amount of increase that "properly belongs" to Wi-Fi, whereas Method 2 is more conservative. Hence, we are more confident in the results estimated using Method 2.

8. Conclusions

Using data collected through an on-board survey administered among passengers of the California Capitol Corridor in March 2012, this research project evaluated the key impacts associated with the introduction of the AmtrakConnect free Wi-Fi service in November 2011. In addition to supporting descriptive analyses, we estimated two models: a binary logit model of the decision to use the free Wi-Fi or not, and a linear regression model of the impact of Wi-Fi on trip frequency. Both descriptive statistics and the choice model revealed that the prominent users of the free Wi-Fi service were younger individuals using the train to commute to and from their place of work or school. Descriptive statistics showed that passengers with cellular broadband internet access still used the free Wi-Fi. The choice model revealed that, of passengers who access the internet via some means on board, those with broadband internet are (not surprisingly) less likely to use the free service than others. Device ownership influenced the choice to use Wi-Fi; those with tablets and/or laptops on board were more likely to use the Wi-Fi than others, and those without Wi-Fi enabled devices simply could not access the Wi-Fi.

The descriptive analysis method of determining added trips in 2012 due to free Wi-Fi indicated a trip increase due to Wi-Fi falling in the range from 0.7% (extreme confidence) to 8.4% (lowest confidence). For a definition of "Wi-Fi influenced" that, in our judgment, offers the most appropriate balance between liberal and conservative criteria[32], the estimated increase due to Wi-Fi (using this method) is 2.9%. When comparing the Wi-Fi-influenced trip increasers to the respondents who did not have any qualities indicating a trip frequency increase due to the addition of free Wi-Fi, statistically significant differences between groups made it evident that the Wi-Fi-influenced increasers tended to have fewer commuters, younger passengers, and more employed individuals. This method also identified Wi-Fi-influenced *new* riders, who were much younger, more likely to be recreational passengers, and less likely to be commuting passengers than the continuing and non-Wi-Fi-influenced new passengers.

A linear regression model was also built to better understand the impact of selected variables on the expected number of CC trips in 2012. Trip frequency in 2011, trip purpose, station-to-station distance, employment and two variables indicating reasons for changing trip frequency – including the availability of free Wi-Fi as well as job location changes – are significant in the final model. The impacts of these variables are allowed to differ by segment, where the three segments are new (including one-time) riders, lower-frequency continuing riders (those using CC less than once a week in 2011) and higher-frequency continuing riders (using CC once a week or more in 2011).

The impact of free Wi-Fi on 2012 trip frequency is statistically significant and positive for all three segments of travelers. Using the estimated parameters from the model, the number

[32] Specifically (Tables 7-3 and 7-4), respondents in this group, "group 5", reported Free Wi-Fi as a factor changing their CC trip frequency, and either changed their trip frequency by at least one category from 2011 to 2012, or indicated that their frequency would have been different without Wi-Fi.

of trips the sample expects to make in 2012 is 2.7% higher than would have been the case if free Wi-Fi had no impact. In particular, the effect seems to be more important among new riders (who collectively expect to make 8.6% more trips than if Wi-Fi had no impact) and for lower-frequency continuing riders (6.2%). By comparison, the corresponding number for higher-frequency continuing riders is only 1.0%. This is a reasonable result, as it is more likely that higher-frequency riders have already maximized their use of the CC service as far as is practical (and therefore have little room to increase it), than that lower-frequency or new riders have done so.

The reason the impact of Wi-Fi estimated by the 2012 frequency model (2.7%) is lower than the result from the descriptive analysis (2.9%) is that the frequency model is capturing the impact of Wi-Fi on the trip frequency in 2012 after controlling for other factors, whereas in the descriptive analysis part of the influence being attributed to Wi-Fi is in fact shared with some other variables. Accordingly, we consider the frequency model results (2.7% increase in trips attributable to Wi-Fi) to be more appropriate, although overall the results from the two methods are similar.

It is important to note that prior to the installation of free AmtrakConnect Wi-Fi on Capitol Corridor, CCJPA indicated that a 1-2% increase in round trips in a year would be necessary to justify the free Wi-Fi business model. Our research has shown with reasonable confidence that the results have met, and most likely exceeded, this requirement.

This study has several limitations that should also be mentioned. One is the relatively crude measurement of trip frequency, classified into six categories which we then treated as continuous. This approximation, required to make the survey more "user-friendly", necessarily introduces a certain amount of noise (random error) into the final results. A second limitation is the cross-sectional and choice-based nature of the sample: the restriction to a single, onboard, survey means that riders who *discontinued* using the service after 2011 (constituting a source of *declining* trip frequency) are not captured. It would be highly desirable to replicate this survey one year later, to permit further investigation of the dynamics of ridership changes, and it would be even more desirable to conduct a true panel survey, in which a sample of riders is recruited and followed over time, whether they continued to use the service or not. Such a study would permit a comparison of the actual frequency of use of Capitol Corridor during 2012 with the expected trip frequencies reported "ex-ante" by travelers in this study, as well as investigations into travel behavior adjustments in reaction to other changes in service, fares and amenities provided on this corridor.

It would also be of interest to compare several different methods of estimating the impact of Wi-Fi, for example including a time series analysis of aggregate data on CC ridership that could allow the isolation of the influence of Wi-Fi from background trends in ridership attributable to higher gasoline prices and/or improvements in service. Finally, we expect to compare the results of this study with those to be obtained from the data collected in another survey that was carried out by the same (and additional) researchers during Fall 2011 (a few weeks before the launch of the new Wi-Fi service on this transportation corridor). The latter study will investigate (among other subjects) travelers' propensity to change the frequency with which they ride transit if Wi-Fi were introduced.

9. Acknowledgements

This project was funded by the Capitol Corridor Joint Powers Authority (CCJPA) and the Sustainable Transportation Center of UC Davis, which receives funding from the U.S. Department of Transportation and Caltrans, the California Department of Transportation, through the University Transportation Centers program. The third author was also supported by a fellowship from the China Scholarship Council and the National Natural Science Foundation of China, Research on Transportation Pattern of Urban Agglomeration based on the Travel Service Chain (No. 51178346). The authors wish to thank Aliaksandr Malokin, who provided very valuable input in the design and administration of the survey. Andre Tu, Aurina Lam, Cheng Zhuo, Eileen Coleto and Kelly Caines provided additional assistance during the data collection and data cleaning. Daryl Chan from the CCJPA provided invaluable assistance in collecting the data.

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APPENDIX A

SURVEY
AND
RESPONSE TABULATIONS

N=1576 (all 18 years old or older)

All %s below are based on the subsample who answered that question. "NR" = "no response".

CAPITOL CORRIDOR PASSENGER SURVEY

Thank you for helping us to serve you better, by giving us some information about your experience with Capitol Corridor.

Are you 18 or older?

☐ *No* (thank you for your willingness to participate! This completes the survey for you)

☐ *Yes* (please continue below)

Part A: YOUR TRAVEL ON THE CAPITOL CORRIDOR

1. *In this section, we would like to know about your usage of the Capitol Corridor service.*

   Last year (2011), on average, how often did you use the *Capitol Corridor service?* (anywhere between the Auburn station and the San Jose/Diridon station). Count a round trip as ***one*** time rather than two. NR: 5

   220 (14.00%) ☐ Not at all — 244 (15.53%) ☐ Less than once a ***month*** → how many times in 2011? ____________

   232 (14.77%) ☐ 1–3 times a ***month*** — ☐ 1–2 times a ***week*** 212 (13.49%)

   293(18.65%) ☐ 3–4 times a ***week*** — ☐ 5 or more times a ***week*** 370 (23.55%)

Please think about ***the trip you are taking now*** *when you answer the following questions:*

2. At what station did you board the train? ________________________________

3. What was your approximate boarding time? ________________________________

4. At what station do you plan to disembark the train? ________________________________

5. Thinking of this as part of a round trip from and back to a "home base", which portion of the trip is this? NR: 12

   697 (44.57%) ☐ The "outbound" (initial) portion (e.g. from home to work) — 865 (55.30%) ☐ The "return home" portion — Double choice: 2 (0.13%)

6. What is/was the primary purpose of this trip (even if you are returning home now)? Please check one. NR: 3

   1023 (65.03%) ☐ Commuting to / from work or school — 7 (0.45%) ☐ Shopping

   139 (8.84%) ☐ Other work- or school-related purpose — 174 (11.06%) ☐ Personal business

   214 (13.60%) ☐ Social / entertainment / recreation — 16 (1.02%) ☐ Other: ________________________

1

NR: 8

7. With whom are you traveling? Please check that all apply, or: ☐ I am traveling alone 1327 (84.63%)

☐ Family 93 (5.93%) ☐ Colleague(s) 91 (5.80%) ☐ Friend(s) 79 (4.97%) ☐ Other: ____________ 26 (1.66%)

8. Even if undesirable in some respects, did you have any reasonable alternative ways of making this trip? Please check all that apply. NR: 17

1092 (70.04%) ☐ Driving alone

255 (16.36%) ☐ Driver of a carpool / vanpool

218 (13.98%) ☐ Passenger in a carpool / vanpool / employer-provided shuttle

234 (15.01%) ☐ Local bus / express bus / BART / light rail

28 (1.80%) ☐ Caltrain / other intercity train: ____________

160 (10.26%) ☐ Using phone, internet, etc. instead of traveling

280 (17.96 %) ☐ No, Amtrak was my only reasonable alternative

Part B: FREE Wi-Fi ACCESS ON THE CAPITOL CORRIDOR

Free AmtrakConnect Wi-Fi** was launched on the **Capitol Corridor** on **November 28, 2011**. This service allows you to connect your laptop computer, smart phone, or other Wi-Fi- enabled device to the internet for free while on the train. In this section we ask for your thoughts about this service. **We want to know about your experience and opinions, even if you haven't used the service or don't intend to.

1. Before today, how many times had you traveled on the Capitol Corridor since November 28, 2011? NR: 15

☐ None 227 (14.54%) ☐ 1-5 times 310 (19.86%) ☐ 6-10 times 125 (8.01%) ☐ 11-15 times (about once a week) 108 (6.92%) ☐ More than 15 times 791 (50.67%)

2. When you travel (on the Capital Corridor or otherwise), which of the following ***devices with wireless internet access*** do you generally have with you (whether you use them or not)? Please check all that apply. NR: 26

1010 (65.16%) ☐ Smartphone 250 (16.13%) ☐ Tablet (e.g., iPad®) 955 (61.61%) ☐ Laptop / netbook computer

144 (9.29%) ☐ E-Reader (e.g., Kindle®) ☐ MP3 player (e.g., iPod touch®) 158 (10.19%)

172 (11.10%) ☐ None 13 (0.84%) ☐ Other (please specify): ____________

3. Do you have cellular broadband internet access on a smartphone or other device? NR: 20

☐ No (go to question B5) 407 (26.16%) ☐ Yes (for example, 3G or 4G) 1114 (71.59%) ☐ Not sure 35 (2.25%)

4. What type of service plan do you have for that access?

19 (1.68%) ☐ I pay for each megabyte of data uploaded/downloaded NR: 445

358 (31.65%) ☐ I have a ***limited*** number of megabytes included for a fixed price per month

632 (55.88%) ☐ I have an ***unlimited*** number of megabytes included for a fixed price per month

116 (10.26%) ☐ I'm not sure Double choice: 6 (0.53%)

5. Have you accessed the internet while traveling on the Capitol Corridor since November 28, 2011? NR: 18

334 (21.44%) ☐ No (go to question B9) ☐ Yes 1224 (78.56%)

6. What means did you use to access the internet while traveling on the Capitol Corridor since Nov. 28, 2011? Please check all that apply. NR: 362

☐ My own wireless internet plan (e.g., 3G, 4G) 642 (52.88%) ☐ Free Wi-Fi 982 (80.89%) ☐ Not sure 31 (2.55%)

7. Since November 28, 2011, for what activities have you used the internet while traveling on the Capitol Corridor? Please check all that apply. *NR: 359*

- ☐ Check email 1100 *(90.39%)*
- ☐ Download/upload files 436 *(35.83%)*
- ☐ Read news, blogs, etc. 789 *(64.83%)*
- ☐ Shop online 196 *(16.11%)*
- ☐ Play games 211 *(17.33%)*
- ☐ Stream audio or video 250 *(20.54%)*
- ☐ Social networking (Facebook, Twitter, ...) 554 *(45.52%)*
- ☐ Obtain trip information 372 *(30.57%)*
- ☐ Other: ______________ 201 *(16.52%)*

8. How ***satisfied*** are you with your use of the free Wi-Fi on the Capital Corridor? *NR: 359*

☐ Haven't used it yet 121 *(9.94%)* ☐ Not at all 103 *(8.46%)* ☐ Somewhat 363 *(29.83%)* ☐ Fairly 419 *(34.43%)* ☐ Extremely 211 *(17.34%)*

9. Before today, were you aware that free Wi-Fi is available on the Capital Corridor?

☐ No 203 *(13.23%)* ☐ Yes 1300 *(84.75%)* ☐ Not sure 31 *(2.02%)* *NR: 42*

10. In general, ***how important*** do you think it is for the Capitol Corridor to offer free Wi-Fi? *NR: 31*

☐ Not at all important 51 *(3.30%)* ☐ Somewhat important 182 *(11.78%)* ☐ Fairly important 412 *(26.67%)* ☐ Extremely important 900 *(58.25%)*

11. To maximize service availability to everyone, the free AmtrakConnect Wi-Fi service does not allow streaming audio or video. How important is it to you to have that capability when traveling on the Capitol Corridor? *NR: 48*

☐ Not at all important 677 *(44.31%)* ☐ Somewhat important 402 *(26.31%)* ☐ Fairly important 263 *(17.21%)* ☐ Extremely important 186 *(12.17%)*

12. In its present form, ***how useful*** to you personally will it be to have free Wi-Fi on the Capitol Corridor? *NR: 50*

☐ Not at all useful 141 *(9.24%)* ☐ Somewhat useful 307 *(20.12%)* ☐ Fairly useful 399 *(26.15%)* ☐ Extremely useful 679 *(44.50%)*

13. Considering others' use of Wi-Fi as well as your own, what impact does free Wi-Fi have on your ***overall trip experience***? *NR: 44*

18 *(1.17%)* ☐ Makes it worse 74 *(4.83%)* ☐ Makes it worse in some ways , and better in others

340 *(22.19%)* ☐ Has no effect 1100 (71.80%) ☐ Makes it better

14. This year (2012), how often do you expect to use Capitol Corridor (not counting the present trip)? *NR: 35*

70*(4.54%)* ☐ Not at all → go to question B16 267 *(17.33%)* ☐ Less than once a ***month*** 235 *(15.25%)* ☐ 1–3 times a ***month***

218 *(14.15%)* ☐ 1–2 times a ***week*** 337 *(21.87%)* ☐ 3–4 times a ***week*** 414 *(26.87%)* ☐ 5 or more times a ***week***

15. On what proportion of these trips do you expect to use ***the free Wi-Fi service***? *NR: 114*

198 *(13.54%)* ☐ None 282 *(19.29%)* ☐ Some 141 *(9.64%)* ☐ Half 391 *(26.74%)* ☐ Most 450 *(30.78%)* ☐ All

16. Compared to your frequency in 2011 (question A1), which of the following factors (if any) are changing the frequency with which you expect to use Capitol Corridor in 2012? *NR: 33*

Please check all that apply, or: ☐ I do not expect my frequency to change 989 *(64.09%)*

215 *(13.93%)* ☐ Job location change 123 *(7.97%)* ☐ Home location change 71 *(4.60%)* ☐ Change in preferences

33 *(2.14%)* ☐ Change in auto ownership 134 *(8.68%)* ☐ Free Wi-Fi 118 *(7.65%)* ☐ Other: ______________

17. What impact does the availability of free Wi-Fi have on your frequency of using Capitol Corridor in 2012? *NR: 84*

122 *(8.18%)* ☐ Without free Wi-Fi, I would use Capitol Corridor *little or not at all*

192 *(12.87%)* ☐ Without free Wi-Fi, I would use Capitol Corridor sometimes, but *not as often* as I indicated in question B14

1150 *(77.08%)* ☐ Without free Wi-Fi, I would still use Capitol Corridor *as often* as I indicated in question B14

28 *(1.88%)* ☐ Without free Wi-Fi, I would use Capitol Corridor *more often* than I indicated in question B14

Part C: BACKGROUND INFORMATION

*Your responses in this section enable us to project the results from this small sample to the population as a whole. By "**household**" we mean, "people who live together and share at least some financial resources".*

1. What is your gender? *NR: 22*

636 (40.93%) ☐ Female 903 (58.11%) ☐ Male 15 (0.97%) ☐ Decline to state

2. What is your age? *NR: 24*

170 (10.95%) ☐ 18 to 24 327 (21.07%) ☐ 25 to 34 331 (21.33%) ☐ 35 to 44 337 (21.71%) ☐ 45 to 54

275 (17.72%) ☐ 55 to 64 85 (5.48%) ☐ 65 to 74 26 (1.68%) ☐ 75 or older Double choice: 1 (0.06%)

3. Which single category best describes your occupation (even if you are retired or not currently working)? *NR: 22*

48 (3.09%) ☐ Homemaker 258 (16.60%) ☐ Manager / administrator 41 (2.64%) ☐ Service / repair

776 (49.94%) ☐ Professional / technical 61 (3.93%) ☐ Sales / marketing 62 (3.99%) ☐ Clerical / administrative support

221 (14.22%) ☐ Student 38 (2.45%) ☐ Production / construction 49 (3.15%) ☐ Other: ____________________

4. Which one of the following most closely describes your employment situation, regardless of whether full-time or part-time? If you are a working student, please answer with respect to your paid employment.

134 (8.68%) ☐ Self-employed 823 (53.34%) ☐ Salaried 254 (16.46%) ☐ Hourly wage *NR: 33*

58 (3.76%) ☐ Contract worker 90 (5.83%) ☐ Non-working student 94 (6.09%) ☐ Retired

79 (5.12%) ☐ Not currently working 11 (0.71%) ☐ Other: ____________________

5. What is the highest level of education you have completed? *NR: 29*

24 (1.55%) ☐ Some grade / high school 99 (6.40%) ☐ High school diploma 340 (21.98%) ☐ Some college / technical school

385 (24.89%) ☐ 4-year college degree 120 (7.76%) ☐ Some graduate school 579 (37.43%) ☐ Graduate degree(s)

6. Do you have a driver's license? ☐ No 136 (9.02%) ☐ Yes 1371 (90.98%) *NR: 69*

7. How many people (***including*** yourself) are there in your household? __________ *NR: 57*

8. How many people in your household (***NOT including*** yourself) have a driver's license? __________ *NR: 142*

9. How many motorized on-road vehicles (car, vans, motorcycles, etc.) does your household have? *NR: 70* __________

10. What is the ZIP code of your home address? __________

11. Please check the category that contains your approximate annual household income before taxes. *NR: 172*

139 (9.90%) ☐ Less than $25,000 198 (14.10%) ☐ $25,000 to $49,999 204 (14.53%) ☐ $50,000 to $74,999

178 (12.68%) ☐ $75,000 to $99,999 218 (15.53%) ☐ $100,000 to $124,999 466 (33.19%) ☐ $125,000 or more

Double choice: 1 (0.07%)

THANK YOU VERY MUCH! We welcome any additional comments you might have about Capitol Corridor or AmtrakConnect.

APPENDIX B

UNWEIGHTED ANALYSIS

- **Unweighted counterparts to the tables of Section 5.1 (crosstabulations relevant to the Wi-Fi choice model of Section 6)**

Table B-1 Trip purpose by internet access on the Capitol Corridor (N=1555)

			Internet access		Total
			No	Yes	
Trip purpose	Commuting	Count	133	885	1018
		% within purpose	13.1%	86.9%	100.0%
	Other work- or school-related purpose	Count	37	101	138
		% within purpose	26.8%	73.2%	100.0%
	Personal business	Count	57	110	167
		% within purpose	34.1%	65.9%	100.0%
	Social / entertainment / recreation / shopping	Count	99	117	216
		% within purpose	45.8%	54.2%	100.0%
	Other	Count	6	10	16
		% within purpose	37.5%	62.5%	100.0%
Total		Count	332	1223	1555
		% within purpose	21.4%	78.6%	100.0%

Table B-2 Trip purpose by Means used to access the internet when traveling on CC (N=1213)

			Means used to access internet*			Total
			3G/4G	Wi-Fi	Not sure	
Trip purpose	All work- or school-related	Count	539	828	19	979
		% within purpose	55.0%	84.6%	2.0%	100.0%
	Personal business	Count	51	65	5	108
		% within purpose	47.2%	60.2%	4.6%	100.0%
	Social / entertainment / recreation / shopping	Count	48	82	6	116
		% within purpose	41.4%	70.7%	5.2%	100.0%
	Other	Count	4	6	1	10
		% within purpose	40.0%	60.0%	10.0%	100.0%
Total		**Count**	642	981	31	1213
		% within purpose	52.9%	80.9%	2.6%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for each purpose. The numbers in the "Total" column are the total number of individuals reporting each purpose, not the total number of responses.

Table B-3 Cellular broadband internet access by Means used to access the internet when traveling on CC (N=1213)

			Means used to access the internet*			Total
			3G/4G	Wi-Fi	Not sure	
Cellular broadband internet access	No	Count	10	193	7	203
		% within cellular internet	4.9%	95.1%	3.4%	100.0%
		% within means	1.6%	19.7%	22.6%	16.7%
	Yes	Count	632	772	20	990
		% within cellular internet	63.8%	78.0%	2.0%	100.0%
		% within means	98.4%	78.7%	64.5%	81.6%
	Not sure	Count	0	16	4	20
		% within cellular internet	0.0%	80.0%	20.0%	100.0%
		% within means	0.0%	1.6%	12.9%	1.6%
Total		Count	642	981	31	1213
		% within cellular internet	52.9%	80.9%	2.6%	100.0%
		% within means	100.0%	100.0%	100.0%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for the "no" and "yes" responses to the cellular broadband question. The numbers in the "Total" column are the total number of individuals reporting each row response, not the total number of responses.

Table B-4 Age by Importance of offering free Wi-Fi on Capitol Corridor (N=1523)

			Importance				Total
			Not at all important	Somewhat important	Fairly important	Extremely important	
Age	18 to 24	Count	3	23	54	90	170
		% within age	1.8%	13.5%	31.8%	52.9%	100.0%
	25 to 34	Count	1	26	83	214	324
		% within age	0.3%	8.0%	25.6%	66.0%	100.0%
	35 to 44	Count	9	27	71	220	327
		% within age	2.8%	8.3%	21.7%	67.3%	100.0%
	45 to 54	Count	12	51	84	184	331
		% within age	3.6%	15.4%	25.4%	55.6%	100.0%
	55 to 64	Count	9	29	82	144	264
		% within age	3.4%	11.0%	31.1%	54.5%	100.0%
	65 to 74	Count	10	16	21	35	82
		% within age	12.2%	19.5%	25.6%	42.7%	100.0%
	75 or older	Count	5	6	12	1	24
		% within age	20.8%	25.0%	50.0%	4.2%	100.0%
Total		Count	49	178	407	889	1523
		% within age	3.2%	11.7%	26.7%	58.4%	100.0%

- **Unweighted counterparts to the tables of Section 5.2 (crosstabulations relevant to the frequency model of Section 7)**

Table B-5 Crosstabulation of expected trip frequency in 2012 with conventional factors

Numbers in parentheses are row percentages		Expected trip frequency in 2012					
		Not at all	*Less than once a month*	*1–3 times a month*	*1–2 times a week*	*3–4 times a week*	*5 or more times a week*
Frequency in 2011 N=1536	*Not at all*[1]	54(25.6%)	74 (35.1%)	29 (13.7%)	12 (5.7%)	15 (7.1%)	27 (12.8%)
	< once a month[2]	10 (4.3%)	162 (69.8%)	38 (16.4%)	10 (4.3%)	7 (3.0%)	5 (2.2%)
	1–3 times a month[2]	6 (2.6%)	26 (11.5%)	147 (64.8%)	30 (13.2%)	11 (4.8%)	7 (3.1%)
	1–2 times a week[3]	0 (0.0%)	3 (1.4%)	11 (5.2%)	151 (71.9%)	43 (20.5%)	2 (1.0%)
	3–4 times a week[3]	0 (0.0%)	0 (0.0%)	4 (1.4%)	13 (4.4%)	243 (82.9%)	33 (11.3%)
	≥ 5times a week[3]	0 (0.0%)	1 (0.3%)	5 (1.4%)	2 (0.5%)	16 (4.4%)	340 (93.4%)
Trip Purpose N=1539	*Commuting*	6 (0.6%)	29 (2.9%)	87 (8.6%)	178 (17.5%)	318 (31.3%)	397 (39.1%)
	Other work- or school-related	9 (6.6%)	60 (44.1%)	37 (27.2%)	14 (10.3%)	6 (4.4%)	10 (7.4%)
	Personal business	17 (10.5%)	75 (46.3%)	48 (29.6%)	14 (8.6%)	5 (3.1%)	3 (1.9%)
	Soc / entertain / rec	34 (16.2%)	96 (45.7%)	59 (28.1%)	12 (5.7%)	5 (2.4%)	4 (1.9%)
	Other	4 (26.7%)	7 (46.7%)	4 (26.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Employment N=1515	*Self-employed*	12 (9.2%)	40 (30.5%)	38 (29.0%)	19 (14.5%)	14 (10.7%)	8 (6.1%)
	Salaried	15 (1.8%)	76 (9.3%)	78 (9.6%)	128 (15.7%)	246(30.2%)	272 (33.4%)
	Hourly wage	15 (6.0%)	41 (16.5%)	41 (16.5%)	28 (11.2%)	38 (15.3%)	86 (34.5%)
	Contract worker	1 (1.8 %)	11 (19.3%)	7 (12.3%)	12 (21.1%)	11 (19.3%)	15 (26.3%)
	Non-working student	4 (4.4%)	23 (25.6%)	20 (22.2%)	16 (17.8%)	13 (14.4%)	14 (15.6%)
	Retired	10 (11.5%)	42 (48.3%)	25(28.7%)	5 (5.7%)	1 (1.1%)	4 (4.6%)
	Not working	10 (13.2%)	27 (35.5%)	20 (26.3%)	8 (10.8%)	5 (6.6%)	6 (7.9%)
	Other	1 (4.5%)	3 (33.3%)	2 (22.2%)	0 (0.0%)	2 (22.2%)	1 (11.1%)

[1] New riders (in 2012); [2] Lower-frequency continuing riders; [3] Higher-frequency continuing riders

Table B-6 Impact of Wi-Fi for different traveler segments

Group	**Wi-Fi influenced a frequency change** (column percentages, by segment)	**Expected trip frequency in 2012** (row percentages)					
		Not at all	*Less than once a month*	*1–3 times a month*	*1–2 times a week*	*3–4 times a week*	*5 or more times a week*
NR[1] N=211	*No*	50	65	25	10	11	24
	185 (87.7%)	(27.0%)	(35.1%)	(13.5%)	(5.4%)	(5.9%)	(13.0%)
	Yes	4	9	4	2	4	3
	26 (12.3%)	(15.4%)	(34.6%)	(15.4%)	(7.7%)	(15.4%)	(11.5%)
LFR[2] N=864	*No*	14	172	173	33	14	8
	414 (90.2%)	(3.4%)	(41.5%)	(41.8%)	(8.0%)	(3.4%)	(1.9%)
	Yes	2	16	12	7	4	4
	45 (9.8%)	(4.4%)	(35.6%)	(26.7%)	(15.6%)	(8.9%)	(8.9%)
HFR[3] N=187	*No*	4	19	161	282	51	364
	830 (95.7%)	(0.5%)	(2.3%)	(19.4%)	(34.0%)	(28.0%)	(43.9%)
	Yes	0	1	5	20	4	11
	45 (4.3%)	(0.0%)	(2.7%)	(13.5%)	(54.1%)	(8.9%)	(29.7%)

[1] New riders (in 2012); [2] Lower-frequency continuing riders; [3] Higher-frequency continuing riders

- **Unweighted counterparts to the tables of Section 5.3 (other crosstabulations relevant to this research)**

Table B-7 Service plan by Means used to access the internet when traveling on CC (N=992)

			Means of accessing the internet*			
			3G/4G	**Wi-Fi**	**Not sure**	**Total**
Service plan	**pay for each megabyte of data**	Count	9	8	1	17
		% within service plan	52.9%	47.1%	5.9%	100.0%
		% within means	1.4%	1.0%	4.3%	1.7%
	limited number of megabytes	Count	187	279	3	320
		% within service plan	58.4%	87.2%	0.9%	100.0%
		% within means	29.7%	35.8%	13.0%	32.1%
	unlimited number of megabytes	Count	385	435	7	566
		% within service plan	68.0%	76.9%	1.2%	100.0%
		% within means	61.2%	55.8%	30.4%	56.7%
	not sure	Count	43	51	12	89
		% within service plan	48.3%	57.3%	13.5%	100.0%
		% within means	6.8%	6.5%	52.2%	8.9%
Total		Count	624	773	23	992
		% within service plan	62.9%	77.9%	2.3%	100.0%
		% within means	100.0%	100.0%	100.0%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for each type of service plan. The numbers in the "Total" column are the total number of individuals reporting each service plan type, not the total number of responses.

Table B-8 Awareness of free Wi-Fi by Means used to access the internet when traveling on CC (N=1198)

			Means of accessing the internet*			
			3G/4G	Wi-Fi	Not sure	Total
Awareness of free Wi-Fi	No	Count	50	38	7	83
		% within awareness	60.2%	45.8%	8.4%	100%
		% within means	7.9%	3.9%	23.3%	6.9%
	Yes	Count	579	925	18	1098
		% within awareness	52.7%	84.2%	1.6%	100%
		% within means	91.2%	95.2%	60.0%	91.7%
	Not sure	Count	6	9	5	17
		% within awareness	35.3%	52.9%	29.4%	100%
		% within means	0.9%	0.9%	16.7%	1.4%
Total		Count	635	972	30	1198
		% within awareness	53.0%	81.1%	2.5%	100.0%
		% within means	100.0%	100.0%	100.0%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for each level of awareness. The numbers in the "Total" column are the total number of individuals reporting each level of awareness, not the total number of responses.

Table B-9 Usefulness of Wi-Fi by Means used to access the internet when traveling on CC (N=1201)

			Means of accessing the internet*			
			3G/4G	Wi-Fi	Not sure	Total
Usefulness of Wi-Fi	Not at all useful	Count	56	29	5	65
		% within usefulness	86.2%	44.6%	7.7%	100.0%
	Somewhat useful	Count	152	169	5	226
		% within usefulness	67.3%	74.8%	2.2%	100.0%
	Fairly useful	Count	165	253	11	310
		% within usefulness	53.2%	81.6%	3.5%	100.0%
	Extremely useful	Count	266	521	9	600
		% within usefulness	44.3%	86.8%	1.5%	100.0%
Total		Count	639	972	30	1201
		% within usefulness	53.2%	80.9%	2.5%	100.0%

* More than one answer is allowed, so the sum of row percents exceeds 100 for each level of perceived usefulness. The numbers in the "Total" column are the total number of individuals reporting each level of usefulness, not the total number of responses.

Table B-10 Trip purpose by Impact of Wi-Fi on overall trip experience (N=1529)

			Impact on overall trip experience				Total
			Make it worse	Makes it worse in some ways, and better in others	Has no effect	Makes it better	
Trip purpose (Combined shopping and social/ entertainment)	Commuting	Count	15	50	218	727	1010
		% within purpose	1.5%	5.0%	21.6%	72.0%	100.0%
	Other work- or school-related purpose	Count	0	7	17	110	134
		% within purpose	0.0%	5.2%	12.7%	82.1%	100.0%
	Personal business	Count	2	6	45	108	161
		% within purpose	1.2%	3.7%	28.0%	67.1%	100.0%
	Social / entertainment / recreation	Count	1	11	57	140	209
		% within purpose	.5%	5.3%	27.3%	67.0%	100.0%
	Other	Count	0	0	2	13	15
		% within purpose	0.0%	0.0%	13.3%	86.7%	100.0%
Total		Count	18	74	339	1098	1529
		% within purpose	1.2%	4.8%	22.2%	71.8%	100%

Table B-11 Service plan by Impact of W-Fi on overall trip experience (N=1114)

			Impact on overall trip experience				Total
			Make it worse	Makes it worse in some ways , and better in others	Has no effect	Makes it better	
Service plan	**pay for each megabyte of data**	Count	0	2	4	13	19
		% within B4.service_plan	0.0%	10.5%	21.1%	68.4%	100.0%
	limited number of megabytes	Count	6	13	47	291	357
		% within B4.service_plan	1.7%	3.6%	13.2%	81.5%	100.0%
	unlimited number of megabytes	Count	7	40	126	453	626
		% within B4.service_plan	1.1%	6.4%	20.1%	72.4%	100.0%
	not sure	Count	1	2	27	82	112
		% within B4.service_plan	0.9%	1.8%	24.1%	73.2%	100.0%
Total		Count	14	57	204	839	1114
		% within B4.service_plan	1.3%	5.1%	18.3%	75.3%	100.0%

- **Method 1: Descriptive approach**

Table B-12 Increase in round trips due to Wi-Fi by group (unweighted)

<table>
<tr><th rowspan="2">Group</th><th rowspan="2">No. of cases</th><th rowspan="2">Increase in round trips from 2011 to 2012</th><th colspan="4">Group definitions</th></tr>
<tr><th>Respondents chose “Free Wi-Fi” as the ONLY factor changing their trip frequency</th><th>Respondents chose “Free Wi-Fi” as a factor changing their trip frequency</th><th>Respondents’ trip frequency increased by at least one category from 2011 to 2012</th><th>Respondents indicated that they would use CC less frequently without Wi-Fi</th></tr>
<tr><td>1</td><td>17</td><td>1142.50</td><td>x</td><td></td><td>x</td><td>x</td></tr>
<tr><td>2</td><td>46</td><td>1909.50</td><td>x</td><td></td><td colspan="2">at least one of these is met</td></tr>
<tr><td>3</td><td>38</td><td>3046.50</td><td></td><td>x</td><td>x</td><td>x</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">67</td><td rowspan="2">3813.50</td><td>OR x</td><td></td><td colspan="2">at least one of these is met</td></tr>
<tr><td></td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>5</td><td>99</td><td>5276.73</td><td></td><td>x</td><td colspan="2">at least one of these is met</td></tr>
<tr><td>6</td><td>182</td><td>9861.43</td><td></td><td colspan="3">at least two of these are met</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">309</td><td rowspan="2">12130.95</td><td>OR</td><td></td><td></td><td>x</td></tr>
<tr><td></td><td colspan="3">at least two of these are met</td></tr>
</table>

Table B-13 Decrease in round trips due to Wi-Fi by group (unweighted)

<table>
<tr><th rowspan="2">Group</th><th rowspan="2">No. of cases</th><th rowspan="2">Decrease in round trips from 2011 to 2012</th><th colspan="4">Group definitions</th></tr>
<tr><th>Respondents chose “Free Wi-Fi” as the ONLY factor changing their trip frequency</th><th>Respondents chose “Free Wi-Fi” as a factor changing their trip frequency</th><th>Respondents’ trip frequency decreased by at least one category from 2011 to 2012</th><th>Respondents indicated that they would use Capitol Corridor more frequently without Wi-Fi</th></tr>
<tr><td>1</td><td>0</td><td>0</td><td>x</td><td></td><td>x</td><td>x</td></tr>
<tr><td>2</td><td>6</td><td>-128</td><td>x</td><td></td><td colspan="2">at least one of these is met</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td></td><td>x</td><td>x</td><td>x</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">6</td><td rowspan="2">-128</td><td>x</td><td></td><td colspan="2">at least one of these is met</td></tr>
<tr><td>OR</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>5</td><td>9</td><td>-320</td><td></td><td>x</td><td colspan="2">at least one of these is met</td></tr>
<tr><td>6</td><td>12</td><td>-428</td><td></td><td colspan="3">at least two of these are met</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">28</td><td rowspan="2">-767</td><td rowspan="2">OR</td><td></td><td></td><td>x</td></tr>
<tr><td colspan="3">at least two of these are met</td></tr>
</table>

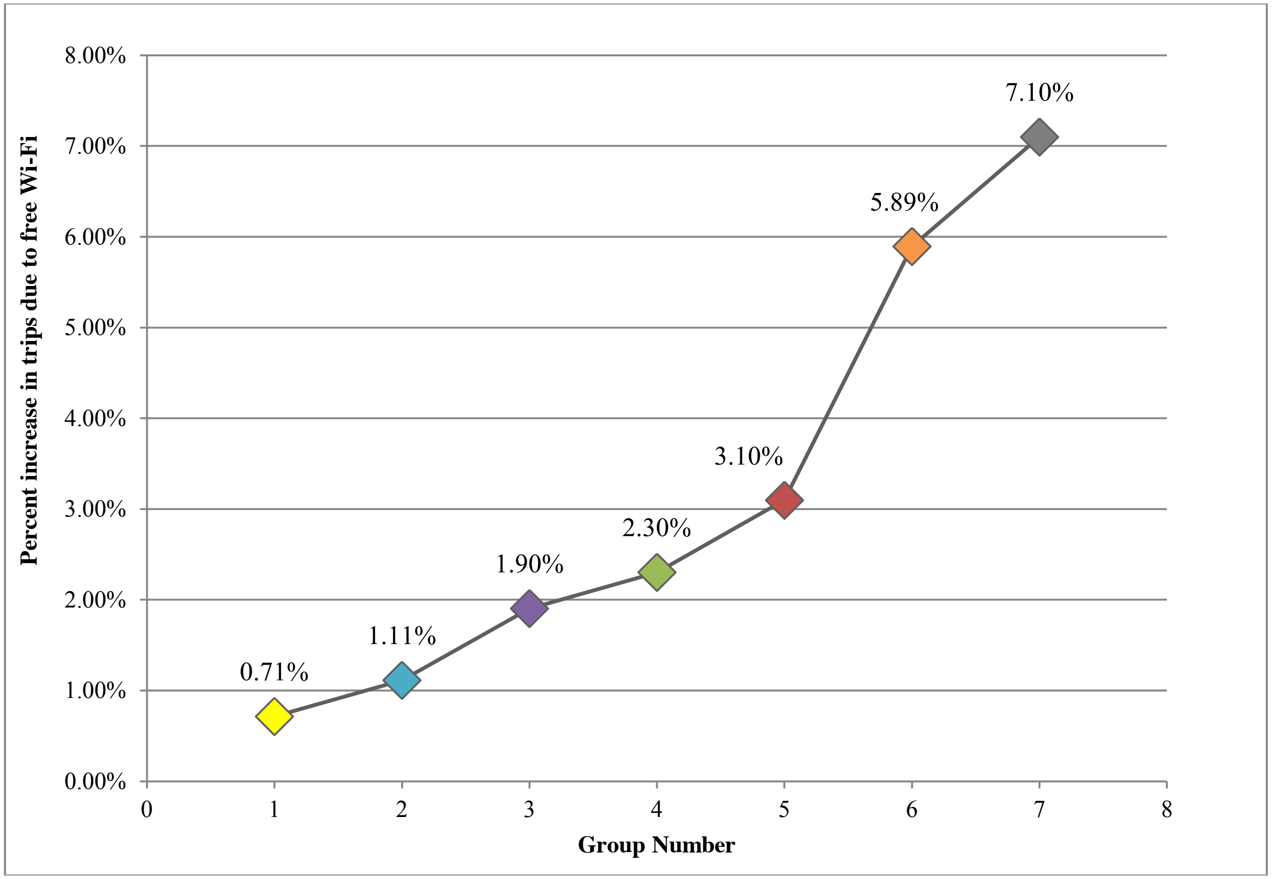

Figure B-1 Percent increase in Capitol Corridor trips due to free Wi-Fi, by group

Table B-14 Chi-squared test for trip purpose

		Trip Purpose				Total
		Commute	**Other work- or school-related purpose**	**Personal business**	**Social / entertainment / recreation & Other**	
Group X	Count	690	90	134	79	993
	%	69.5%	9.1%	13.5%	8.0%	100.0%
Group 5	Count	60	13	9	17	99
	%	60.6%	13.1%	9.1%	17.2%	100.0%
Pearson's chi-square: value =12.644, d.f. = 3, asymp. sig. = 0.005						

Table B-15 Chi-squared test for age

		Age range					Total[1]
		18-24	**25-34**	**35-44**	**45-54**	**55+**	
Group X	Count	90	174	206	227	280	977
	%	9.2%	17.8%	21.1%	23.2%	28.7%	100.0%
Group 5	Count	11	27	26	17	15	96
	%	11.5%	28.1%	27.1%	17.7%	15.6%	100.0%
Pearson's chi-square: value = 13.464, d.f. = 4, asymp. sig. = 0.009							

[1]Blank cases excluded.

Table B-16 Chi-squared test for occupation

		Occupation					Total[1]
		Manager / admin.	Professional / technical	Sales / market.	Student	Other	
Group X	Count	163	510	28	124	154	979
	%	16.6%	52.1%	2.9%	12.7%	15.7%	100.0%
Group 5	Count	17	53	8	13	6	97
	%	17.5%	54.6%	8.2%	13.4%	6.2%	100.0%
Pearson's chi-square: value = 13.250, d.f. = 4, asymp. sig. = 0.010							

[1]Blank cases excluded.

Table B-17 Chi-squared test for employment status

		Employment					Total[1]
		Self-employed	Salaried	Hourly wage	Contract worker	Other[2]	
Group X	Count	64	558	155	28	167	972
	%	6.6%	57.4%	15.9%	2.9%	17.2%	100.0%
Group 5	Count	11	56	16	5	9	97
	%	11.3%	57.7%	16.5%	5.2%	9.3%	100.0%
Pearson's chi-square: value =7.685, d.f. = 4, asymp. sig. = 0.104							

[1]Blank cases excluded. [2] Includes "non-working student", "retired", "not currently working", and "other."

- **Method 2: 2012 Frequency models**

Table B-18 Unweighted segmented model of 2012 expected CC trip frequency* (N= 1448)

Variable name	**Model**								
	Unstandardized Coefficient			*Standardized Coefficient*			*P-value*		
Constant	59.608						0.000		
Lower-frequency rider (DV)	-35.987			-0.173			0.013		
Higher-frequency rider (DV)	-45.558			-0.237			0.001		
	New riders (V_n)			*Lower-frequency riders (V_{lf})*			*Higher-frequency riders (V_{hf})*		
	Unstandardized Coefficient	*Standardized Coefficient*	*P-value*	*Unstandardized Coefficient*	*Standardized Coefficient*	*P-value*	*Unstandardized Coefficient*	*Standardized Coefficient*	*P-value*
Conventional variables									
Trips in 2011	——	——	——	0.730	0.064	0.001	0.832	0. 869	0.000
Commuting purpose (DV)	85.276	0.193	0.000	31.109	0.092	0.000	17.578	0.092	0.005
Other work/school related purpose (DV)	17.825	0.028	0.050	——	——	——	——	——	——
Station-to-station distance	-0. 817	-0.251	0.000	-0.227	-0.099	0.000	——	——	——
Salaried worker (DV)	13.564	0.032	0.089	——	——	——			
Hourly wage worker (DV)	21.651	0.034	0.014	——	——	——	9.460	0.028	0.023
Contract worker (DV)	31.872	0.030	0.023	——	——	——	——	——	——
Reasons for changing									
Job location change (DV)	55.050	0.102	0.000	23.926	0.051	0.000	-20323	-0.052	0.000
Home location change (DV)	17.848	0.028	0.029	20.071	0.038	0.002	——	——	——
Free Wi-Fi (DV)	——	——	——	25.543	0.046	0.000	30.423	0.050	0.000
R^2	0.810								
Adjusted R^2	0.807								
F	292.463								
Significance level	0.000								

* Dummy variables are identified as (DV) in the table.

Table B-19 Impact of free Wi-Fi on (projected) 2012 ridership (unweighted)

	Sum of estimated trips with Wi-Fi in 2012	Sum of estimated trips without Wi-Fi in 2012	Impact of Wi-Fi on trips in 2012	Percent of total impact
Pooled data (N=1463)	176,591	174,346	1.3%	100%
New riders (N=196)	6,927	6,927	No sig. impact	___
Lower-frequency continuing riders (N=436)	22,291	21,141	5.4%	51%
Higher-frequency continuing riders (N=831)	147,373	146,278	0.7%	49%

[1] New riders (in 2012); [2] Lower-frequency continuing riders; [3] Higher-frequency continuing riders