CTPP Status Report

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U.S. Department of Transportation
Federal Highway Administration (FHWA)
Bureau of Transportation Statistics (BTS)
Federal Transit Administration (FTA)

AASHTO Standing Committee on Planning
TRB Census Subcommittee

Census Transportation Planning Products (CTPP) AASHTO Update

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The Program: The CTPP Oversight Board met in Kansas City, MO in August 21-23 2013. The Board welcomed its new Chair, Tracy Larkin-Thomason of the Nevada DOT. Tracy is the Deputy Director for Southern Nevada at the Nevada Department of Transportation. She has more than 23 years of transportation experience with NDOT and has held positions in the areas of planning, design, Maintenance, and operations and is a former SCOP member. Other new board members and first time attendees to the meeting include Erik Sabina from Colorado DOT, Tom Faella from La Crosse (WI) Area Planning Committee, and Shimon Israel from Metropolitan Transportation Commission (San Francisco Bay Area, CA MPO). At the 2013 annual meeting, a new task force was established to plan the future on-going program, clarifying CTPP Board's expectation and connecting CTPP to the rest of data community.

In November 2012, the AASHTO Executive Board approved a change to the CTPP program from an *ad hoc* program to an ongoing technical services program. The CTPP Board suggested a $4.5 million budget for the first five years of the new CTPP on-going technical service program (FY 2015 – FY 2019). The program solicitation materials were sent to State DOTs in July, along with FHWA's memo approving local match waiver for state planning and research funds (SPR). This solicitation has had a very positive response, with 40% of states on board with no follow up and 14% of funds remitted. CTPP expects 100% participation as in years past.

The Data: As of May 2013, CTPP 2006-2010 data tables for all states were delivered from the Census Bureau to the data access software vendor. The software vendor has been working on loading the data to the software and the data loading is expected to be completed by September 9th, when rigorous beta testing will take place. The data release to public is scheduled for October 2013.

Research: The CTPP program has recently sponsored and funded several research projects, highlights include:

- *Commuting in America 2013.* As of August 2013, the first two briefs have been published: Commuting in America 2013 Overview and the Role of Commuting in Overall Travel. The hard copies can be obtained from AASHTO website: https://bookstore.transportation.org/item_details.aspx?ID=2064
  The remaining fourteen briefs are expected to be completed by December, 2013. The website for the Commuting in America is under development and the dissemination plan is not fed yet.
- *Assessing the Utility of the 2006-2010 CTPP 5-Year Data.* The project kicked off with a CTPP Utility session at TRB mid-year meeting on June 11, 2013. The session introduced the project to the community and sought support and feedback. It is a fifteen month project and the final report will be delivered in September, 2014.
- Two NCHRP 08-36 projects: *NCHRP 08-36 Task 127, Employment data for planning: do you know what you're getting, who's your supplier, and how good are the goods?* and *NCHRP 08-36 Task 128, Modern Visualization and analysis tools for strengthening transportation agencies' reporting and analysis requirements.* NCHRP is currently putting together oversight panels.

- *Microdata Analysis System Feasibility Study*. This project was designed to look at the feasibility of introducing transportation variables into the Census Bureau's nascent microdata analysis system. The purpose of such a tool is to create on the fly PUMS style analysis for small area data without compromising the privacy of respondents. The project was terminated since this research is occurring too far ahead of development of the microdata analysis system at the Census Bureau.

Training: CTPP hands-on training has been modified to be a one day session with a longer and more in depth software section. CTPP is investigating offering AICP credit for training, we will keep you posted. Training is launching in the Northeast (PA, MA, ME, NJ) in October with the data release and can be requested by States and MPOs. Training is free. If you are interested in attending training, contact me at the email above. Requirements for hosting are computers and internet, registration service for attendees for the one-day course, and an active role in advertising. To request to host training for your area, contact me at the email above.

Census 2020 Research and Planning Overview

Burton H. Reist from the Census Bureau provided an overview of the research and testing activities underway for Census 2020 at the 2013 TRB Mid-Year Meeting held in June. The 2010 Census produced exceedingly high quality data, but at the cost of $94/housing unit. This was an increase of over 34% relative to 2000. Rising costs are partially driven by declining response rates. Unless the Census Bureau makes significant changes costs will continue to rise.

The Census Bureau has embarked on a research and testing program to develop innovations in a wide range of operations designed to reduce costs while maintaining a high quality census. This includes:

- Using administrative records to enumerate a significant portion of the households that do not return a census questionnaire. As a preliminary study, the Census Bureau matched administrative records with the Census 2010 and found out that about 40% of non-responding population can be derived from the administrative data, including IRS, VA and records from Health and Human Services (e.g. Medicare). Mr. Reist also pointed out that there are some potential issues with the administrative records. For example, race information is missing from administrative records, and imputation procedures are required to obtain detailed characteristics for special race population;
- Leveraging the internet including social media and new communications strategies to improve self-response;
- Focus address canvassing on areas where significant changes have occurred, rather than full coverage; and
- Streamlining field operations. Ramping up and training the staff needed to check addresses and conduct face-to-face interviews is the most expensive part of the census. While an extensive field staff will be needed regardless of the breakthroughs the Census Bureau makes with administrative records and targeted address canvassing, the more Census Bureau can reduce staff, enable them to work more efficiently, and streamline management, the more the costs of the census can be contained.

Additionally, the Census Bureau is updating the master address database which directly drives the quality of the Census data.

For more information, please contact Mr. Reist at burton.h.reist@census.gov.

Counting Workers: Comparison of Employment Data for CPS, ACS and LODES

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Employment data are used in transportation planning to model work trips, conduct economic assessments, carry out transit and travel demand planning, examine and plan social service delivery and evaluate fixed physical infrastructure investments. This article introduces and compares three primary federal resources for employment data:

- Current Population Survey (CPS),
- American Community Survey (ACS), and
- Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics (LODES).

For information about private employment data sources, please see the article of *Sources of Employment Data* from CTPP Status Report December 2009 issue http://www.fhwa.dot.gov/planning/census_issues/ctpp/status_report/sr1209.cfm.

The CPS, released by the U.S. Bureau of Labor Statistics (BLS) monthly, provides official estimates of employment and unemployment for the nation and states, and is considered the most authoritative source of employment data for the population of the United States. It provides a comprehensive body of data on the labor force, employment, unemployment, persons not in the labor force, hours of work, earnings, and other demographic and labor force characteristics.[1] The CPS only covers Civilian noninstitutional population 16 years and older and excludes uniformed military personnel. The CPS has one of the highest response rates among government household surveys, consistently ranging from 91 to 93 percent.[2]

ACS asks employment questions including employment status, worked last week, temporarily absent, and looking for work, etc. Some of the employment status questions were modified in 2008, resulting in ACS employment estimates which are better matched with the CPS labor force estimates.[3] ACS is conducted continuously, and 12 months are accumulated to issue tabulations for areas with more than 65,000 population. It requires about five years of accumulation for data to be available in small geographies including census tracts and block groups. The mail-back response rate for ACS is about 57-59% although the overall weighted response rate is about 98% after the field follow-up interview.[4]

While the CPS and the ACS are based on sample surveys, the LODES uses administrative records. The Quarterly Census of Employment and Wages (QCEW) files from each State are combined with other federal administrative records (IRS and others). The LODES program is based on a negotiated partnership arrangement between the Census Bureau and each state Employment Security Agency (ESA). The QCEW includes workers who are covered by unemployment insurance, therefore workers who are NOT covered by unemployment insurance such as self-employed and uniformed military personnel are excluded. In LODES, workplace location is imputed for people who work for a business with multiple work locations in a county. The imputation of the workplace uses a probability model based on Minnesota QCEW data using length of employment. Residence location is taken mostly from IRS records.

CPS and ACS count employed persons, whereas the QCEW program counts "covered" (by unemployment insurance) workers who earned wages during the pay period that includes the 12th of the month. Consequently, CPS and ACS include workers "with a job but not at work" who earn no wages—for example, workers on extended unpaid leaves of absence. QCEW data, by contrast, exclude unpaid workers.[5] Additionally, ACS also produces estimates of "Workers at work," which refers to all persons 16 years or older who were at work during the reference week (excluding workers on leave due to illness, personal business, vacation etc.). One example of workers at work estimate is ACS Table B08101, *Means of Transportation to Work by Age*. For more information about adjustments for vacations and absenteeism, please see the article *A discussion on some*

[1] http://www.bls.gov/cps/

[2] http://www.census.gov/cps/about/faq.html

[3] http://www.census.gov/hhes/www/laborfor/researchnote092209.html

[4] http://www.pewsocialtrends.org/2010/07/06/should-the-american-community-survey-be-voluntary/

[5] http://www.bls.gov/cew/cewbultn11.htm#Comparison

Census terms from CTPP Status Report May 2003 (http://www.fhwa.dot.gov/planning/census_issues/ctpp/status_report/sr0503.cfm).

QCEW data count separately each job held by multiple jobholders and provide estimates of "primary jobs" and "all jobs." CPS and ACS count such workers only once, in the job at which they worked the most hours. CPS counts employed persons at their place of residence; the QCEW program counts jobs at the place of work; and ACS counts workers at both residence location and at workplace location.[6] CPS and ACS exclude persons under age 16, while the QCEW program counts all covered workers, regardless of age.[5] Table 1 highlights the key differences among the three datasets.

Table 1 Key Differences in Employment Data Available from CPS, ACS, and LODES

	CPS	**ACS**	**LODES**
Data Sources	Collected by personal and telephone interviews monthly	Mail-out/Mail-back survey with field follow-up of a sample of non-respondents	Uses unemployment administrative records
Sample Size	a sample of 60,000 households per month	250,000 households per month (2.5% of housing units per year)	Workers who are covered by unemployment insurance
Employers-Industry Categories	All employers and industry categories in sample universe	All employers and industry categories in sample universe	Does not include self-employed (approx. 10% of workers)
Uniformed Military Personnel Included	No	Yes	No
Job Categories	Excludes second jobs held by workers with multiple jobs	Excludes second jobs held by workers with multiple jobs	Includes all jobs held by workers in covered employment categories
Unpaid Workers Included	Yes	Yes	No
Workers under age 16 Included	No	No	Yes
Geographic Resolutions	At the state level and for 12 of the largest metropolitan statistical areas	Block Groups	Census Blocks
Key Notes	Does not include institutionalized (e.g., prisons, residential treatment centers, and nursing facilities) Group Quarter (GQ) in its survey universe [a]	N/A	Uses a gravity model to link individual workers to a workplace location for businesses with multiple sites in a county

Source: http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP08-36(98)_FR.pdf.

[a] Excluding institutional GQ population affects total population counts and, likewise, employment-population ratio comparisons. However, it does not impact employment and unemployment estimates since those in the institutionalized GQ population are not considered part of the labor force. http://www.census.gov/hhes/www/laborfor/researchnote092209.html.

[6] The Census Bureau regular workplace geocoding only goes down to the county and place. Thus ACS tabulations at workplace are only available down to county and place levels.

Table 2 lists annual employment from each source for year of 2008 and 2011. The best estimate of total annual Civilian employment for 2011 is 139.8 million, about 5.6 million less than 2008 based on CPS. ACS Civilian employment estimates are quite close to those of CPS, with approximately a 5% difference. Uniformed military personnel have declined from 1.24 million to 1.0 million from 2008 to 2011 according to ACS. The average annual workers for 2008 and 2011 are respectively 134.8 and 129.4 million based on the LODES/QCEW (after adjustment for multiple jobholders). Therefore, the QCEW excludes 10%-11% of all U.S. Civilian Employment including self-employed population.

Table 2
Annual Employment from CPS, ACS, and LODES: 2008

	CPS	**ACS**	**LODES/QCEW**
Total Civilian Employment (millions)	145.4	146.3	129.4[6]
Armed Forces(millions)	N/A	1.24	N/A
Workers at Work(Including Armed Forces)	N/A	143.9	N/A

Annual Employment from CPS, ACS, and LODES: 2011

	CPS	**ACS**	**LODES/QCEW**
Total Civilian Employment (millions)	139.8	140.3	124.8
Armed Forces(millions)	N/A	1.0	N/A
Workers at Work (Including Armed Forces)	N/A	138.2	N/A

[6] http://www.bls.gov/news.release/archives/cewqtr_04012010.pdf

How hard is it to count workers? Challenge of counting telecommuters.

Predicting or even understanding employment data and the worker population growth trends have become very challenging. The greatest challenge is differentiating the trend from the anecdotal; the structural from the cyclical. Historically, travel demand modelers have used the journey-to-work as a critical element for estimating "Home-based work" trips. But how people work today includes telecommuting (or working at home to partially replace trips to work); job splitting where 2 workers share one full-time job; working part-time after retirement. How do these changes occurring today impact how we forecast travel for the 20 year horizon?

This article specifically discusses the challenges that are faced by travel behavior analysts and travel demand forecasters on counting telecommuters.

With more workers switching to a flexible work schedule, gathering information on telecommuting is becoming very important. Because the American Community Survey (ACS) asks only about the "usual" mode to work last week, workers can answer only one choice, therefore the "work at home" selection only captures employees who have no other work place. It does not count workers who occasionally work at home even as much as 2 days a week.

Travel demand forecasting assists in making more informed policy decisions on the basis of observed data. Hence the effectiveness of the policy decisions depends on the accuracy of model predictions which in turn depends on the quality of the observed data. Conventional trip-based model development is only indirectly sensitive to existing levels of telecommuting and implicitly assumes that whatever levels of telecommuting exist today is what will exist in the future. In a typical Trip Generation model, there are provisions to distinguish between full-time and part-time workers and between workers with one job and multiple jobs, but there is no place for use of an explicit determination of how many base year jobs/workers/employees in a zone (either the workers in households, or the workers at a workplace) are telecommuting on a typical average weekday.

Since most planning agencies rely on whatever can be summarized from the expanded household survey. So most agencies have a hard time simply coming up with HBW trip attraction rates that vary by employment type (NAICS groups), and understandably do not further develop specialized trip attraction rates like for part-time versus full-time jobs, or rates that vary by area type or activity density. If there is an expectation that part-time jobs will grow at a much faster rate than full-time jobs, or that the percent of workers who telecommute one or more days in a week in horizon year will be much higher than what existed in base year, then the travel model predictions for horizon year are probably going to be inaccurate.

The complexity of working at home part or all of the time means that it is not likely to be included in revisions to the American Community Survey. Instead, improvements to the National Household Travel Survey (NHTS) and regional household travel surveys should be a target/aim. Several questions in the 2009 NHTS survey focused on employment related information. One of these questions asked whether workers had the option to work at home instead of going to their primary workplace. If the workers did have the option to telecommute, there was a subsequent question regarding the frequency of working at home instead of going to primary workplace in the last month. These two questions formed the basis of understanding the telecommute component of travel behavior of an average worker using the 2009 NHTS survey. NHTS 2009 also captures self-employed workers, whose homes are assumed as their primary workplaces. Future improvements to the survey can focus on segregating different types of telecommuters in the workforce. The questions should be designed to capture the entire spectrum of such workers ranging from those who work at home in addition to their regular work location (which does not qualify as telecommuting as there are no work trips canceled or replaced), to occasional and regular telecommuters, to workers who work only from home.

NHTS 2009 data show that about 11% of the workforce has the option to telecommute, but only 64% ever exercise their option. More males

workers (12.3%) have the option to telecommute as compared to females workers (9.3%) but females tend to telecommute more than males if they have the option. Commute distance between home and primary workplace significantly influences workers' decision to telecommute. As expected, those who live within 5 miles telecommute less (6%), whereas those living over 100 miles away telecommute significantly more (31%). Workers who work full-time telecommute more (8%) as compared to part-time workers (4%) although part-time workers tend to telecommute more if they have the option. Education level significantly influences worker's job type which in turn affects their telecommuting behavior. White collar workers telecommute more compared with blue collar workers which is expected as blue collar jobs require physical presence, compared to white collar workers who can work remotely. The following tabulations show how education and job type affect telecommuting.

Table 3 Telecommuting Patterns by Education and Job Type

Worker's Education Attainment	**% Workers with option to telecommute**	**% Workers who Telecommute at least 1 day each month**
Less than high school graduate	3.40%	1.76%
High school graduate, GED	4.71%	2.76%
Some college or Associate's degree	7.31%	4.46%
Bachelor's degree	17.74%	11.65%
Graduate or Professional Degree	22.68%	14.81%

Worker's Job Category	**% Workers with option to telecommute**	**% Workers who Telecommute at least 1 day each month**
Sales / service	7.24%	4.42%
Clerical / admin support	6.06%	3.54%
Manuf., construct, maintenance, or farming	3.55%	2.16%
Professional, managerial, or technical	18.35%	11.91%
Other	9.62%	6.88%

Source: NHTS 2009 http://nhts.ornl.gov/tools.shtml

Some informative works based on the 2009 NHTS telecommuting data include:

- On Modeling Telecommuting Behavior: Option, Choice and Frequency http://www.caee.utexas.edu/prof/bhat/ABSTRACTS/Telecommuting_Paper_13June2012.doc.
- Are Commuting and Personal Travel Complements or Substitutes http://scholarworks.boisestate.edu/cgi/viewcontent.cgi?article=1043&context=pubadmin_facpubs

Data limitations should not discourage the development of useful travel forecasts. Using an integrated land use and travel forecasting model from multiple years of observed data from multiple regions will likely improve long range forecasts to account for telecommuting.

This article is contributed by Ken Cervenka from Federal Transit Administration (FTA), Alan Pisarski, Ed Christopher from Federal Highway Administration (FHWA) and Steve Polzin from University of South Florida and compiled by Aayush Thakur and Liang Long from Cambridge Systematics. If you have any questions, please contact Dr. Liang Long by e-mail at liang.long@dot.gov.

New York City Transit's Environmental Justice Strategies: Using CTPP Journey-to-Work Data to Perform Service Change Impact Analysis by Demographics

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The implementing regulations of Title VI of the Civil Rights Act of 1964 prohibit Federal funding recipients (including transit agencies) from discriminating on the basis of race, color, or national origin, or placing undue burden on Environmental Justice (EJ) populations as a result of its policy decisions or service and fare changes. For major service changes (greater than 25% of route length per MTA Board standard for New York City Transit), transit agencies are required to perform an impact equity analysis to determine whether the burden of service changes are equally borne by minority and non-minority populations, and by low- and high-income populations.

In 2010, NYC Transit proposed eliminating the "V" Train (2 Avenue to Continental, via Local) to save an estimated $4 million per year, and replacing it with an extended "M" Train (rerouted from Broad St. Terminal to Continental). The new service also offers a Midtown direct service for riders originating from Middle Village, Ridgewood, and Fresh Pond in Queens, and Bushwick and Williamsburg in Brooklyn. An impact equity analysis was required to demonstrate compliance with Title VI.

Impact Analysis Method

Travel time and cost analysis is required to determine whether a given service change is equitable. First, the catchment area of each route is established by including all Census Tracts within ¼ mile of the route. Each Census Tract is classified as either minority or non-minority based on whether the proportion of minority persons residing in that area exceeds the average proportion of minority persons in the overall service area. The Census shows that minorities consist of 65.02% of New York City's population. A Census Tract is considered to be "At or Below Poverty" if the population is equal to or greater than citywide average of 21.25%; otherwise it is "Above Poverty."

System wide customer O-D surveys do not provide data at sufficient resolution to have accurate O-D data at a route-by-route level therefore an Origin-Destination table (O-D) was created from the Census Transportation Planning Package (CTPP) Journey-to-Work (JTW) matrix. Separate matrices were created for Census Tracts identified as "Minority" and "Non-Minority." Within the catchment area, the top five tracts in terms of passenger origination are selected. From these top five origin tracts, the top three destinations within NYC Transit's service area are selected, making a selection of 15 O-D pairs with heavy traffic on NYC Transit's services, on which travel time and cost analysis will be conducted.

1. Shortest path using the route proposed for elimination is selected as the 'before' travel time. Shortest path without the use of that route is the 'after' travel time. These shortest paths are recommended by a generic web-based shortest path journey planning tool.
2. If the shortest path is to walk between the origin and destination Census Tracts, the walk time is entered and $0 is entered for the fare.
3. In some cases, it is necessary to find the shortest path by forcing a transfer at an intermediate transfer point, as trip planner is not always able to pick a path utilizing the route. Paths are rejected for being unreasonable if it involves circuitous changes of direction.
4. If no means exist to use the subject route, then the shortest path travel time is used for both before and after condition (i.e. elimination of route will have no impact for that O-D pair.)

The travel times and costs are found for each O-D pair before and after route modification. The average differences are calculated. A *t*-test is conducted to determine if the changes in travel times and cost are equitable.

Application and Results

This method was applied to the "M" Train modification. Figure 1 illustrates the top five origins and top three destinations for the "M" Train from the CTPP, with trip timings from Google Transit. Figure 2 shows average differences in travel time and cost affecting four demographic categories before and after the "M" Train modification. For average travel times for minorities there is a fraction of a minute difference. The same is true for non-minorities. When comparing minorities and non-minorities, the difference was equitably small. The two tailed test of hypothesis (*t*-test) confirms this conclusion of "No Significant Disparity." Due to NYC Transit's "One City, One Fare" policy, the average difference in total cost per trip between minority and non-minority riders are identical; therefore there is no Title VI disparity. The average difference for Above Poverty and At or Below Poverty is also insignificant according to *t*-test results.

The new orange "M" Train ("M" Extension) runs from Broadway-Lafayette St., Manhattan to Forest Hills, Queens. This extension completely replaces—and thus eliminates in name only—the "V" Train. The neighborhoods the "M" now travels through (all former "V" stops) traverses a largely non-minority and above poverty population in Manhattan. Once the "M" Train crosses underneath the East River and enters Queens the population becomes quite diverse in terms of race and income.

Discussion

The methodology takes into account people who walk distances up to a quarter mile of which there could be several stops in between. The distance between Allen St. at Delancey St. and Crosby St. at Grand St. is easily 4-5 minutes walking but has four separate subway stations within its vicinity. The variances in these O-D pair comparisons (Figure 1) jump to 52.81 when you add in trips between 31 Ave. at 34 St. in Queens and Stone St. at Broad St. in Manhattan. The distance between these two points is approximately 7 miles and requires at least one transfer between two train routes. The difference in travel time could range from four to forty four minutes.

Conclusion

The method developed in this paper utilizes the CTPP JTW data to identify the biggest transit markets that could potentially be affected by a proposed service change, and focuses on the largest origin-destination pairs when analyzing impacts. The JTW data was critical to this effort as NYC Transit's system wide customer O-D surveys do not provide data at sufficient resolution to have accurate O-D data at a route-by-route level. At this time due to the complexity of subway routing options within New York City, the shortest-path analysis remains manual. In future it is anticipated that an automated model could be developed that would utilize all O-D pairs within the CTPP JTW data to develop the average time and cost impacts, not just the largest O-D pairs.

Table 4. Title VI—Minority/Non-Minority Analysis. The O-D Centroid Pairs Come From Census Year 2000 Journey-to-Work Matrix. These Tracts are Adjacent to the Affected Routes. The Top 5 Origins and Top 3 Destinations are Selected.

"M" Train Elimination

TITLE VI SUBWAY TRAVEL ANALYSIS

MINORITY

Census Tract(s)						Travel Time (Minutes)		Total Cost per Trip**	
Origin	Origin Centroid	Destination	Destination Centroid	Originating Riders in Census Tract	Riders in the O-D Market	Before Route Elimination	After Route Elimination	Before Route Elimination	After Route Elimination
61001800	Allen St at Delancey St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,494	305	8	8	$1.50	$1.50
61001800	Allen St at Delancey St, New York, NY	61001800	Allen St at Delancey St, New York, NY	1,494	290	0	0	$0.00	$0.00
61001800	Allen St at Delancey St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,494	260	9	8	$1.50	$1.50
61001600	Eldridge St at Canal St, New York, NY	61001600	Eldridge St at Canal St, New York, NY	1,424	435	0	0	$0.00	$0.00
61001600	Eldridge St at Canal St, New York, NY	61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	1,424	175	10 w	10 w	$0.00 w	$0.00 w
61001600	Eldridge St at Canal St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,424	130	8 w	8 w	$0.00 w	$0.00 w
61000800	Madison St at Market St, New York, NY	61000800	Madison St at Market St, New York, NY	1,374	360	0	0	$0.00	$0.00
61000800	Madison St at Market St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,374	230	15 *	15	$1.50 *	$1.50
61000800	Madison St at Market St, New York, NY	61001600	Eldridge St at Canal St, New York, NY	1,374	165	5 w	5 w	$0.00 w	$0.00 w
61004100	Mott St at Grand St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,298	435	0	0	$0.00	$0.00
61004100	Mott St at Grand St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,298	240	4 w	4 w	$0.00 w	$0.00 w
61004100	Mott St at Grand St, New York, NY	61003100	Worth St at Lafayette St, New York, NY	1,298	160	9	7	$1.50	$1.50
61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	898	310	0	0	$0.00	$0.00
61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	61004100	Mott St at Grand St, New York, NY	898	165	11 *	11	$1.50 *	$1.50
61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	61004500	Crosby St at Grand St, New York, NY	898	105	10	10	$1.50	$1.50

NON-MINORITY

Census Tract(s)						Travel Time (Minutes)		Total Cost per Trip**	
Origin	Origin Centroid	Destination	Destination Centroid	Originating Riders in Census Tract	Riders in the O-D Market	Before Route Elimination	After Route Elimination	Before Route Elimination	After Route Elimination
47000500	Pierrepont St at Henry St, Kings, NY	47000500	Pierrepont St at Henry St, Kings, NY	1,480	305	0	0	$0.00	$0.00
47000500	Pierrepont St at Henry St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,480	155	7 *	7	$1.50 *	$1.50
47000500	Pierrepont St at Henry St, Kings, NY	61009200	E 45th St at Lexington Ave, New York, NY	1,480	135	28 *	28	$1.50 *	$1.50
47000301	Pierrepont St at Willow St, Kings, NY	47000301	Pierrepont St at Willow St, Kings, NY	1,330	290	0	0	$0.00	$0.00
47000301	Pierrepont St at Willow St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,330	225	10 *	10	$1.50 *	$1.50
47000301	Pierrepont St at Willow St, Kings, NY	47001100	Pearl St at Willoughby St, Kings, NY	1,330	130	11	13	$1.50	$1.50
61004900	Wooster St at Prince St, New York, NY	61004900	Wooster St at Prince St, New York, NY	1,245	675	0	0	$0.00	$0.00
61004900	Wooster St at Prince St, New York, NY	61010200	Madison Ave at E 53rd St, New York, NY	1,245	90	22 *	22	$1.50 *	$1.50
61004900	Wooster St at Prince St, New York, NY	61000900	Stone St at Broad St, New York, NY	1,245	85	15 *	15	$1.50 *	$1.50
61003300	W Broadway at Franklin St, New York, NY	61003300	W Broadway at Franklin St, New York, NY	1,185	600	0	0	$0.00	$0.00
61003300	W Broadway at Franklin St, New York, NY	61012500	7th Ave at W 48th St, New York, NY	1,185	95	15 *	15	$1.50 *	$1.50
61003300	W Broadway at Franklin St, New York, NY	61031701	N End Ave at Vesey St, New York, NY	1,185	70	10 *	10	$1.50 *	$1.50
47000100	Cranberry St at Hicks St, Kings, NY	47000100	Cranberry St at Hicks St, Kings, NY	1,070	260	0	0	$0.00	$0.00
47000100	Cranberry St at Hicks St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,070	130	9 *	9	$1.50 *	$1.50
47000100	Cranberry St at Hicks St, Kings, NY	47000900	Livingston St at Court St, Kings, NY	1,070	105	9 *	9	$1.50 *	$1.50

Notes:

w - Walking only (No transit usage involved)

"0" - Same Census Tract, travel occurs within the census tract, no transit service used

- Long Island Rail Road

* - Riders not using service proposed for elimination

** - Based on current fare structure (doesn't include future increase)

EQUITY ANALYSIS RESULT (t-test)

	Total Travel Time		Total Cost per Trip	
	Minority	Non-Minority	Minority	Non-Minority
Average Travel Time after route elimination	5.73	9.20	0.60	1.00
Average Travel Time before route	5.93	9.07	0.60	1.00
Average difference	-0.20	0.13	0.00	0.00
Variance	0.31	0.27	0.00	0.00

Total Travel Time *:* Using a two-tailed test of hypothesis with a 5% error (95% confidence), the resulting t-statistic = -1.69. The t-critical values are +/- 2.05. Since -1.69 > –2.05 and < +2.05, we can therefore conclude that there is no significant difference in the total travel time before and after eliminating the proposed route between minority and non-minority population.

Table 5 Travel Time and Cost Analysis: "M" and "V" Subway Restructuring

Travel Time Analysis

Group	Before (Mins.)	After (Mins.)	Avg. Diff.	Var.	t-Test	Result
"M" Elim Minority	5.9	5.7	-0.2	0.3	-2.05 < -1.69 < 2.05	No Disparity
"M" Elim Non-Minority	9.1	9.2	0.1	0.3		
"V" Elim Minority	15.4	15.1	-0.3	0.4	-2.09 < -1.54 < 2.09	No Disparity
"V" Elim Non-Minority	4.7	4.7	-0.1	0.1		
"M" Ext Minority	14.9	14.9	0.0	0.0	Not Required	No Disparity
"M" Ext Non-Minority	4.7	4.7	0.0	0.0	No Change	
"M" Elim Poverty	5.7	5.5	-0.2	0.3	-2.05 < -1.69 < 2.05	No Disparity
"M" Elim Non-Poverty	10.8	10.9	0.1	0.3		
"V" Elim Poverty	14.3	16.9	2.7	52.8	-2.14 < 1.46 < 2.14	No Disparity
"V" Elim Non-Poverty	4.7	4.7	-0.1	0.1		
"M" Ext Poverty	14.7	14.7	0.0	0.0	Not Required	No Disparity
"M" Ext Non-Poverty	4.7	4.7	0.0	0.0	No Change	

Travel Cost Analysis

Group	Before	After	Avg. Diff.	Var.	t-Test	Result
"M" Elim Minority	$0.60	$0.60	0¢	0¢	Not Required	No Disparity
"M" Elim Non-Minority	$1.00	$1.00	0¢	0¢	No Change	
"V" Elim Minority	$1.23	$1.33	10¢	15¢	-2.14 < 1.00 < 2.14	No Disparity
"V" Elim Non-Minority	$0.90	$0.90	0¢	0¢		
"M" Ext Minority	$1.43	$1.43	0¢	0¢	Not Required	No Disparity
"M" Ext Non-Minority	$0.90	$0.90	0¢	0¢	No Change	
"M" Elim Poverty	$0.60	$0.60	0¢	0¢	Not Required	No Disparity
"M" Elim Non-Poverty	$1.00	$1.00	0¢	0¢	No Change	
"V" Elim Poverty	$0.90	$1.77	87¢	523¢	-2.14 < 1.47 < 2.14	No Disparity
"V" Elim Non-Poverty	$0.90	$0.90	0¢	0¢		
"M" Ext Poverty	$2.20	$2.20	0¢	0¢	Not Required	No Disparity
"M" Ext Non-Poverty	$0.90	$0.90	0¢	0¢	No Change	

Note: This is an excerpted version of Wang, Lu, and Reddy, 2013. Maintaining Key Services While Retaining Core Values: NYC Transit's Environmental Justice Strategies, *Journal of Public Transportation*, Vol. 16, No. 1, pp. 123-152. Opinions expressed are the authors' and do not necessarily reflect official policy or positions of the Metropolitan Transportation Authority State of New York, Metro-North Railroad, or any other organizations.

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