

User's Manual and Final Modelling Report

NJDOT 2012-13: *Integration of Bus Stop Count Data with Census data for Improving Bus Service and Efficiency*

Prepared for New Jersey Department of Transportation and NJ Transit

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10/20/2014

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2 OVERVIEW

2.1 TRANSIT DEMAND MODELING

This collection of tools and methodologies are intended to allow planners to assess changing transit demand in customizable market areas defined simply by GTFS routes and census geographies. The web-tool designed by AVAIL aggregates a number of data sets which are universally available in the US, such as the American Community Survey (ACS), Census Transportation Planning Products (CTPP) and The Longitudinal Employment and Household Dynamics (LEHD) survey, with data generated by transit agencies like GTFS and ridership surveys. These data sets are then run through an algorithm to approximate bus ridership. Custom developed software combined with Open Trip Planner is then used to microsimulate bus ridership in a given market area. The collection of tools and methodologies together, illuminate dynamics of bus ridership in a given area.

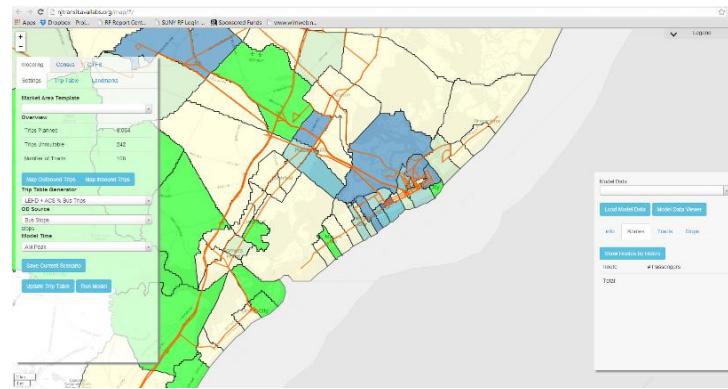


Figure 1 Map Viewer

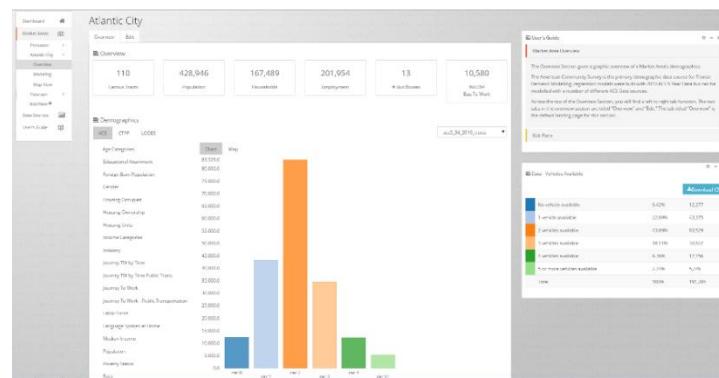


Figure 2 Admin Tool

2.2 USER'S GUIDE

This User's Guide is broken into two sections:

1. Admin Tool: This section discusses every functionality of the web tool guiding a user through the process of uploading data, creating market areas, running models, and reviewing model outputs.

Atlantic City					
	Atlantic City1	Atlantic City2	Atlantic City3	Atlantic City5	Atlantic City5
Dependent Variable	bus_to_wor	bus_to_wor	bus_to_wor	bus_to_wor	bus_to_wor
Constant	14.8622	-36.62	-36.82*	14.23	5.27
car_0_hous	0.42**	.36**	.28**	.22**	.31**
arts		.015**	.14**	.21**	.19**
emp_den			.02**	.01*	.12**
bachelors			.01*	-.13**	-.19**
pop_den					-.05**
R Sq.	0.32	0.50	0.54	0.62	0.65
N	110	110	110	110	110

Table 1 Regression Modelling

2. Modeling: This section contains a summary of data elements and the regression model specifications used in the microsimulation process, including the sources of data, descriptive statistics, the correlations coefficients, regression model development and latest regression model for Atlantic City.

3 ADMIN TOOL

The Admin Tool contains three sections: a navigation panel on the left; a content section in the center; and a user's guide at right. As a user navigates throughout the website, the User's Guide at right changes to reflect the functionalities located in the center pane. The right panel User's Guide provides information about how to use each of the tools located in the center panel.

The Admin Tool (see Figure 3, below) is the landing page or **Dashboard** which users will see when signing in. This figure illustrates the Left Navigation Pane, the Center Pane, and the User's Guide at Right. A user can access a PDF of the entire User's Guide by clicking on the **User's Guide** link in the Left Navigation Pane.



The screenshot shows the NJTDM Admin dashboard. On the left is a sidebar with links: Dashboard, Market Areas (highlighted), Data Sources, and User's Guide. The main center area displays a table titled "Market Areas GTFS subsets" with four rows:

Name	# of Routes	# of Zones	Action
Princeton	10	69	Map
Atlantic City	13	110	Map
Paterson	16	128	Map

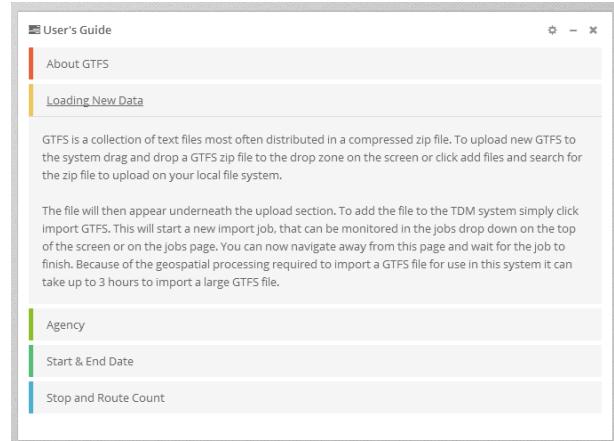
At the bottom of this area is a blue button labeled "Add New Market Area". To the right is a "User's Guide" panel with a title "Using the Dashboard". It contains instructions: 1. Clicking on a city name opens its overview. 2. The "Add New Market Area" button uploads new market areas. 3. The "Map" button navigates to the map viewer. Below this is a section titled "About NJTDM Admin".

Figure 3 Admin Tool, Dashboard

3.1 USER'S GUIDE - RIGHT PANE

The Admin Tool contains a User's Guide in the Right Side Panel (see Figure 4 at right). This User's Guide contains information and instructions related to the functionalities of the Admin Tool's Center Pane.

The category titles are named for each of the functionalities and columns located in the Center Pane.



The screenshot shows the "User's Guide" panel. It has a title bar and a main content area. The content area is divided into sections:

- About GTFS**: Information about GTFS files, including how to upload them.
- Loading New Data**: Instructions for importing GTFS files.
- Agency**: Placeholder for agency information.
- Start & End Date**: Placeholder for date ranges.
- Stop and Route Count**: Placeholder for route and stop counts.

Figure 4 Admin Tool, Right Pane User's Guide

3.2 LEFT NAVIGATION PANE

Before discussing the Center Pane functionality tools or their corresponding Right Pane User's Guide sections, the following section describes the full suite of functions in the Left Navigation Pane.

3.2.1 Left Navigation - Market Areas

Selecting Market Areas opens a list of each of the models in your web tool. Below each model is an Overview, Model Runs, and access to the Map Tool.

3.2.2 Left Navigation - Data Sources

By Clicking on **Data Sources**, you open a list of each of the data sources used in building the web tool and it allows you to upload new data.

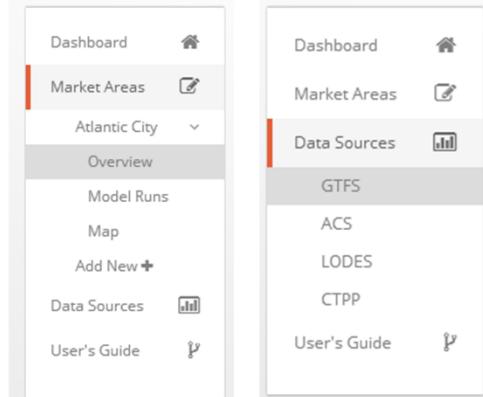
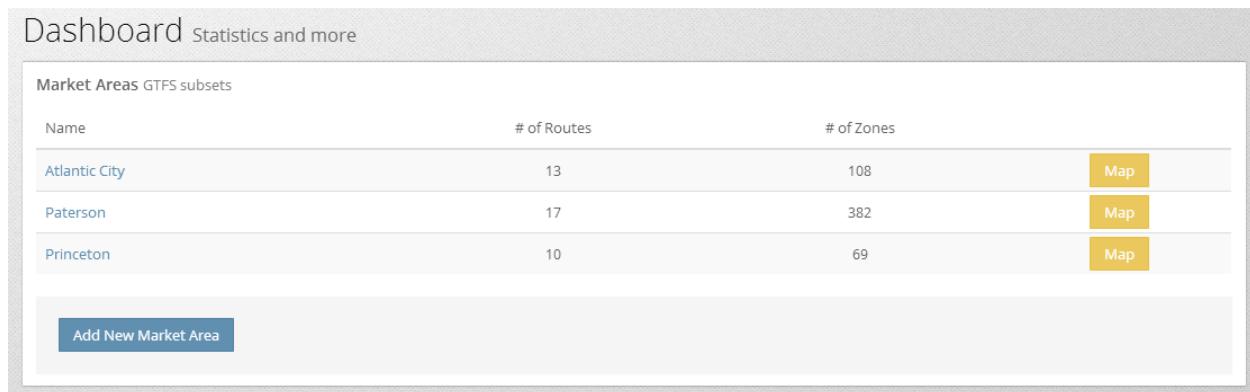


Figure 5 Admin Tool, Left Navigation Pane

3.3 DASHBOARD

Upon opening the Admin Tool, users will find the Dashboard page with the three navigation panes discussed above. The Center Pane is currently set to land on **Market Areas**. At this time, the only market area in the web tool is Atlantic City.

3.3.1 Dashboard - Center Pane



Market Areas GTFS subsets			
Name	# of Routes	# of Zones	
Atlantic City	13	108	Map
Paterson	17	382	Map
Princeton	10	69	Map

Add New Market Area

Figure 6 Admin Tool, Dashboard, Center Pane

The Center Pane has three functionalities:

1. By Clicking on the name of a city, a user can access the Overview for that city
2. The **Add New Market Area** Button is for creating a new Market area
3. The **Map** Button navigates to the Map View Tool

3.4 MARKET AREAS

When you click on **Market Areas** in the Left Navigation Panel you'll get a dropdown list of all of the Market Areas listed in your tool and an **Add New** option. At this time, the only city in this tool is Atlantic City.

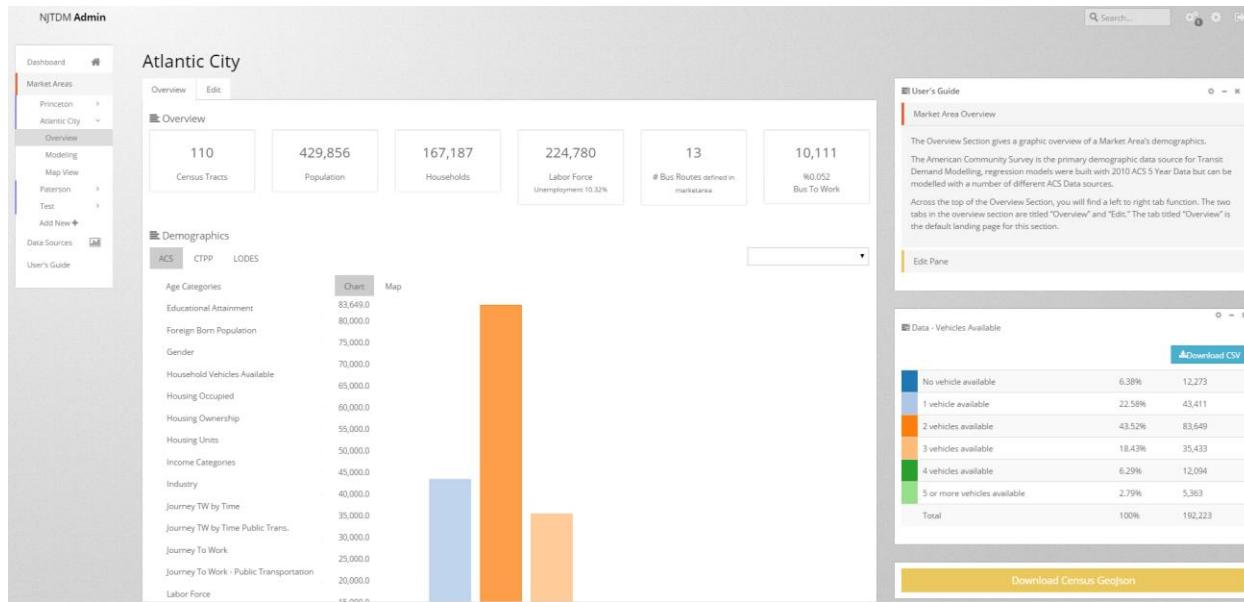
By clicking on Atlantic City, the user opens a dropdown menu that includes three sections:

1. Overview
2. Market Runs
3. Map View

3.4.1 Overview (Market Areas>Atlantic City)

The Overview Section gives a graphic overview of a Market Area's demographics.

Figure 7 Admin Tool, Market Area Overview



The screenshot shows the 'Overview' tab selected in the top navigation bar. The main content area displays various demographic statistics in boxes and a bar chart. The 'Demographics' section on the left lists categories like Educational Attainment, Household Vehicles Available, and Labor Force, each with numerical values. A bar chart titled 'Age Categories' compares three categories: No vehicle available (blue bar), 2 vehicles available (orange bar), and 3 vehicles available (yellow bar). To the right, there is a 'User's Guide' panel with information about the overview section and a 'Data - Vehicles Available' table showing the percentage of households with different numbers of vehicles. A 'Download CSV' button is also present.

The Overview Section is split into three distinct areas:

- The **Center Pane** allows you to view charts and maps and to edit market area routes and census tracts.
- The **User's Guide** in the top right corner of the page will contain much of the text from this user's manual that pertains to navigating the functionalities of this section.
- The **Data Section** on the lower right section of the page allows you to see exact category numbers and percent by category. contains the **Download CSV button**, and is the control mechanism for the center pane.

Across the top of the Overview Section, you will find a left to right tab function. The two tabs in the overview section are titled **Overview** and **Edit**. The tab titled **Overview** is the default landing page for this section.

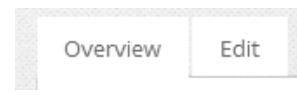


Figure 8 Admin Tool, Market Area Overview, Tabs

3.4.1.1 Overview Tab (Market Areas>Atlantic City>Overview)

In the Center Pane of the Overview Section, there is a left to right feature across the top of the page. This feature provides broad market area statistics relevant to transit modeling.

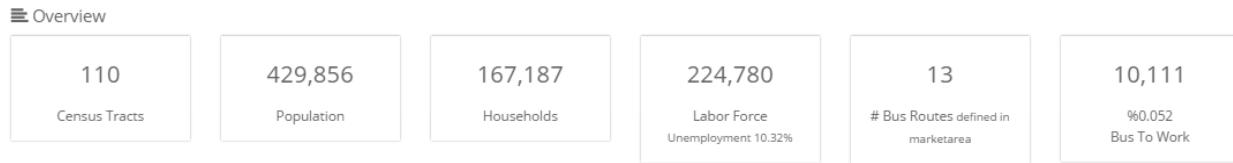


Figure 9 Admin Tool, Market Area Overview, Census Data Table

The data listed left to right above the graph includes: Census Tracts, Population, Number of Households, Number of Bus Routes, Number of people indicating “Bus to Work” on the Census, and Number of Zero Car Households.

On the left side of the Overview Center Pane, there is a column of data. The categories listed here can be clicked on and they will change the graph in the center. The data in this column includes:

- Age Categories, Education Attainment, Employment, Foreign Born Population, Gender, Household Vehicles Available, Housing Units, Income Categories, Industry, Journey to Work, Journey to Work by Time, Language Spoken at Home, Population, Race, School Enrollment and Vehicles Available.

3.4.1.1.1 Charts and Maps

The center pane of the Overview Tab allows a user to choose between viewing market area statistics in chart form or on a census tract level map. To navigate between charts and map simply click on the labels in the top left corner of the chart.

Chart Map



Figure 10 Admin Tool, Market Area Overview, Census Data Graph Section

3.4.1.1.1 Maps

The Map Section of the Overview Tab is controlled by the Data Box located in the lower right section. To see distribution of census statistics across the market area simply click on the statistic you're interested in and the map will show distribution.

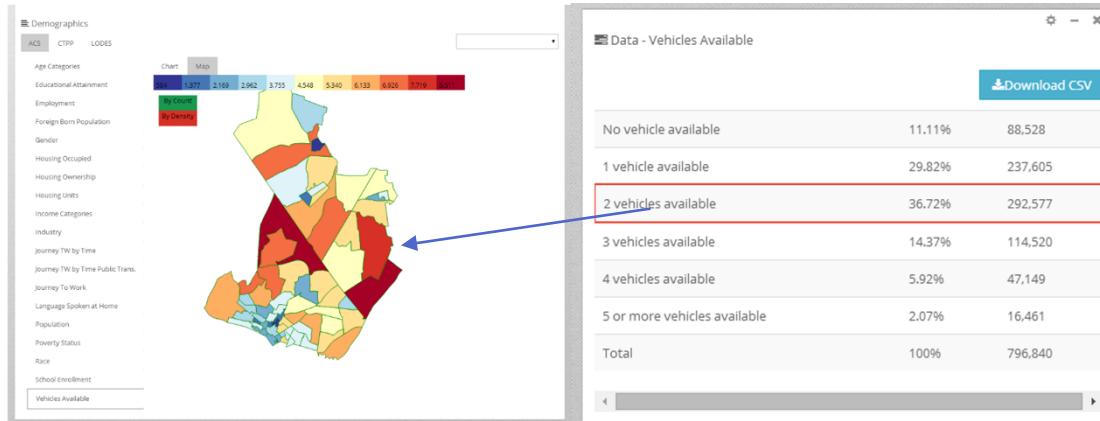


Figure 11 Overview Section, Map and Right Side Data Box

3.4.1.1.2 Data Box

The Data Box in the lower right interacts with other areas of the Overview page. The Data Box is controlled by the Demographics column and the Data Type Tabs. To change the data displayed in the Data Box at right, click on a demographic category in the column on the left side of the center pane.

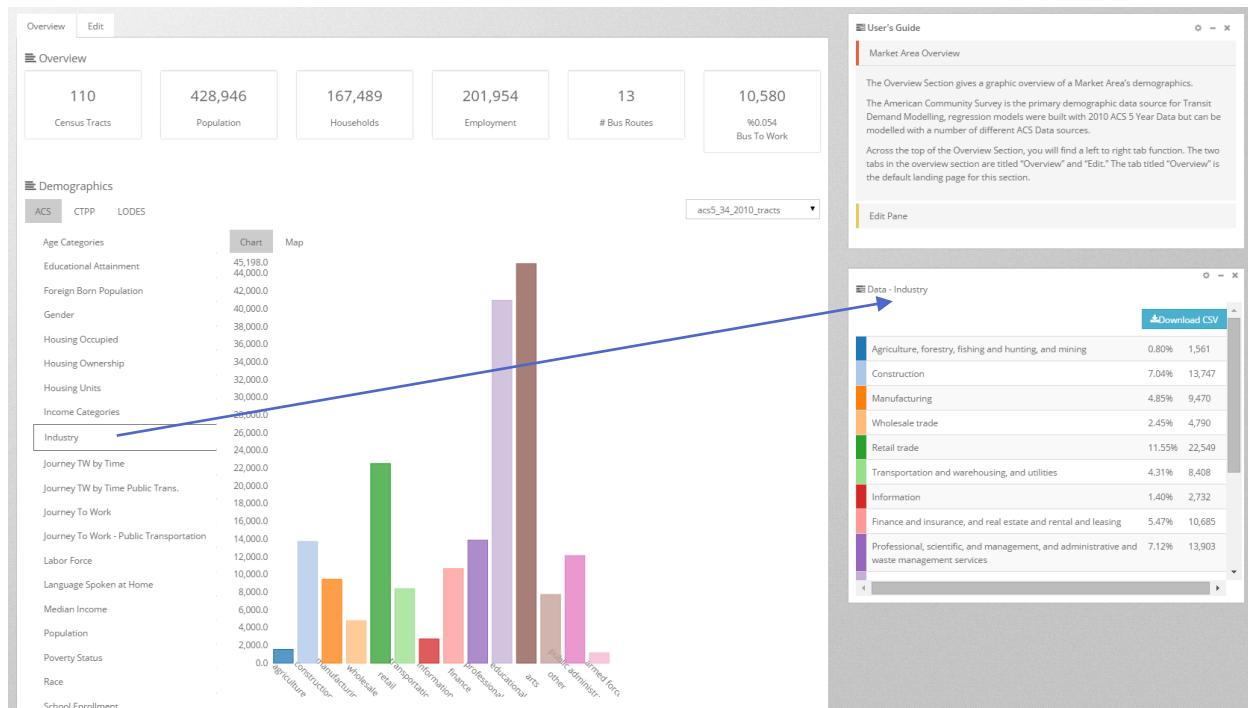


Figure 12 Admin Tool, Overview Section, Illustration of Graph Selection Changing Data Box

3.4.1.1.3 Data Sets

- Data Sets:** To change data type in the center pane of the overview section click on one of the data types located in the top left.
- Data Sources:** There is also a drop down menu to change the source of the data type. ACS 5 year, 10 year, etc.

ACS CTPP LODES

Figure 13 Data Set Tabs

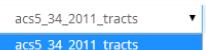


Figure 14 Data Source Dropdown

3.4.1.1.4 CTPP

The CTPP map allows a user to view home-to-work ridership data to and from census tracts. The first map that appears when you click on the CTPP tab shows the number of bus-to- work riders in each census tract. This section contains a toggle that allows the user to view outbound data and inbound.

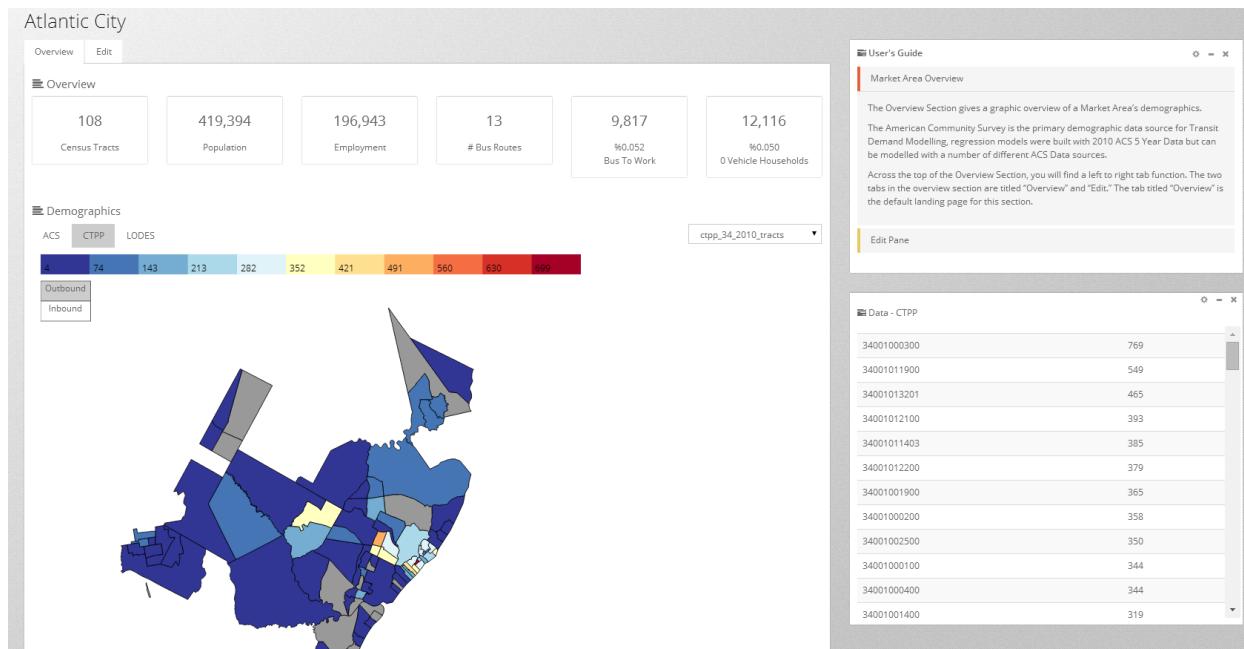


Figure 15 Market Area Overview, CTPP Map

Mousing over each census tract in the right side data table magnifies the census tract in the map.

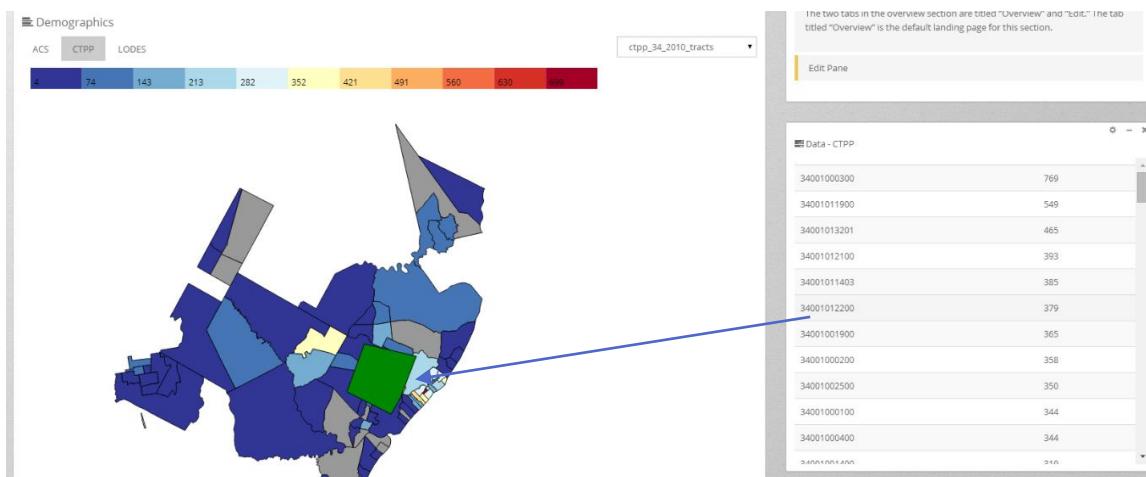


Figure 16 Illustration of Mouse-over Highlighting Census Tract

By selecting a census tract in either the map or the data table the user can view information about home-to-work trips outbound from that census tract.

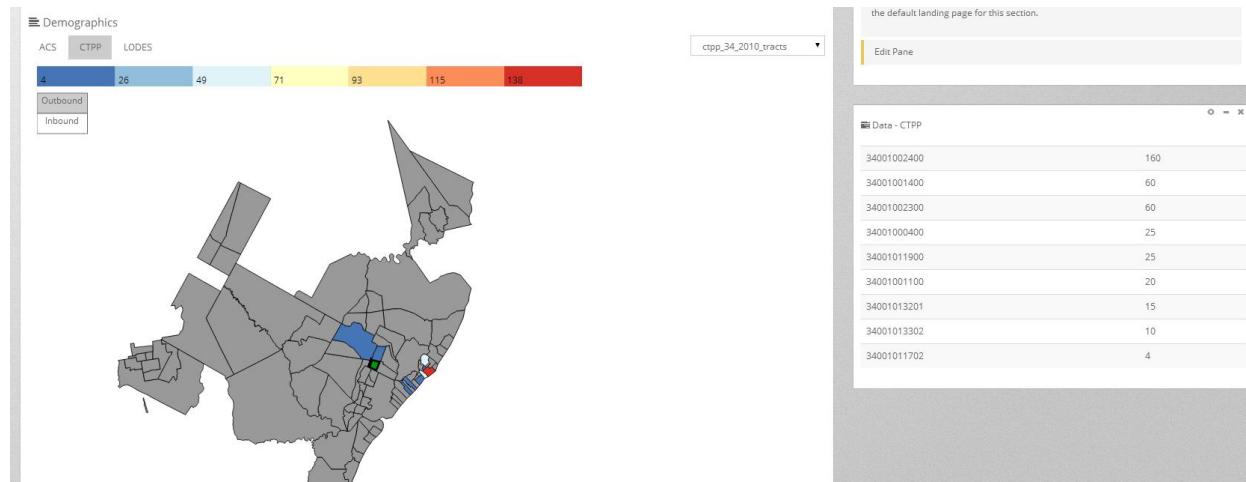


Figure 17 CTPP Bus-to-Work Outbound Trips from Chosen Census Tract

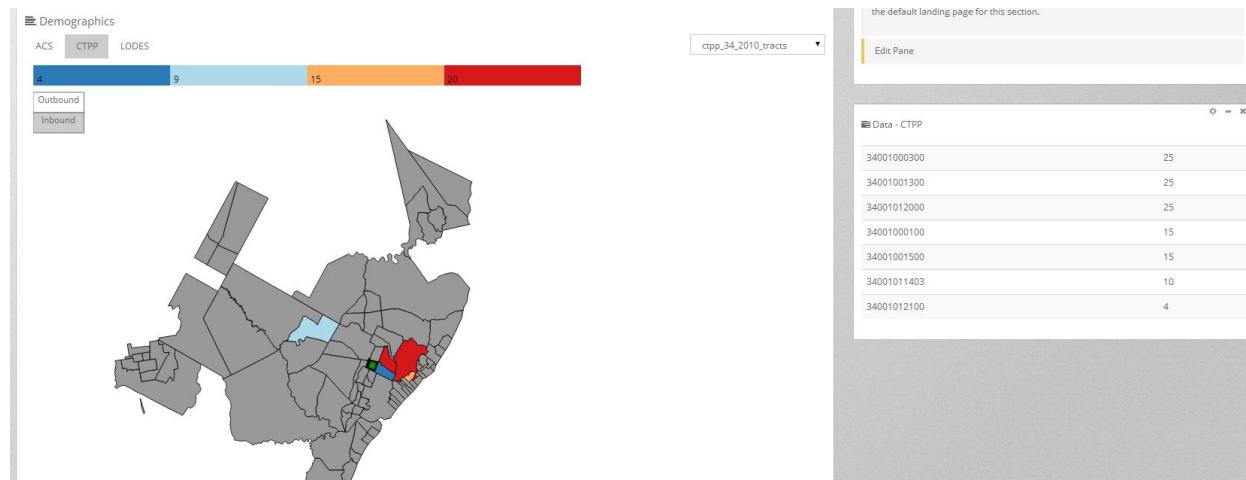


Figure 18 CTPP Inbound Trips to the Chosen Census Tract

3.4.1.1.5 LODES

The LODES tab allows the user to view LEHD Origin Destination Employment Statistics. These maps work in exactly the same way as the CTPP maps.



Figure 19 Market Area Overview, LODES Map, Illustration of Mouseover Function

When a user selects a census tract, either on the map or in the data table, the map and table change to show travel to work data outbound from the selected census tract.

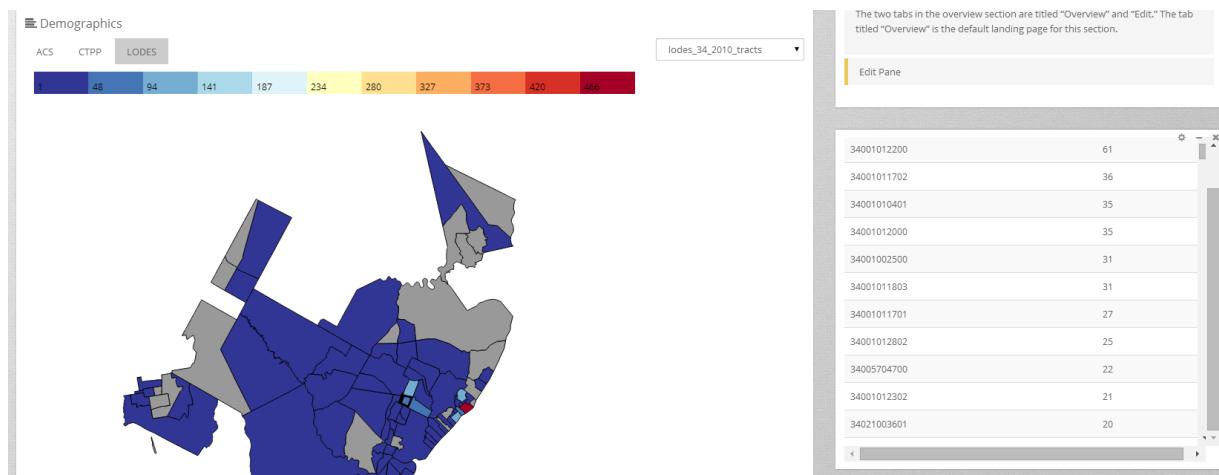


Figure 20 LODES All Modes Travel-to-Work Outbound from Chosen Census Tract

3.4.1.2 The Edit Tab (Market Areas>Atlantic City>Overview>Edit)

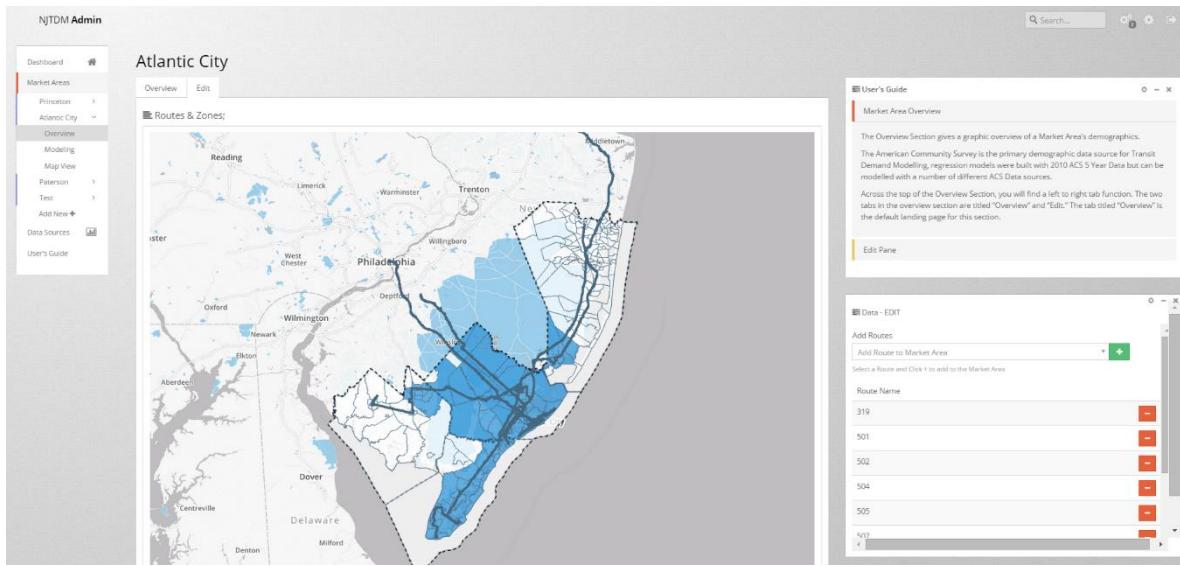


Figure 21 Admin Tool, Edit Market Area, Tab

The Edit section allows you to add (Green + Button) or remove (Red – Button) a bus route in the right side box.

The map in the center of the screen shows you which census tracts are in your market area as well as which routes you've chosen for your market area.

The right side Routes Box (Figure 22) allows you to search all of the bus routes in a given Market Area in a smart dropdown menu. You can either search all bus routes or narrow your search by typing one of the numbers in the bus route you would like to use.

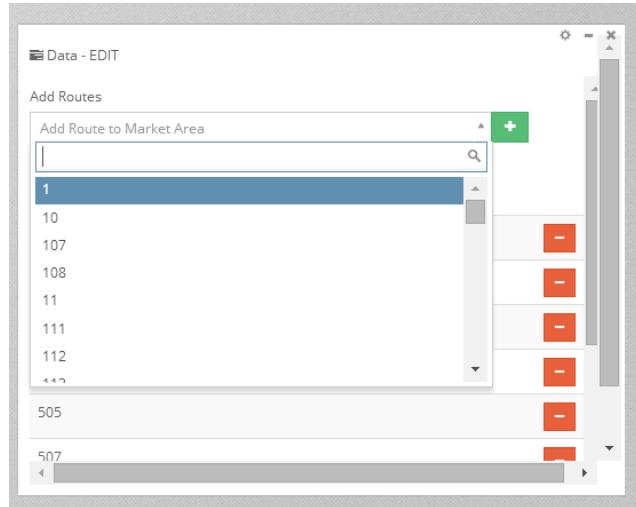
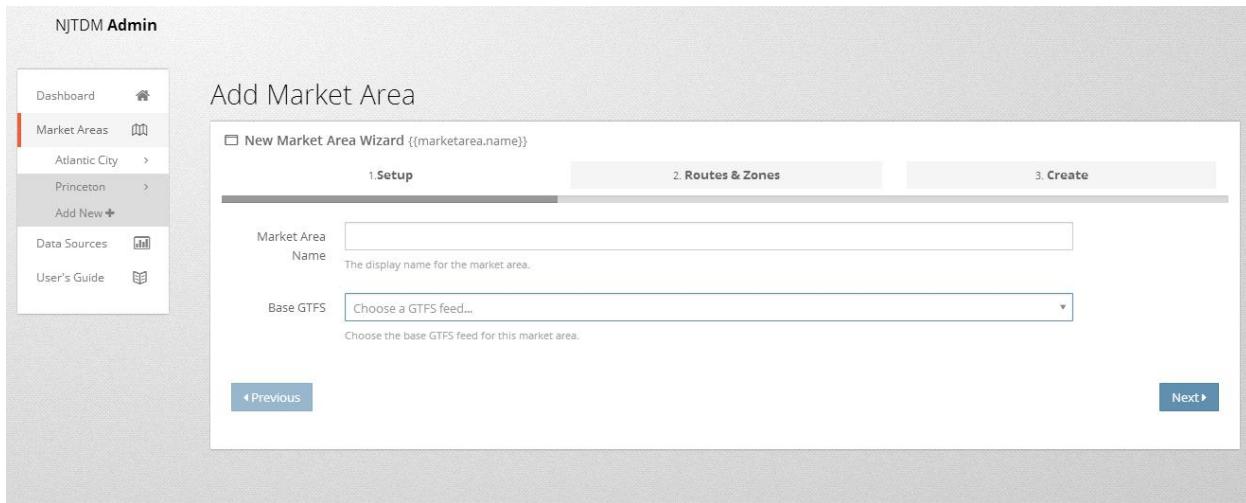


Figure 22 Admin Tool, Edit Bus Routes Dropdown Menu

3.4.2 Add Market Area

You can add new market areas by following the step-by-step process of the **Add Market Area Wizard**.

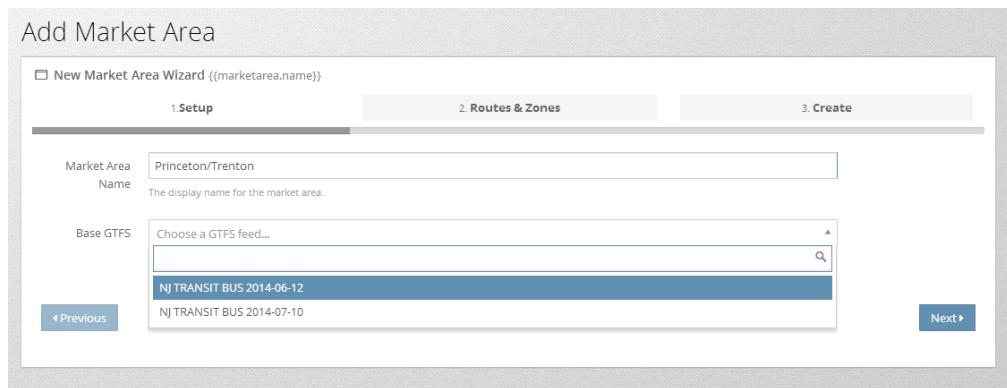


The screenshot shows the 'Add Market Area' wizard in the NJTDM Admin tool. The left sidebar has 'Market Areas' selected. The main area is titled 'Add Market Area' and shows 'Step 1: Setup'. It has fields for 'Market Area Name' (Princeton) and 'Base GTFS' (Choose a GTFS feed... dropdown with options: NJ TRANSIT BUS 2014-06-12 and NJ TRANSIT BUS 2014-07-10). Navigation buttons 'Previous' and 'Next' are at the bottom.

Figure 23 Admin Tool, Add Market Area

3.4.2.1 Step 1 - Name the Market Area

The first step is to give your market area a name and choose a base GTFS feed. Then click next.



The screenshot shows the 'Add Market Area Wizard' in the NJTDM Admin tool, Step 1: Setup. The 'Market Area Name' field is filled with 'Princeton/Trenton'. The 'Base GTFS' dropdown is open, showing 'NJ TRANSIT BUS 2014-06-12' as the selected option. Navigation buttons 'Previous' and 'Next' are at the bottom.

Figure 24 Admin Tool, Add Market Area Wizard

3.4.2.2 Step 2 - Routes & Zones.

Here you'll need some knowledge of your market area's bus routes. You'll need to type in the route numbers then click on the green plus symbol to add it to your market area.

Each Route you add to the Market Area will be included as a red line in the map below. Each route you add will include its corresponding census tracts illustrated in Figure 26 as black tract outlines. After viewing the map of census tracts and bus routes click **Next** to go to step 3.

Add Market Area

New Market Area Wizard {{marketarea.name}}

1. Setup 2. Routes & Zones 3. Create

Add Routes	
655	<input style="background-color: #008000; color: white; border: none; width: 20px; height: 20px; float: right;" type="button" value="+"/>
65	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
165	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
65	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
153	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
655	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
165	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
166	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
167	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
156	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
158	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
159	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
162	<input style="background-color: #f08080; border: none; width: 20px; height: 20px; float: right;" type="button" value="x"/>
612	
613	
619	
603	
605	
606	
609	

Figure 25 Admin Tool, Add Market Area Wizard Step 2

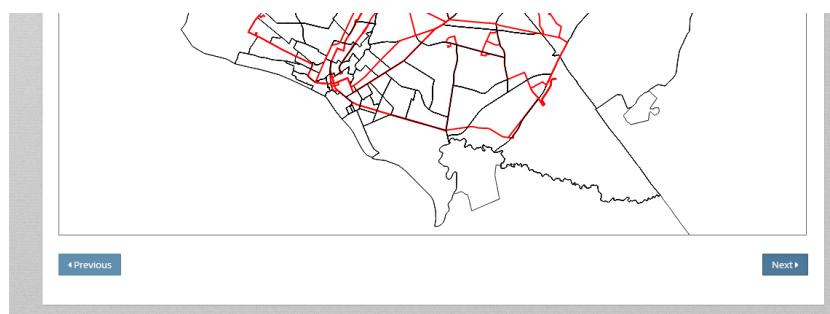


Figure 26 Admin Tool, Add Market Area Wizard, Step 2 Routes and Zones Map

3.4.2.3 Step 3 - Review Market Area and Create

Here you'll view the number of routes and census tracts in your new Market Area. When you click **Finish** you will be brought to the Market Area > Overview page for your new Market Area.

Add Market Area

New Market Area Wizard Princeton

1. Setup 2. Routes & Zones 3. Create

Princeton

Overview

Routes	9
Census Tracks	86
Center Point	[-74.689873,40.275383500000004]

Click Finish to create this MarketArea

Figure 27 Admin Tool, Add Market Area Wizard, Step 3 Finish

3.4.3 Modelling

The Modelling section of the Admin Tool allows you to run models and analyze their outputs.

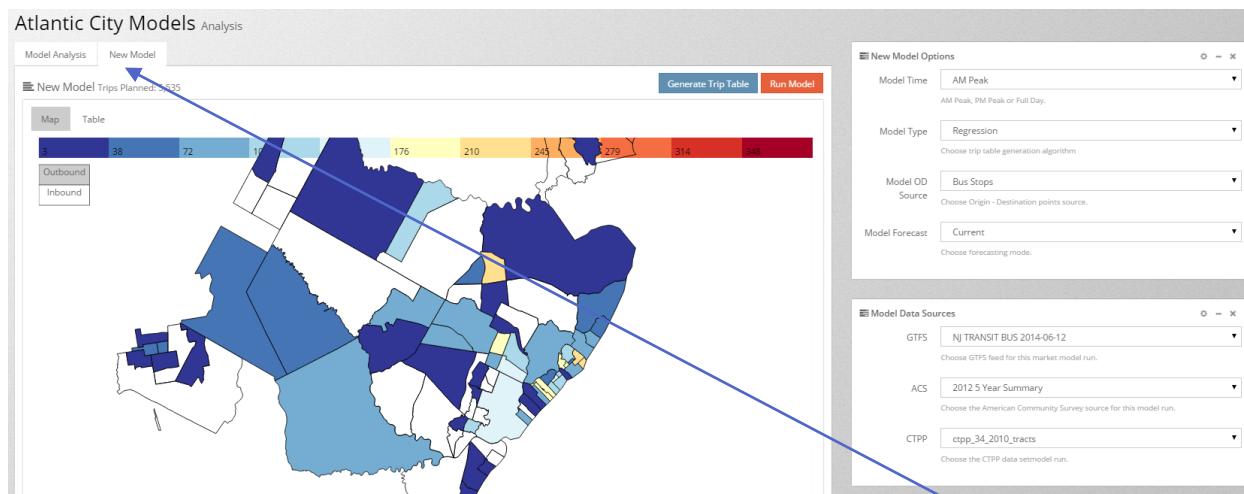


Figure 28 Admin Tool, Modelling Section

This section contains two tabs: **Model Analysis** and **New Model**. The landing page for this section is the **New Model** Tab.

Model Analysis | New Model

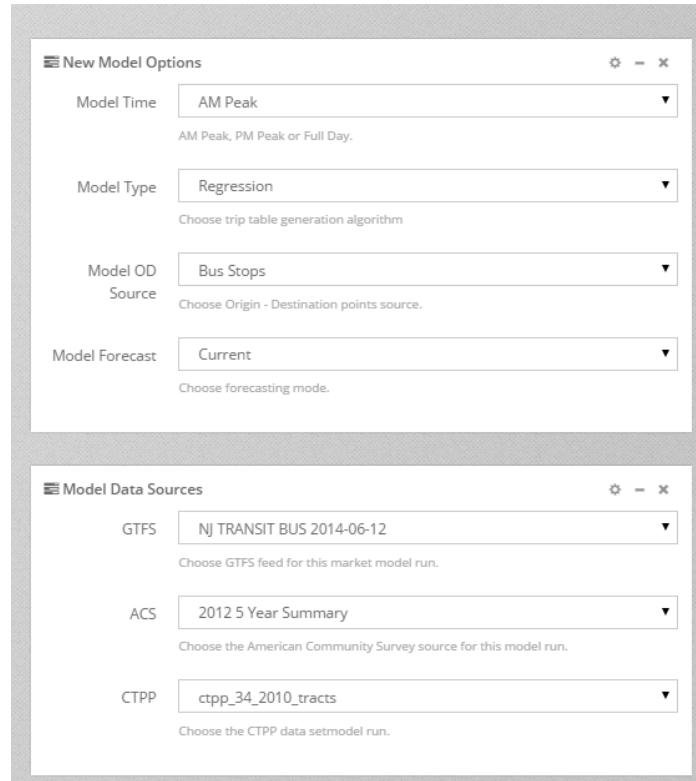
Figure 29 Admin Tool, Modelling Section, Tabs

3.4.3.1 New Model

The New Model tab allows you to run a model in the Admin Tool without navigating to the Map View. This feature is controlled by the right side workspace as seen in Figure 30. These boxes control settings for your new model. The Settings are as follows:

New Model Options

- Model Time
 - AM Peak
 - Full Day
 - PM Peak
- Model Type
 - CTPP
 - LODES+ACS
 - Regression
 - Survey
- Model OD Source
 - Bus Stops
 - Parcels
 - Survey Data
- Model Forecast
 - Custom by Market Area or census Tract
 - MPO Five Year Future Forecast
 - Current



The figure shows the 'New Model Options' and 'Model Data Sources' sections of the Admin Tool. The 'New Model Options' section includes dropdowns for 'Model Time' (AM Peak), 'Model Type' (Regression), 'Model OD Source' (Bus Stops), and 'Model Forecast' (Current). The 'Model Data Sources' section includes dropdowns for 'GTFS' (NJ TRANSIT BUS 2014-06-12), 'ACS' (2012 5 Year Summary), and 'CTPP' (ctpp_34_2010_tracts).

Figure 30 Admin Tool, Modelling Section, Model Settings Boxes

3.4.3.1.1 Running a Model in the Admin Tool: New Model Tab

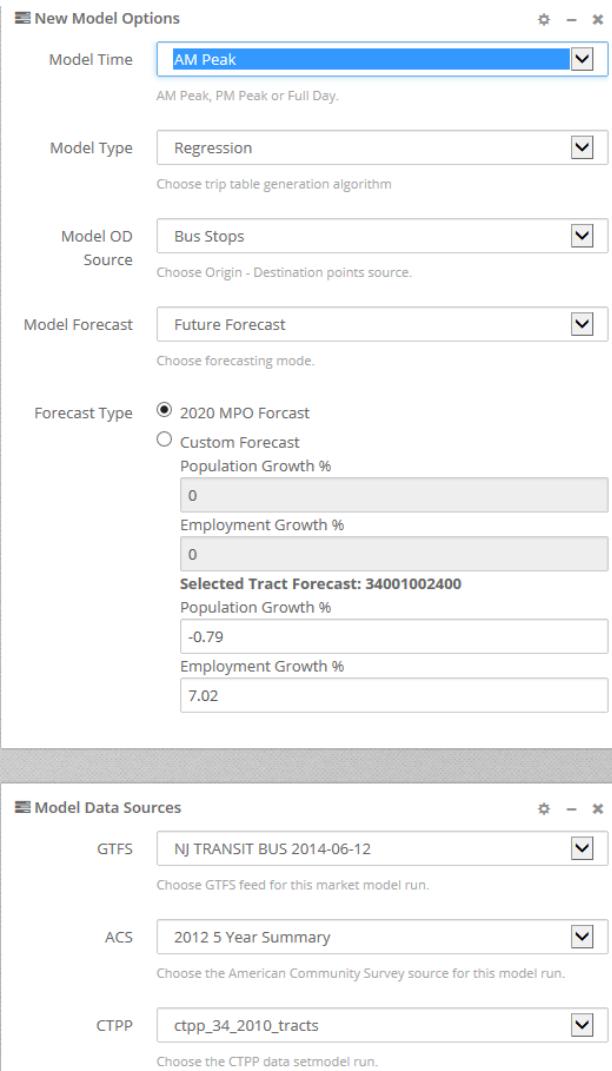
The Process for running a model in the Admin Tool is exactly the same as running a model in the Map View (**See Section: 3.6 Map View** for a run through on the process). The Difference here is that each setting you need for running a model is organized for you in the two boxes in the right. The two boxes are New Model Options and Model Data Sources.

New Model Options box has all of your basic model settings that are available to you on the Map View page. The Model Data Sources Box allows you change between data sources.

In the New Model Options Box you can change data and time parameters as well as perform forecasts. To run a model, simply set each box to your desired setting and click **Generate Trip Table**.

3.4.3.1.2 New Model: Map Tab

The **Trip Table Map** allows you view trips generated by census tract.



The screenshot shows two panels side-by-side. The left panel is titled "New Model Options" and contains the following settings:

- Model Time:** AM Peak (selected)
- Model Type:** Regression
- Model OD Source:** Bus Stops
- Model Forecast:** Future Forecast
- Forecast Type:** 2020 MPO Forecast (radio button selected)
- Population Growth %:** 0
- Employment Growth %:** 0
- Selected Tract Forecast:** 34001002400
- Population Growth %:** -0.79
- Employment Growth %:** 7.02

The right panel is titled "Model Data Sources" and contains the following settings:

- GTFS:** NJ TRANSIT BUS 2014-06-12
- ACS:** 2012 5 Year Summary
- CTPP:** ctpv_34_2010_tracts

Figure 31 Admin Tool, Modelling, New Model Tab, Trip Table Selections

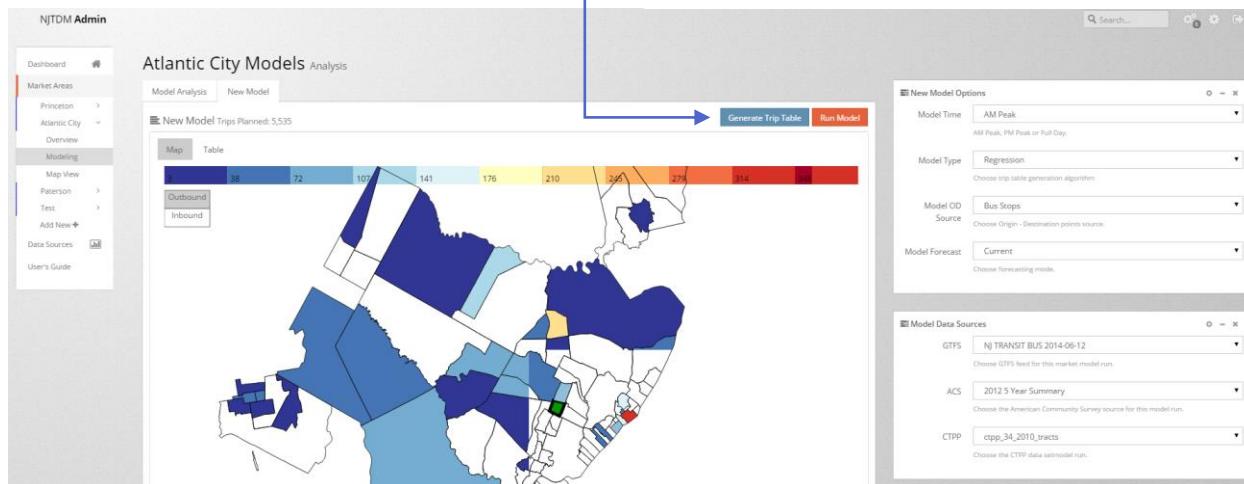


Figure 32 Admin Tool, Modelling, Trip Table Map

To toggle between inbound and outbound trips click on the box in the top left.

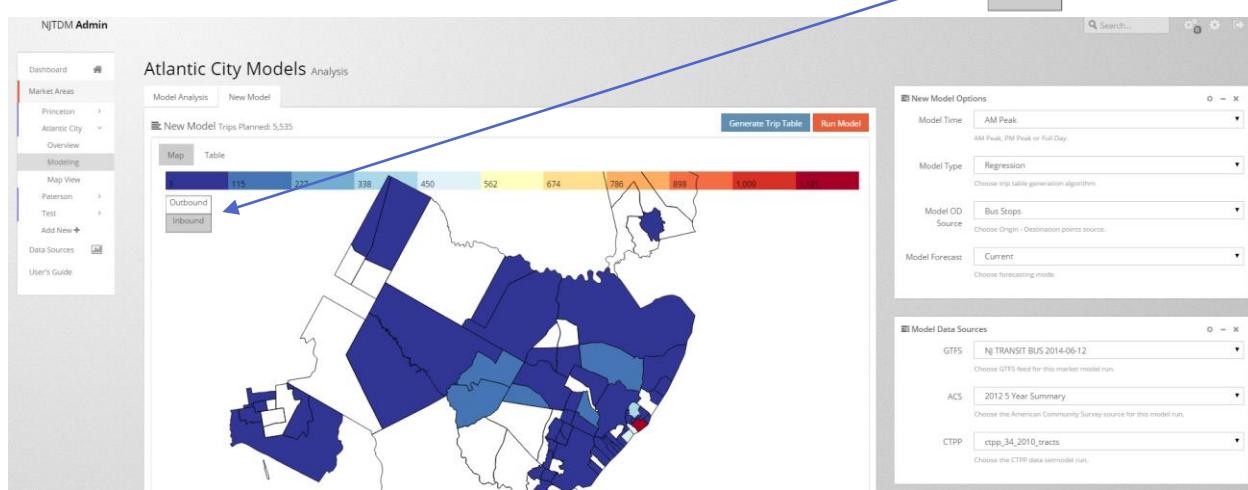
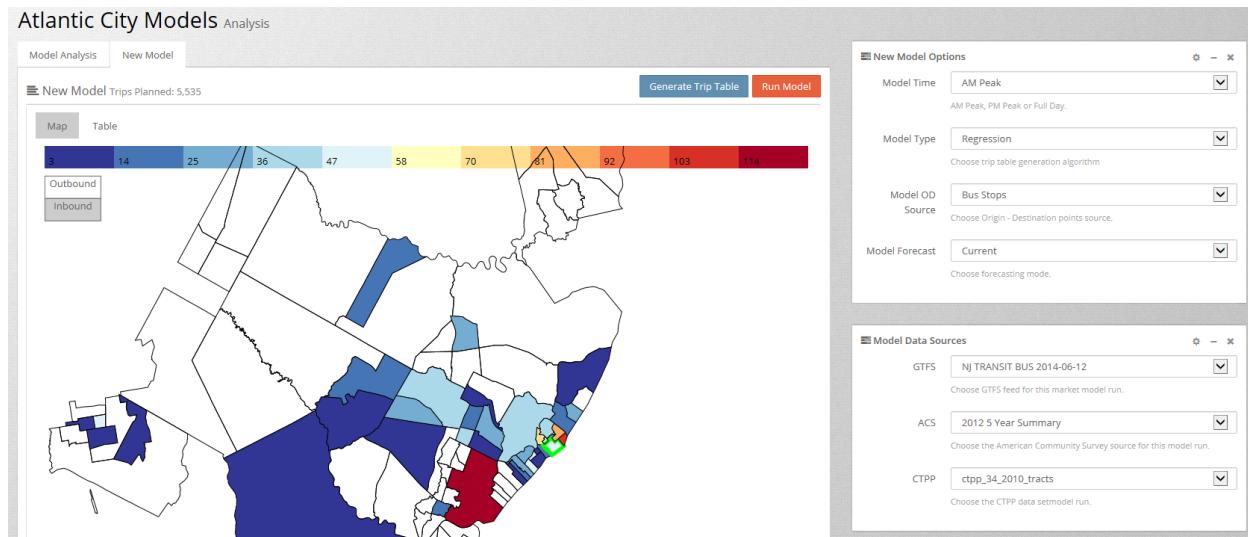


Figure 33 Admin Tool, Modelling, Trip Table Map, Inbound/Outbound Toggle

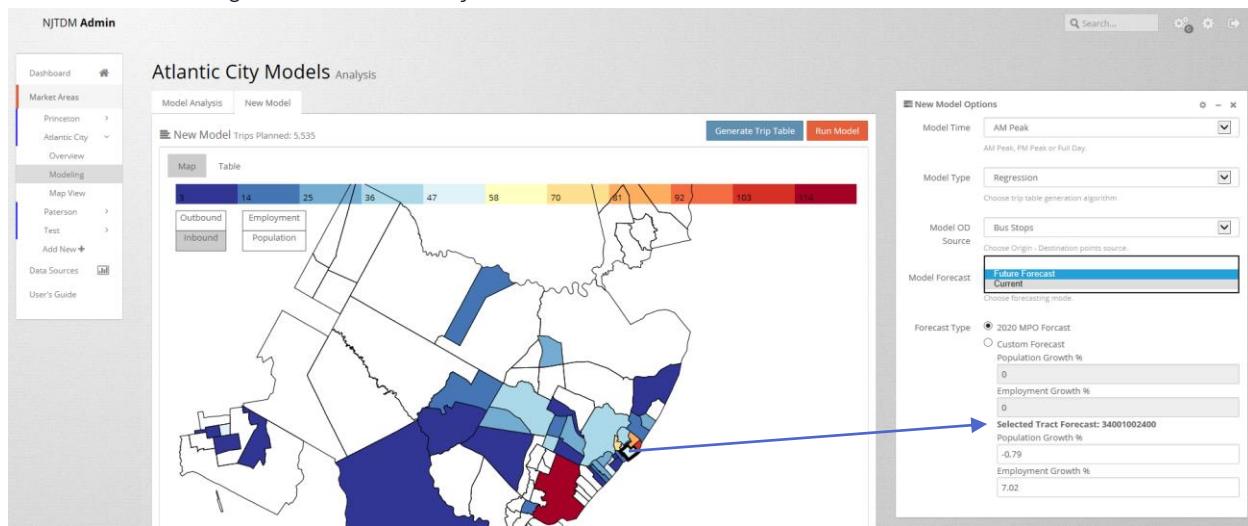
When you click on a census track the map will reorganize to show inbound and outbound trips for that tract. The chosen census tract will be highlighted in the map.



3.4.3.1.3 Model Forecasting

Five Year Future Forecast allows the user to run a model that forecasts future ridership. When you click on the model forecasting dropdown menu and select Five Year Future Forecast a new box will open below that allows you to choose the % Growth as set by the MPO models or to choose to set your own % Growth (including negative growth).

3.4.3.1.3.1 Setting Growth Scenarios for Future Forecasts



The Model Forecasting section allows you to apply growth (or negative growth) by entire market area or by census tract. For example, a user can run a forecast based on the scenario of losing 10% of jobs in a given census tract due to the removal of a large employer.

To apply a percent growth to a census tract click the radio button associated with the **Growth %** box. Next, click on a census tract to select that tract.

Below the Market Area Population Growth box and the Employment Growth box, there is census tract level growth for Population and Employment, titled **Selected Tract Forecast**. In the box below the census tract enter the percent growth (positive or negative). This percent growth will be applied only to the census tract chosen.

The new model will be run based on adjusted trip tables accounting for 10% negative growth in Census Tract 002400.

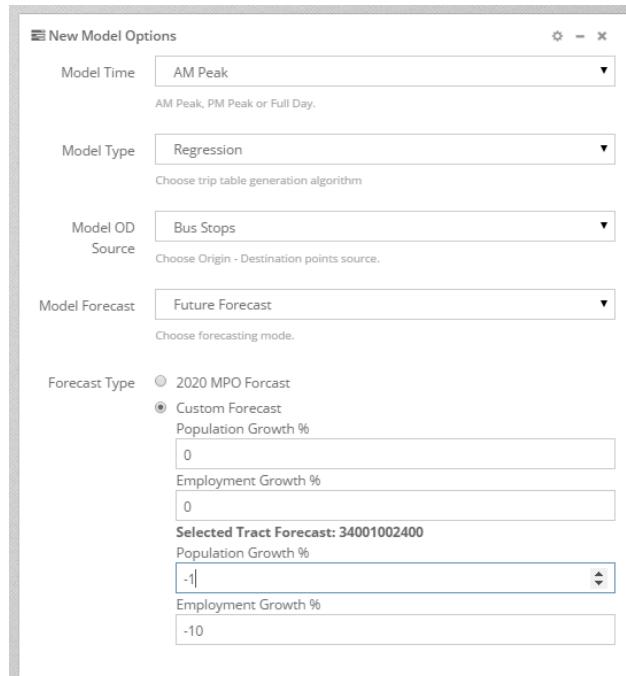


Figure 34 Model Forecasting Menu, -10% Growth in Census Tract 002400

The results show approximately 10% decline in ridership but that percent decline has been

Route ID	AC AM Reg 2010, -10% Employment in Tract 002400	AC AM Reg 2010
319	210	210
501	452	479
502	338	346
504	210	246
505	1518	1596
507	398	389
508	739	731
509	335	336
551	84	98
552	624	637
553	581	565
554	293	299
559	41	49

Figure 36 Model Analysis of AC AM Reg 2010 vs. AC AM Reg 2010, -10% Employment in Tract 002400

microsimulated which shows larger declines on certain routes, smaller declines on others, and even an increase in a small number of routes.

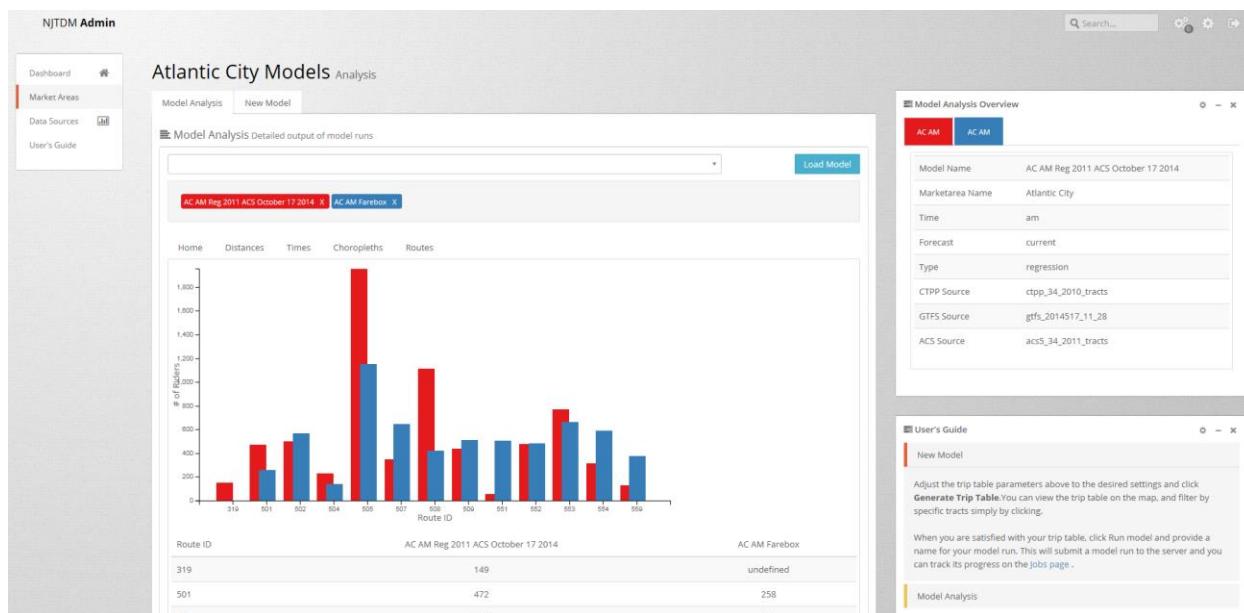


Figure 35 Graph of AC AM Reg 2010 Model vs. -10% Employment in Tract 002400 Model

3.4.3.1.4 MPO Future Forecast

AVAIL processed the forecast spreadsheet supplied by NJTransit containing the future employment and population forecasts by municipality. AVAIL then posted that data to the Trip Table map by census tract as seen in figure 35.

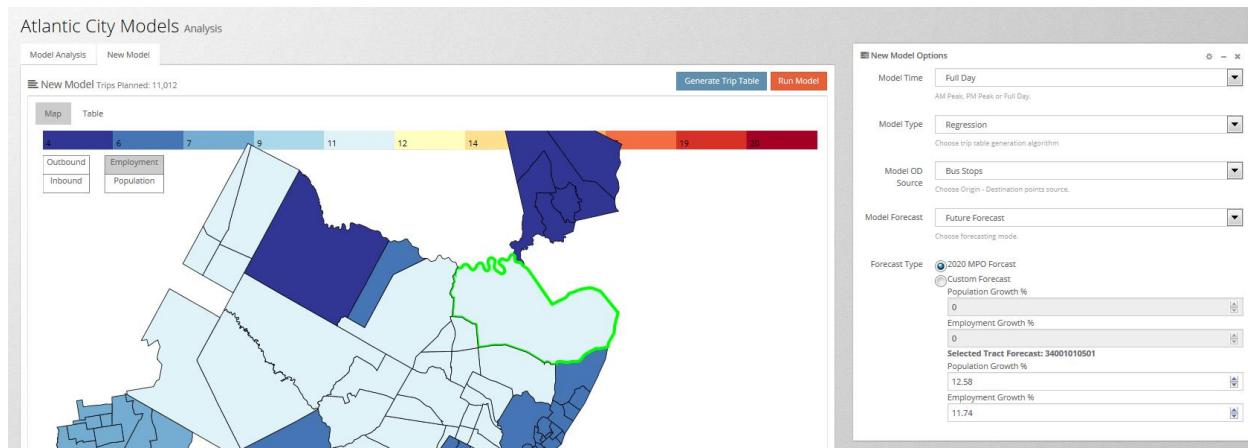


Figure 37 Admin Tool, Modelling, Trip Table Map, MPO Future Forecast

To see the MPO 5 year forecast applied to each census tract click on the radio button associated with **2020 MPO Forecast**. Next click on any tract in the market area.

The User can now change the Employment Growth & and/or Employment Growth % (or negative growth) associated with the selected census tract.

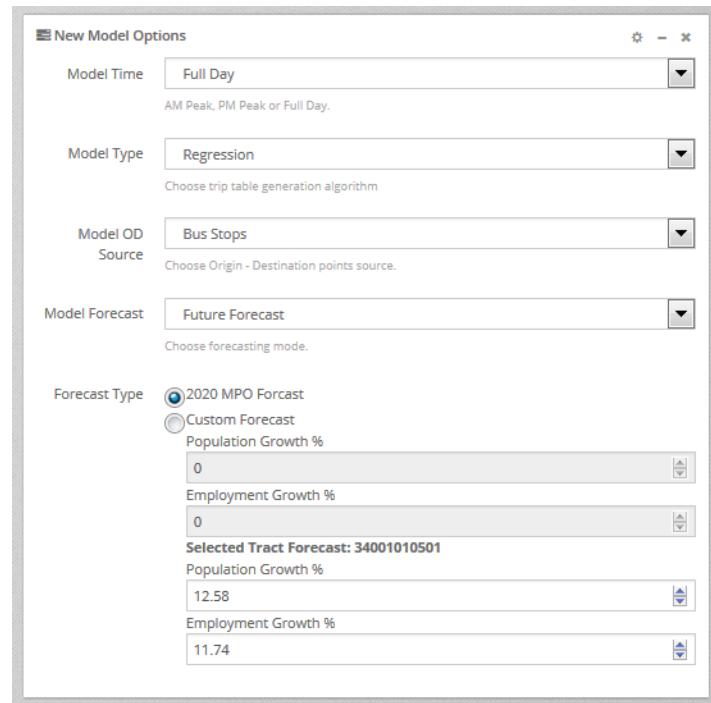


Figure 38 MPO Future Forecast for Selected Census Tract

The 2020 MPO Forecast percentages for employment and population of each census tract were calculated by dividing the 2020 forecast by the current 2010 census data.

Table 2 MPO Future Forecast Calculations for Atlantic County

	Employment			Population		
	<u>2010</u>	-	<u>2020</u>	<u>2010</u>	-	<u>2020</u>
SJTPO REGION	259,782	9.51%	284,483	594,795	6.15%	631,396
Atl (non-farm)	136,800	8.77%	148,796	274,549	7.25%	294,449
Absecon city	3,670	11.74%	4,101	8,411	6.47%	8,955
Atlantic City city	56,263	7.02%	60,213	39,558	-0.79%	39,246
Brigantine city	1,592	6.51%	1,695	9,450	-8.32%	8,664
Buena borough	1,260	6.51%	1,342	4,603	12.05%	5,158
Buena Vista township	1,350	11.74%	1,509	7,570	1.15%	7,657
Corbin City city	514	6.51%	548	492	3.28%	508
Egg Harbor City city	3,125	6.51%	3,329	43,323	18.35%	51,274
Egg Harbor township	14,404	10.65%	15,938	4,243	-2.21%	4,149
Estell Manor city	239	6.51%	254	1,735	6.05%	1,840
Folsom borough	872	11.74%	975	1,885	-1.47%	1,857
Galloway township	8,901	11.74%	9,946	37,349	12.58%	42,048
Hamilton township	10,554	10.65%	11,679	26,503	18.73%	31,467
Hammonton town	8,838	11.74%	9,876	14,791	11.10%	16,432
Linwood city	2,803	6.51%	2,986	7,092	-0.37%	7,066
Longport borough	160	6.51%	170	895	-5.03%	850
Margate City city	1,680	11.74%	1,877	6,354	-7.48%	5,879
Mullica township	615	6.51%	655	6,147	2.37%	6,293
Northfield city	4,077	6.51%	4,342	8,624	7.44%	9,266
Pleasantville city	7,720	11.74%	8,626	20,249	4.16%	21,091
Port Republic city	86	6.51%	92	1,115	4.81%	1,169
Somers Point city	6,137	11.74%	6,857	10,795	-2.35%	10,541
Ventnor City city	1,733	6.51%	1,846	10,650	-5.84%	10,029
Weymouth township	180	6.51%	191	2,715	12.98%	3,067

For model running purposes, these forecast percentages are then applied to each census tract after trip generation. A negative Employment % change reduces number of trips into a census tract whereas a negative Population % change decreases the number of trips leaving a census tract. A -10% Employment growth is calculated by multiplying incoming trips, into a given census tract, by 0.90.

3.4.3.1.5 Trip Tables

The New Model tab allows you to view information about the inbound and outbound trips generated by the new model options. The information can be viewed in both map and chart form.

3.4.3.1.6 Run Model

After choosing your settings, generating your trip tables and reviewing the details of inbound and outbound ridership by census tract and bus route, you are ready to run the model. Click **Run Model** and a box will appear. The box contains all of the settings of your model and a box for entering your model name. Type in your model name and click **Run Model**.

[Generate Trip Table](#) [Run Model](#)

The Web-Tool will now send your model through Open Trip Planner for microsimulation.

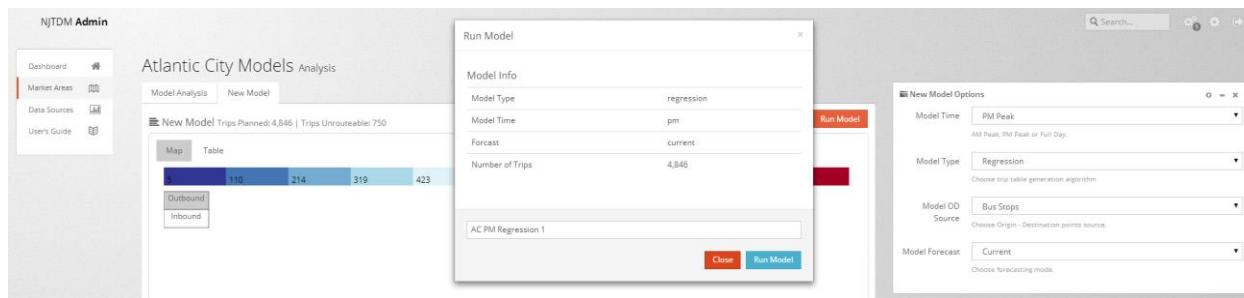


Figure 40 Admin Tool, Modelling, Run Model Popup Box

3.4.3.1.7 The Jobs Page

Running a model takes time. The Jobs Page allows a user to monitor the status of the newly created model.

To access the Jobs page, click on the gear symbol, located on the right side of the page, beside the search bar. In the dropdown menu click on **See all Jobs** to see all current and previous uploads, including their status. You can cancel your model run here as well.

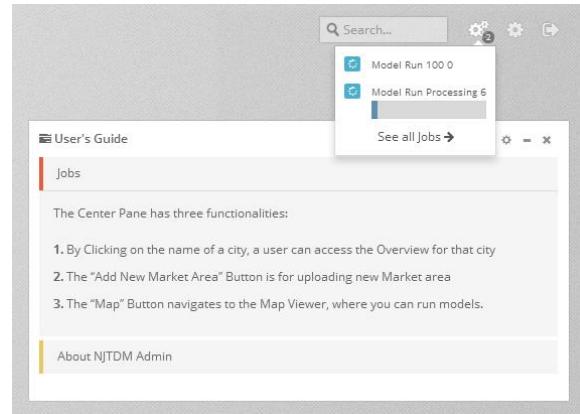


Figure 39 Admin Tool, Jobs Dropdown

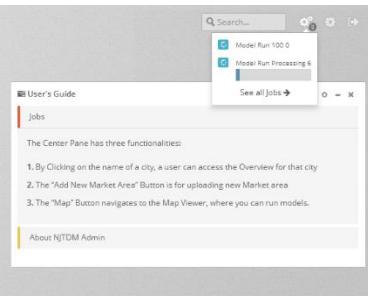
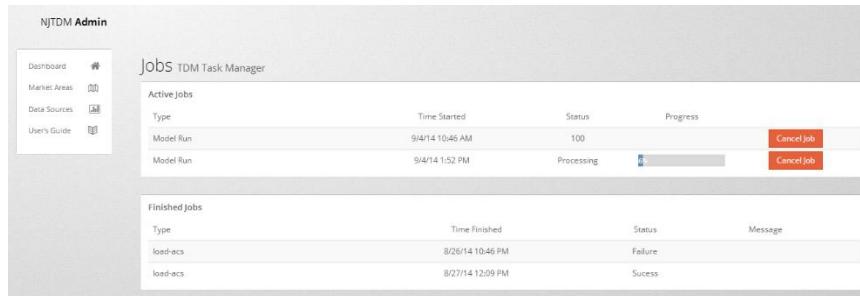
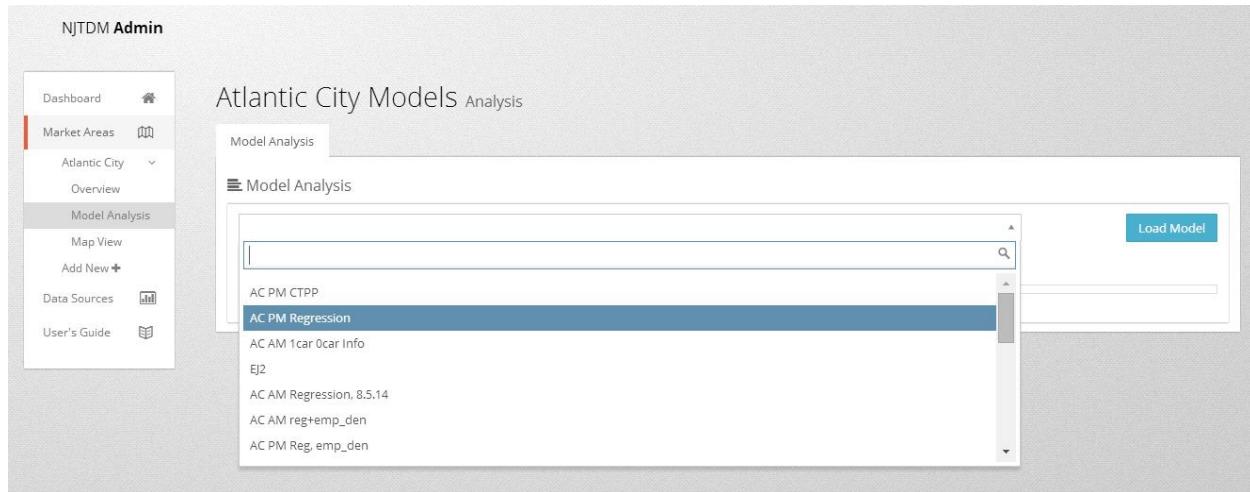


Figure 41 Admin Tool, Jobs Page

3.4.3.2 Model Analysis Tab

The Model Analysis section of the Admin Tool allows you to view graphs and data about model you've run in the Map View (See section 3.6). To analyze a model click on the dropdown menu, locate the model you would like to review and click **Load Model**. After loading your model a graph will appear.



NJTDM Admin

Atlantic City Models Analysis

Model Analysis

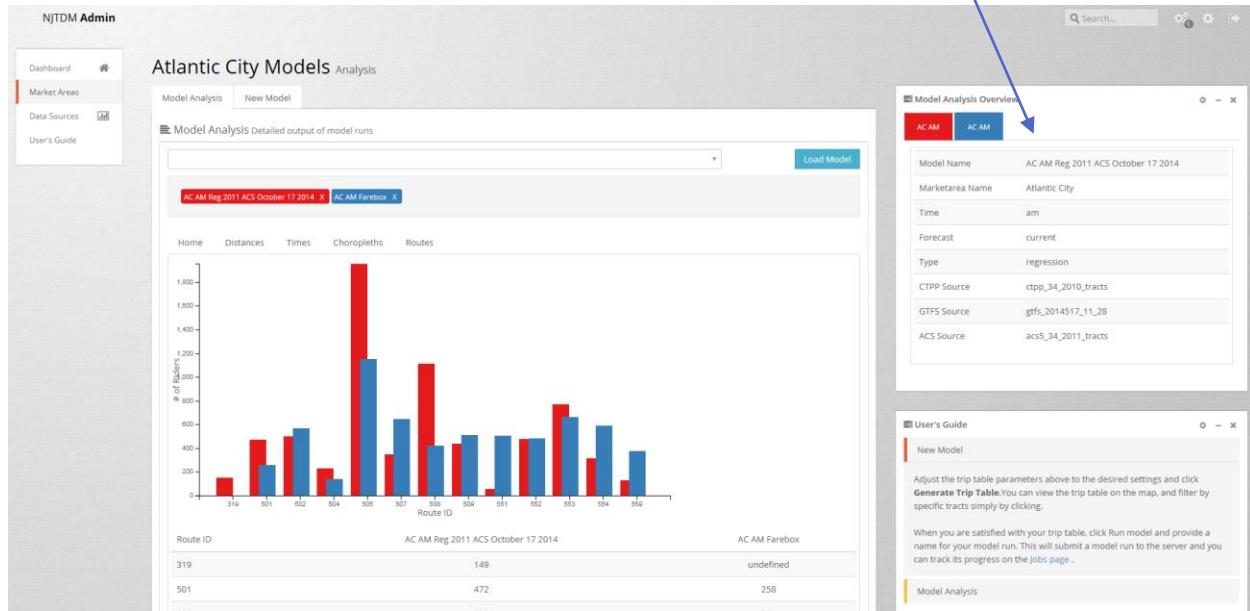
Model Analysis

AC PM CTPP
AC PM Regression
AC AM 1car 0car Info
EJ2
AC AM Regression. 8.5.14
AC AM reg+emp_den
AC PM Reg, emp_den

Load Model

Figure 42 Admin Tool, Model Analysis

The models you chose will now be displayed in graphs and charts. **Model input details** are displayed at right.



NJTDM Admin

Atlantic City Models Analysis

Model Analysis

Model Analysis Detailed output of model runs

AC AM Reg 2011 ACS October 17 2014 X AC AM Farebox X

Load Model

Home Distances Times Choropleths Routes

of Riders

Route ID

AC AM Reg 2011 ACS October 17 2014

AC AM Farebox

319	149	undefined
501	472	258
...

AC AM Analysis Overview

AC AM

Model Name: AC AM Reg 2011 ACS October 17 2014

Marketarea Name: Atlantic City

Time: am

Forecast: current

Type: regression

CTPP Source: ctpp_34_2010_tracts

GTFS Source: gtfs_2014517_11_28

ACS Source: acs3_24_2011_tracts

User's Guide

New Model

Adjust the trip table parameters above to the desired settings and click Generate Trip Table. You can view the trip table on the map, and filter by specific tracts simply by clicking.

When you are satisfied with your trip table, click Run model and provide a name for your model run. This will submit a model run to the server and you can track its progress on the jobs page.

Model Analysis

The Model Analysis tab is broken into sections, **Home**, **Directions**, **Time**, **Choropleth** and **Routes**. Each section contains visualizations for comparing models.

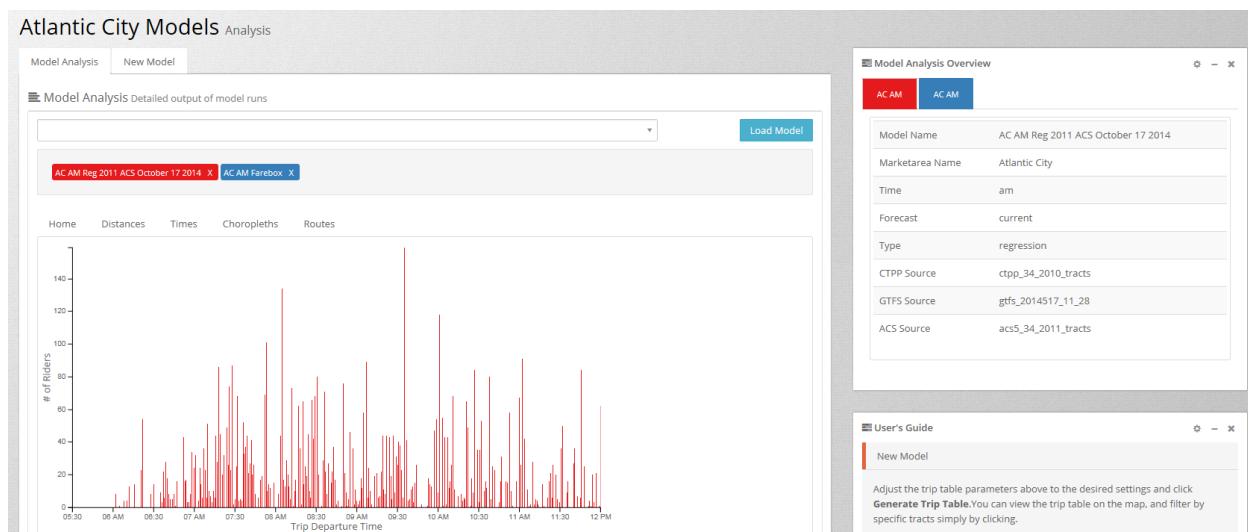
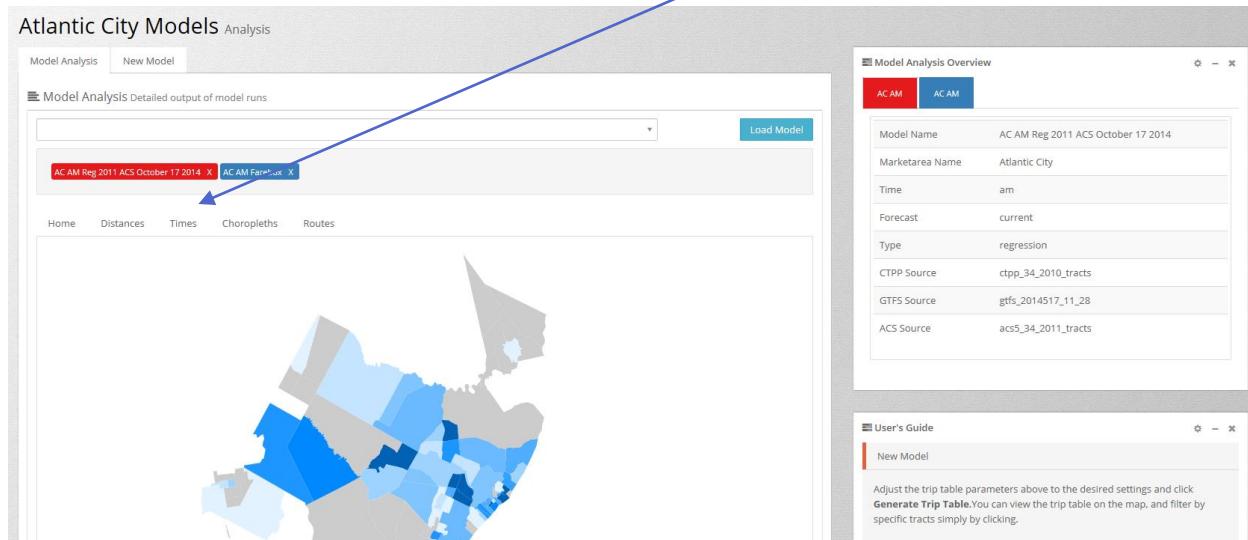


Figure 43 and 44 Admin Tool, Model Analysis, Choropleth Tab and Time Tabs

3.5 DATA SOURCES

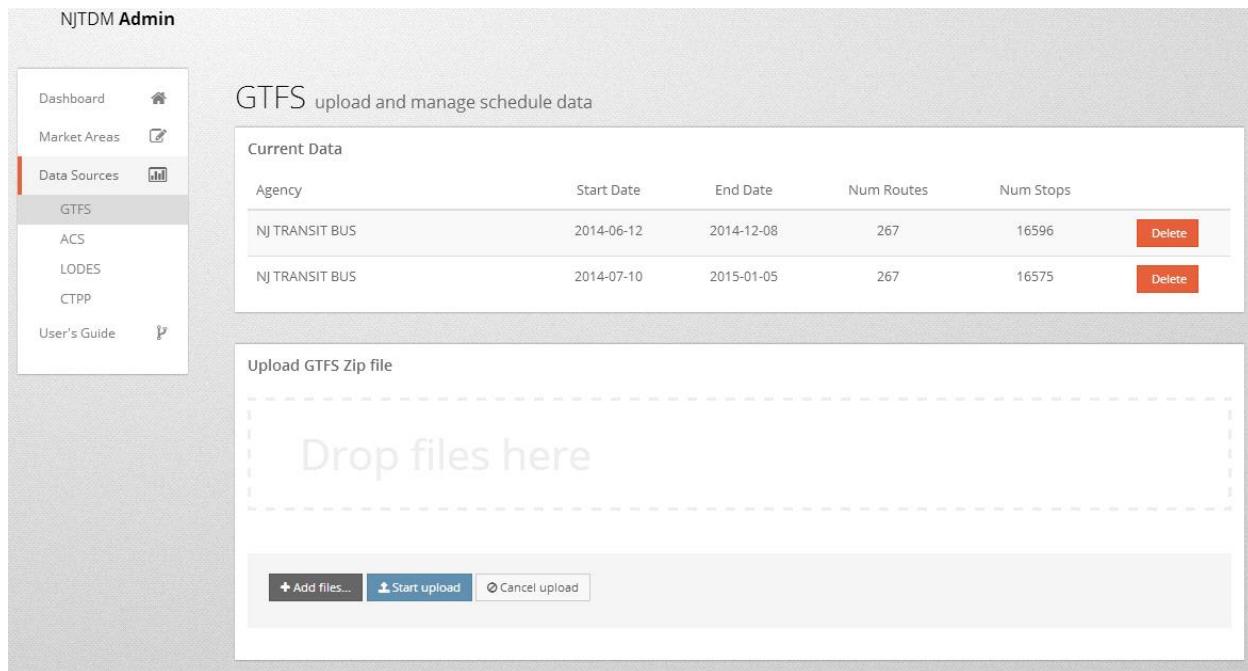
The Data Sources section serves two functions:

1. Data Upload and Management: This functionality is located in the Admin Tool Center Pane.
2. Information about Data Sources and User's Guide: This functionality is located in the Right Pane.

3.5.1 GTFS

3.5.1.1 About GTFS

The **General Transit Feed Specification (GTFS)** is a data standard for encoding transit schedule and operations information. GTFS is a collection of text files most often distributed in a compressed zip file.



Agency	Start Date	End Date	Num Routes	Num Stops
NJ TRANSIT BUS	2014-06-12	2014-12-08	267	16596
NJ TRANSIT BUS	2014-07-10	2015-01-05	267	16575

Figure 44 Admin Tool, Data Sources Section, GTFS Upload and Manage

3.5.1.2 Loading New Data

To upload new GTFS to the system drag and drop a GTFS zip file to the drop zone on the screen or click **add files** and search for the zip file to upload on your local file system.

The file will then appear underneath the upload section. To add the file to the TDM system simply click **Start upload** to import GTFS. This will start a new import job that can be monitored in the jobs dropdown on the top of the screen or on the jobs page. You can now navigate away from this page and wait for the job to finish. Because of the geospatial processing required to import a GTFS file for use in this system it can take up to 3 hours to import a large GTFS file.

3.5.1.3 Agency

Every GTFS file is required to have an agency file that lists the agency that created the GTFS file. This column lists the agency of loaded GTFS Data.

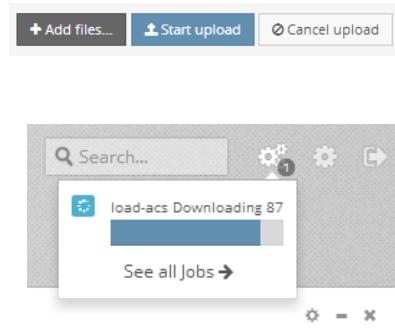


Figure 45 Loading New Data, Jobs Dropdown, Top Right Corner of Page

3.5.1.4 Start and End Date

A GTFS file is only valid for a specific amount of time as specified by the Calendar and/or Calendar dates files of the GTFS feed. These listings let you know when the file starts and ends its valid use.

3.5.1.5 Stop and Route Count

Lists the number of stops and routes present in each GTFS file.

3.5.2 ACS

The American Community Survey is the primary demographic data source for Transit Demand Modelling, regression models were built with 2010 ACS 5 Year Data but can be modelled with a number of different ACS Data sources.

3.5.2.1 Add New Data

ACS Data is loaded directly from the census ACS Application Programming Interface (API) into our Transit Demand Modeling database. To add data from neighboring states use the state dropdown menu to locate the desired state, enter Data Source, Base Year and Sum Level then click **Add Dataset**.

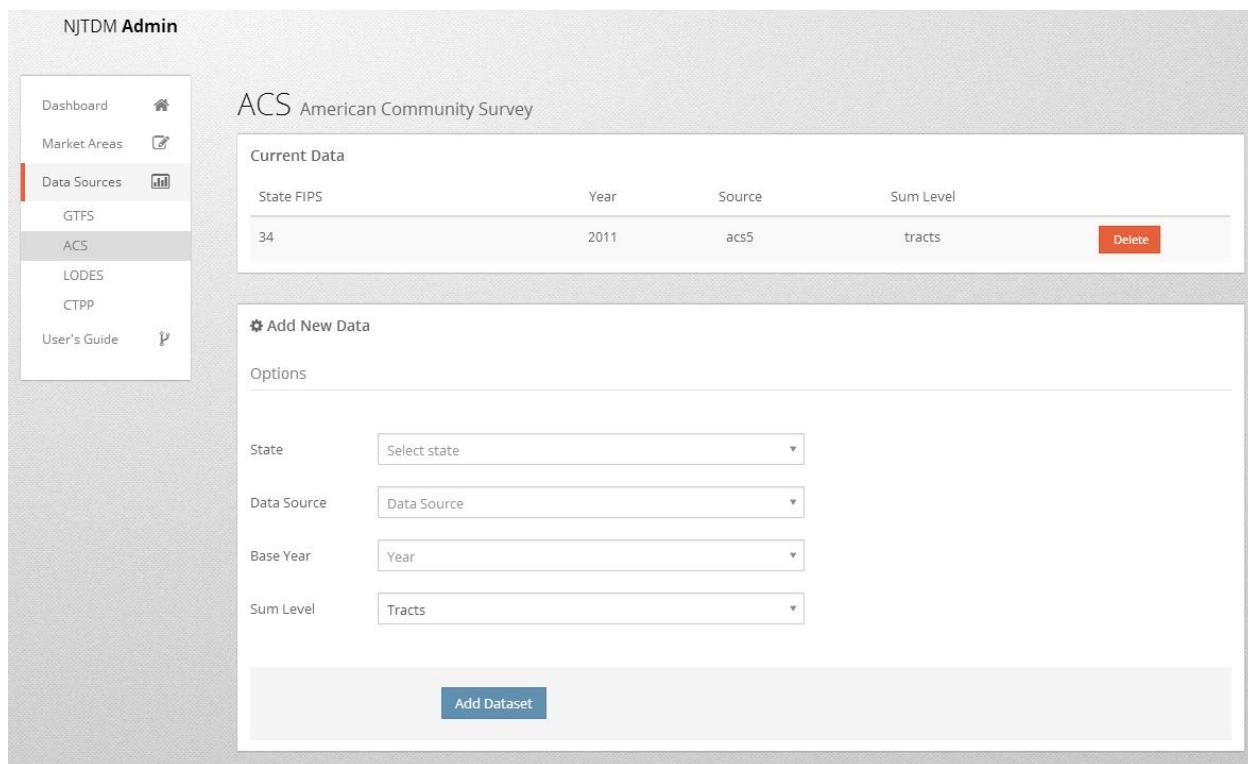


Figure 47 Admin Tool, Data Sources Section ACS Upload and Manage

State	New Jersey
Data Source	ACS 5 Year
Base Year	2012
Sum Level	Tracts

Add Dataset

Figure 46 Admin Tool, Data Sources with Chosen Settings

3.5.2.1.1 Monitoring your Data Source Upload

After Choosing your settings, click **Add Dataset**. This will start a new import job that can be monitored in the jobs drop down on the top of the screen or on the jobs page. You can now navigate away from this page. Because of the processing required to import a census API file for use in this system it can take significant time to import file.

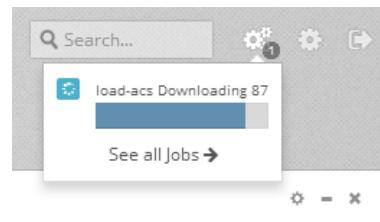


Figure 48 Jobs Dropdown

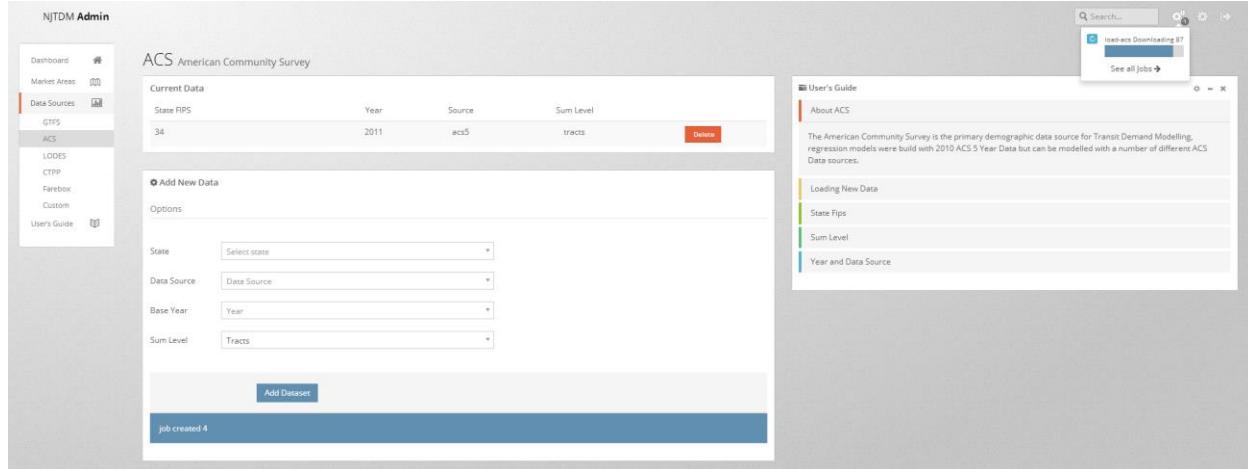


Figure 49 ACS Data Source Upload, New Job Created, Monitoring Process in Jobs Dropdown

3.5.2.2 Current Data Bar

3.5.2.2.1 State FIPS

State FIPS is the code used by the census to identify a state. New Jersey State FIPS Code is 34.

3.5.2.2.2 Sum Level

In this case, sum level is the geographic level to which the data is summed. For this tool we can use either census tracts or block groups.

3.5.2.2.3 Year and Data Source

ACS Data is available in 1, 3 & 5 year summary groups, the data source denotes which of these groups is being used. The year always denotes the last year of the summary group.

3.6 MAP VIEW

The Map View is accessed through the Left Navigation Panel (Market Areas>City>Map View). The Map View will open in another tab.

There are four Map View Tools to help in building and analyzing your model runs. Three of them are located on the left navigation panel. The fourth is the Model Data Viewer button on the right side of the page. The three tabs in the left navigation panel are as follows:

1. The Modeling Tab – This is the default tab where models are run.
2. The Census Tab – For viewing data about a given Market Area.
3. The GTFS Tab – For viewing routes and adding or removing routes.

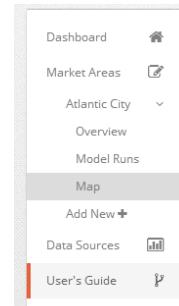


Figure 50 Admin Tool,
Left Navigation Panel,
Access to Map View

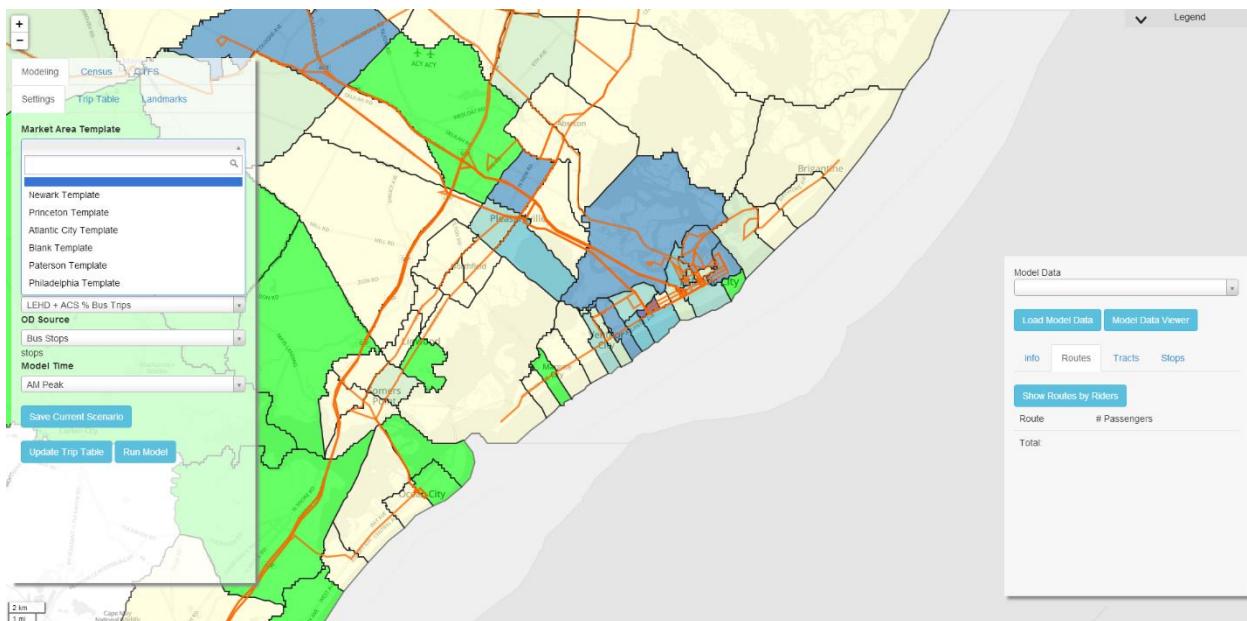


Figure 51 Map View

3.6.1 Modeling View – How to use Map View to Run Models

3.6.1.1 Step 1 - Load a Template

The first step in running a model involves loading your template.

Atlantic City is the default template. To choose another template, click on the dropdown menu titled **Market Area Template** located on the left side of the page.

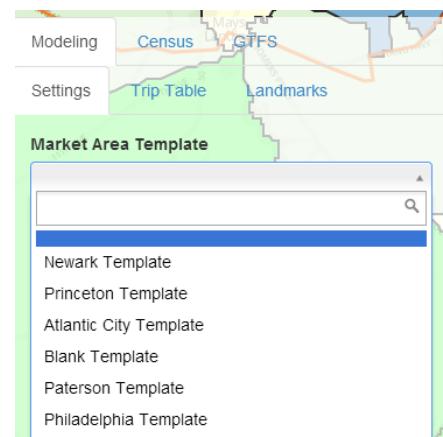


Figure 52 Map View, Load Market Area Template

3.6.1.2 Step 1.2 Editing the Scenario

You can add or remove census tracts from your market area simply by holding the CTRL button and clicking on the census tract you want to add or remove. When a census tract is changed the census data and trip table for the market area are automatically recalculated. When you remove a census tract, it is dimmed as can be seen on the right side of Figure 49. The deselected tract will be removed from the

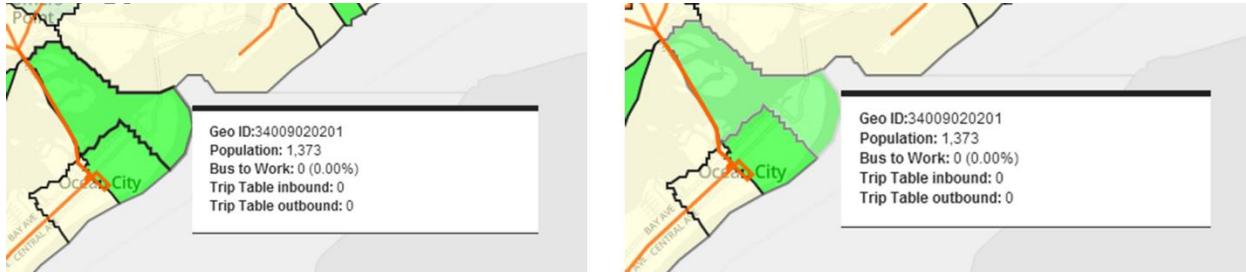


Figure 53 Map View, Illustration of Census Tract Removal

scenario map the next time the scenario is loaded.

3.6.1.3 Step 2 - Choose Your Trip Table Generation Algorithm (Model)

We have designed a number of algorithms to generate trip tables for a market area, they are based on different data sources and methodologies. These different algorithms perform differently in each market area and respond to different factors.

Choose your algorithm by clicking on the dropdown menu titled **Trip Table Generator** located on the left navigation panel.

3.6.1.4 Step 3 - Update Trip Tables

Once you have selected the trip table algorithm you want to use, click on the button below titled **Update Trip Table**. This will update the number of trips planned by the model you've chosen. You'll notice a change in the number of **Trips Planned**, **Trips Unroutable** and **Number of Tracts**. These numbers are generated by a set of algorithms based on the model you've chosen combined with the census tracts and bus routes chosen and the time of day.

3.6.1.5 Step 4 - Choose Your OD Points Source

Trip table generation algorithms work at the level of a geographic zone, like a census tract. To create a trip table that can be simulated by Open Trip Planner, we need specific points of latitude and longitude inside each census tract to map those individual trips. **Bus Stops** - Uses bus stops from GTFS as origin destination points. **Parcel Data (experimental)** - Uses centroids of random parcels within 1/2 mile of bus stops. **Survey Data (where**

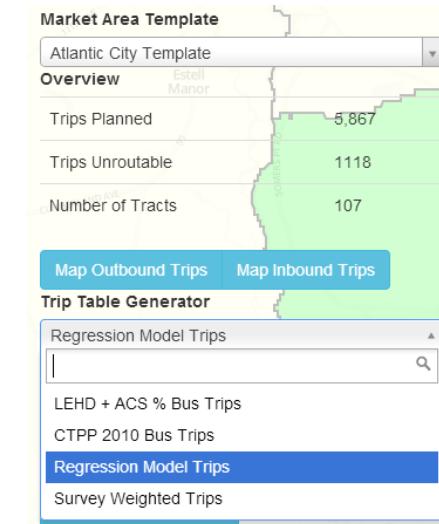


Figure 55 Map View, Trip Table Generation, Algorithm Selection

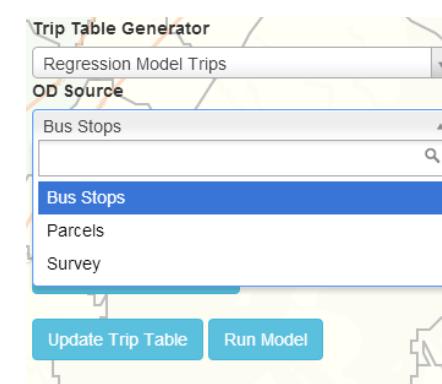


Figure 54 Map View, OD Source Selection

available) - Uses survey origins and destinations as origin and destination points.

3.6.1.6 Step 4 - Choose Your Model Time Period

Data in CTPP, LODES and Regression Models use time of travel to work to understand and schedule ridership in the trip table during peak times. Survey data is available for AM only, PM is generated by reversing the direction of AM work traffic.

AM Peak - AM peak includes work trips from 6am to 10am.

PM Peak - PM Peak includes trips from 3pm to 7pm.

Full Day - (Coming soon) All work trips from peaks, plus non work trip estimate.

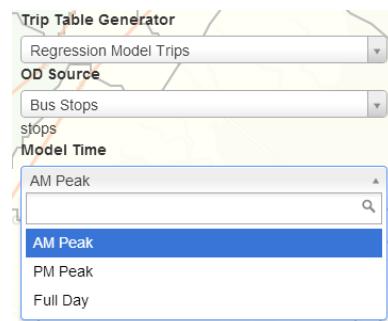


Figure 56 Map View, Model Time Selection

3.6.1.7 Run Model

Once you have chosen all your settings you are ready to run your model. It's worth noting that within the Trip Table tab of the model pane you can hide or show your trip table origins and destinations, you may want to investigate your trip table closely before running your model.

Running a model takes all of the Trips Planned and runs those trips through Open Trip Planner to simulate each rider. To initiate this final step, click the button titled **Run Model**. You'll be asked to name the model. AVAIL has been naming the models based on city name, followed by time of day, followed by algorithm. For instance, AVAIL has chosen titles like AC AM Regression or AC PM Regression.

Once you've named the model click **OK**. Check the bottom of the left navigation panel to see model status. A bar will appear at the bottom of the left navigation pane as illustrated in Figure 58. It will contain a set of numbers, in Figure 58 you see 1/3064. This means that Open Trip Planner has simulated 1 out of a total of 3064 trips. It may take anywhere from 10 minutes to over an hour to complete the model run depending on the number of planned trips. However even if you navigate away from the page the model will continue to run on the server.

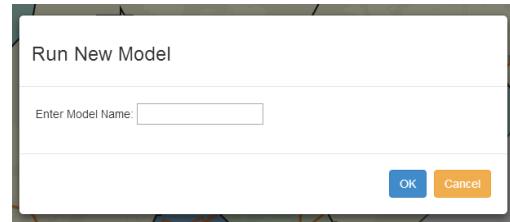


Figure 57 Map View, Model Name Window

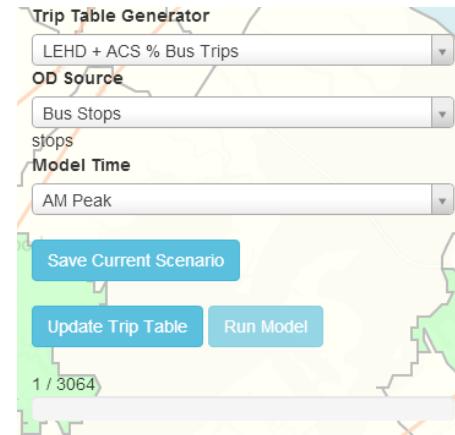


Figure 58 Map View, Run Model Button, Trips Run Bar with ratio of trips run to total trips planned

3.6.2 Model Analysis

The Model Analysis button on the Left Navigation Pane of the Map Viewer will take you back to the Admin Tool>Market Area>Model Analysis (see section 3.4.3 of this document).

3.6.3 GTFS View

The GTFS tab allows you to turn Routes and Stops on and off. This can help in analyzing model runs.

To filter down to a single bus stop, start by clicking on the Show/Hide Stops button. Routes are shown by default, Stops are hidden. Next, mouse over the map to find the “Stop Code” for the bus stop you want. In the example at right we chose Arctic Ave at Christopher Columbus. We then entered the Stop Code for this bus stop, 10054, into the filter bar. You’ll notice on the second map that Arctic Ave at Christopher Columbus is now the only bus stop showing.

This very same process can be used to turn Routes on or off.

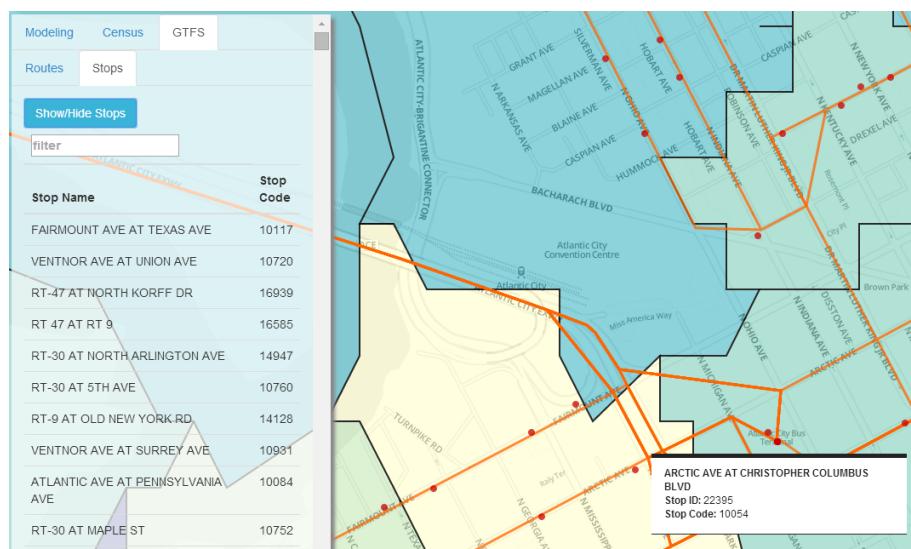


Figure 59 Map View, with Stops and Routes Shown

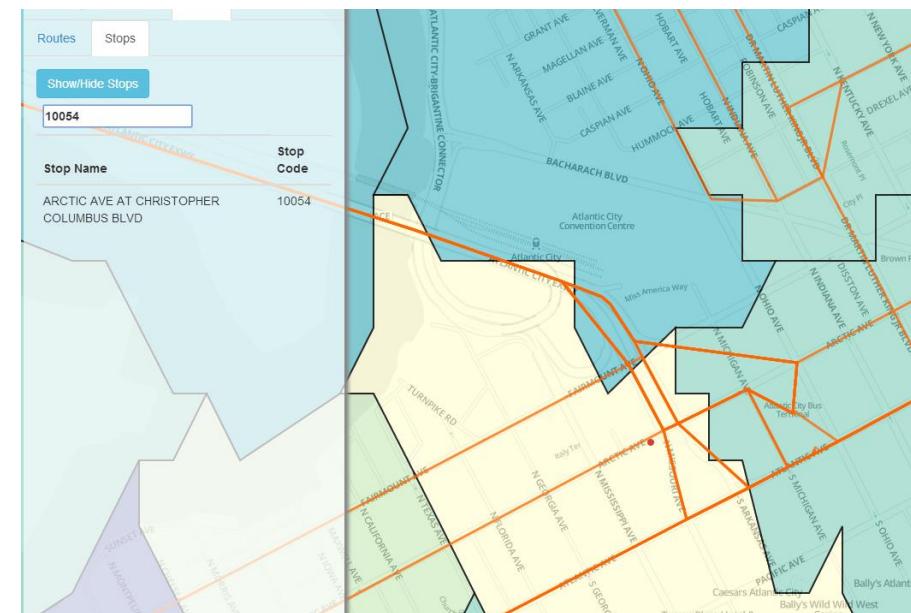


Figure 60 Map View, Filtered to show only one stop

3.6.4 Census View

The Census Tab allows you to view census data in choropleth shading on the map. To view census data, click on the box below the population number that looks like this: 

To see what values each shadings indicates, click on the **Legend** tab at the top right:

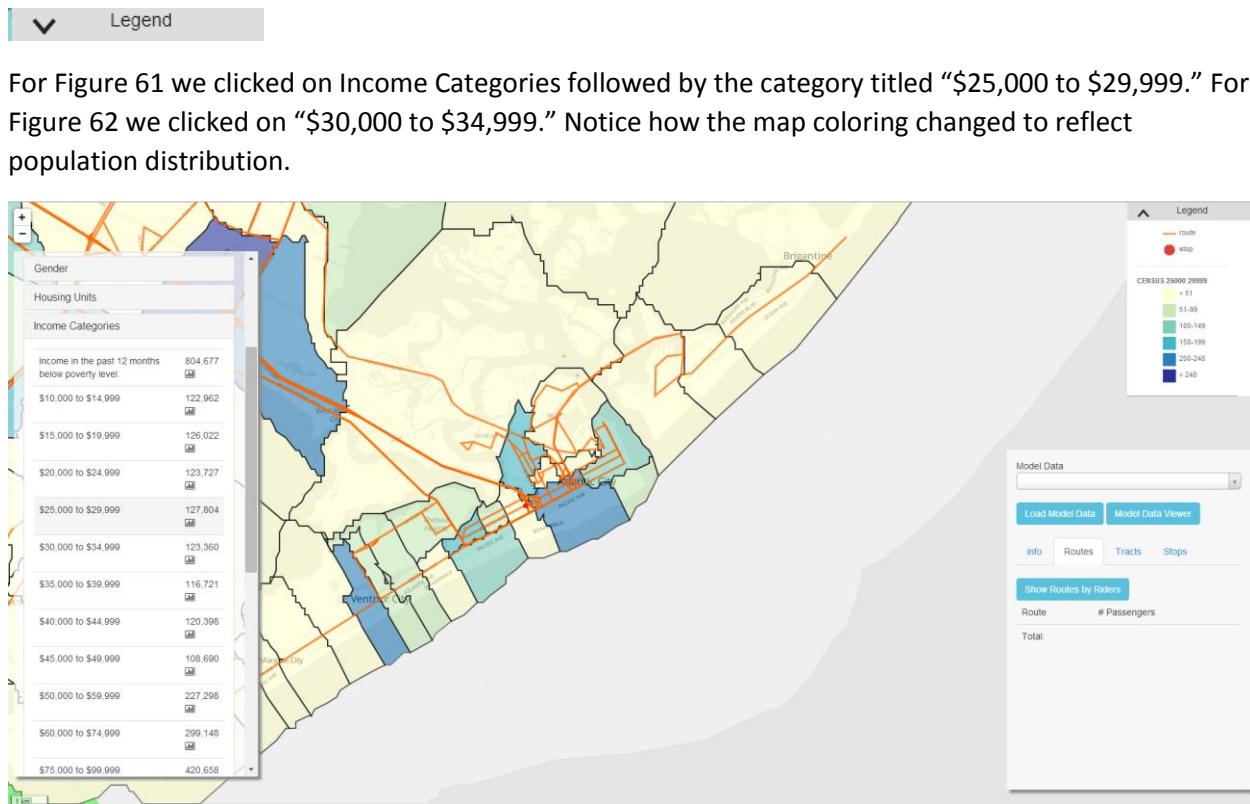


Figure 61 Map View, Census Data Shown in Chloropleth, Income \$25,000 to \$29,999

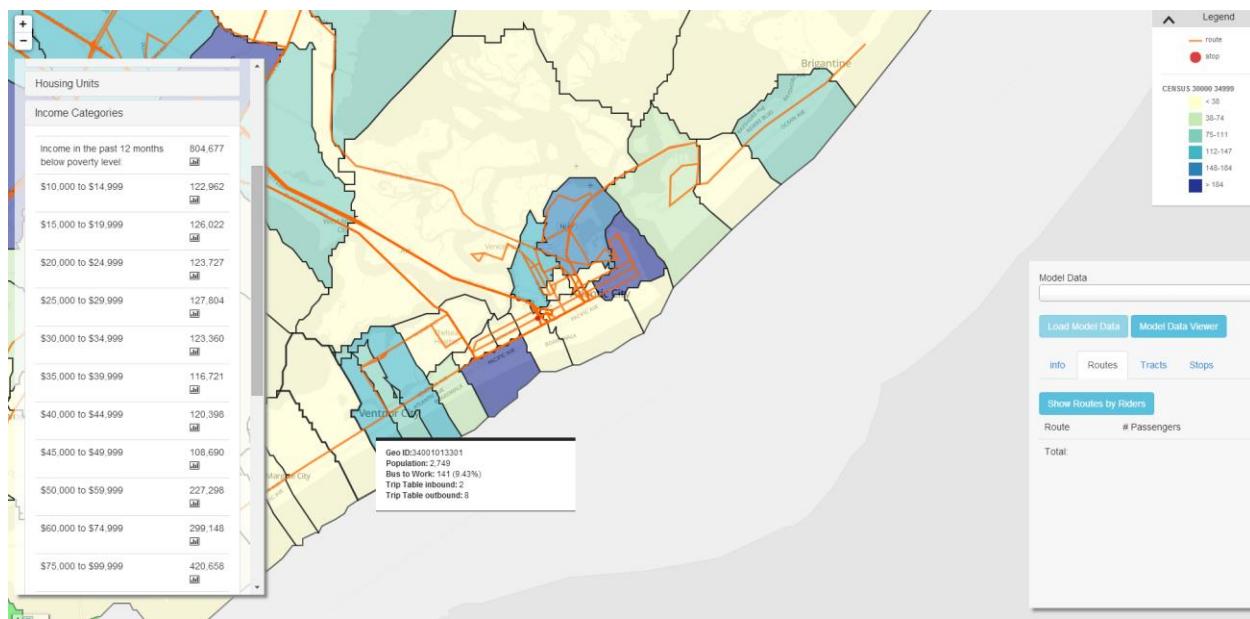


Figure 62 Map View, Census Data Shown in Chloropleth, Income \$30,000 to \$34,999

4 ATLANTIC CITY

4.1 INTRODUCTION

This section contains a summary of data elements and regression model methodology including the source of the data, descriptive statistics, the correlations coefficients, regression model development, and model outputs.

4.2 META DATA

The data used in this study was obtained from the US Census Application Programming Interface (API). The data set is called the American Community Survey Five-Year Data 2007-2011 (ACS). The ACS is an ongoing survey that provides data every year -- giving communities the current information they need to plan investments and services. The ACS covers a broad range of topics about social, economic, demographic, and housing characteristics of the U.S. population.¹ Employment Density (EMP_DEN) and Population Density (POP_DEN) were derived by dividing the employment at tract level by polygon tract area and population at tract level by polygon tract area.

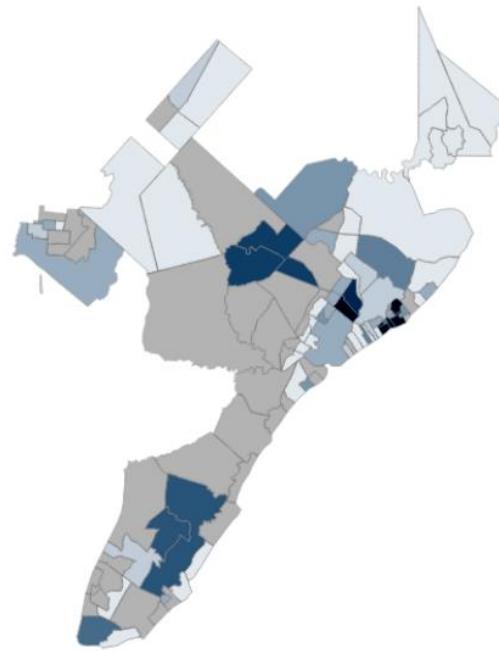


Figure 63 Map of Atlantic City by Census Tract

4.3 DESCRIPTIVE STATISTICS

Descriptive Statistics include, among others, the mean, median and standard deviation of each of the variables. The **Mean** and **Median** are measures of central tendency. The **Mean** is the numerical value found by summing the values and dividing by the number of cases. The **Median** is the numerical value separating the higher half of a data sample from the lower half. The **Median** can be found by arranging all observations from lowest value to highest value and picking the middle. The **Standard Deviation** measures the amount of variation or dispersion from the average and is equal to the square root of the sample variance. The **Sum (Frequency)** is the total total cases for each variable. The **Percent of Category** is the ratio of the **Sum** to the parent **Category Sum**.

¹United States Census Bureau, American Community Survey, <http://www.census.gov/data/developers/data-sets/acs-survey-5-year-data.html>

Table 3 Atlantic City, Descriptive Census Statistics

Atlantic City Descriptive Statistics											
	Description	Category	N	Mean	Median	Std. Deviation	Variance	Min	Max	Sum (Freq)	% of Category
total_popu			110	3,907.78	3,352.50	2,253.27	5,077,245.97	82	15,742	429,856	
total_hous			110	2,254.24	2,093.00	1,327.69	1,762,770.55	4	8,526	247,966	
unemployme	Unemployed Population	Labor Force	110	210.98	189.50	142.60	20,333.38	15	772	23,208	10.32%
public_tra	Journey to Work by Public Transportation Total	Journey to Work	110	98.68	43.50	135.25	18,293.12	-	687	10,855	5.57%
bus_to_wor	Journey to Work by Public Transportation by Bus or Trolley Bus	Journey to Work, Public Trans.	110	91.92	37.50	133.13	17,722.70	-	681	10,111	94.16%
informatio	Employment in Information	Labor Force	110	23.32	16.50	28.64	820.16	-	155	2,565	1.32%
arts	Employment in Arts	Labor Force	110	411.53	325.50	355.46	126,351.54	35	1,977	45,268	23.22%
under_1000	Annual Income Under \$10,000	Households	110	97.05	78.50	85.50	7,310.19	-	465	10,675	N/A
10000_1499	Annual Income \$10,000-\$14,999	Households	110	77.16	63.00	67.55	4,563.62	-	365	8,488	5.42%
15000_1999	Annual Income \$15,000-\$19,999	Households	110	73.82	68.50	50.95	2,596.26	-	258	8,120	5.19%
25000_2999	Annual Income \$25,000-\$29,999	Households	110	79.80	67.00	59.40	3,528.18	-	298	8,778	4.84%
30000_3499	Annual Income \$30,000-\$34,999	Households	110	78.30	63.50	56.20	3,158.65	-	221	8,613	5.61%
35000_3999	Annual Income \$35,000-\$39,999	Households	110	74.40	53.00	62.85	3,950.37	-	310	8,184	5.50%
125000_149	Annual Income \$125,000-\$149,999	Households	110	76.63	59.00	74.59	5,563.28	-	469	8,429	5.23%
150000_199	Annual Income \$150,000-\$199,999	Households	110	71.75	66.00	58.06	3,370.49	-	287	7,892	5.39%
200000+	Annual Income Greater than \$200,000	Households	110	57.57	39.50	56.30	3,169.46	-	291	6,333	5.04%
poverty_st	Poverty Status	Households	110	454.21	346.50	408.91	167,208.11	2	2,168	49,963	4.05%
no_high_sc	No High School Education	Households	110	258.78	170.50	246.25	60,637.00	-	1,309	28,466	12.61%
bachelors	Bachelors degree	Labor Force	110	517.47	438.00	369.62	136,619.66	42	2,516	56,922	13.24%
foreign_bo	Foreign Born	Population	110	485.78	307.00	516.46	266,733.51	-	2,178	53,436	12.43%
spanish_sp	Spanish Speaking	Household	110	220.68	94.50	321.58	103,416.16	-	2,224	24,275	N/A

other_lang	Other Language Speaking	House-hold	110	135.05	68.00	192.07	36,892.74	-	867	14,855	N/A
	Description	Category	N	Mean	Median	Std. Deviation	Variance	Min	Max	Sum (Freq)	% of Category
age25_29	Age 25 to 29 Total	Population	110	218.13	197.50	159.65	25,488.11	-	758	23,994	5.92%
age30_34	Age 30 to 34 Total	Population	110	215.85	161.00	177.71	31,580.47	-	745	23,744	5.86%
race_white	Race White	Population	110	2,831.38	2,481.00	1,752.57	3,071,517.56	205	10,974	311,452	72.45%
race_black	Race Black	Population	110	506.35	200.50	705.17	497,265.51	-	4,005	55,698	12.96%
race_asian	Race Asian	Population	110	203.12	62.50	348.79	121,656.78	-	1,710	22,343	5.20%
race_other	Race Other	Population	110	248.59	97.50	356.40	127,023.05	-	1,972	27,345	6.36%
race_two	Bi-racial	Population	110	101.20	54.00	144.05	20,751.26	-	806	11,132	2.59%
1_unit_det	Housing 1 Unit Detached	Households	110	1,263.95	1,086.00	821.72	675,217.42	4	4,953	139,035	56.07%
5_9units	Housing 5-9 Units	Households	110	111.29	51.00	156.10	24,365.84	-	795	12,242	4.94%
20_49units	Housing 20-49 Units	Households	110	58.00	28.50	98.12	9,626.81	-	728	6,380	3.40%
50+_units	Housing 50+ Units	Households	110	135.48	29.50	244.93	59,990.97	-	1,365	14,903	2.57%
occupanc_1	Tenure, Occupancy Status, Renter Occupied	Households	110	434.72	360.00	314.30	98,784.88	-	1,487	47,819	6.01%
car_0	Zero Vehicles Available by Worker	Labor Force, Employed	110	111.57	64.00	129.77	16,840.34	-	638	12,273	N/A
car_1	One Car Available by Worker	Labor Force, Employed	110	394.65	352.00	244.68	59,867.52	-	1,565	43,411	N/A
car_3	Three Cars Available by Worker	Labor Force, Employed	110	322.12	248.00	325.71	106,084.53	-	2,273	35,433	N/A
car_4	Four Cars Available by Worker	Labor Force, Employed	110	109.95	84.50	117.32	13,763.13	-	541	12,094	N/A
car_0_hous	Households, Zero Vehicles Available	Households	110	184.62	125.00	186.76	34,878.53	-	1,000	20,308	8.19%
car_1_hous	Households, One Car Available	Households	110	532.27	494.00	268.78	72,240.27	-	1,309	58,550	23.61%
car_3_hous	Households, Three Cars Available	Households	110	170.17	120.00	158.43	25,098.77	-	1,044	18,719	7.55%
car_4_hous	Households, Four Cars Available	Households	110	48.05	33.00	47.93	2,297.54	-	245	5,286	2.13%
emp_den	Employment/Area	N/A	110	1,060.04	601.03	1,682.39	2,830,444.48	26	11,276	116,604	N/A
pop_den	Population/Area	N/A	110	2,392.72	1,305.14	3,950.59	15,607,169.73	64	25,410	263,199	N/A

4.4 CORRELATIONS

A correlation coefficient is the measure of strength of the linear association between two variables (-1 to +1). This table contains only variables that have a statistically significant correlation with the *bus_to_wor* variable.

Table 4 Atlantic City, Correlations

	Description	Pearson Correlation
unemployme	Unemployed Population	.285**
public_tra	Journey to Work by Public Transportation Total	.996**
bus_to_wor	Journey to Work by Public Transportation by Bus or Trolley Bus	1
informatio	Employment in Information	-.229*
arts	Employment in Arts	.504**
under_100	Annual Income Under \$10,000	.416**
10000_1499	Annual Income \$10,000-\$14,999	.223*
15000_1999	Annual Income \$15,000-\$19,999	.261**
25000_2999	Annual Income \$25,000-\$29,999	.349**
30000_3499	Annual Income \$30,000-\$34,999	.250**
35000_3999	Annual Income \$35,000-\$39,999	.238*
125000_149	Annual Income \$125,000-\$149,999	-.265**
150000_199	Annual Income \$150,000-\$199,999	-.330**
200000+	Annual Income Greater than \$200,000	-.256**
poverty_st	Poverty Status	.448**
no_high_sc	No High School Education	.503**
bachelors	Bachelors Degree	-.178†
foreign_bo	Foreign Born	.561**
spanish_sp	Spanish Speaking	.406**
other_lang	Other Language Speaking	.416**
age25_29	Age 22 to 24 Total	.336**
age30_34	Age 25 to 29 Total	.225*
race_white	Race White	-.281**
race_black	Race Black	.500**
race_asian	Race Asian	.338**
race_other	Race Other	.394**
race_two	Bi-racial	.209*
1_unit_det	Housing 1 Unit Detached	-.370**
5_9units	Housing 5-9 Units	.221*
20_49units	Housing 20-49 Units	.239*
50+_units	Housing 50+ Units	.392**
occ_renter	Tenure, Occupancy Status, Renter Occupied	.527**
car_0	Zero Vehicles Available by Worker	.749**
car_1	One Car Available by Worker	.467**
car_3	Three Cars Available by Worker	-.224*
car_4	Four Cars Available by Worker	-.225*
car_0_hous	Households, Zero Vehicles Available	0.586**
car_1_hous	Households, One Car Available	0.207*
car_3_hous	Households, Three Cars Available	-0.256**
car_4_hous	Households, Four Cars Available	-0.291**
emp_den	Employment/Area	.524**
pop_den	Population/Area	.507**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

†. Correlation is significant at the 0.10 level (2-tailed).

4.5 REGRESSION METHODOLOGY

The model used in this analysis is a linear regression model that assumes a linear relationship between the dependent variable (`bus_to_wor`) and a set of independent variables. A regression model fits a straight line to a set of observed data and provides the statistical significance of the included variables.²

The regression model will produce a number of parameters and model fitting indicators such as the coefficient of determination (R Squared). The R Squared is defined as the percent of the variation of the dependent variable (`bus_to_wor`) explained by the set of independent variables. The percent of bus riders from each census tract will be explained by the regression model's set of independent variables. Therefore the higher the R Squared the more explanatory power the model provides.

The regression model output also provides a constant (intercept) which is the average value of the dependent variable when the independent variables equal zero.³

Slope coefficient indicate the average change in the dependent variable with a one unit change in the independent variable.

For the purposes of this modelling effort statistical significance is defined as a p-value of <.05 or a t-value >2.5.

4.6 ATLANTIC CITY MODEL DEVELOPMENT

AVAIL developed a regression model for Atlantic City that has an R-Squared of 0.65. The model uses the dependent variable of bus-to-work in the initial regression model and keeps only the independent variables which are statistically significant and contribute to increases in R-Squared and Adjusted R-Squared. When the coefficient for a variable is not statistically significant we must accept the null hypothesis that the coefficient equals zero. In the final regression model, Atlantic City5, the constant is not statistically significant in any of the specifications.

Table 5 Atlantic City, Regression Model Development

Atlantic City					
	Atlantic City1	Atlantic City2	Atlantic City3	Atlantic City5	Atlantic City5
Dependent Variable	<code>bus_to_wor</code>	<code>bus_to_wor</code>	<code>bus_to_wor</code>	<code>bus_to_wor</code>	<code>bus_to_wor</code>
Constant	14.8622	-36.62	-36.82*	14.23	5.27
car_0_hous	0.42**	.36**	.28**	.22**	.31**
arts		.015**	.14**	.21**	.19**
emp_den			.02**	.01*	.12**
bachelors			.01*	-.13**	-.19**
pop_den					-.05**
R Sq.	0.32	0.50	0.54	0.62	0.65
N	110	110	110	110	110

** T-value >2.5 and P-value <.05. * T-value >2.5 or P-value <.05.

² Rogerson, Peter A., 2006, *Statistical Methods for Geography 2nd Edition*, London: Sage Publications

³ Lewis-Beck, Michael S., 1980, *Applied Regression, An Introduction*, Newbury Park: Sage Publications

4.7 ATLANTIC CITY REGRESSION EQUATION

This equation uses the following five variables:

- bus_to_wor = Journey to Work by Public Transportation by Bus or Trolley Bus
- car_0_hous = Households, Zero Vehicles Available
- arts = Employment in Arts Sector
- emp_den = Employment/Area
- bachelors = Bachelors Degree
- pop_den = Population/Area

The regression equation with an R Squared of 63% is specified as follows:

$$\text{bus_to_wor} = 0.2728917 * (\text{car_0_hous}) + 0.1886528 * (\text{arts}) + 0.0814334 * (\text{emp_den}) - 0.1128937 * (\text{bachelors}) - 0.03049128 * (\text{pop_den})$$

4.8 IMPLEMENTING REGRESSION MODELS FOR MICROSIMULATION

To predict ridership in our microsimulation, we use the following process for each tract in the market area. To show this process on a smaller scale, we will show a Regression Model example using a single census tract, 34001012200 and the Atlantic City Regression Equation. This census tract has 379 individuals indicating bus-to-work as their mode of transportation. On the map below, the tract has been enlarged in green for viewing:

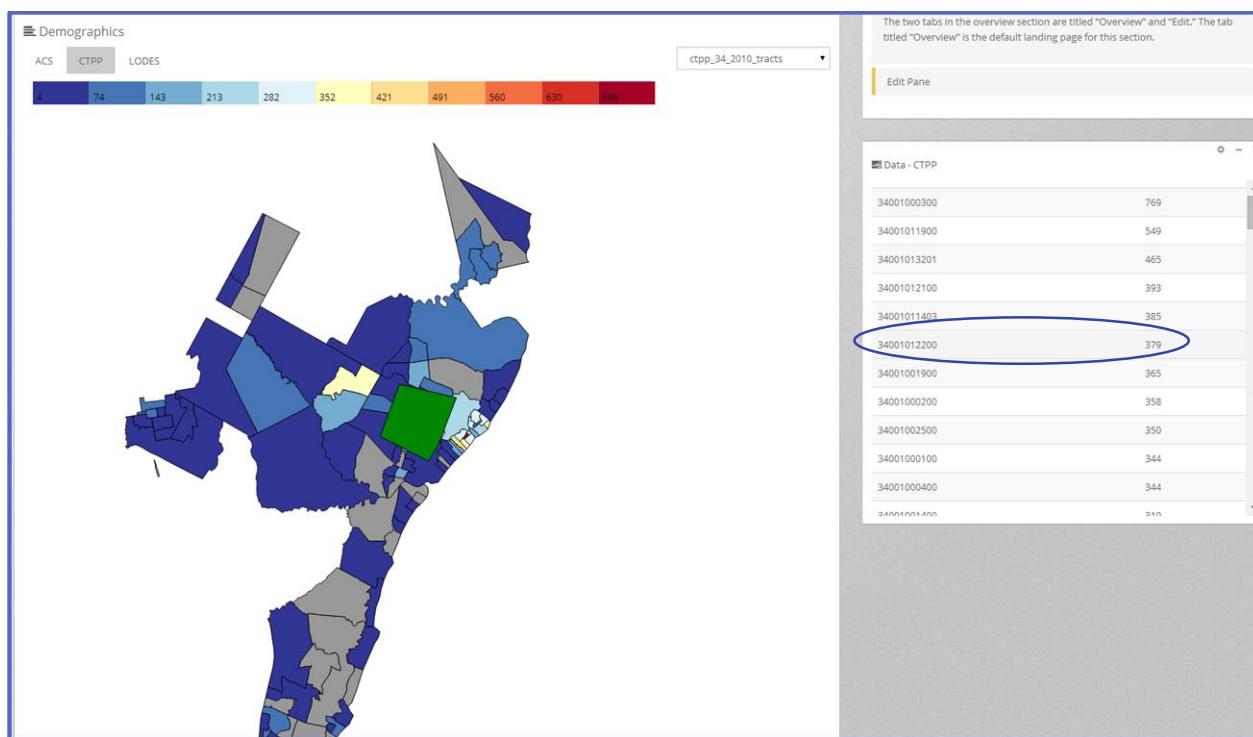


Figure 64 Admin Tool, Overview Map

4.8.1 Find the number of riders predicted by the regression model for the tract.

To find the number of riders AVAIL has developed an algorithm that pulls specific census data for each census tract into the regression model. In this example, we will collect the variables for the Atlantic City Regression Equation and the corresponding data for census tract 34001012200. One can access this information using the Admin Tool by accessing the overview map and scrolling over the desired census tract.

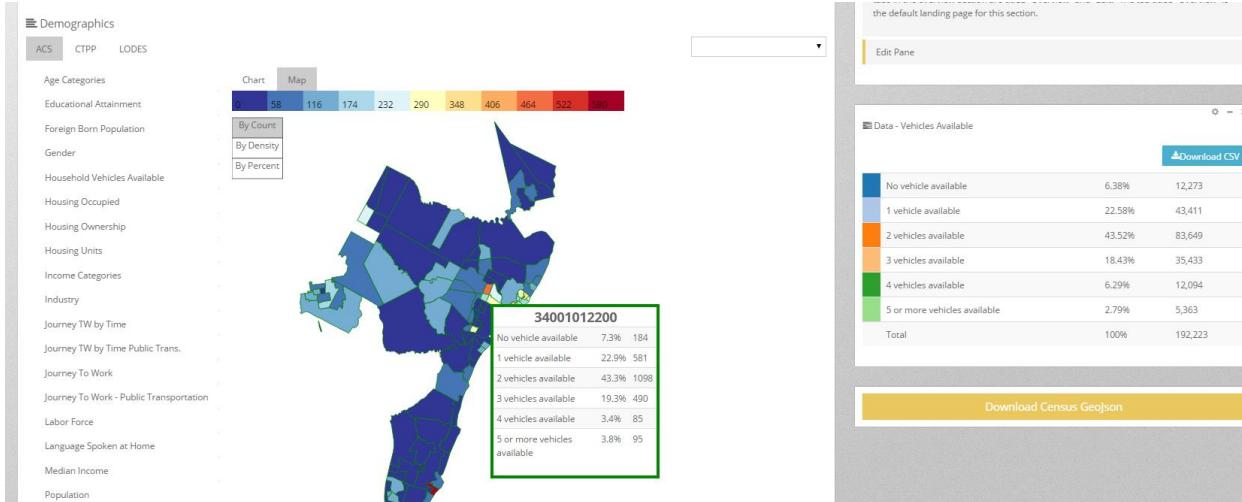


Figure 65 Admin Tool. Overview Map with Mouseover

The trip table generating algorithm gathers the census tract data for each regression model variable.

Table 6 Trip Table Algorithm, Census Tract Variables

Equation Variable	Description	Census Category	Amount in Census Tract 34001012200
bus_to_wor	Journey to Work by Public Transportation by Bus or Trolley Bus	Journey To Work	382
car_0	Households, Zero Vehicles Available	Household	184
arts	Employment in the Arts Sector	Labor Force	1125
bachelors	Bachelors Degree	Labor Force	128
emp_den	Employment/Area	Total Employment/Total Area	2251
pop_den	Population/Area	Total Population/Total Area	4715

4.8.2 The Regression Model Equation

In Atlantic City census tract 34001012200, the Atlantic City Regression Model is run as follows

$$\text{bus_to_wor} = 0.2728917 * (\text{car_0_hous}) + 0.1886528 * (\text{arts}) + 0.0814334 * (\text{emp_den}) - \\ 0.1128937 * (\text{bachelors}) - 0.03049128 * (\text{pop_den})$$

When filled with census data for the tract:

$$\text{bus_to_wor} = 0.2728917 * (184) + 0.1886528 * (1125) + 0.0814334 * (2251) - 0.1128937 * (128) - \\ 0.03049128 * (4715)$$

The number of riders in census tract 34001012200 predicted by the Atlantic City Regression Model is 307.

4.8.3 ACS Regression Ratio

We take the number of riders predicted by the regression, and divide that by ACS variable Journey To Work: Public Transportation –Bus for the tract, giving us the ratio of predicted riders to census counted riders.

Regression Model Riders / ACS Riders = ACS Regression Ratio

287.5/382=0.75

4.8.4 CTPP Home Tract to Work Tract Counts

Then for each home tract to work tract bus travel count in the CTPP, we multiply the count by the ACS Regression Ratio to find the ridership numbers for input into the trip table.

Trip Table Input = CTPP*Regression Ratio

Table 7 Trip Table Output

Riders from Home Tract 34001012200			
Work Tract	Riders	Trip Table Output = CTPP*Regression Ratio (0.75)	Forecasted Ridership
34001002400	160	120	108
34001001400	60	45	41
34001002300	60	45	41
34001000400	25	19	17
34001011900	25	19	17
34001001100	20	15	14
34001013201	15	11	10
34001013302	10	8	7
34001011702	4	3	3
Total	379	285	257

4.8.5 Forecasting

If any forecasts were applied to a census tract during model building, those percentages are applied to the trip table as the very last step before microsimulation. If a -10% population growth was applied to tract 34001012200, for instance, the ridership numbers for each of the work tracts would be reduced by 10%. The results for a -10% growth in tract 34001012200 is illustrated in Table 7.

4.8.6 All resulting trips are added to our trip table to be simulated by the modeling software. The resulting trip table shows the number of bus trips from the origin point (census tract 3400101220) to each corresponding work census tract.

4.8.7 The trip is microsimulated using Open Trip Planner. The trip table output is then run through Open Trip Planner, an open source transportation planning software. Open Trip Planner returns the three fastest-by-travel-time routes from the origin point to the destination point by departure time.



4.8.8 Model Analysis
The Admin Tool has a number of charts, tables and maps designed to allow the user to analyze the microsimulation. These include:

- Inbound and outbound trips for the zone
- Number of riders per route
- Number of unroutable trips which occur when there is not both a valid origin and destination point between two zones.
- Trips are listed by most likely bus route taken
- Wait times are estimated for each person's trip.

4.8.9 Implementing Regression Models Flow Chart

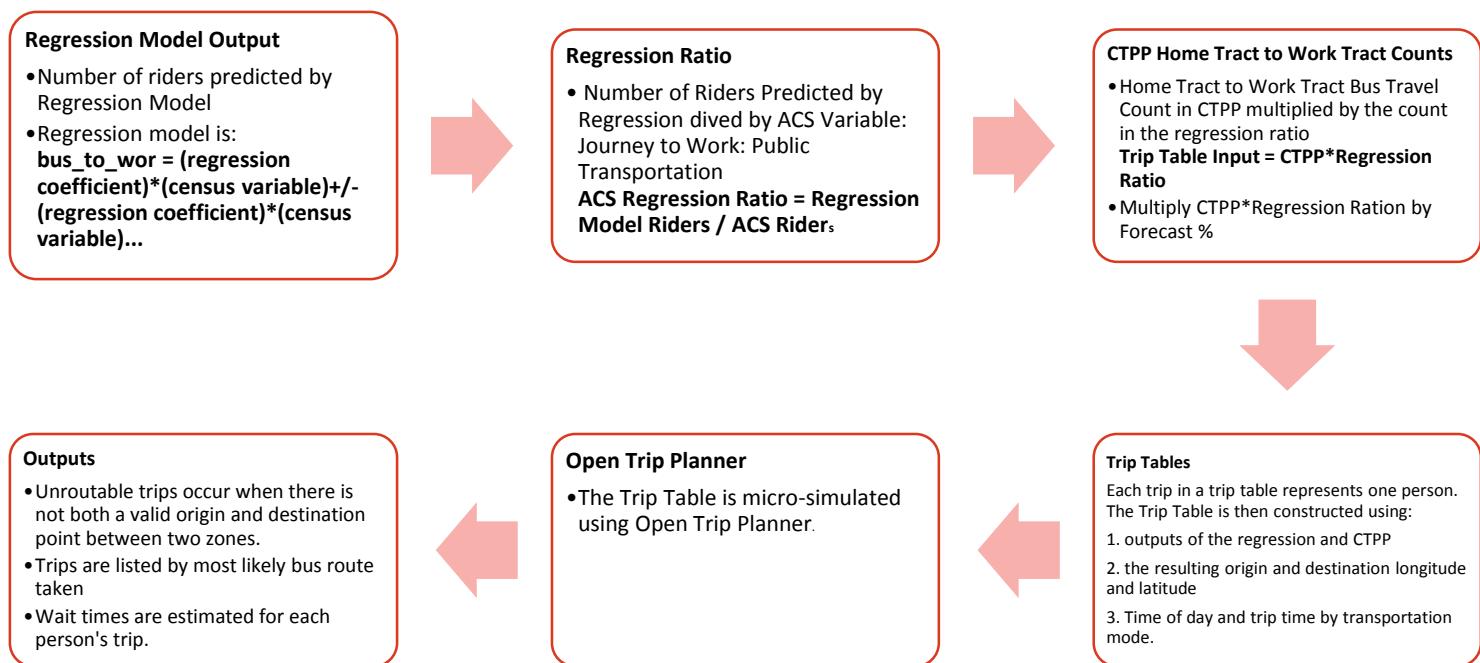


Figure 66 Flow Chart: Implementing Regression Models for Microsimulation

4.9 MODEL VALIDATION (INCLUDES: MODEL OUTPUTS, OBSERVATIONS ON MODEL OUTPUT)

4.9.1 Model Outputs

4.9.1.1 *Atlantic City AM Regression Model*

Figure 67 Atlantic City5 Regression Model vs. Farebox. Distribution Graph of Riders by Route ID

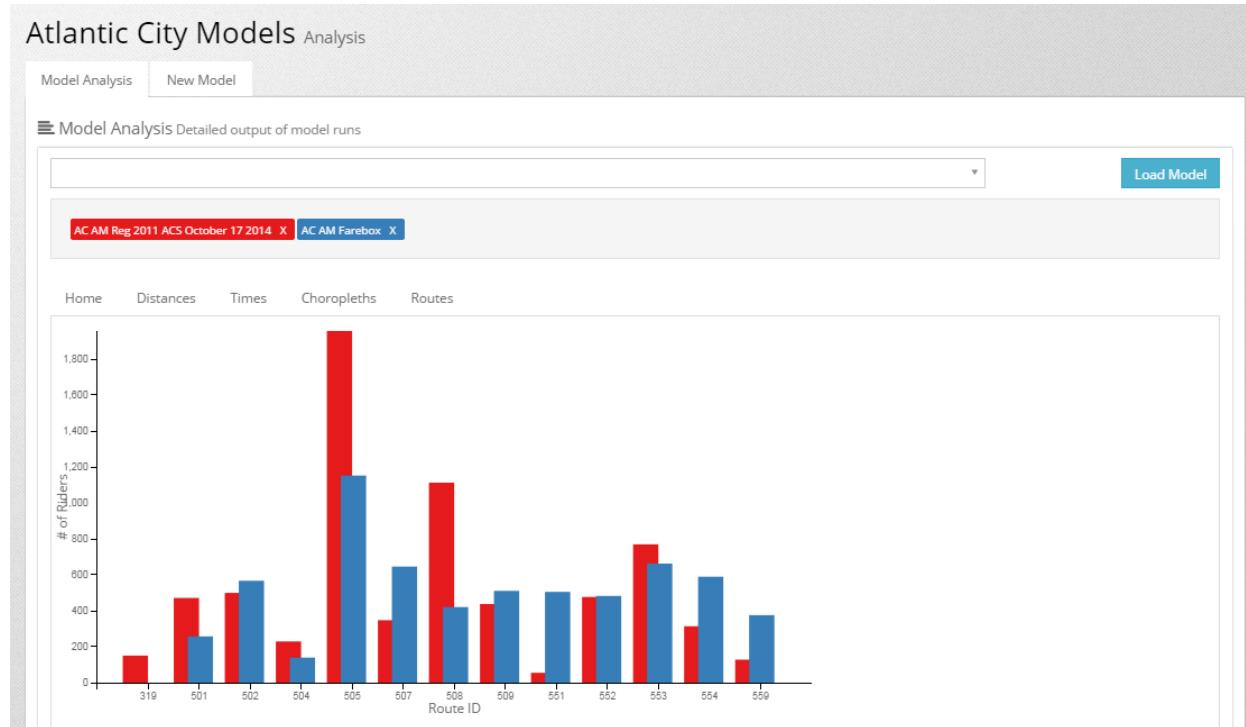


Table 8 Atlantic City5 Regression Model vs. Farebox. Distribution Graph of Riders by Route ID.

Route ID	AC AM Reg 2011 ACS October 17 2014	AC AM Farebox
319	149	undefined
501	472	258
502	500	569
504	232	138
505	1956	1154
507	349	647
508	1111	423
509	438	513
551	55	505
552	477	483
553	768	666
554	313	592
559	129	375
	6949	6323

4.9.2 Observations on Model Outputs

4.9.2.1 AC AM Findings

- The Atlantic City5 Regression Model puts 149 riders onto Route 319. AM Farebox has no available data for Route 319. To best compare the Atlantic City5 Regression Model output with Farebox data the Route 319 riders are removed from total ridership. Total AM ridership for the market area is adjusted from 6949 to 6800.
- Using the Atlantic City5 Regression Model to test AM bus ridership, the microsimulation accuracy is within 7% of Farebox. AM Farebox total ridership is 6,323. Atlantic City5 Regression Model total ridership after removing Route 319 is 6,800.
- Microsimulation overestimates Routes 508, 505, and to a lesser-degree 501. These are downtown on-island routes that compete directly with Jitney service and as a result Farebox numbers are below microsimulation estimates. One possible explanation is that this represents bus riders that are not utilizing NJTransit.
- The microsimulation underestimates AM ridership on Route 551 and 559 which are both long distance low-service bus routes that caters to non-work related patrons. This is likely related to entertainment activities downtown.

4.9.2.2 Atlantic City PM Regression Model

Figure 68 Atlantic City5 Regression Model vs. Farebox. Distribution Graph of Riders by Route ID

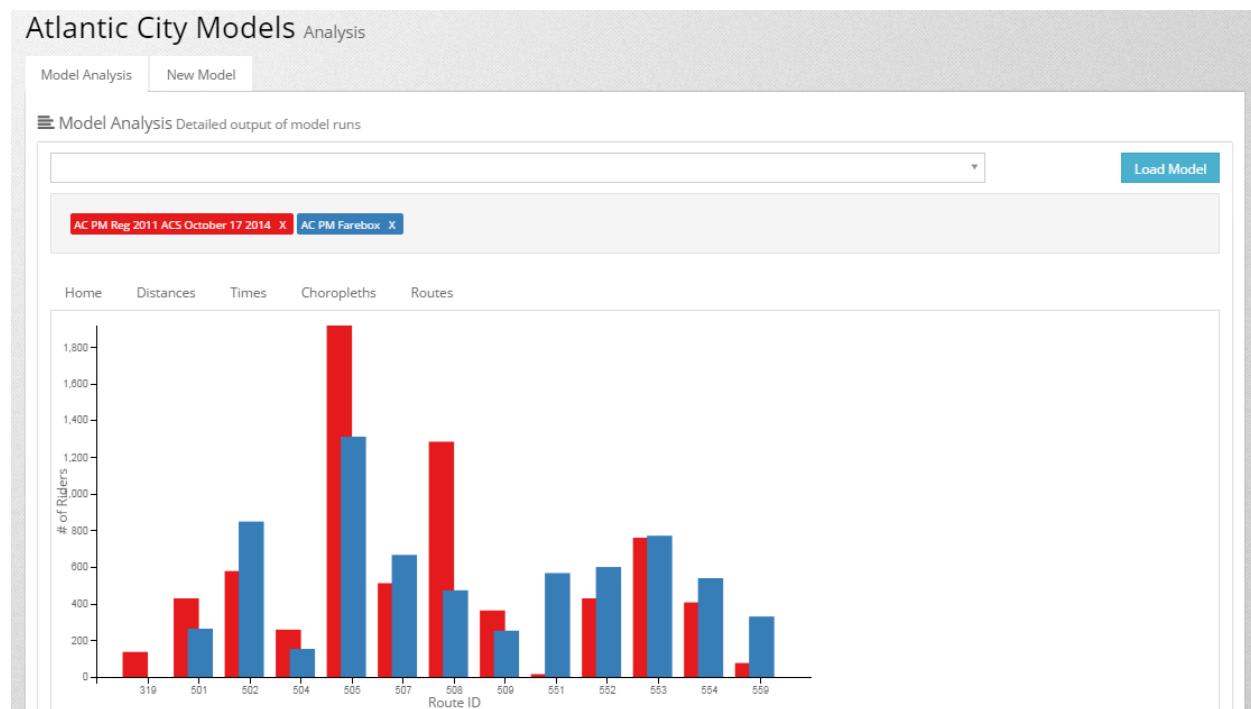


Table 9 Atlantic City5 Regression Model vs. Farebox. Distribution Graph of Riders by Route ID

Route ID	AC PM Reg 2011 ACS October 17 2014	AC PM Farebox
319	140	undefined
501	432	264
502	582	852
504	261	153
505	1920	1314
507	513	667
508	1286	475
509	363	256
551	15	569
552	430	602
553	763	775
554	410	543
559	79	332
	7194	6802

4.9.2.3 AC PM Findings

- The Atlantic City5 Regression Model puts 140 riders onto Route 319. AM Farebox has no available data for Route 319. To best compare the Atlantic City5 Regression Model output with Farebox data the Route 319 riders are removed from total ridership. Total AM ridership for the market area is adjusted from 7194 to 7054.
- Using the Atlantic City5 Regression Model to test PM bus ridership, the microsimulation accuracy is within 3.6% of Farebox. PM Farebox total ridership is 6,802. Atlantic City5 Regression Model total PM ridership after removing Route 319 is 7,054.
- Microsimulation overestimates Routes 508 and to a lesser-degree 505 and 501. These are downtown on-island routes that compete directly with Jitney service and as a result Farebox numbers are below microsimulation estimates. One possible explanation is that this represents bus riders that are not utilizing NJTransit.
- The microsimulation once again under-estimates ridership on routes 551 and 559 which are long distance low-service bus routes that caters to non-work related patrons. This is likely related to entertainment activities downtown.

5 APPENDIX A: OVERVIEW ON BUILDING REGRESSION MODELS

The following is an overview of processes followed in building the regression models derived from the census data. At this time, the regression models show high sensitivity to changes in geographies.

5.1 EXTRACT CENSUS TRACTS FROM WEB TOOL

Our first step is to extract the GeOID's of the Census Tracts for a given market area from the database of our web-tool. For Atlantic City, the GeOID's are shown below:

```
"34001010102","34001010104","34001010105","34001001400","34001002500","34001002400","34001001900","34001001200","34001001500","34001001100","34001000300","34001002300","34001000500","34001000400","34001001000","34001000200","34001013201","34001013202","34001013302","34001013301","34001013000","34001013101","34001013102","34001001300","34001010101","34001010505","34001010200","34001011900","34001010300","34001012000","34001012100","34001012200","34001012401","34001012302","34001012402","34001012501","34001013500","34001012602","34001012701","34001012801","34001011803","34001012502","34001011702","34001011701","34001010506","34001010503","34001983400","34001010403","34001011802","34001011804","34001011404","34001012702","34001011805","34001011403","34009020201","34009020101","34009020102","34009020203","34001012802","34001011600","34001011500","34001011401","34011030100","34009020301","34009020205","34009020800","34009020206","34001010401","34001010501","34009021001","34009020902","34009020901","34009021100","34009022102","34009022101","34009021804","34009021803","34009021701","34009021702","34009021805","34009021806","34009021900","34009022000","34009021600","34009021500","34009021400","34009021300","34009021002","34009020302","34009020700","34011041000","34011040800","34011040700","34011040600","34011040500","34011041100","34011040300","34011040400","34001011202","34001011100","34001011000","34001010900","34001010800","34029736101","34029736102","34029737000","34029736002","34029736001"
```

5.2 CREATING A DATA RICH GIS FILE

Now that we have a subset of Census Tracts, we slice this group out of our database that contains New Jersey Census Tracts, and query the Census API to acquire a selection of ACS data for these tracts. Once completed, this data is exported from our database as a JavaScript Object Notation (JSON) object that contains the census geographies and with the ACS data as attributes, this JSON object is then converted to a shapefile for use in GIS applications.

geoid	total_popu	employment	unemployme	travel_to_	car_to_wor	public_tra	bus_to_wor
34009020901	828	318	27	308	244	0	0
34009021002	3623	1930	141	1897	1735	16	16
34009022102	5533	2367	356	2299	2140	37	37
34009021001	2600	848	89	835	738	20	20
34009022101	1887	649	57	649	545	0	0
34009020301	4202	2136	185	2070	1969	10	0
34009021500	2150	1116	206	1084	944	43	24
34009020102	2413	1220	47	1210	867	19	9
34009021400	3650	1687	202	1657	791	104	101
34009020101	3307	1703	172	1703	1190	48	38
34009021804	5603	2789	343	2633	2448	79	79
34009021300	4111	1670	196	1580	1411	25	12

5.3 GEODA

Next, we take advantage of the Open Source program GeoDA⁴, a statistical tool for analyzing sets of spatial data. Using GeoDA, we developed a regression model for Atlantic City that provides significant ridership determination values using ACS variables.

Figure 69 GeoDA Regression Model Output for Atlantic City5, 10.15.2014

SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION				
Data set	:	Atlantic City 10-15-14		
Dependent Variable	:	BUS_TO_WOR	Number of Observations:	110
Mean dependent var	:	91.9182	Number of Variables	: 6
S.D. dependent var	:	132.52	Degrees of Freedom	: 104
R-squared	:	0.646382	F-statistic	: 38.0205
Adjusted R-squared	:	0.629381	Prob(F-statistic)	: 5.15314e-022
Sum squared residual	:	683111	Log likelihood	: -636.449
Sigma-square	:	6568.37	Akaike info criterion	: 1284.9
S.E. of regression	:	81.0455	Schwarz criterion	: 1301.1
Sigma-square ML	:	6210.1		
S.E. of regression ML	:	78.8042		
<hr/>				
Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	5.272991	17.43688	0.3024044	0.7629513
CAR_0_HOUS	0.305623	0.05855778	5.21917	0.0000009
ARTS	0.1868154	0.02924864	6.387148	0.0000000
EMP_DEN	0.1229869	0.03852947	3.192021	0.0018689
BACHELORS	-0.1180412	0.02676742	-4.409884	0.0000253
POP_DEN	-0.04845768	0.01688847	-2.869276	0.0049836
<hr/>				
REGRESSION DIAGNOSTICS				
MULTICOLLINEARITY CONDITION NUMBER		28.630725		
TEST ON NORMALITY OF ERRORS				
TEST	DF	VALUE	PROB	
Jarque-Bera	2	7.533599	0.0231260	
DIAGNOSTICS FOR HETEROSKEDASTICITY				
RANDOM COEFFICIENTS				
TEST	DF	VALUE	PROB	
Breusch-Pagan test	5	36.2896	0.0000008	
Koenker-Bassett test	5	25.32799	0.0001204	
SPECIFICATION ROBUST TEST				
TEST	DF	VALUE	PROB	
White	20	45.36795	0.0009835	

⁴ <http://geodacenter.asu.edu/software/downloads>

6 APPENDIX B MPO FORECASTS FOR SJTPO REGION

Table 10 MPO Forecasts, Employment and Population 2010 to 2020

SJTPO –EMPLOYMENT and POPULATION PROJECTIONS						
Municipality	Employment			Population		
	<u>2010</u>	-	<u>2020</u>	<u>2010</u>	-	<u>2020</u>
SJTPO REGION	259,782	9.51%	284,483	594,795	6.15%	631,396
Atl (non-farm)	136,800	8.77%	148,796	274,549	7.25%	294,449
Absecon city	3,670	11.74%	4,101	8,411	6.47%	8,955
Atlantic City city	56,263	7.02%	60,213	39,558	-0.79%	39,246
Brigantine city	1,592	6.51%	1,695	9,450	-8.32%	8,664
Buena borough	1,260	6.51%	1,342	4,603	12.05%	5,158
Buena Vista township	1,350	11.74%	1,509	7,570	1.15%	7,657
Corbin City city	514	6.51%	548	492	3.28%	508
Egg Harbor City city	3,125	6.51%	3,329	43,323	18.35%	51,274
Egg Harbor township	14,404	10.65%	15,938	4,243	-2.21%	4,149
Estell Manor city	239	6.51%	254	1,735	6.05%	1,840
Folsom borough	872	11.74%	975	1,885	-1.47%	1,857
Galloway township	8,901	11.74%	9,946	37,349	12.58%	42,048
Hamilton township	10,554	10.65%	11,679	26,503	18.73%	31,467
Hammonton town	8,838	11.74%	9,876	14,791	11.10%	16,432
Linwood city	2,803	6.51%	2,986	7,092	-0.37%	7,066
Longport borough	160	6.51%	170	895	-5.03%	850
Margate City city	1,680	11.74%	1,877	6,354	-7.48%	5,879
Mullica township	615	6.51%	655	6,147	2.37%	6,293
Northfield city	4,077	6.51%	4,342	8,624	7.44%	9,266
Pleasantville city	7,720	11.74%	8,626	20,249	4.16%	21,091
Port Republic city	86	6.51%	92	1,115	4.81%	1,169
Somers Point city	6,137	11.74%	6,857	10,795	-2.35%	10,541
Ventnor City city	1,733	6.51%	1,846	10,650	-5.84%	10,029
Weymouth township	180	6.51%	191	2,715	12.98%	3,067
Employment						
	<u>2010</u>	-	<u>2020</u>	<u>2010</u>	-	<u>2020</u>
Cape May County	41,500	12.80%	46,812	97,265	2.74%	99,928
Avalon borough	1,333	4.12%	1,388	1,334	-9.44%	1,208
Cape May city	5,115	21.80%	6,231	3,607	-2.65%	3,512
Cape May Point borough	163	4.12%	170	291	10.49%	322
Dennis township	1,884	4.12%	1,962	6,467	-0.10%	6,461
Lower township	3,012	12.50%	3,389	22,866	-0.09%	22,846
Middle township	10,741	21.80%	13,083	18,911	15.66%	21,872
North Wildwood city	1,307	4.12%	1,361	4,041	-4.53%	3,858
Ocean City city	5,717	4.12%	5,952	11,701	-5.98%	11,002
Sea Isle City city	1,190	4.12%	1,239	2,114	-6.36%	1,980
Stone Harbor borough	924	4.12%	962	866	-5.81%	816
Upper township	2,970	12.50%	3,342	12,373	6.99%	13,237

West Cape May borough	163	4.12%	170	1,024	-1.62%	1,007
West Wildwood borough	56	21.80%	68	603	17.52%	709
Wildwood city	3,589	4.12%	3,737	5,325	-0.51%	5,298
Wildwood Crest borough	1,361	4.12%	1,417	3,270	-4.46%	3,124
Woodbine borough	1,974	21.80%	2,404	2,472	-2.25%	2,416
		Employment			Population	
		2010	0.50%	2020		
Cumberland County	59,330	8.05%	64,107	156,898	5.99%	166,302
Bridgeton city	10,235	8.82%	11,138	25,349	9.17%	27,674
Commercial township	390	5.95%	413	5,178	-0.51%	5,151
Deerfield township	923	9.84%	1,013	3,119	5.31%	3,285
Downe township	455	9.84%	500	1,585	-0.94%	1,570
Fairfield township	1,021	5.95%	1,081	6,295	0.15%	6,305
Greenwich township	60	5.95%	64	804	-1.69%	790
Hopewell township	105	5.94%	111	4,571	2.50%	4,685
Lawrence township	687	5.95%	727	3,290	16.94%	3,847
Maurice River township	2,544	9.84%	2,794	7,976	12.25%	8,953
Millville city	10,354	5.95%	10,970	28,400	4.69%	29,731
Shiloh borough	88	5.95%	93	516	-1.12%	510
Stow Creek township		5.95%		1,431	0.11%	1,433
	325		345			
Upper Deerfield township	1,898	5.95%	2,011	7,660	1.11%	7,745
Vineland city	30,245	8.82%	32,913	60,724	6.41%	64,616
		Employment			Population	
		2010	0.50%	2020		
Salem County	22,152	11.81%	24,768	66,083	7.01%	70,717
Alloway township	524	8.76%	570	3,467	14.65%	3,975
Carneys Point township	3,022	16.70%	3,527	8,049	8.36%	8,722
Elmer borough	1,594	8.76%	1,734	1,395	1.48%	1,416
Elsinboro township	152	16.70%	177	1,036	-1.71%	1,018
Lower Alloways Creek township	978	16.70%	1,142	1,770	-0.75%	1,757
Mannington township	1,428	16.70%	1,667	1,806	9.14%	1,971
Oldmans township	525	8.76%	571	1,773	0.70%	1,785
Penns Grove borough	1,119	8.76%	1,217	5,147	6.48%	5,480
Pennsville township	3,526	8.76%	3,835	13,409	11.09%	14,896
Pilesgrove township	1,500	16.70%	1,751	4,016	4.24%	4,186
Pittsgrove township	1,685	8.76%	1,832	9,393	9.74%	10,307
Quinton township	291	16.70%	340	2,666	0.02%	2,666
Salem city	3,164	8.76%	3,441	5,146	-1.51%	5,068
Upper Pittsgrove township	688	8.76%	748	3,505	3.23%	3,618
Woodstown borough	1,886	16.70%	2,201	3,505	8.33%	3,797