THE NATIONAL ACADEMIES PRESS

SHARE

Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation: Final Workbook

DETAILS

BUY THIS BOOK

FIND RELATED TITLES

AUTHORS

Vanasse Hangen Brustlin, Inc.

TCRP REPORT 161

Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation: Final Workbook

VANASSE HANGEN BRUSTLIN, INC.
Vienna, VA

W I T H

LSC TRANSPORTATION CONSULTANTS, INC.
Colorado Springs, CO

A N D

ERICKSON CONSULTING, LLC
Evergreen, CO

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.
2013
www.TRB.org

TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions,* published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), Transportation 2000, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, the National Academies, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at any time. It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. The TCRP results support and complement other ongoing transit research and training programs.

NOTICE

The project that is the subject of this report was a part of the Transit Cooperative Research Program, conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council.

The members of the technical panel selected to monitor this project and to review this report were chosen for their special competencies and with regard for appropriate balance. The report was reviewed by the technical panel and accepted for publication according to procedures established and overseen by the Transportation Research Board and approved by the Governing Board of the National Research Council.

The opinions and conclusions expressed or implied in this report are those of the researchers who performed the research and are not necessarily those of the Transportation Research Board, the National Research Council, or the program sponsors.

The Transportation Research Board of the National Academies, the National Research Council, and the sponsors of the Transit Cooperative Research Program do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of the report.

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. On the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, on its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

The **Transportation Research Board** is one of six major divisions of the National Research Council. The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation. **www.TRB.org**

www.national-academies.org

COOPERATIVE RESEARCH PROGRAMS

FOREWORD

By Stephan A. Parker
Staff Officer
Transportation Research Board

TCRP Report 161: Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation: Final Workbook presents step-by-step procedures for quantifying the need for passenger transportation services and the demand that is likely to be generated if passenger transportation services are provided. These procedures will be of interest to planners in rural areas and operators of rural passenger transportation systems. This report is supplemented by two products: an Excel spreadsheet that can be used to implement the procedures included in the workbook; and a methodology report, *TCRP Web-Only Document 58,* which documents (1) how the research team developed the need and demand estimation methods, (2) the findings of the analyses, and (3) recommendations for functions to be used in estimation of need and demand. The Excel spreadsheet and *TCRP Web-Only Document 58* can be accessed by searching the TRB website for *TCRP Report 161.*

This research, conducted under TCRP Project B-36 by a research team led by Vanasse Hangen Brustlin (VHB), resulted in methods to estimate need and demand for rural passenger transportation. Need can be estimated according to (1) the number of people likely to need passenger transportation and (2) the number of trips required to provide individuals without personal vehicles with a level of mobility equal to those having access to personal vehicles. Demand is addressed according to four markets: (1) general public rural passenger transportation, (2) passenger transportation specifically related to social services or other programs, (3) travel on fixed-route services in micropolitan areas, and (4) travel on commuter services from rural counties to urban centers.

The research team used data from the Rural National Transit Database (2006, 2009, and 2010), the National Household Transportation Survey (2001 and 2009), the American Community Survey (various years) and the Longitudinal Employment-Household Dynamics dataset as well as data on services operated and ridership on those services provided by over 200 individuals who participated in workshops held in a dozen states in 2010 and 2011 to develop the procedures. The workbook will be of interest to planners, service providers, state transportation program managers, consultants, trade and professional organizations, and other stakeholders involved in transportation planning.

CONTENTS

Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

QUICK START GUIDE

This workbook provides step-by-step instructions for developing forecasts of the need and demand for passenger transportation in rural communities. The data used in developing these forecasts come from many sources. The following table has space to enter data about public transportation service characteristics and community characteristics of your area. These data will be required for some of the calculations included in this workbook. Not every calculation in this workbook requires all the data listed below.

This page is provided to give you a quick start by highlighting some key data used in estimating need and demand. These are not intended to be all the data required to complete the estimates included as part of this workbook. Please read the workbook thoroughly and assemble all the data needed from published sources or the internet before applying the methods.

Service Characteristics		
Service Area Population		
Service Area (square miles)		
Vehicle-Miles	_per Month	_____per Year
Vehicle-Hours	_per Month	_____per Year
1-Way Trips Served	_per Month	_____per Year

Community Characteristics	
Transit Service Area (square miles)	
College/University Enrollment (for each in the Service Area)	Base Year ( ) Forecast Year ( )
List of Social-Service Agencies Providing Transportation	List of Social-Service Agencies Requiring Transportation

CHAPTER 1

Introduction

Purpose of Workbook

This workbook is designed to help planners answer questions about the magnitude of the need for public transit services within a geographic area, as well as the annual ridership (i.e. , demand) that a transit service could be expected to carry.

Examples of questions that this workbook can help answer include

- How many residents of my community need passenger transportation service?
- How many trips per year are not being made because of the current lack of passenger transportation service?
- How many transit trips will the average resident make on a transit service in our community?
- We have enough annual funding to operate 50,000 vehicle-miles of service per year. How many passenger-trips per year are we likely to serve?
- If we operate a fixed-route transit service in our small city, how many passenger-trips per year are we likely to serve?
- If there were a commuter bus program from our community to the big city, how many daily passenger-trips would be served?

For each question, a specific section/page of the workbook presents the method by which the question may be answered.

These methods are intended to evaluate area-wide need or demand at a planning level of analysis. The methods were developed using data for rural counties and are most applicable for estimating need and demand in rural counties. The methods are also most useful in evaluating areas not currently served by passenger transportation. These methods are not intended to be used to assess demand for specific routes or needs in individual neighborhoods. In addition, the reader should be aware that the estimates of demand represent the demand that could be expected in a mature system (i.e., one that has been in operation for at least 12 to 18 months). Chapter 16 of *TCRP Report 95* has information about the likely time for a newly established system to achieve mature demand.

An Excel spreadsheet is available for applying the procedures described in this workbook. The spreadsheet can be downloaded from the TRB website by searching for *TCRP Report 161*. Appendix B provides step-by-step instructions for use of the spreadsheet.

Organization of Workbook

This workbook has four major chapters: Introduction, Need, Demand, and Data Sources. The remainder of this chapter explains the data collection necessary for using the methods in the workbook as well as definitions of terms used in the workbook. Chapters 2 and 3 provide

methods for estimating need (Chapter 2) and demand (Chapter 3). Chapter 4 lists sources for the data required for application of the methods.

For Chapter 2 on **need**, two procedures are described. One documents a method for estimating the number of people needing passenger transportation. The other describes a method for estimating the number of trips that would have to be served to satisfy **all** unmet needs. The former method is likely to be most useful for presentations to policy-making groups and other non-technical audiences. The latter method is more suited for understanding the true magnitude of need and establishing long-term goals for passenger transportation services. Step-by-step instructions are provided for both methods to obtain the needed data. Tables have been included to record and/or summarize data.

Chapter 3 on **demand** estimation provides methods for four markets:

1. Public (i.e., Section 5311 funded) services
2. Program or sponsored trips
3. Fixed-route service in small urban towns in rural areas
4. Commuters from rural areas to central cities

For each market, the basic functional relationships are described. Explanations on the data needed and how to gather them are also included. Worksheets for carrying out computations and tables of values are provided. These are followed by an example calculation.

Data Collection

The methods in this workbook require data about the services provided as well as the demographic characteristics of the service area in question. There are various sources for demographic data; however, the preferred source for demographic data used in this workbook is the American Community Survey (ACS).

The ACS is administered by the U.S. Bureau of Census every year to 2.5% of households across the nation. The information collected in the ACS has replaced the data previously collected every 10 years in the decennial Census long-form. Results are made available for each year, for a rolling 3-year period, and for a rolling 5-year period. In order to protect the privacy of those surveyed, data for areas with a population of 20,000 and under are available only in the 5-year datasets; therefore, the 5-year dataset is the preferred dataset for collection of demographic data in this workbook.

Data from the ACS come in the form of tables that show the characteristic in question as well as any further breakdown (i.e., sex, age, household size). Each table is associated with a specific table number that can be searched for using a Census website known as American FactFinder. (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml)

In addition, tables can be located by searching using general subject terms (i.e., household vehicles) or searching by topic. Figure 1 shows the American FactFinder main page. Search terms or table numbers can be entered into the "topic or table name" box and clicking "GO." In addition, the user can also click "Topics" along the left-hand side of the screen and use the headings to drill down to the appropriate topic table.

The American FactFinder page allows the user to search for data from many different Census products. Searches can be conducted using a number of different steps. This workbook provides one search method. Users can use different search methods to obtain the same data required for the analyses contained in this workbook depending on their familiarity and comfort level with American FactFinder.
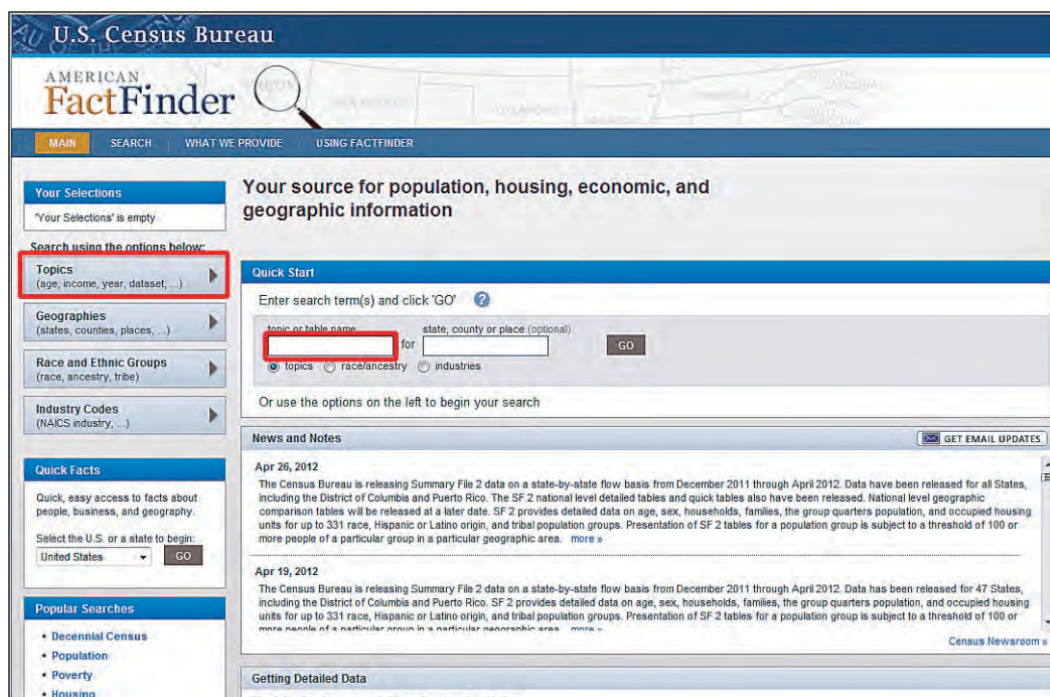
Figure 1.   Methods to Search for ACS Tables.

It is assumed that the table numbers associated with each table are unlikely to change on a frequent basis. Therefore, this is the preferred method used to search for and collect the appropriate data for each method contained in the workbook. The various table numbers and titles are included in Table 1. They are organized by method.

The instructions given throughout the remainder of this workbook for obtaining ACS data will yield data for the current 5-year period as of early 2012, except for disability characteristics. When data are available, the 5-year dataset for each table is the preferred dataset for all the methods contained in this workbook because it includes all jurisdictions, regardless of population size. The specific steps required to retrieve ACS data may change as the Census Bureau revises its website or its surveys.

Table 1.   ACS Table Numbers used in this Workbook.

ACS Table Number	Table Title	Methods Using These Data
B08201	Household Size by Vehicles Available	Need – Population Segments, Need – Mobility Gap, Demand – Non-program, Demand – Non-market specific
B17001	Poverty Status in the Past 12 Months by Sex by Age	Need – Population Segments, Demand – Non-program
B01001	Sex by Age	Demand – Non-program
S1810	Disability Characteristics	Demand – Non-program
B01003	Total Population	Demand – Small City Fixed-Route

Note: Disability is not currently available in any 5-year datasets. It is only available in 3-year and 1-year datasets. The 5-year dataset will be available in ACS 2008-2012 in 2013.

Definitions

Need

1. The number of people in a given geographic area likely to require a passenger transportation service.
2. The difference between the number of trips made by persons who reside in households owning no personal vehicle and the number of trips that would likely be made by those persons if they had access to a personal vehicle. This measure is referred to as the Mobility Gap.

Demand

The number of trips likely to be made over a given period within a given geographic area at a given price and level of service. The procedures for preparing forecasts of demand have been stratified by market:

- Public (i.e., Section 5311 funded) services
- Program or sponsored trips
- Fixed-route service in small urban towns in rural areas
- Commuters from rural areas to central cities

Trips

As used in this workbook trips are defined as one-way trips made over a given time period—a day or a year.

Given differences in data sources, trips are defined differently for different markets.

For **public systems** and **fixed-route services in small urban towns** in rural areas, the Rural National Transit Database was used as the source of data. The definition of a trip is, therefore, the same as used in the NTD: *The number of passengers who board operational revenue vehicles. Passengers are counted each time they board a vehicle, no matter how many vehicles they use to travel from their origin to their destination. The time period for these estimates is one year.*

For **program or sponsored trips**, the data used for analysis were gathered from many social-service agencies. For this market, a trip is a "linked trip" from an original origin to an ultimate destination. Transfers or intermediate stops are not counted as additional trips. The forecast method produces estimates of annual trips.

For **commuter trips**, the method forecasts the number of transit trips based on a user-provided measure of person-trips. The definition of a trip will therefore depend on the source used. If the source is the Longitudinal Employment-Household Dynamics (LEHD) dataset, the values represent **commuters** rather than **trips**. To get estimates of trips, the values must be doubled to represent travel to and from work. If the source for "person-trips" is the ACS or the Census Transportation Planning Package, a trip is a daily one-way journey from home to work. The value must be multiplied by two to get daily transit trips. When using either LEHD or ACS data that report commuting travel on an average day, the daily values should be multiplied by 255 to get annual transit trips. If some other source is used for person-trips (e.g., estimated by the urban area Metropolitan Planning Organization or by the State Transportation Agency), then the estimates will be in the units used for those projections.

Mobility Gap

The difference between the number of trips per day made by persons living in households having one personal vehicle available and those living in households that own no personal

vehicles. This is a more conservative measure than comparing the trip rate for households with no vehicle available against households having one or more vehicles available.

American Community Survey (ACS)

A survey administered by the U.S. Bureau of the Census that collects data each year from a sample of approximately 2.5% of the households in the nation. The information collected in the ACS has replaced the data previously collected every 10 years in the decennial Census long-form. Results are made available for each year, for a rolling 3-year period, and for a rolling 5-year period. Given that the Census must suppress some data to maintain confidentiality, data for areas with a population of 20,000 or less are available only in the 5-year rolling summaries.

Rural

For the methodologies presented in this workbook, a rural county is defined as one having a population density of less than 1,000 persons per square mile.

Urbanized Area

As defined by the U.S. Census, an area consisting of a central place and adjacent territory with a general population density of at least 1,000 people per square mile of land area that together has a minimum residential population of at least 50,000 people.

Urban Cluster

As defined by the U.S. Census, an urban cluster consists of densely settled territory that contains at least 2,500 people, but fewer than 50,000 people.

Urban Center

A method is included in this workbook for estimating the demand for passenger transportation from rural counties to urban centers. In this context an urban center is defined as the central place of an urbanized area.

CHAPTER 2

Need

Need is defined in two ways: (1) as the number of people in a given geographic area likely to require a passenger transportation service and (2) as the number of trips that would be made by those persons if they had minimal limitations on their personal mobility. Because the incremental cost of a trip using a car is low for those who have ready access to and ability to use a car, the difference between the number of daily trips made by persons with ready availability to a personal vehicle and by those lacking such access is used as the indicator of the unmet need for additional person-trips. Not all of this unmet need will be provided by public passenger transportation services. Persons lacking a personal vehicle or the ability to drive receive transportation from friends, relatives, volunteers, and social-service agencies, as well as from public services.

Population Segments

Data analyzed in the development of this method indicated that although there is a daily trip rate decline for individuals as they age, the two factors showing the greatest impact on trip need are vehicle ownership and poverty.

Data related to poverty status and vehicle ownership had been collected regularly as part of the decennial Census. Since 2005, these data are collected as part of the ACS. Therefore, this will be the primary source for collecting the data necessary to perform this method. These data may also be available from the local county or regional planning agencies that serve the areas under study.

Data on the number of persons residing in households owning no vehicle can be derived from a specific dataset within the ACS. Table 2 illustrates the computation to obtain the number of persons residing in households owning no personal vehicle (using data obtained from the ACS).

Estimates of need for passenger transportation services in rural areas should be presented as

- Number of persons residing in households with income below the poverty level, plus
- Number of persons residing in households owning no vehicle.

To document the number of persons who need passenger transportation service in your area, complete Table 3.

In practice, there is some overlap of these groups (i.e., some households with income below the poverty level also lack a personal vehicle). Although a detailed analysis of the ACS data could determine the degree of overlap in specific areas, the added precision would not be consistent with the intended use of this measure.

Table 2.   Example Computation to Convert Households Owning No Personal Vehicle to Residents in Households Owning No Personal Vehicle.

	Owning No Vehicle	Multiplier	Persons resident in households owning no vehicle
1-person households	A	1	A x 1
2-person households	B	2	2
3-person households	C	3	C x 3
4- or more person households	D	4	4
Total Persons			(A x 1) + (B x 2) + (C x 3) + (D x 4)

Table 3.   Worksheet for Documenting Persons with Transportation Needs.

Persons residing in households with income below the poverty level	
Persons residing in households owning no automobile	

Example Computation–Population Segments Method

To obtain the required data from the ACS, go to the main Census website at www.census.gov (see Figure 2).

Hovering over *Data* at the top of the page will bring down a menu. Then clicking on the link to the American FactFinder will bring the user to the FactFinder home page (see Figure 3).
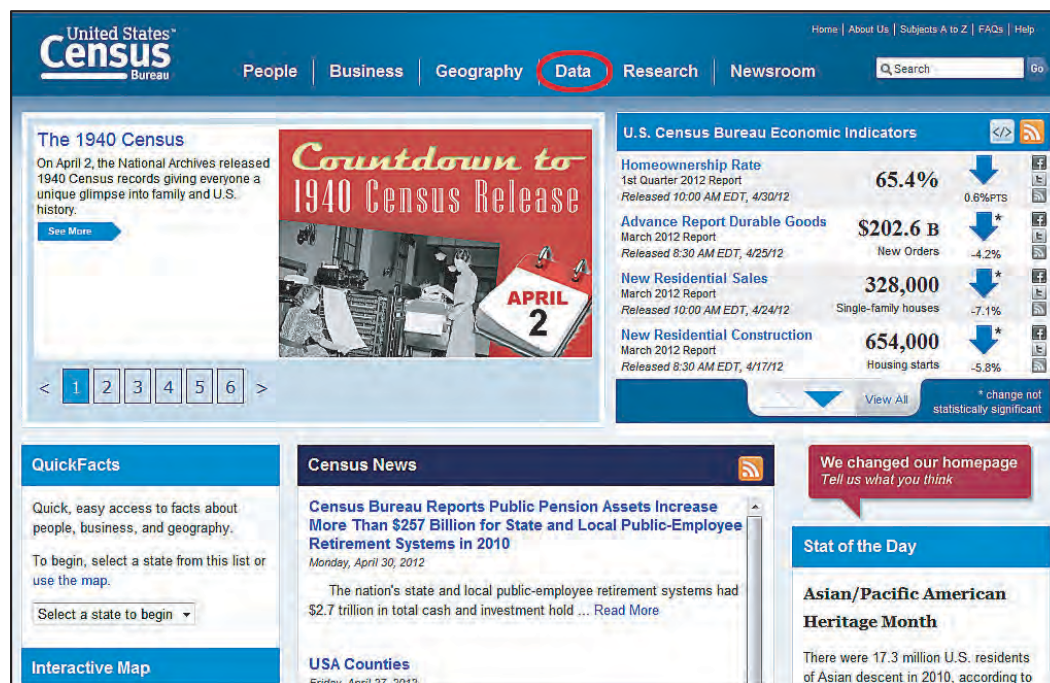
Figure 2.   Census Main Page.
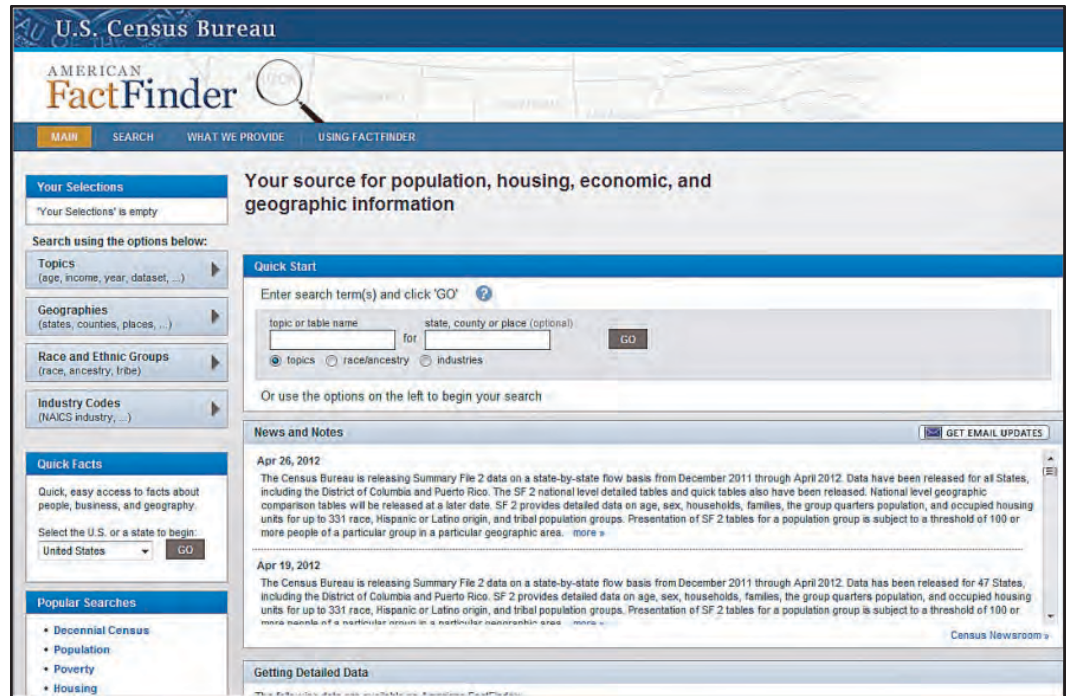
Figure 3.   *American FactFinder Home Page.*

To obtain data about the number of persons residing in households lacking a personal vehicle, enter Table **B08201** in the *topic or table name* box and click *GO* (see Figure 4). Then select the geographic area for which the data are required. This is done by selecting the *Geographies* menu along the side, and selecting the *Geographic Type* that corresponds to the service area (e.g., state and county) (see Figure 5).
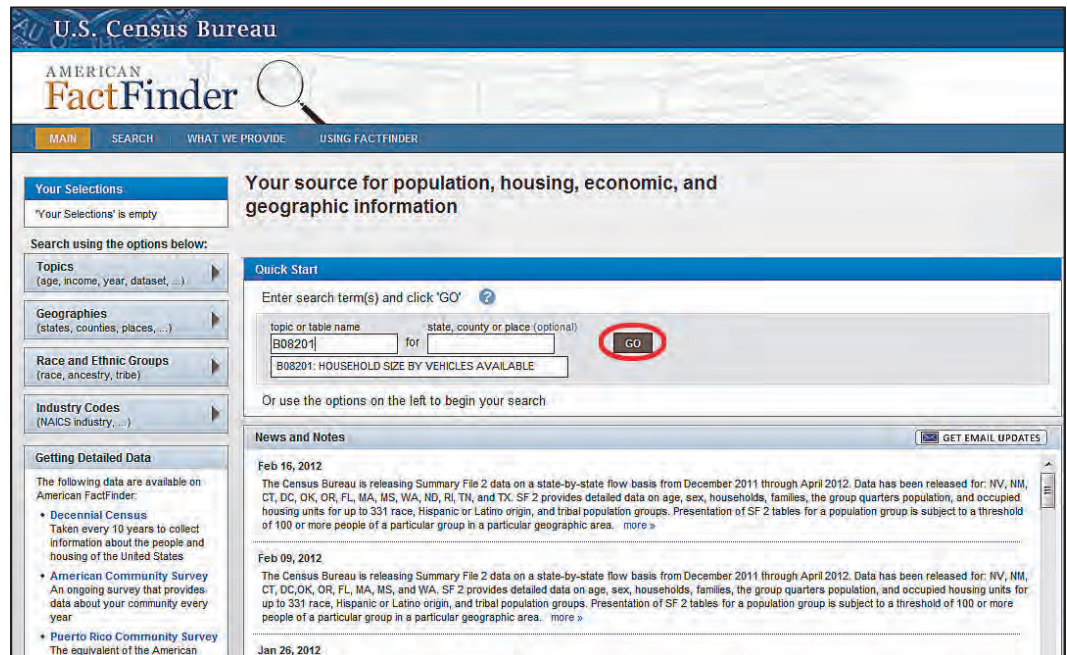
Figure 4.   *American FactFinder Table Selection.*

Figure 5.   American FactFinder Geographic Area Type Selection.

Once the geographic type has been chosen (e.g., county), filtering the geography further will be necessary to obtain data for the county or counties of interest. This can be accomplished using the *Geography Filter Options* along the left side of the *Select Geographies* box. Clicking the drop-down menu for *Within State* will allow the user to narrow the focus by State (see Figure 6). The user can then check the various individual geographies (e.g., counties) that constitute the service area for the agency in question. When all of the geographies have been checked, click *Add* (see Figure 7). Once the study area has been identified through the geography selection process, click the *Close X* to close the *Select Geographies* menu (see Figure 8).

Figure 6.   American FactFinder Filtering Geographic Area Type Selection.
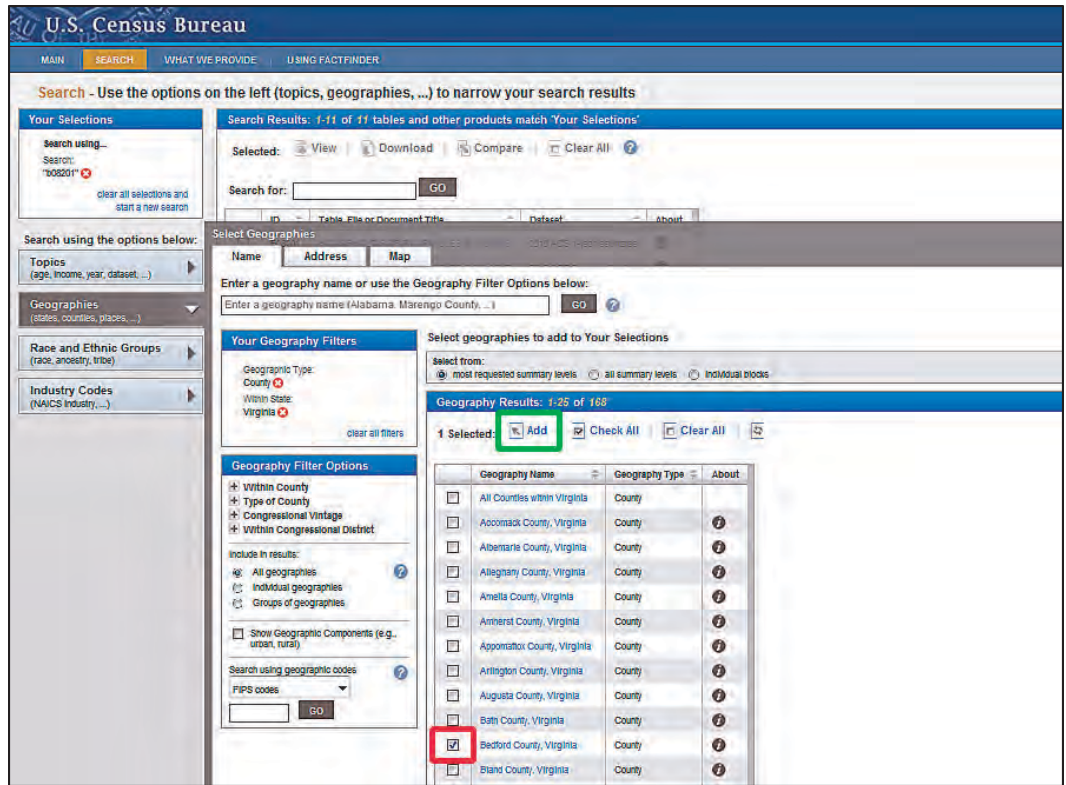
Figure 7.   American FactFinder Adding Geography.

In order to view the results once the geography has been selected, select the appropriate dataset. Use the most recent ACS 5-year dataset available. This is accomplished by selecting the appropriate dataset and clicking *View* (see Figure 9).

The results screen will appear (see Figure 10). The data can be pulled directly from the screen, or they can be downloaded into other formats (e.g., .PDF, .xls, .rtf) by clicking the *Download* action.

Using the results for ACS Table B08201, pull the figures for households with *No vehicle available* and place them in a table similar to Table 2 by household size (see Figure 11 and Table 4).
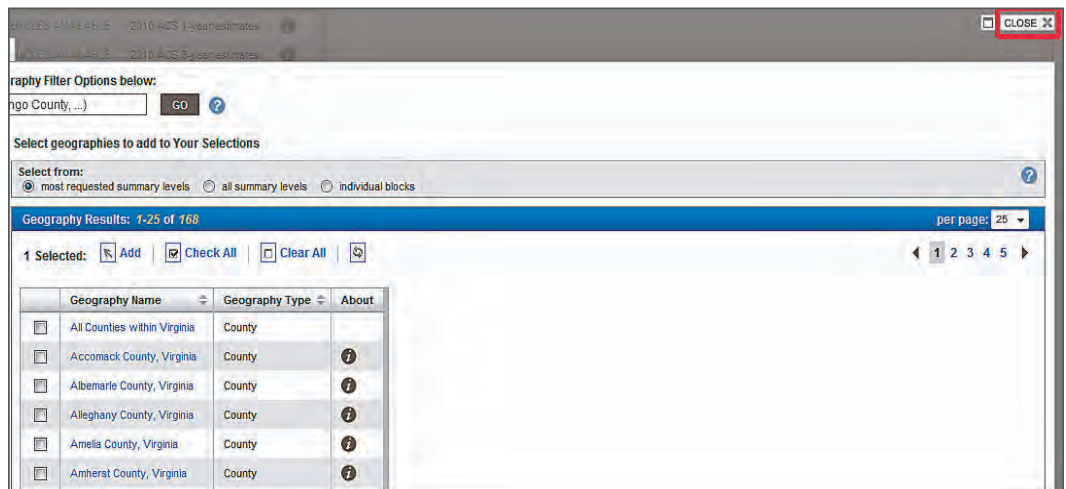
Figure 8.   American FactFinder Close Geography Selection Menu.
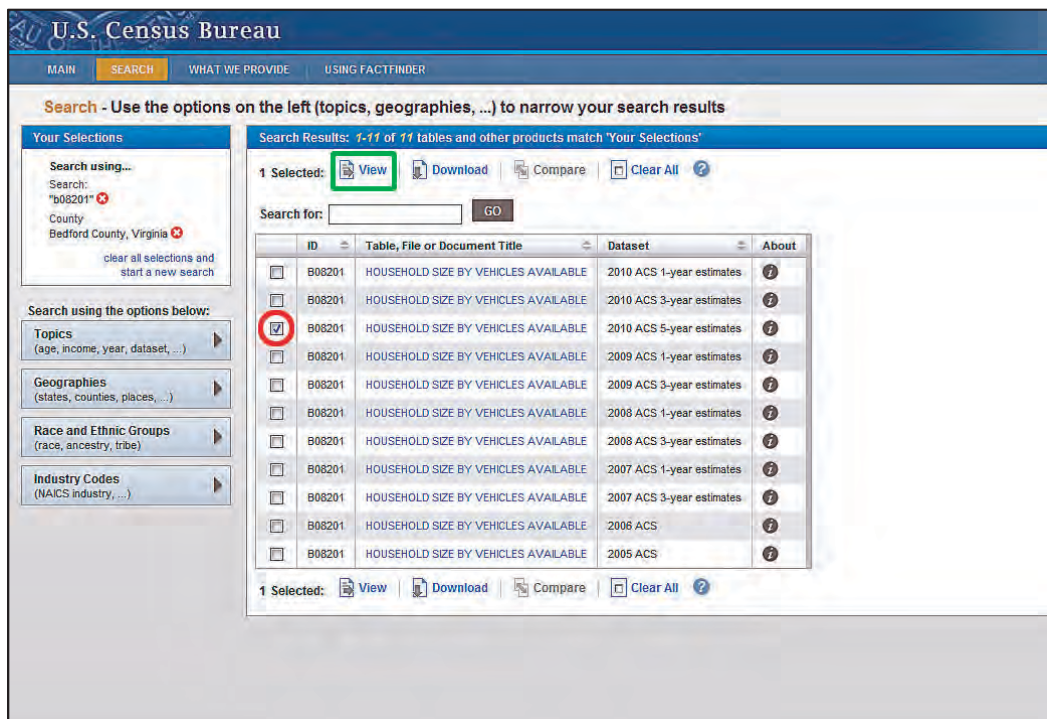
Figure 9.   American FactFinder Selecting Dataset.
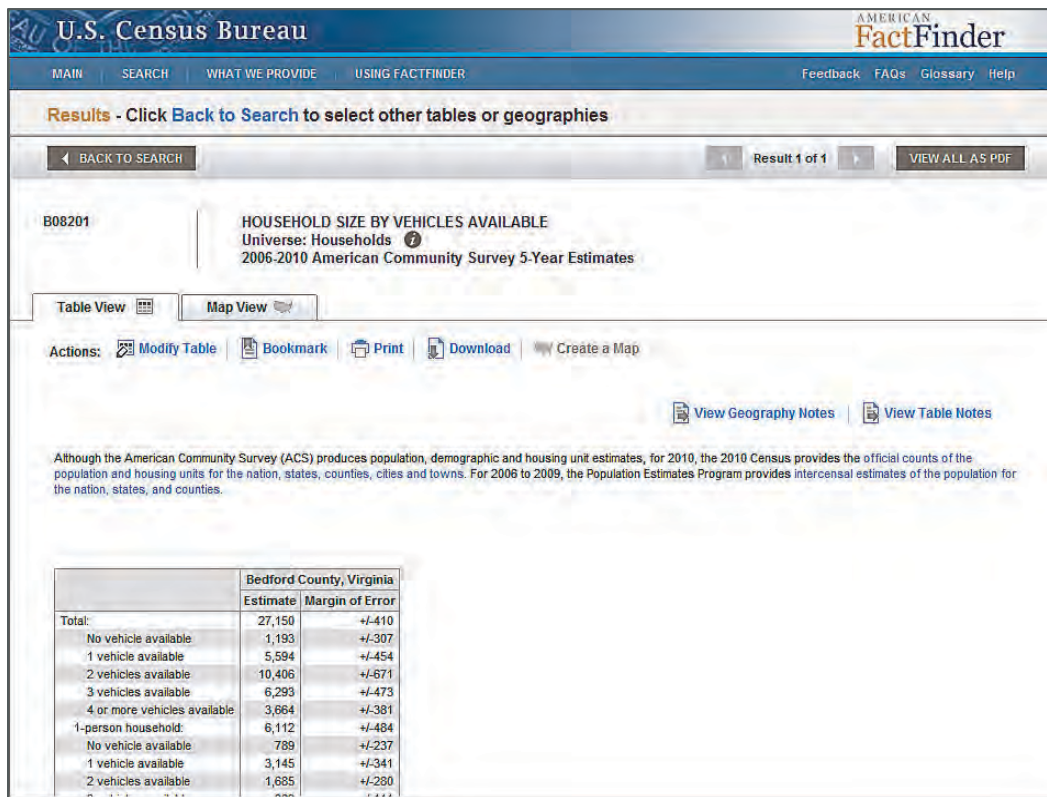
Figure 10.   ACS Table B08201 Results Screen (Example).

	Bedford County, Virginia	
	Estimate	Margin of Error
Total:	27,150	+/-410
No vehicle available	1,193	+/-307
1 vehicle available	5,594	+/-454
2 vehicles available	10,406	+/-671
3 vehicles available	6,293	+/-473
4 or more vehicles available	3,664	+/-381
1-person household:	6,112	+/-484
No vehicle available	789	+/-237
1 vehicle available	3,145	+/-341
2 vehicles available	1,685	+/-280
3 vehicles available	369	+/-111
4 or more vehicles available	124	+/-60
2-person household:	11,100	+/-426
No vehicle available	274	+/-147
1 vehicle available	1,503	+/-255
2 vehicles available	4,992	+/-397
3 vehicles available	2,880	+/-307
4 or more vehicles available	1,531	+/-266
3-person household:	4,426	+/-374
No vehicle available	112	+/-87
1 vehicle available	501	+/-141
2 vehicles available	1,627	+/-240
3 vehicles available	1,315	+/-195
4 or more vehicles available	881	+/-158
4-or-more-person household:	5,422	+/-405
No vehicle available	18	+/-21
1 vehicle available	445	+/-155
2 vehicles available	2,102	+/-300
3 vehicles available	1,729	+/-252
4 or more vehicles available	1,128	+/-211

Source: U.S. Census Bureau, 2006–2010 American Community Survey

Figure 11.   ACS Table B08201 Results – Bedford County, VA (Example).

Table 4.   Computation to Convert Households Owning No Personal Vehicle to Residents in Households Owning No Personal Vehicle – Bedford County, VA (Example).

	No Vehicle	Multiplier	Persons resident in households owning no vehicle
1-person household	789	1	789
2-person household	274	2	548
3-person household	112	3	336
4- or more person household	18	4	72
Total Persons			1,745

Figure 12.   American FactFinder Return to Search.

Sum the results; this is the number of persons residing in the study area that live in a household with no vehicle available.

Information on the number of persons living below the poverty level can be obtained in the same way, using ACS Table **B17001**. This is accomplished by clicking *Back to Search* near the top of the screen after viewing the results from the previous table (see Figure 12). Prior to searching for the next table number, clear the previous table number from the *Your Selections* menu on the left. Once the previous table has been removed, type **B17001** into the *Search for:* box and select *GO* when the appropriate table has been identified (see Figure 13). Note: The geography selected as part of the first table selection should be retained. If the geography selection has not been retained, follow the steps outlined above to reselect the geography. Select the most current 5-year dataset and click *View*. The results table will appear (see Figure 14). Make note of the number of persons whose *Income in the past 12 months was below the poverty line* in a table similar to Table 1 (see Table 5).

Adding the number of persons residing in households below the poverty line and the number of persons residing in households owning no vehicle will produce an estimate of the number of persons within the given study area who are in need of passenger transportation services.

Mobility Gap

The mobility gap is the total number of trips **not** taken because members of zero-vehicle households do not have the ease of mobility available to members of households with ready access to a car. The mobility gap for the nation as a whole and the nine Census regions has been
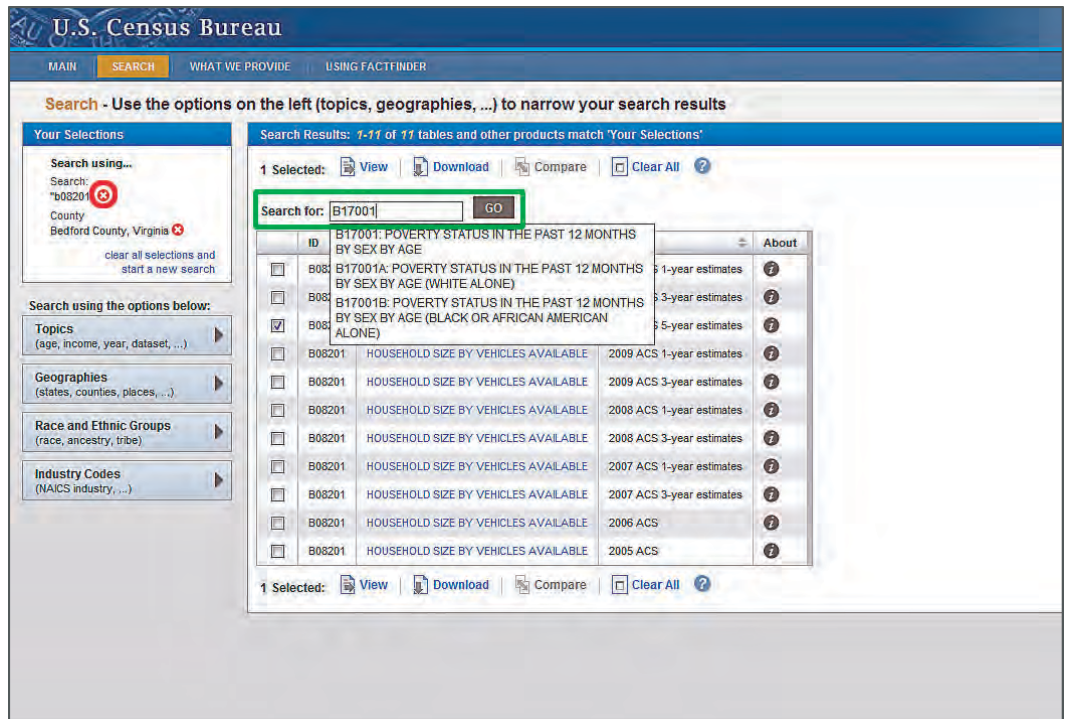
Figure 13. American FactFinder Table Selection – B17001 (Example).

| | Bedford County, Virginia | |
	Estimate	Margin of Error
Total:	67,402	+/-194
Income in the past 12 months below poverty level:	5,897	+/-804
Male:	2,658	+/-441
Under 5 years	290	+/-116
5 years	24	+/-28
6 to 11 years	299	+/-119
12 to 14 years	173	+/-86
15 years	34	+/-29
16 and 17 years	27	+/-31
18 to 24 years	314	+/-111
25 to 34 years	226	+/-116
35 to 44 years	378	+/-156
45 to 54 years	372	+/-136
55 to 64 years	300	+/-107
65 to 74 years	115	+/-62
75 years and over	106	+/-63
Female:	3,239	+/-504
Under 5 years	269	+/-118
5 years	15	+/-24
6 to 11 years	390	+/-154
12 to 14 years	112	+/-74
15 years	25	+/-32
16 and 17 years	50	+/-49
18 to 24 years	340	+/-145
25 to 34 years	367	+/-133
35 to 44 years	317	+/-129
45 to 54 years	445	+/-138
55 to 64 years	356	+/-121
65 to 74 years	210	+/-108
75 years and over	343	+/-130
Income in the past 12 months at or above poverty level:	61,505	+/-793
Male:	30,817	+/-435
Under 5 years	1,474	+/-131
5 years	393	+/-148
6 to 11 years	2,443	+/-229

Figure 14.   ACS Table B17001 Results – Bedford County, VA (Example).

Table 5.   Worksheet for Documenting Persons with Transportation Needs (Example).

Persons residing in households with income below the poverty level (Figure 14)	5,897
Persons residing in households owning no automobile (Table 4)	1,745
Persons in need of Passenger Transportation Services	**7,642**

developed from data in the 2009 National Household Travel Survey (see Table 6). A mobility gap estimate based on household vehicle availability, with the gap measured in trips per day, is computed as

Need (trips) = Number of Households having No Car × Mobility Gap

The mobility gap computation uses one of the pieces of data used in the *Population Segments* method above, households with no vehicle available (**Table B08201**). Multiply the gap number for your region found in Table 6 by the number of *households owning no personal vehicle* in your service area to estimate the daily mobility gap. This method may also be used to estimate the mobility gap for subareas of your region.

The estimate produced by the mobility gap method is measured in one-way trips per day. Having an estimate of the number of trips to be served over a given service area provides a way to quantify the resources that would be needed to meet this unserved demand. *TCRP Report 98:*

Table 6.   Mobility Gap.

Census Division	States	Trips per Rural Household Per Day		
		Vehicles Available		Gap
		0	1	
National		3.2	4.7	1.5
Division 1: New England	Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island	3.3	5.0	1.7
Division 2: Middle Atlantic	New Jersey, New York, Pennsylvania	3.5	4.8	1.3
Division 3: East North Central	Wisconsin, Michigan, Ohio, Indiana, Illinois	2.7	4.1	1.4
Division 4: West North Central	North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, Minnesota	2.4	4.5	2.1
Division 5: South Atlantic	Maryland, Delaware, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida	3.2	4.5	1.3
Division 6: East South Central	Kentucky, Tennessee, Alabama, Mississippi	2.7	4.1	1.4
Division 7: West South Central	Oklahoma, Arkansas, Texas, Louisiana	2.9	4.9	2.0
Division 8: Mountain	Idaho, Montana, Wyoming, Colorado, Utah, Nevada, Arizona, New Mexico	5.2	6.0	0.8
Division 9: Pacific	Washington, Oregon, California, Alaska, Hawaii	3.8	4.9	1.1

	Bedford County, Virginia	
	Estimate	Margin of Error
Total:	27,150	+/-410
No vehicle available	1,193	+/-307
1 vehicle available	5,594	+/-454
2 vehicles available	10,406	+/-671
3 vehicles available	6,293	+/-473
4 or more vehicles available	3,664	+/-381
1-person household:	6,112	+/-484
No vehicle available	789	+/-237
1 vehicle available	3,145	+/-341
2 vehicles available	1,685	+/-280
3 vehicles available	369	+/-111
4 or more vehicles available	124	+/-60
2-person household:	11,180	+/-426
No vehicle available	274	+/-147
1 vehicle available	1,503	+/-255
2 vehicles available	4,992	+/-397
3 vehicles available	2,880	+/-307
4 or more vehicles available	1,531	+/-266
3-person household:	4,436	+/-374
No vehicle available	112	+/-87
1 vehicle available	501	+/-141
2 vehicles available	1,627	+/-240
3 vehicles available	1,315	+/-195
4 or more vehicles available	881	+/-158
4-or-more-person household:	5,422	+/-405
No vehicle available	18	+/-21
1 vehicle available	445	+/-155
2 vehicles available	2,102	+/-300
3 vehicles available	1,729	+/-252
4 or more vehicles available	1,128	+/-211

Source: U.S. Census Bureau, 2006-2010 American Community Survey

Figure 15. ACS Table B08201 Mobility Gap Results – Bedford County, VA (Example).

Resource Requirements for Demand-Responsive Transportation Services provides a method for estimating the number of vehicles needed to serve a given level of demand over a given service area when the call-ahead time window and the required degree of assurance that a trip can be served are specified (http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp_rpt_98.pdf).

Example Computation–Mobility Gap Method

Retrieve ACS Table B08201 for the study area (see Figure 15). This can be accomplished following the steps outlined above for retrieving the data for the *Population Segments Method.*

Collect the gap number from Table 6 (1.3–South Atlantic). Produce the estimate of need by multiplying the gap number by the number of households with no vehicle available (see Table 7).

Table 7. Mobility Gap Calculation – Bedford County, VA (Example).

Households with No Vehicle Available	1,193
Gap Number	1.3
Mobility Gap (Trips per day)	1,551

To produce an estimate for annual need, it is recommended that the daily Mobility Gap figure be multiplied by 300 days. This figure reflects that trip need is likely reduced on the weekends, but annual need is not just associated with weekdays. This results, for the example above, in an annual need of 465,300 trips.

The estimates of need made using the mobility gap method are typically far greater than the number of trips actually observed on rural passenger transportation systems and are likely greater than the demand that would be generated for any practical level of service. Much of the remaining trip-based mobility gap is likely filled by friends and relatives driving residents of non-car-owning households. Therefore, agencies choosing to use the mobility gap may wish to establish a target or goal for the proportion of the gap to be satisfied by publicly provided services. In the testing of these suggested methodologies with a number of rural transit agencies, it was found that, at best, only about 20% of the mobility gap trip-based need was met.

CHAPTER 3

Demand

General Public Rural

Two methods are available to estimate the demand expected for passenger transportation in rural areas not related to social-service programs. A third method for estimation of demand for **general public** transportation (i.e., service used as reported to the rural NTD) also included in this section addresses demand based on need and the supply of service. This third method provides a figure for demand that is not tied to a specific market, but provides an estimate for demand for transportation in general.

The methods for general public (non-program) demand are listed below in order of suggested application:

1. Peer data from your system, other nearby systems or systems in same state or
2. Non-program Demand = (2.20 × Population age 60+) + (5.21 × Mobility Limited Population age 18 to 64) + (1.52 × Residents of Households having No Vehicle)

Peer Data

The preferred approach to estimating the demand for general public rural passenger transportation services is to base the estimate on the experience of your system, if one is operating, or the experience of other systems operating in similar rural settings in your own state. If there are few other systems in similar communities or regions within your state, you may need to obtain data from systems in adjacent states. To do this, you will want to obtain some information from the peer agencies so that their experience can be applied to your system. The information you will want is as follows (see Table 8):

- Population of the area served
- Size in square miles of the area served
- Annual vehicle-miles and/or vehicle-hours of service provided
- Nature of the operation (e.g., fixed-route, route-deviation, demand-response)
- Number of one-way trips served (per month, per year)
- Degree of coordination with other carriers

From these data, compute such key ratios as

- Passenger-trips per capita
- Passenger-trips per vehicle-mile (by service type)
- Passenger-trips per vehicle-hour (by service type)

Compute these ratios for each peer system. Then determine the average value and the median value. (Note: The Excel functions =AVERAGE and =MEDIAN can be used to do this once the

Table 8.   Worksheet for Peer System Data Collection.

Input Data from Peer Transit Systems or Existing Transit Service					
Name of Peer System					
Population of Area					
Size of Area Served (Square Miles)					
Annual Vehicle-Miles of Service Provided					
Annual Vehicle-Hours of Service Provided					
Service Type (Fixed-Route, Route-Deviation, Demand-Response)					
Number of One-Way Trips Served per Year					
Degree of Coordination with Other Carriers (Circle One)	Low Medium High	Low Medium High	Low Medium High	Low Medium High	Low Medium High

data are entered in an Excel spreadsheet. Other spreadsheet software will have similar functions.) Also determine the maximum and minimum values.

Define your proposed operation in terms of

- Population that will be served
- Vehicle-miles that will be operated (per month, per year)
- Vehicle-hours of service that will be operated (per month, per year)

Fill in the cells in Table 9. In the row *My System*, enter the values for the population of your proposed service area and the number of vehicle-miles and/or vehicle-hours of service you propose to operate.

In the column, *Trip Rates*, enter the values of trips per unit (population, miles, hours) determined from the identified peer systems. Then multiply the value for your system (column) by the peer rate (row) and enter the value in the appropriate column (see Figure 16).

For each column determine the maximum, average, median, and minimum values. This gives reasonable estimates of the range of trips that may be expected.

NOTE: your best peer system is your own operation.

If you are operating service and wish to analyze the effects of adding new service or reducing existing service, simply compute the rates per capita, per hour, and per mile for your current operations and apply them to the proposed revised service plan. If you provide different levels of service to different parts of your community, then you can use your own data to estimate how other parts of your service area will respond to a different level of service. If you have changed service levels in past years, the experience gained from those changes can be used to estimate planned changes.

Table 9.   Worksheet for Application of Peer System Values.

My System		Population	Annual Vehicle-miles	Annual Vehicle-hours
Peer Values	Observed Trip Rates	Demand Estimate Based On		
		Population	Annual Vehicle-miles	Annual Vehicle-hours
Trips per Capita				
Maximum				
Average				
Median				
Minimum				
Trips per Vehicle-mile				
Maximum				
Average				
Median				
Minimum				
Trips per Vehicle-hour				
Maximum				
Average				
Median				
Minimum				
Values Expected For My System				
Maximum				
Average				
Median				
Minimum				

General Public (Non-program) Demand Function

Based on analysis of data collected in workshops and reported to the Rural National Transit Database for 2009, the following function was developed to produce reasonable estimates of the demand for general public, or non-program, passenger transportation in rural areas:

Non-program Demand (trips per year) = (2.20 × Population Age 60+) + (5.21 × Mobility Limited Population age 18-64) + (1.52 × Residents of Household Having No Vehicle)

To apply the function for analysis or planning, simply determine how many persons are in each demographic group in your service area, multiply by the proper factor, and add the results together. The demographic data can be gathered from the American Community Survey, following the steps outlined above for accessing ACS data for estimating need. The table numbers associated with each are

- Persons Age 60+ – B01001
- Persons with a Mobility Limitation age 18-64 – S1810
- Persons residing in Households with No Vehicle Available* – B08201

Table 10 provides space to record the values above along with the factors that should be applied.

It will be necessary to do some calculations to arrive at the necessary demographic figures required for this method due to the breakdown of figures by age and/or sex. Simple addition will provide the required numbers.

Figure 16.   Example Computation to Derive Trip Rates for Peer Data Method.

* Table B08201 provides values for households with no vehicle available. In order to produce values for persons living in households with no vehicle, follow the procedure outlined above in the *Population Segments Method for Estimating Need.*

Example Computation–General Public Demand

Pull Table B01001 for the ACS from American FactFinder. The steps for using American Fact-Finder can be found in the section addressing the *Example Computation – Population Segments Method.* Once the results table has been retrieved, calculate the number of persons Age 60 and older (see Figure 17). This is accomplished by adding the figures for each of the age groups starting with "60 and 61 years" and ending with "85 years and over" for males and females together.

Once data for persons age 60 and older have been gathered, go back to the table search and search for Table **S1810** (see Figure 18). Steps for accomplishing this task can be found in the

Table 10.   Worksheet for Estimating General Public (Non-Program) Demand.

	Column A (persons)	Column B Factor	Column C (A x B)
Age 60+		2.20	
Mobility Limited age 18-64		5.21	
Household with No Vehicle Available		1.52	
Estimated Demand (Sum of Column C)			

	Total:				Bedford County, Estimate	Margin of
					67,697	*****
Male:	33,585	+/-110	Female:		34,112	+/-110
Under 5 years	1,764	+/-69	Under 5 years		1,651	+/-73
5 to 9 years	2,147	+/-215	5 to 9 years		1,869	+/-235
10 to 14 years	2,504	+/-238	10 to 14 years		2,564	+/-230
15 to 17 years	1,403	+/-42	15 to 17 years		1,527	+/-63
18 and 19 years	815	+/-62	18 and 19 years		726	+/-68
20 years	301	+/-106	20 years		330	+/-141
21 years	193	+/-97	21 years		172	+/-86
22 to 24 years	1,002	+/-147	22 to 24 years		898	+/-157
25 to 29 years	1,307	+/-88	25 to 29 years		1,398	+/-96
30 to 34 years	1,671	+/-105	30 to 34 years		1,710	+/-87
35 to 39 years	2,324	+/-313	35 to 39 years		2,221	+/-251
40 to 44 years	2,456	+/-266	40 to 44 years		2,865	+/-240
45 to 49 years	2,890	+/-102	45 to 49 years		2,901	+/-27
50 to 54 years	2,909	+/-114	50 to 54 years		2,883	+/-39
55 to 59 years	2,770	+/-213	55 to 59 years		2,829	+/-236
60 and 61 years	1,056	+/-175	60 and 61 years		1,058	+/-187
62 to 64 years	1,201	+/-180	62 to 64 years		1,057	+/-179
65 and 66 years	737	+/-162	65 and 66 years		924	+/-198
67 to 69 years	921	+/-168	67 to 69 years		1,011	+/-173
70 to 74 years	1,462	+/-174	70 to 74 years		1,202	+/-181
75 to 79 years	939	+/-131	75 to 79 years		1,080	+/-135
80 to 84 years	417	+/-103	80 to 84 years		670	+/-137
85 years and over	396	+/-108	85 years and over		566	+/-129

Figure 17.   ACS Table B01001 Results – Bedford County, VA (Example).

section titled *Example Computation – Population Segments Method.* The figure for persons with a mobility limitation can be pulled from the figure for persons "with an independent living difficulty." Persons in this category are thought to be the group most likely to require passenger transportation services. Note: As of the development of this workbook, these data were only available in the 3-Year ACS dataset. Once more yearly ACS datasets have been collected and published, a 5-year dataset should be available and used in the future.

Obtaining the number of persons resident in households with no vehicle available requires the most manipulation from the base table pulled from the ACS. The *Example Computation – Population Segments Method* section describes how to use the data from Table **B08201** and put it into Table 11 to derive the number of persons resident in households with no vehicle available.

An example of the calculation for the demand estimate can be found in Table 12, using the example data from above.

Rural Public Transportation Demand (Not Market Specific)

The methods described above may be used to estimate the demand for "non-program related passenger transportation" (i.e., transportation not resulting from participation in a particular

Table 11.   Worksheet for Documenting Persons with Transportation Needs – Bedford County, VA (Example).

	No Vehicle	Multiplier	Persons resident in households owning no vehicle
1-person household	789	1	789
2-person household	274	2	548
3-person household	112	3	336
4- or more person household	18	4	72
Total Persons			1,745

Table 12.   Worksheet for Estimating General Public Demand – Bedford County, VA (Example).

	Column A (persons)	Column B Factor	Column C (A x B)
Age 60+	14,697	2.20	32,333
Mobility Limited age 18-64	1,537	5.21	8,008
Household with No Vehicle Available	1,745	1.52	2,652
Estimated Demand (Sum of Column C)			42,993

Subject	Bedford County, Virginia					
	Total		With a disability		Percent with a disability	
	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error
Total civilian noninstitutionalized population	68,111	+/-110	8,387	+/-875	12.3%	+/-1.3
Population under 5 years	3,379	+/-153	0	+/-165	0.0%	+/-1.8
With a hearing difficulty	(X)	(X)	0	+/-165	0.0%	+/-1.8
With a vision difficulty	(X)	(X)	0	+/-165	0.0%	+/-1.8
Population 5 to 17 years	11,957	+/-144	836	+/-276	7.0%	+/-2.3
With a hearing difficulty	(X)	(X)	50	+/-57	0.4%	+/-0.5
With a vision difficulty	(X)	(X)	189	+/-110	1.6%	+/-0.9
With a cognitive difficulty	(X)	(X)	631	+/-247	5.3%	+/-2.1
With an ambulatory difficulty	(X)	(X)	182	+/-147	1.5%	+/-1.2
With a self-care difficulty	(X)	(X)	128	+/-132	1.1%	+/-1.1
Population 18 to 64 years	42,102	+/-187	4,239	+/-620	10.1%	+/-1.5
With a hearing difficulty	(X)	(X)	758	+/-216	1.8%	+/-0.5
With a vision difficulty	(X)	(X)	724	+/-235	1.7%	+/-0.6
With a cognitive difficulty	(X)	(X)	1,714	+/-459	4.1%	+/-1.1
With an ambulatory difficulty	(X)	(X)	2,156	+/-424	5.1%	+/-1.0
With a self-care difficulty	(X)	(X)	1,031	+/-335	2.4%	+/-0.8
With an independent living difficulty	(X)	(X)	1,537	+/-353	3.7%	+/-0.8
Population 65 years and over	10,673	+/-157	3,312	+/-403	31.0%	+/-3.7
With a hearing difficulty	(X)	(X)	1,319	+/-249	12.4%	+/-2.4
With a vision difficulty	(X)	(X)	511	+/-181	4.8%	+/-1.7
With a cognitive difficulty	(X)	(X)	958	+/-309	9.0%	+/-2.9
With an ambulatory difficulty	(X)	(X)	1,957	+/-364	18.3%	+/-3.3
With a self-care difficulty	(X)	(X)	715	+/-228	6.7%	+/-2.1
With an independent living difficulty	(X)	(X)	1,527	+/-341	14.3%	+/-3.2
SEX						
Male	33,688	+/-222	4,318	+/-573	12.8%	+/-1.7
Female	34,423	+/-171	4,069	+/-535	11.8%	+/-1.5
RACE AND HISPANIC OR LATINO ORIGIN						
One Race	N	N	N	N	N	N
White alone	62,587	+/-186	7,639	+/-795	12.2%	+/-1.3
Black or African American alone	3,875	+/-254	560	+/-253	14.5%	+/-6.6
American Indian and Alaska Native alone	N	N	N	N	N	N
Asian alone	N	N	N	N	N	N
Native Hawaiian and Other Pacific Islander alone	N	N	N	N	N	N
Some other race alone	N	N	N	N	N	N

Figure 18.   ACS Table S1810 Results – Bedford County, VA (Example).

social-service program). Many rural passenger transportation agencies serve both "program" and "non-program" trips. These "General Public" trips are those that are reported to the Rural NTD.

A method for estimating the demand for such "General Public" trips is presented that relates expected demand to the estimate of need (previously described) and the amount of service provided. This estimation function was developed using data from the 2009 Rural NTD and data from the ACS. This function accounts for the need for transportation services in a given area, regardless of the type of service needed and the amount of service provided. This method produces an estimate of how much demand will result related to the amount of service provided.

Table 13.   Worksheet for Estimating Rural Public Transportation Demand.

Annual Mobility Gap	
Annual Vehicle-miles	

This method can also be used to compare the change in demand associated with an expansion or reduction in service. Use Table 13 to estimate demand. The function is as follows:

Annual Demand on Rural Transportation Services $= 2.44 \times (Need^{0.028}) \times (Annual\ Vehicle\text{-}miles^{0.749})$[1]

Need is computed using the Mobility Gap method discussed above. The daily mobility gap should be multiplied by 300 to produce an annual trip need. Annual vehicle-miles can be the existing service provided or number proposed to be provided. This figure should include all vehicle-miles of service provided to the public, regardless of the type of service.

Example Computation–Non-Market-Specific Rural Demand

Table **B08201** was pulled for Archuleta County, CO, for this example (Figure 19). See Appendix A for steps on how to access ACS data. The mobility gap for Archuleta County is 15,600 annual trips ($65 \times 0.8 \times 300$).

The amount of service provided for Archuleta County, CO, was 167,531 annual revenue miles (Source: 2010 Rural NTD). The resulting demand for Archuleta County, regardless of market, is 26,160 ($2.44 \times (15,600^{0.028}) \times (167,531^{0.749})$). Archuleta County's transit service serves local ski resorts and does not likely demonstrate a typical amount of service or ridership for a rural area this size.

Program (Sponsored) Trips

Program Trips are defined as those trips that would not be made without the existence of a specific social-service program or activity. The distinguishing factor is that the trip time and destination are set not by the traveler, but by the agency sponsoring the trip.

Equations were presented in *TCRP Report 3* for use in estimating Program Trip demand based on specific Census data. These formulas can be accessed from *TCRP Report 3* online.

Given the high variance in program trip demand that was observed in data obtained since the publication of *TCRP Report 3,* it is recommended that better estimates can be derived by using specific information collected directly from individual programs. To develop an estimate of the demand for program trips begin by listing the known programs in your area. Obtain from the agencies providing these services the following data (use Table 14):

- Number of program participants
- Number of days per week that the program meets
- The number of weeks per year the program is offered
- The proportion of program participants who attend the program on an average day
- The proportion of program participants who require transportation service. (It has been observed that some people use provided transportation even though they can drive and own a vehicle because the ride is considered a part of the social aspect of the program. These individuals should be included in the proportion figure.)

---

[1] Raising a number to a non-integer power can be done on most scientific calculators or any spreadsheet program.

	Archuleta County, Colorado	
	Estimate	Margin of Error
Total:	3,377	+/-313
No vehicle available	65	+/-38
1 vehicle available	701	+/-169
2 vehicles available	1,738	+/-251
3 vehicles available	627	+/-145
4 or more vehicles available	246	+/-81
1-person household:	727	+/-171
No vehicle available	49	+/-40
1 vehicle available	492	+/-143
2 vehicles available	155	+/-88
3 vehicles available	7	+/-9
4 or more vehicles available	24	+/-30
2-person household:	1,977	+/-172
No vehicle available	16	+/-18
1 vehicle available	143	+/-70
2 vehicles available	1,277	+/-192
3 vehicles available	432	+/-121
4 or more vehicles available	109	+/-57
3-person household:	223	+/-82
No vehicle available	0	+/-123
1 vehicle available	25	+/-26
2 vehicles available	104	+/-53
3 vehicles available	59	+/-38
4 or more vehicles available	35	+/-28
4-or-more-person household:	450	+/-114
No vehicle available	0	+/-123
1 vehicle available	41	+/-31
2 vehicles available	202	+/-85
3 vehicles available	129	+/-71
4 or more vehicles available	78	+/-45

Source: U.S. Census Bureau, 2006–2010 American Community Survey

Figure 19.   ACS Table B08201 Results – Archuleta County, CO (Example).

Table 14.   Worksheet for Program Transportation Data.

Program Name			
How many participants?			
How many events (per week)?			
What is the percentage of participants who attend on an **average** day?			
What is the percentage of participants who are transit dependent or likely to use transit?			
How many weeks is the program offered (annually)?			
Result x 2 (trips per participant)			

Once the above data has been collected, use the following equation to estimate demand:

Number of Program Participants × Program Events per Week × the Proportion of Program Participants who attend the Program on an Average Day × the Proportion of Program Participants that are Transit Dependent or Likely to Use the Transit Service provided/funded by the Agency × the Number of Weeks per Year the Program is Offered × 2 (trips per participant per event)

Example Computation–Program Trips

Table 15 shows data for a meal program as an example calculation using the method above. The resulting program would result in a demand of 6,310 annual trips. These trips could be served by the agency providing the program directly or coordinated with another program agency or a public transportation provider based on available capacity.

Small City Fixed-Route

In many rural counties there exist one or more small cities in which a traditional fixed-route, fixed-schedule transit service is operated. Analysis of data from the Rural NTD and data provided by representatives from agencies who attended workshops held as part of TCRP Project B-36 led to the following function for estimating ridership. This relationship demonstrates the importance, in these small cities, of transit in supporting the local colleges and universities as well as the amount of service provided. The function for small city fixed-route service is

Unlinked passenger-trips = 5.77 × Revenue-hours of Service + 1.07 × Population + 7.12 × College/University Enrollment

Conditions of application: Revenue-hours > 0; Population of urban center < 50,000.

Does not include community college enrollment.

To develop an estimate of demand, complete Table 16.

Table 15. Worksheet for Program Transportation Data (Example).

Program Name	Meal Program A		
How many participants?	30		
How many events (per week)?	3		
What is the percentage of participants who attend on an **average** day?	90%		
What is the percentage of participants who are transit dependent or likely to use transit?	75%		
How many weeks is the program offered (annually)?	52		
Result x 2	6,319 annual trips		

Table 16. Worksheet for College and University Enrollment Data.

Name of Institution	Current Enrollment (FTEs)	Projected Planning Year Enrollment (FTEs)
Name of first university		
Name of second university		
Name of first college		
Etc.		
Totals		

Use the total enrollment, summed over all institutions, for either the current year or the planning year in the equation above to estimate the ridership that can be expected on a small fixed-route system in an area of less than 50,000 population and less than 70 vehicle-hours of service per day.

This method was developed using information from the Rural NTD. The data used were restricted to the mode coded MB (Motor bus) but both the "fixed-route" and "deviated fixed-route" data were included. The method may properly be applied to any small city operation that is either fixed-route or deviated fixed-route.

Also, although colleges and universities are transit trip generators included in the recommended estimation method, other entities (e.g., military bases or national laboratories) located in rural settings may be of importance in other areas.

Population figures for any city for which an estimate is being prepared can be gathered from several sources. The local planning department or regional planning agency will likely have figures for population. Additionally, the ACS can be used to pull Census population figures. Table **B01003** can be used to gather total population for a city or town from the ACS.

Example Computation–Small City Fixed-Route

Cortland, NY, is used for this example. Cortland is home to SUNY Cortland and has a population under 50,000. SUNY Cortland's most recent enrollment figures show a student population of 7,358 (source: www.cortland.edu). According to the 2010 rural NTD, First Transit-Cortland provided 19,857 revenue-hours of service. The total population for Cortland can be pulled from the ACS. Following the steps for accessing data in Appendix A and using Table **B01003** will yield a population figure of 19,257 (Figure 20).

Using the figures reported above in the example and the formula for estimating demand for small city fixed-route service yields the following result:

Unlinked passenger-trips = 5.77 × Revenue-hours of Service + 1.07 × Population + 7.12 × College/ University Enrollment = 5.77 × 19,857 + 1.07 × 19,257 + 7.12 × 7,358 = 187,569

	Cortland city, New York	
	Estimate	Margin of Error
Total	19,257	+/-32

Source: U.S. Census Bureau,
2006-2010 American Community Survey

Figure 20.   ACS Table B01003 Results – Cortland, NY (Example).

Commuters to Urban Centers

The function developed for estimating the demand for commuter passenger transportation from a rural county to another county is given by

Commuter trips by transit from County to Urban Center per Day = Proportion Using Transit for Commuter Trips from Rural County to Urban Place × Number of Commuters × 2

Proportion Using Transit for Commuter Trips from Rural County to Urban Place = 0.024 + (0.0000056 × Workers Commuting from Rural County to Urban Place) − (0.00029 × Distance in Miles from Rural County to Urban Place) + 0.015 (if the Urban Place is a state capital)

In this function, the number of trips constituting the market for passenger transportation is directly related to the total commuting market. That value must be obtained from other sources.

Information on current and forecast county-to-county commuter flows can be obtained from various sources, including data from the MPO for the urban center or the state transportation agency. Historic data on commuter flows in recent years are available from the US Census Bureau in either the Longitudinal Employer-Household Dynamics (LEHD) program (http://lehd.did.census.gov/led/) or the Journey-to-work tables from the ACS (http://factfinder2.census.gov/). Tables B08007 – Sex of Workers by Place of Work and B08406 – Sex of Workers by Means of Transportation to Work should provide sufficient data from the ACS.

Although both the LEHD and ACS provide estimates of commuting patterns, the two datasets are developed in different ways and can present different results. The LEHD dataset is derived based on a greater proportion of the workers in any given area. As a result it is likely to give a more accurate representation of commuter flows from areas that have smaller populations (e.g., rural areas). As noted in an NCHRP publication NCHRP08-36 Task 98:

> Unlike sample-based surveys (such as the CTPP), the LEHD-OTM provides a (nearly) complete enumeration of home-to-work flows covering over 90 percent of all workers and employers in the United States. As such, it includes many more OD pairs containing low frequency home-to-work flows than are collected through sampled data.

See http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP08-36(98)_FR.pdf for a discussion of the use of both LEHD data and ACS data.

This LEHD website allows the analyst to specifically define the residential area and see the commuter flows to various employment areas. Data can be further aggregated by job type, worker age, earnings level, and industry class.

Information on current and projected county-to-county commuter flows may also be available from the MPO serving the urban center or from your state transportation agency.

Example Computation–Commuters to Urban Centers

Go to http://lehd.did.census.gov/led/ (Figure 21). Click the OnTheMap link in the upper left of the screen.

Once the OnTheMap application is up (Figure 22), search for the rural county where workers will be traveling from and click *Search*. Select the appropriate county if multiple counties of the same name appear in the search. The program will then highlight the area you have selected on the map to the right and bring up a popup with some general information about the county and an option to *Perform Analysis on Selection Area*. Click this link.

Once *Perform Analysis on Selection Area* is clicked, another window will pop up for the *Analysis Settings* (Figure 23). Select *Home* for Home/Work Area, indicating your interest is on residents
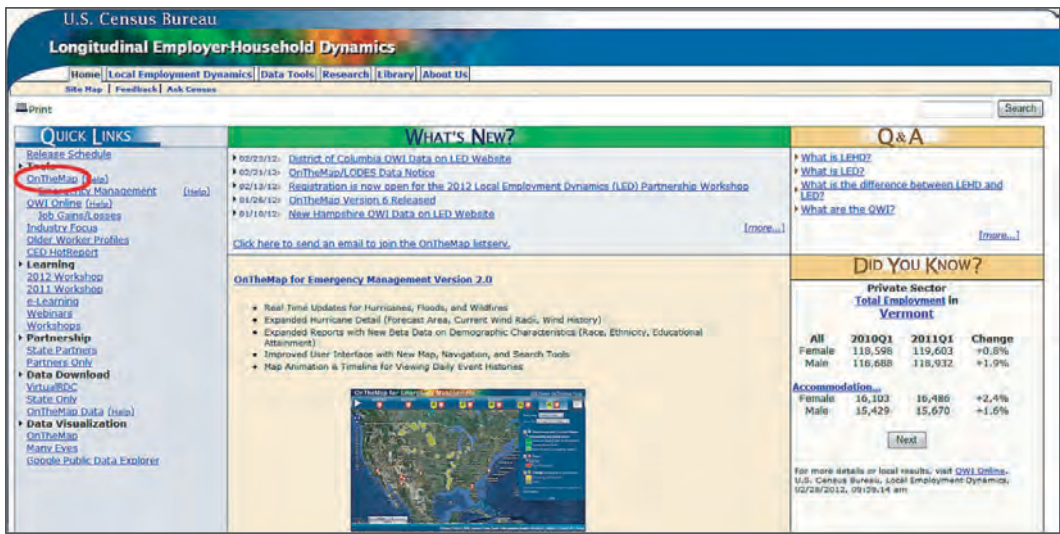
Figure 21.   LEHD Main Page.
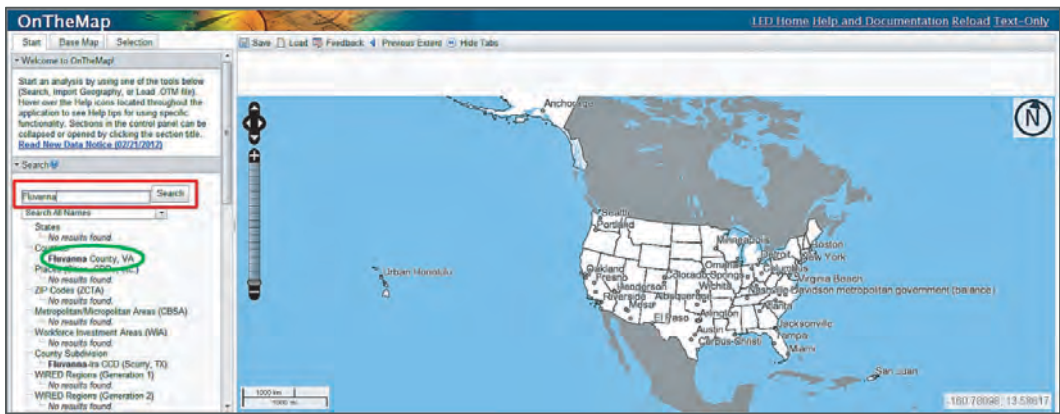
Figure 22.   LEHD Search Page.
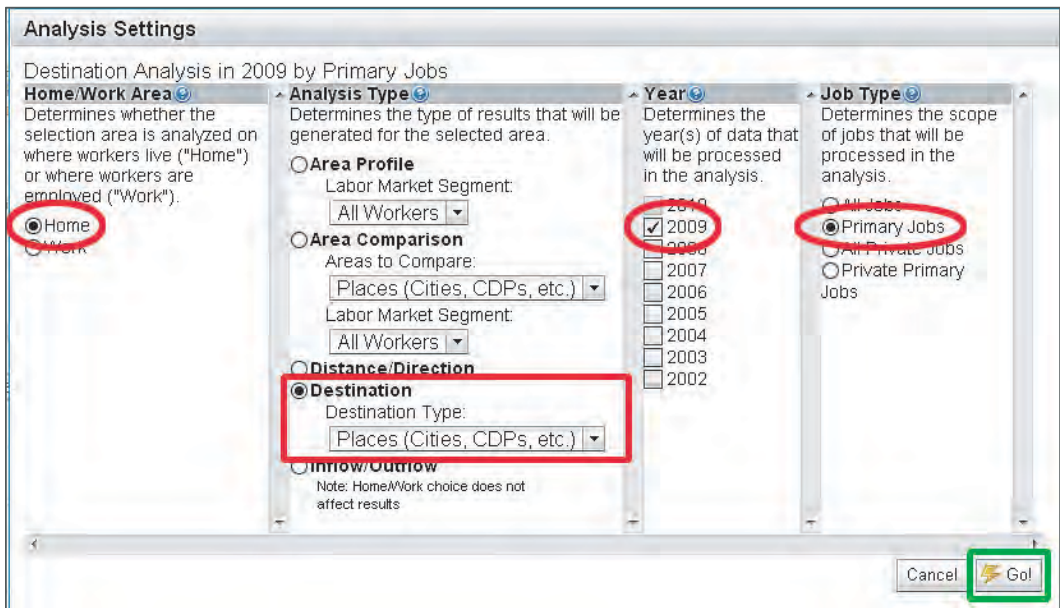
Figure 23.   LEHD Analysis Settings.
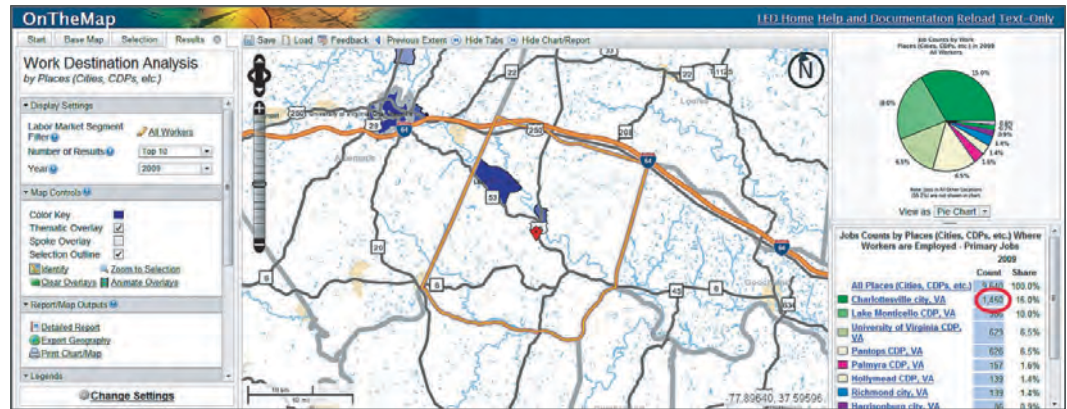
Figure 24.   LEHD Results – Fluvanna County, VA (Example).

who live in the area/county. Select *Destination* for Analysis Type, which will identify the place people travel from their home to work. The drop-down menu should read *Places* (Cities, CDPs, etc.). This will determine the urban center. Select the most current year available for Year. Then select *Primary Jobs* for Job Type. This will provide a county of the primary job everyone travels to and will not count second jobs people might work. This is believed to be the better definition of the types of jobs suitable for commuter service. Then click *Go.*

The results screen (Figure 24) will include a map as well as the count of jobs for each area held by someone in the rural county. This will be used as the number of commuters traveling from a rural county to an urban place.

To calculate the demand in number of trips that would occur by transit between a rural county and urban place, it is necessary to calculate the proportion of commuters from a rural county to an urban place using transit. The formula is as follows:

Proportion using Transit for Commuter Trips from Rural County to Urban Place = 0.024 + (0.0000056 × Workers Commuting from Rural County to Urban Place) − (0.00029 × Distance in Miles from Rural County to Urban Place) + 0.015 (if the Urban Place is a state capital) = 0.024 + (0.0000056 × 1,450) − (0.00029 × 22) = 0.026

The number of workers commuting from a rural county to an urban place is taken from the LEHD results. The distance in miles from the rural county to the urban place can be estimated using a mapping program such as Google Maps. If the urban place is a state capital, then the final figure in the formula is added. If not, then nothing is done. Once a proportion using transit figure is calculated, it can be plugged into the demand formula below to get a number of trips that would occur daily.

Commuter trips by transit from County to County per Day = Proportion using transit for Commuter Trips from Rural County to Urban Place × Number of Commuters × 2 = 0.026 × 1,450 × 2 = 75

Multiplying the daily result by 255 will produce an estimate for annual trips from a rural county to an urban center. The annual number of trips from Fluvanna County to Charlottesville, VA, is likely to be around 19,227.

Data Sources

GoPopulation (Total and by segments)

- US Census
  www.census.gov
- American Community Survey http://www.census.gov/acs/www/index.html

Commuting Trips

- US Census (2000)
  www.census.gov
- US Census Bureau's Longitudinal Employer-Household Dynamics program: http://lehd.did.census.gov/led/
- American Community Survey Commuting data
  http://ctpp.transportation.org/Pages/3yrdas.aspx
- State travel forecasts - from various state transportation agencies
- Metropolitan area travel forecasts - from Metropolitan Planning Organizations

Workers

- US Census Bureau's Longitudinal Employer-Household Dynamics program: http://lehd.did.census.gov/led/

Retrieving Data from the American Community Survey (ACS)

Most of the data required for producing the estimates contained in this workbook can be gathered from the ACS. The ACS is administered by the U.S. Bureau of the Census which collects data each year from a sample of approximately 2.5 percent of the households in the nation. The information collected in the ACS has replaced the data previously collected every 10 years in the decennial Census long-form. Results are made available for each year, for a rolling 3-year period, and for a rolling 5-year period. Because the Census must suppress some data to maintain confidentiality, data for areas with a population of 20,000 or less are available only in the 5-year rolling summaries.

Use the following steps to retrieve the various tables discussed in the body of the workbook.

1. Go to www.census.gov
2. Hover over *Data*
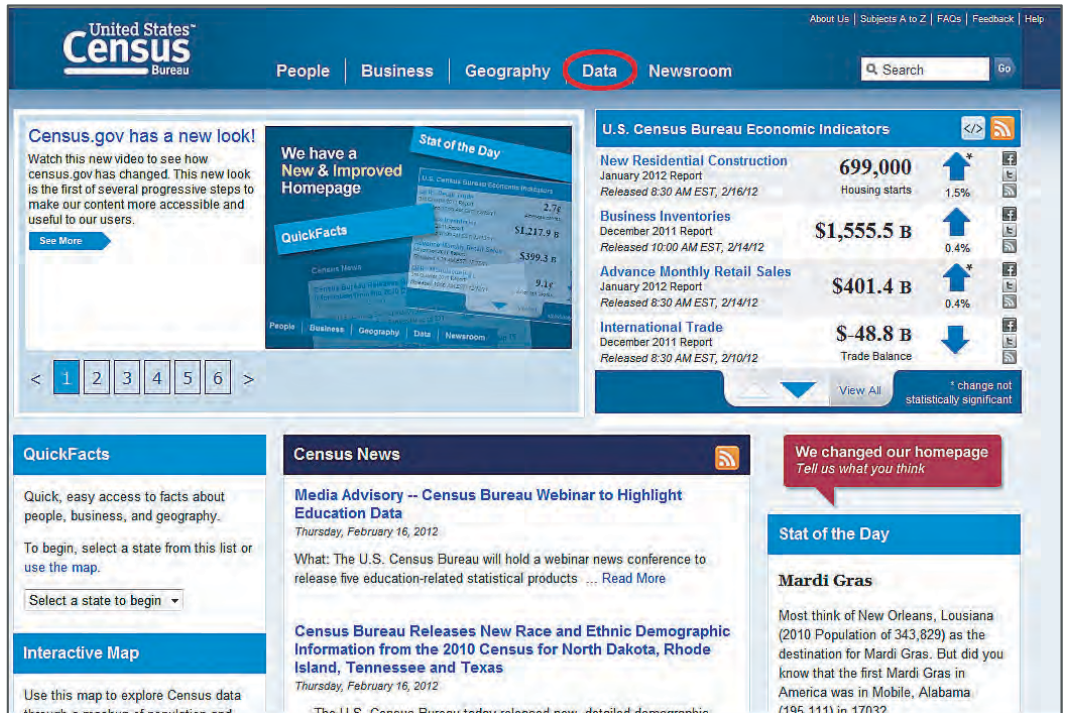
3. Click on *American FactFinder*

4. Enter the table number associated with the required data (i.e., B08201) in the *Search for:* box and select *GO*

5. Click the box labeled *Geographies*
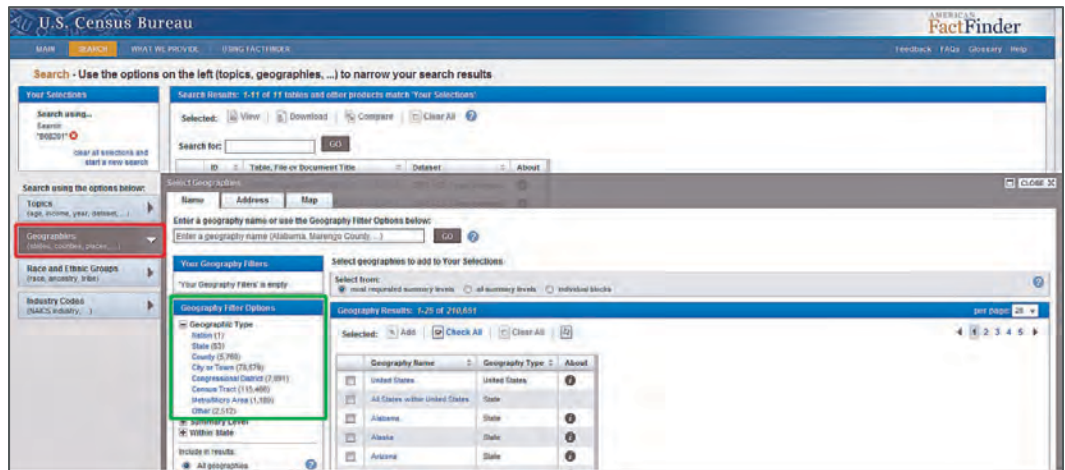
6. Click on *County* or *City of Town* in the *Geography Filter Options*
7. Then click on *Within State* to narrow the search to a specific state
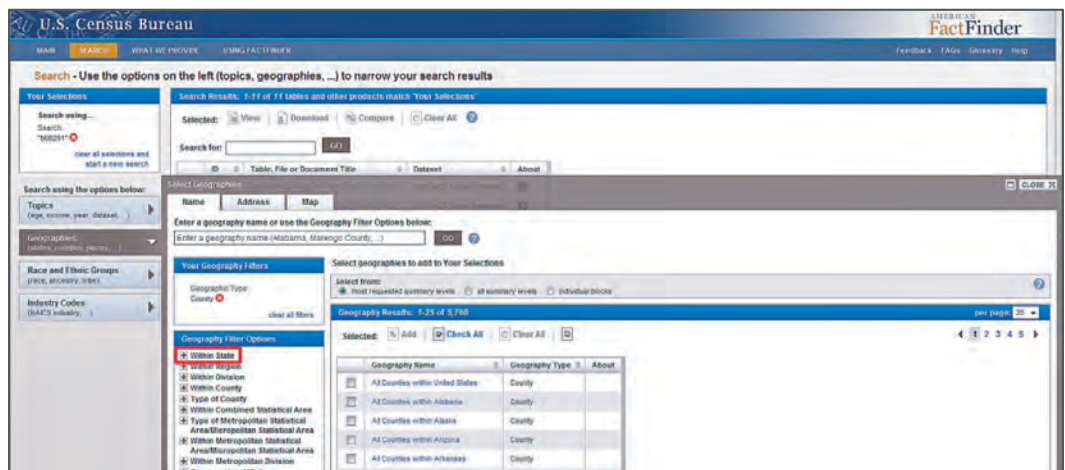
8. Select the appropriate state

9. Check the box(es) for the places that constitute the study area and click *Add*

10. When appropriate geography has been selected, close the filter by clicking *Close X*
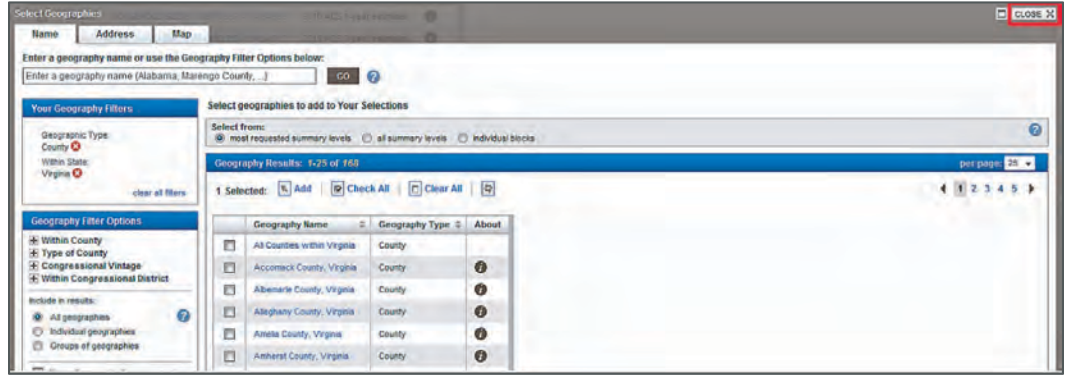
11. Check the box for the most recent ACS 5-Year dataset and click *View*

    NOTE: As of the development of this workbook, Census had recently changed the definition for disability characteristics used in the ACS. This limits these data to communities that have a population of greater than 20,000. Because of this change there was no 5-year dataset available for this table. A 5-year dataset will be available in 2013.
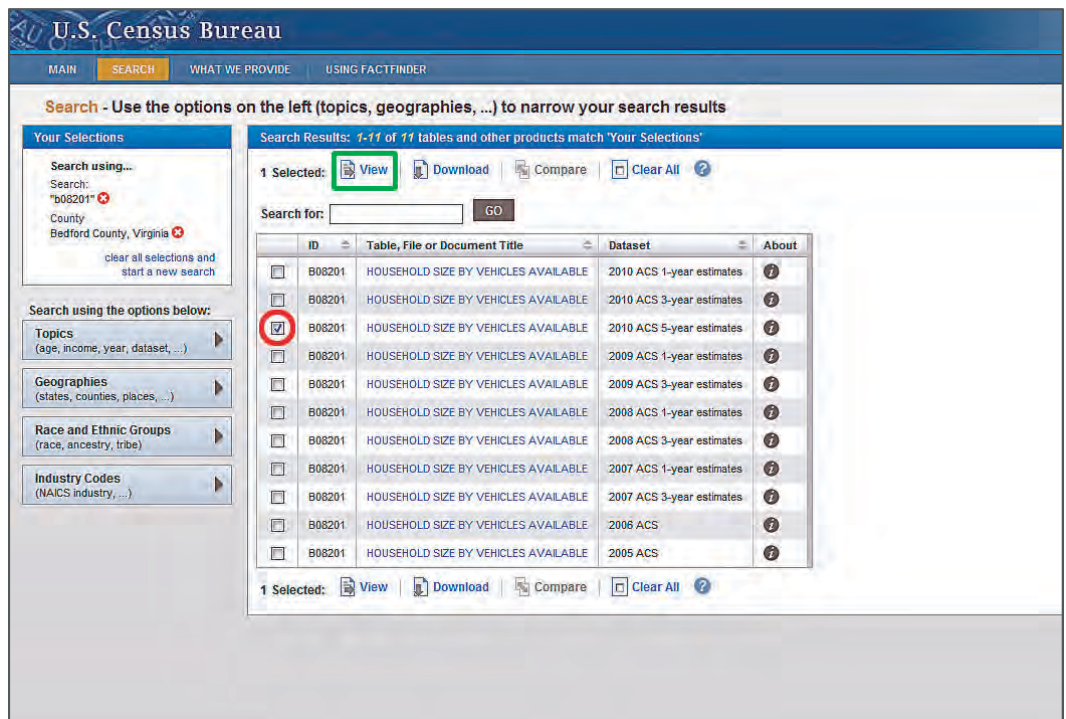
12. Pull the required data points from the table necessary to complete the estimate calculation. **This is discussed in the body of the workbook for each method.**

13. To search for another table, click *BACK TO SEARCH*

14. Click the X next to the previous table prior to searching for the next table
15. Type the next table number into the *Search for:* box and select *GO.*
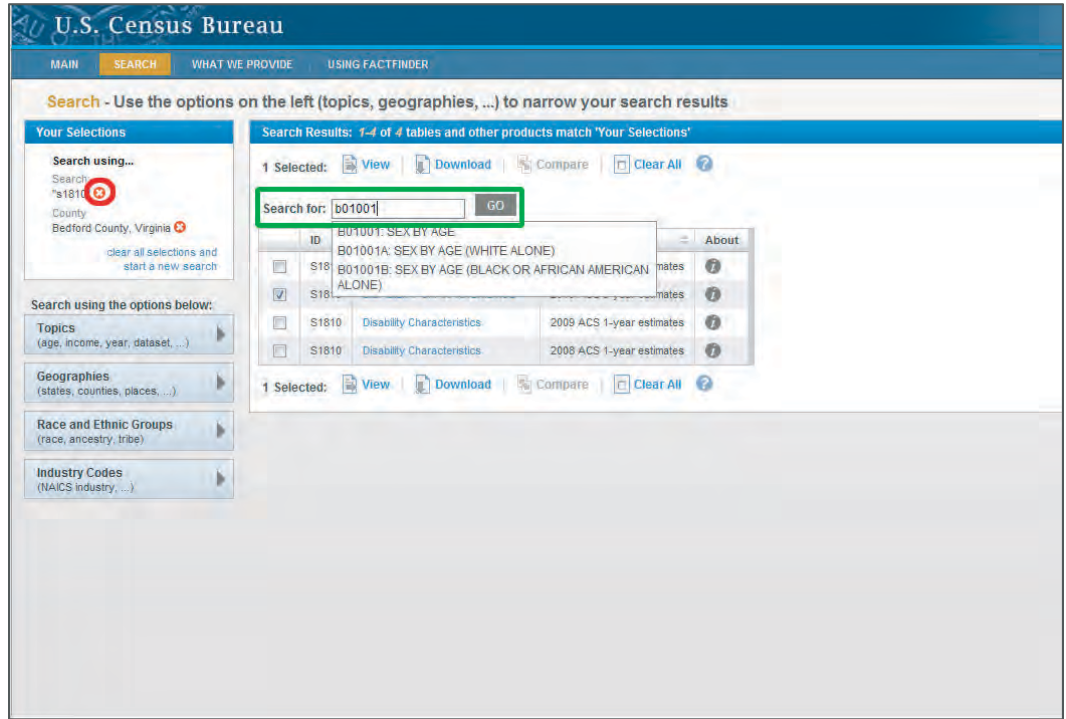
16. Then select the box next to the most recent 5-year dataset and click *View.* The geography should remain unchanged.

Step-By-Step Instructions for the Transit Need and Demand Spreadsheet Tool

The following are step-by-step instructions showing the user how to perform the different analyses available in the *Rural Transit Need and Demand Spreadsheet.* Each of the analyses is performed along with discussion of how to collect the necessary data and where to enter the information. In addition, at the end of each analysis is a manual computation of the desired result using the *TCRP Project B36 Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation Workbook.* This acts as a check on the spreadsheet values produced and shows how the values can be computed manually. The spreadsheet for apply-ing the procedures described below can be found on the TRB website by searching for *TCRP Report 161.*

1. Open the TCRP B36 Need Demand Spreadsheet.
2. The *Instructions* tab provides basic instructions on how to use the spreadsheet (Figure 1). The *Print Reports* button can be used to print copies of the other tabs, showing the analyses performed, the inputs, and the results. The *Clear Forms* button can be used to clear all the information from the form.
   NOTE: IN ORDER TO USE ALL THE BUTTONS ON THE INSTRUCTIONS TAB OF THIS SPREADSHEET, MACROS NEED TO BE ENABLED WITHIN MICROSOFT EXCEL. INSTRUCTIONS FOR ENABLING MACROS ARE PROVIDED IN STEP 4, BELOW.
3. Future references to the *Analysis Setup* tab (1)[1], the *Input* tab (2), and the *Output* tab (3) refer to the tabs at the bottom of the spreadsheet that allow the user to toggle among the different worksheets (Figure 1).
4. The following are instructions for enabling macros in the spreadsheet. The *Macros Instruc-tions* tab (4) also contains these instructions (Figure 1)[2].
   a. The TCRP B36 Spreadsheet contains a few simple macros that make the spreadsheet more user-friendly. Some macros can contain computer viruses, so Microsoft Office has a func-tion that will disable ALL macros if the security level is set too high. Although this safety feature can protect users, it also can cause problems by disabling useful features in spread-sheets. The macros contained in the TCRP B36 Spreadsheet are SAFE. These instructions explain how to remove the security warnings and use the spreadsheet normally. Note: the calculations in the spreadsheet will still function correctly without use of the macros.
   b. This version of the TCRP B36 Spreadsheet contains a security certification created by LSC Transportation Consultants, Inc., that will allow users to operate the macros in the spreadsheet with the macro security setting on High. Because the locally created security

---

[1] The numbers in parentheses (1) refer to the arrows on the referenced figure. These numbers are associated with key features of the figure.
[2] Additionally, page 186 in *TCRP Report 147: Toolkit for Estimating Demand for Rural Intercity Bus Services* provides instructions for allowing macros to function in Excel for versions not covered here.

39

Figure 1.   Instructions Tab of the TCRP B36 Spreadsheet.

certificate was not issued by a licensed certificate dealer, authorized by Microsoft, the user must complete the following steps to accept LSC's certificate.

NOTE: These procedures are not necessary if macro security is set to Low. If macro security is set to Medium, the user can simply check the box to *Enable Macros.*

c.   When the spreadsheet is loaded, a *Security Warning* dialog box will appear. Click on the box to *Always trust macros from this source.* Click *Enable macros.*

d.   If the *Always trust macros from this source* checkbox cannot be selected, complete the following procedure: Click *Details* or *Digital Signature Details.* Click *View Certificate,* and then click *Install Certificate.* This will open the *Certificate Import Wizard.* Click *Next* twice, and then click *Finish.* Now, another security warning will appear, again notifying the user that the LSC certificate has not been validated by Microsoft. Click *Yes* at the bottom of this dialog box. After this step, click *OK* on all the open dialog boxes. The *Always trust macros (or content) from this source* checkbox should now be available. If not, save and close the spreadsheet, and then re-open the spreadsheet. When the spreadsheet opens, the same *Security Warning* dialog box will appear. Click the button for *Always trust content from this source.* Click *Enable Macros.*

e.   The spreadsheet should now function with all of the features working properly. This process should only have to be completed the first time the spreadsheet is used on a new computer. The spreadsheet will open normally for future uses.

Office 2007 users must take these additional steps:

Macros will likely be automatically disabled on opening the spreadsheet.

1. (Figure 2) Click the *Office* icon (1) in the upper-left corner of the display. Click *Excel Options* (2).
2. (Figure 3) Check the box for *Show Developer Tab in Ribbon* (3).
3. (Figure 4) Click the *Developer* tab (4). Click on *Macro security* (5). Check the appropriate security option for the user's firm or agency. Click *Disable all macros except digitally signed macros* (6).
4. When the *Security Warning* dialog box appears (Figure 5), click *Options* (7). Click *Details* or *Digital Signature Details* (8).
5. (Figure 6) Click *View Certificate* (9).
6. (Figure 7) Click *Install Certificate* (10).
7. This will open the *Certificate Import Wizard* (Figure 8). Click *Next* (11) twice, and then click *Finish.* A message should appear saying the import was successful. Click *OK.*
8. Click *OK* on all of the open dialog boxes. When you return to the *Security Alert – Macro* dialog box (Figure 9), check the box that says *Trust all documents from this publisher* (12). Then click *OK.* This should enable the macros from this point forward anytime the file is opened on the same computer.
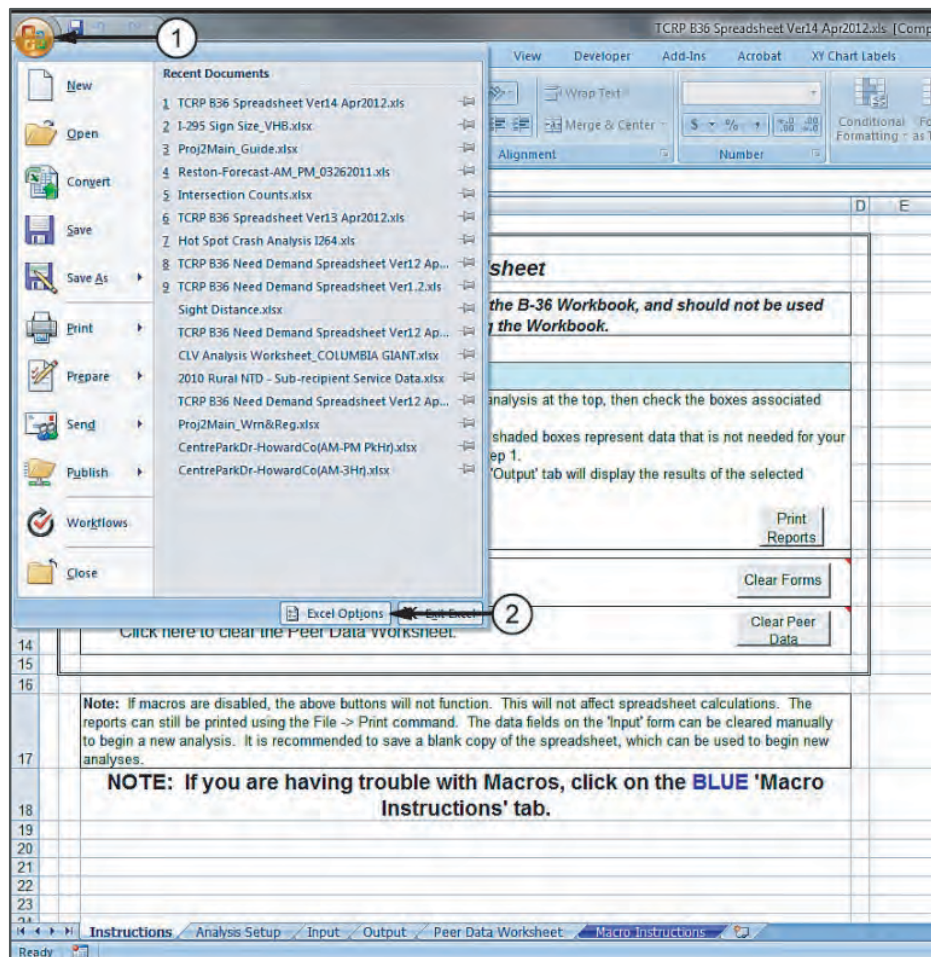
Figure 2.   Excel 2007 Main Menu.
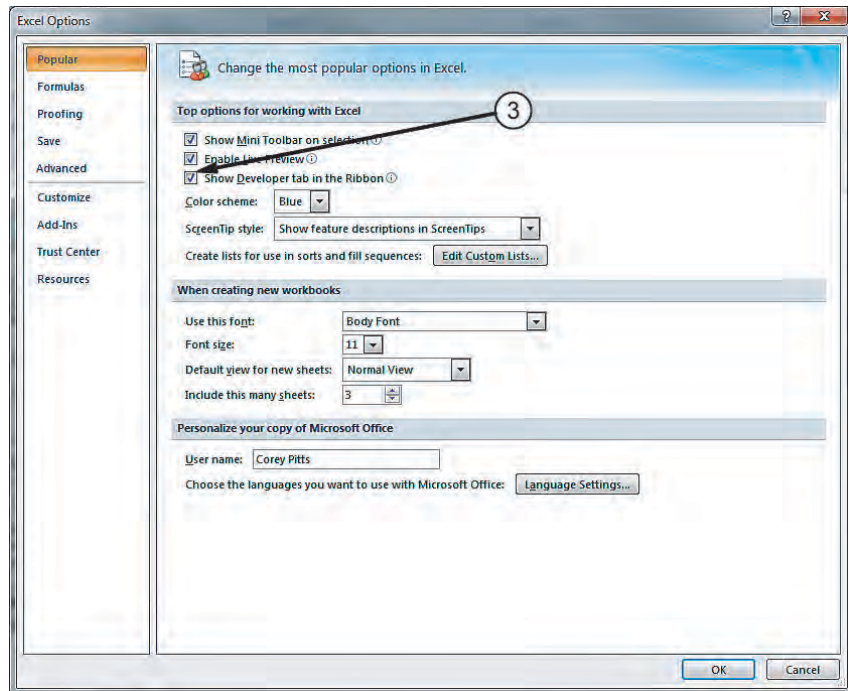
Figure 3.   Excel 2007 Options Menu.
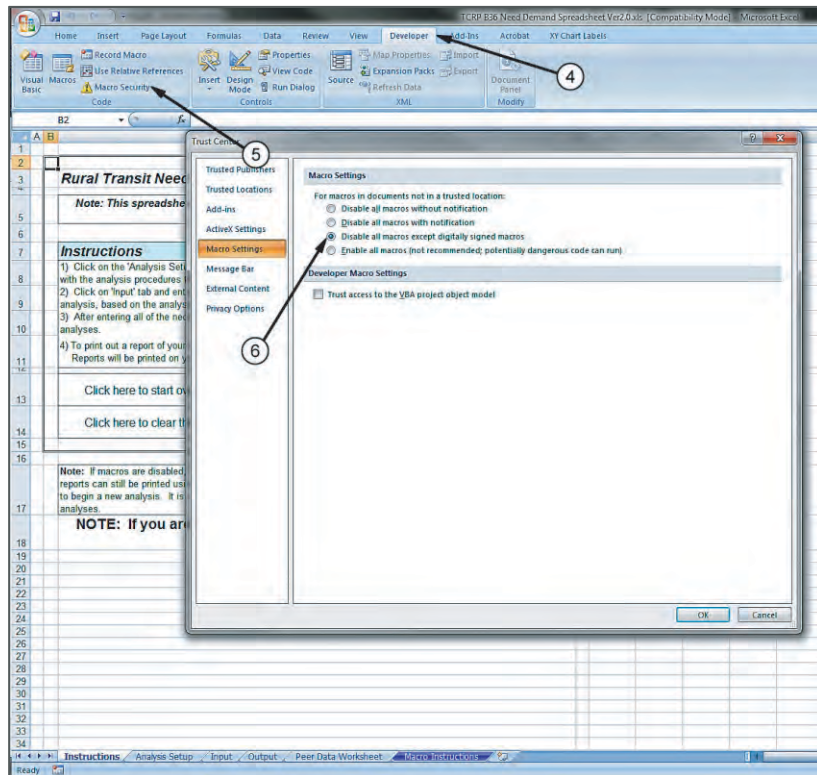
Figure 4.   Excel 2007 Developer Tab.
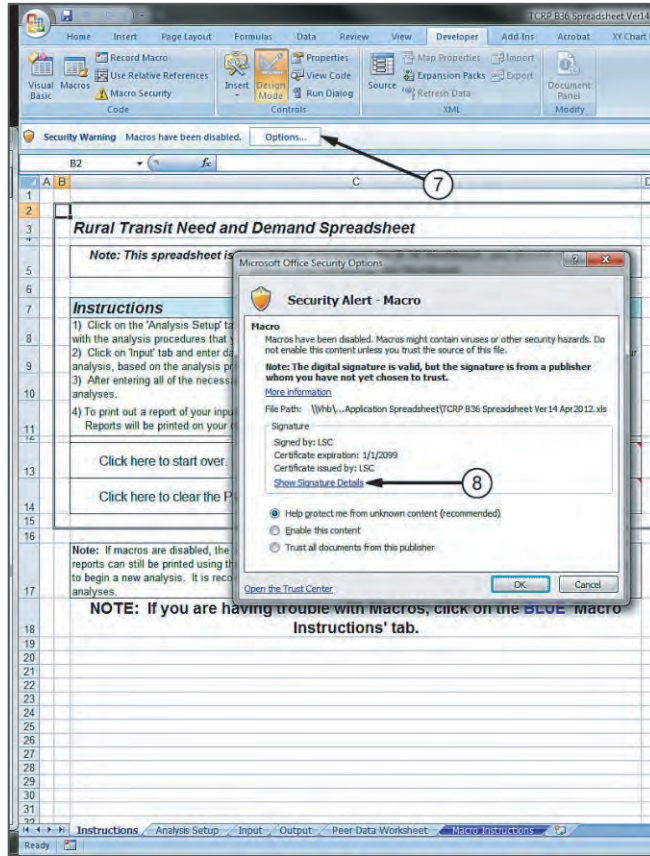
Figure 5.   Excel 2007 Macros Security Dialog Box.
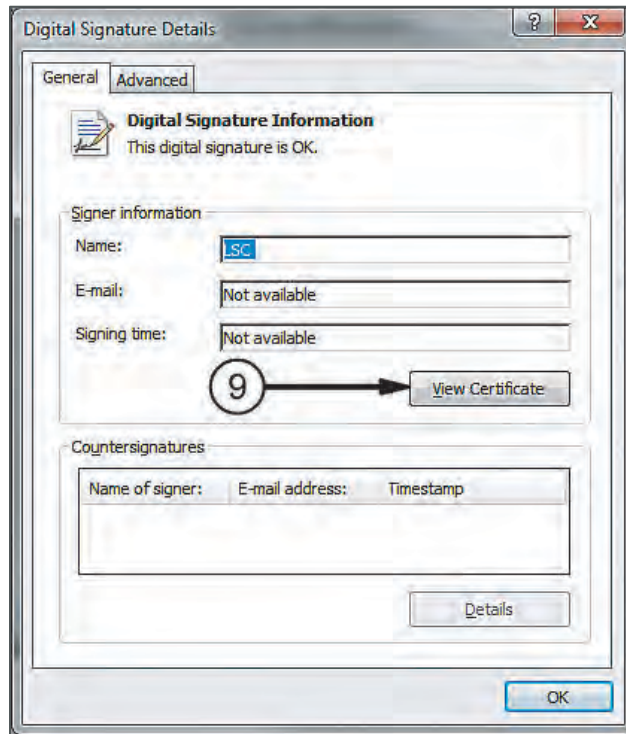
Figure 6.   Excel 2007 Digital Signature Details Menu.
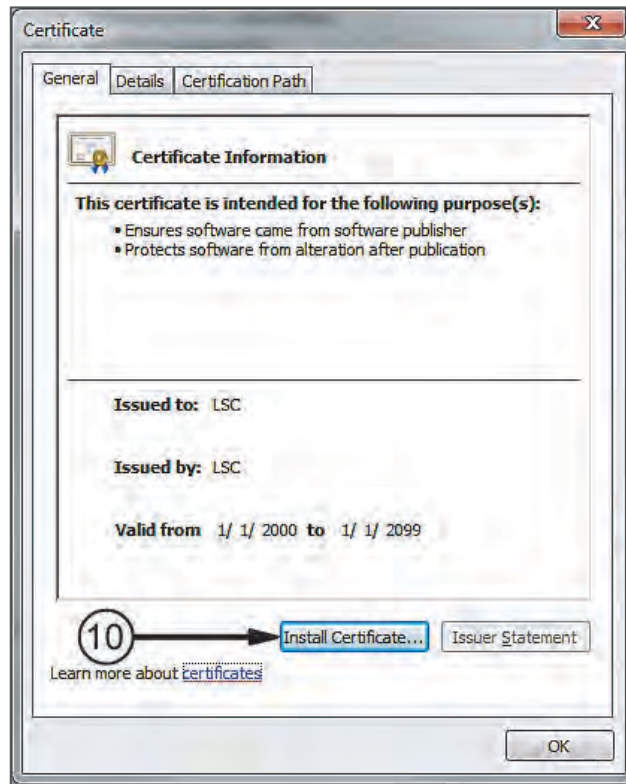
Figure 7.   Excel 2007 Certificate Menu.

Figure 8.   Excel 2007 Certificate Import Wizard.

Figure 9.   Excel 2007 Security Warning – Trust Publisher.

5. The *Analysis Setup* tab allows the user to choose the appropriate analysis or analyses they would like to perform (Figure 10). Seven different analyses can be performed using the workbook:
   a. Need – Number of Persons
   b. Need – Number of Trips
   c. Demand – Program
   d. Demand – Non-Program
   e. General Public Rural Passenger Transportation
   f. Demand – Small City Fixed-Route
   g. Demand – Commuters by Transit to an Urban Center
6. Selecting the *Demand – Program* box (1) will require further input to begin the analysis. A drop-down box to the right needs to have the number of programs offered in the study jurisdiction selected (2). This will activate the appropriate number of rows in the *Input* tab. Data for up to 25 programs can be entered.

Need

Two measures are used to quantify the need for passenger transportation services:

• Number of persons having a need
• Number of trips that are not being served

Need – Number of Persons (refer to Figures 11 and 12)

1. Select the *Need – Number of Persons* box on the *Analysis* tab. This will allow the user to estimate the number of individuals likely to require public transportation.
2. Click the *Input* tab at the bottom of the spreadsheet. This will bring up the input sheet with the required inputs needed for this analysis in white (Figure 11).

Figure 10.   Analysis Setup Tab.

Figure 11.   Need - Number of Persons (Input Tab).

Figure 12.   Need - Number of Persons (Output Tab).

3. Access the ACS[4] via the website link (1). Tables B08201 – Household Size by Vehicles Available and B17001 – Poverty Status in the Past 12 Months by Sex by Age are used to collect the data for this analysis (Tables 1 & 2). Table 1 shows figures for poverty status based on age classification. The figure required for the spreadsheet is the total number of individuals who fall below the poverty line (in the example, 5,897). Enter this figure into the appropriate cell (2). Table 2 shows the number of households based on vehicle ownership. The figures required for the spreadsheet are as follows: 789, 274, 112, and 18. Enter these figures into the corresponding cells (3) shown in Figure 11.
4. Click the *Output* tab at the bottom of the spreadsheet. This will bring up the output sheet with the calculated result displayed 7,600 (4) based on the inputs entered (Figure 12).

---

[4] Instructions for using the American Community Survey to access U.S. Census data can be found on Page 8 or in Appendix 1 of the Workbook. Once a user has arrived at the "Enter Table Number" link on the ACS website, he or she can enter the appropriate table number associated with the desired data (this can be found on the "Input" tab) and follow the remainder of the steps in the Workbook for selecting the appropriate geography and arriving at the results table.

Table 1.   ACS Table B17001 – Bedford County, VA.

	Bedford County, Virginia	
	Estimate	Margin of Error
Total:	67,402	+/-194
Income in the past 12 months below poverty level:	5,897	+/-804
Male:	2,658	+/-441
Under 5 years	290	+/-116
5 years	24	+/-28
6 to 11 years	299	+/-119
12 to 14 years	173	+/-86
15 years	34	+/-29
16 and 17 years	27	+/-31
18 to 24 years	314	+/-111
25 to 34 years	226	+/-116
35 to 44 years	378	+/-156
45 to 54 years	372	+/-136
55 to 64 years	300	+/-107
65 to 74 years	115	+/-62
75 years and over	106	+/-63
Female:	3,239	+/-504
Under 5 years	269	+/-118
5 years	15	+/-24
6 to 11 years	390	+/-154
12 to 14 years	112	+/-74
15 years	25	+/-32
16 and 17 years	50	+/-49
18 to 24 years	340	+/-145
25 to 34 years	367	+/-133
35 to 44 years	317	+/-129
45 to 54 years	445	+/-138
55 to 64 years	356	+/-121
65 to 74 years	210	+/-108
75 years and over	343	+/-130
Income in the past 12 months at or above poverty level:	61,505	+/-793
Male:	30,817	+/-435
Under 5 years	1,474	+/-131
5 years	393	+/-148
6 to 11 years	2,443	+/-229

Table 2.   ACS Table B08201 – Bedford County, VA.

	Bedford County, Virginia	
	Estimate	Margin of Error
Total:	27,150	+/-410
No vehicle available	1,193	+/-307
1 vehicle available	5,594	+/-454
2 vehicles available	10,406	+/-671
3 vehicles available	6,293	+/-473
4 or more vehicles available	3,664	+/-381
1-person household:	6,112	+/-484
No vehicle available	789	+/-237
1 vehicle available	3,145	+/-341
2 vehicles available	1,685	+/-280
3 vehicles available	369	+/-111
4 or more vehicles available	124	+/-60
2-person household:	11,180	+/-426
No vehicle available	274	+/-147
1 vehicle available	1,503	+/-255
2 vehicles available	4,992	+/-397
3 vehicles available	2,880	+/-307
4 or more vehicles available	1,531	+/-266
3-person household:	4,436	+/-374
No vehicle available	112	+/-87
1 vehicle available	501	+/-141
2 vehicles available	1,627	+/-240
3 vehicles available	1,315	+/-195
4 or more vehicles available	881	+/-158
4-or-more-person household:	5,422	+/-405
No vehicle available	18	+/-21
1 vehicle available	445	+/-155
2 vehicles available	2,102	+/-300
3 vehicles available	1,729	+/-252
4 or more vehicles available	1,128	+/-211

Source: U.S. Census Bureau, 2006-2010 American Community Survey

The following is the manual computation of the number of persons in need of public transportation for Bedford County using the *TCRP Project B36 Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation Workbook* as a check to the spreadsheet values produced.

PERSONS HAVING TRANSPORATION NEED = Number of Persons Below the Poverty Level + Number of Persons with No Vehicle Available

$$NEED = 5,897 + [(1 \times 789) + (2 \times 274) + (3 \times 112) + (4 \times 18)]$$
$$= 5,897 + [789 + 548 + 336 + 72]$$
$$= 5,897 + 1,745$$
$$= 7,642$$

$$NEED \approx 7,600$$

Need – Number Of Trips (refer to Figures 13 and 14)

1. Select the *Need – Number of Trips* box on the *Analysis* tab. This will allow the user to estimate the number of trips those individuals requiring transportation would make if there were minimal limitations on their ability to travel.
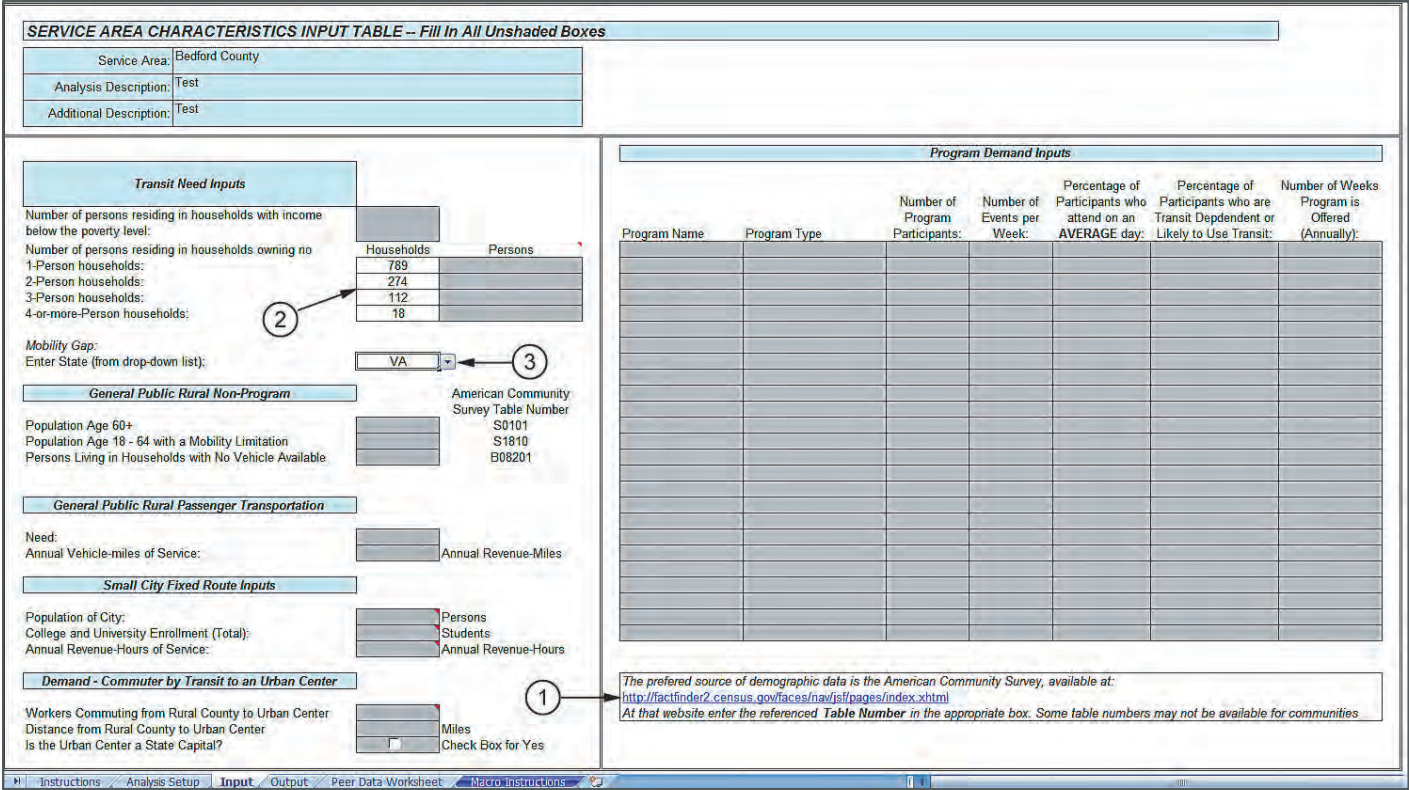
Figure 13.   Need - Number of Trips (Input Tab).

2. Click the *Input* tab at the bottom of the spreadsheet. This will bring up the input sheet with the required inputs needed for this analysis in white (Figure 13).

3. Access the ACS via the website link (1). Table B08201 – Household Size by Vehicles Available is used to collect the data for this analysis (Table 3). Table 3 shows the number of households based on vehicle ownership. The figures required for the spreadsheet are as follows: 789, 274, 112, and 18. Enter these figures into the corresponding cells (2) shown in Figure 13.

4. Click on the *Mobility Gap* drop-down menu (3) and select the appropriate state. This will select the corresponding value that can be found in Table 4.

5. Click the *Output* tab at the bottom of the spreadsheet. This will bring up the output sheet with the calculated result (4) based on the inputs entered (Figure 14). The daily value computed was 2,074 one-way trips. This results in 622,100 annual one-way passenger-trips.

The following is the manual computation of the number of trips those individuals in need of public transportation for Bedford County would require, using the *TCRP Project B36 Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation Workbook* to check the spreadsheet values produced.

$$NEED\ (trips) = Number\ of\ Households\ with\ No\ Vehicle\ Available \times Mobility\ Gap$$
$$= (789 + 274 + 112 + 18) \times 1.3$$
$$= 1{,}193 \times 1.3$$
$$NEED\ (trips) = 1{,}550.9\ (1{,}551)\ Daily\ Trips$$

Annual trip need is based on a multiplier of 300 days per year because the trip rates for Saturdays, Sundays and Holidays are typically lower than for weekdays.

Figure 14.   Need - Number of Trips (Output Tab).

$$ANNUAL\ TRIP\ NEED = 1,551 \times 300 \approx 465,300$$

Note: to determine UNMET NEED, it is necessary to know how many trips are being served by existing passenger transportation services. The number of trips being served can be determined from surveys or interviews with agencies or transportation service providers in the area of interest.

Unmet Need = Estimated need (trips) – trips currently being served

Demand – Program (refer to Figures 15 through 17)

1. Select the *Demand – Program* box on the *Analysis* tab. This will allow the user to estimate the demand for program trips.
2. After checking the *Demand* box (1), a new box will appear to the side asking the user to select the number of programs for which a demand estimate will be calculated. Be sure to select the appropriate number of programs (2).
3. Click the *Input* tab at the bottom of the spreadsheet. This will bring up the input sheet with the required inputs needed for this analysis in white (Figure 16).

Table 3. ACS Table B08201 – Bedford County, VA.

	Bedford County, Virginia	
	Estimate	Margin of Error
Total:	27,150	+/-410
No vehicle available	1,193	+/-307
1 vehicle available	5,594	+/-454
2 vehicles available	10,406	+/-671
3 vehicles available	6,293	+/-473
4 or more vehicles available	3,664	+/-381
1-person household:	6,112	+/-484
No vehicle available	789	+/-237
1 vehicle available	3,145	+/-341
2 vehicles available	1,685	+/-280
3 vehicles available	369	+/-111
4 or more vehicles available	124	+/-60
2-person household:	11,180	+/-426
No vehicle available	274	+/-147
1 vehicle available	1,503	+/-255
2 vehicles available	4,992	+/-397
3 vehicles available	2,880	+/-307
4 or more vehicles available	1,531	+/-266
3-person household:	4,436	+/-374
No vehicle available	112	+/-87
1 vehicle available	501	+/-141
2 vehicles available	1,627	+/-240
3 vehicles available	1,315	+/-195
4 or more vehicles available	881	+/-158
4-or-more-person household:	5,422	+/-405
No vehicle available	18	+/-21
1 vehicle available	445	+/-155
2 vehicles available	2,102	+/-300
3 vehicles available	1,729	+/-252
4 or more vehicles available	1,128	+/-211

Source: U.S. Census Bureau, 2006-2010 American Community Survey

4. Enter the appropriate information related to each program (3). This should include information about the number of participants, events per week, percent of attendees on an average day, percent likely to use transit, and number of weeks the program meets in a year. This should be information readily available from each program.
5. Click the *Output* tab at the bottom of the spreadsheet. This will bring up the output sheet with the calculated results for each individual program (4) based on the inputs entered (Figure 17). There will also be a total demand calculated based on the sum of all the programs (5).

The following is the manual computation of the number of trips required to meet the demand for participants in the three fictitious programs used above.

Number of Program Participants × Program Events per Week × the Proportion of Program Participants who attend the Program on an Average Day × the Proportion of Program Participants that are Transit Dependent or Likely to Use the Transit Service provided / funded by the Agency × the Number of Weeks per Year the Program is Offered × 2 (trips per participant per event)

Table 4.   Mobility Gap.

Division	States	Trips per Rural Household Per Day		
		Vehicles Available		Gap
		0	1	
National		3.2	4.7	1.5
Division 1: New England	Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island	3.3	5.0	1.7
Division 2: Middle Atlantic	New Jersey, New York, Pennsylvania	3.5	4.8	1.3
Division 3: East North Central	Wisconsin, Michigan, Ohio, Indiana, Illinois	2.7	4.1	1.4
Division 4: West North Central	North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, Minnesota	2.4	4.5	2.1
Division 5: South Atlantic	Maryland, Delaware, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida	3.2	4.5	1.3
Division 6: East South Central	Kentucky, Tennessee, Alabama, Mississippi	2.7	4.1	1.4
Division 7: West South Central	Oklahoma, Arkansas, Texas, Louisiana	2.9	4.9	2.0
Division 8: Mountain	Idaho, Montana, Wyoming, Colorado, Utah, Nevada, Arizona, New Mexico	5.2	6.0	0.8
Division 9: Pacific	Washington, Oregon, California, Alaska, Hawaii	3.8	4.9	1.1

$$\text{ESTIMATED PROGRAM TRIPS (meals)} = 50 \times 3 \times .85 \times .90 \times 50 \times 2 \approx 11,500$$
$$\text{ESTIMATED PROGRAM TRIPS (work)} = 15 \times 5 \times 1.00 \times 1.00 \times 52 \times 2 \approx 7,800$$
$$\text{ESTIMATED PROGRAM TRIPS (home)} = 6 \times 1 \times .50 \times 1.00 \times 45 \times 2 \approx 300$$

$$\text{TOTAL ANNUAL ESTIMATED PROGRAM TRIP DEMAND} \approx 11,500 + 7,800 + 300 \approx 19,600$$

Demand – Non-program (REFER TO FIGURES 18 AND 19)

1. Select the *Demand – Non-Program* box on the *Analysis* tab. This will allow the user to estimate the demand for non-program trips.
2. Click the *Input* tab at the bottom of the spreadsheet. This will bring up the input sheet with the required inputs needed for this analysis in white (Figure 18).
3. Enter the respective number of *Households with No Vehicle Available* by household size (1), *Persons Age 60 and Over* (2), and *Persons 18–64 with a Mobility Limitation* (3). All this information can be gathered from the ACS website. The recommended table numbers for each field are located to the right of that field. *Persons Age 60 and Over* use figures from ACS Table B01001 (Table 5). The population Age 60 and Over can be calculated by adding the respective age categories together for both male and female. This value is 14,697. The value for *Persons who have a Mobility Limitation Age 18 to 64* can be pulled from figures in the ACS Table S1810 (Table 6). This figure is 1,537 for Bedford County, VA. Lastly, the figure for *Persons Living in a Household with No Vehicle Available* can be derived from data pulled from ACS Table B08201 (Table 7). This table provides a number of households by vehicle ownership by household
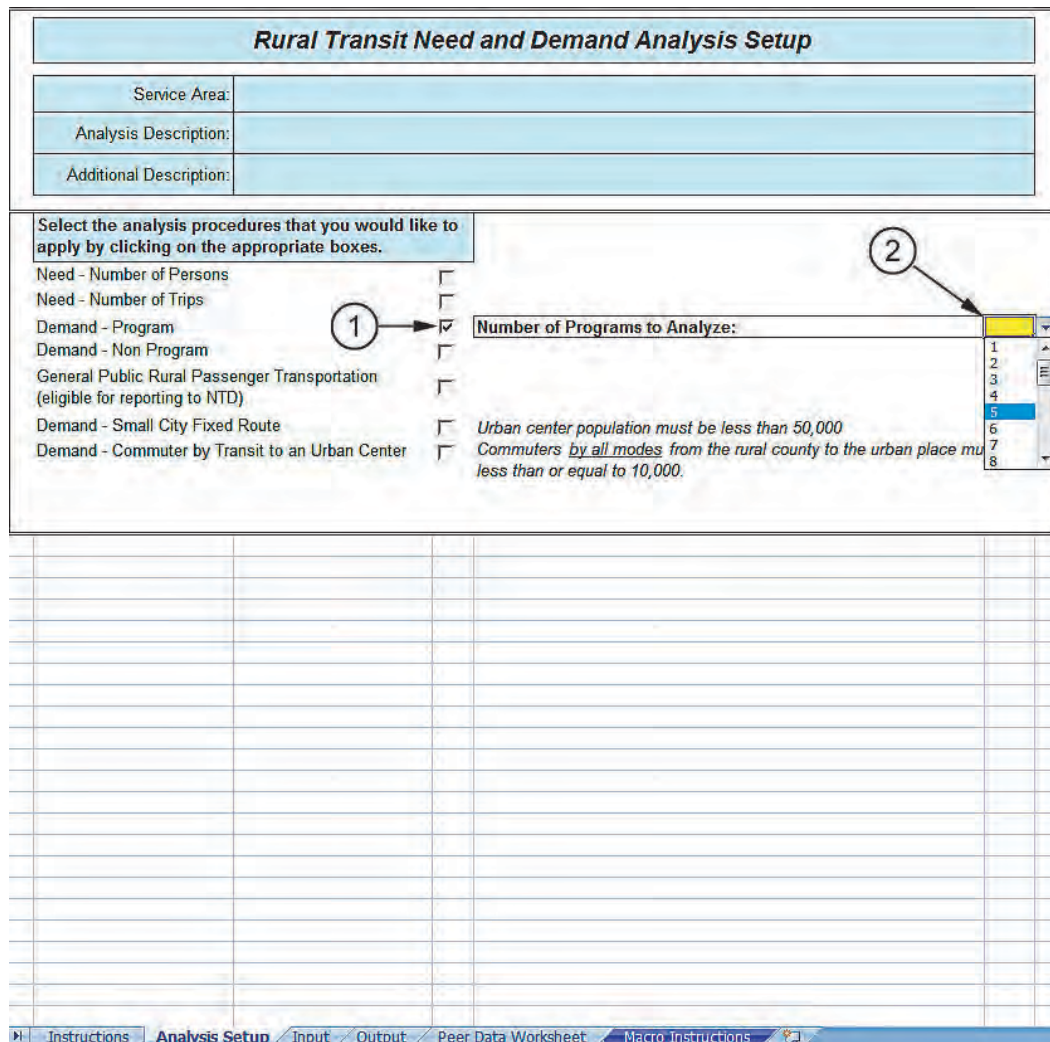
Figure 15.   Demand - Program (Analysis Setup).

size. A factoring of the households must be done to produce a figure of persons with no access to a vehicle (4). This is the same procedure used to produce an estimate of persons in need of passenger transportation. The resulting figure used in the spreadsheet is 1,745.

4. Click the *Output* tab at the bottom of the spreadsheet. This will bring up the output sheet with the demand estimate (Figure 19). The demand estimate will be reported as annual 1-way trips (5).

The following is the manual computation of the number of trips required to meet the general demand for public transportation in Bedford, using the *TCRP Project B36 Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation Workbook* to check the spreadsheet values produced.

$$NON\text{-}PROGRAM\ DEMAND\ (trips\ per\ year) = (2.20 \times Population\ Age\ 60+)$$
$$\times (5.21 \times Mobility\ Limited\ Population\ age\ 18-64)$$
$$+ (1.52 \times Residents\ of\ Household\ having\ No\ Vehicle)$$

$$NON\text{-}PROGRAM\ DEMAND\ (trips\ per\ year) = (2.20 \times 14{,}697) + (5.21 \times 1{,}537)$$
$$+ (1.52 \times 1{,}745) = 32{,}333.4 + 8{,}007.77 + 2{,}652.4 \approx 43{,}000$$

Figure 16.   Demand - Program (Input Tab).

Demand – General Public Rural Passenger Transportation (refer to Figures 20 and 21)

1. Select the *Demand – General Public Rural Passenger Transportation* box on the *Analysis* tab. This will allow the user to estimate the demand for rural passenger transportation based on need and supply of existing service.
2. Click the *Input* tab at the bottom of the spreadsheet. This will bring up the input sheet with the required inputs needed for this analysis in white (Figure 20).
3. Access the ACS via the website link (1). Table B08201 – Household Size by Vehicles Available is used to collect the data for this analysis (Table 8). Table 8 shows the number of households based on vehicle ownership. The figures required for the spreadsheet are as follows: 49, 16, 0, and 0. Enter these figures into the corresponding cells (2) shown in Figure 20. Select the appropriate state in the drop-down for *Mobility Gap* (3). Then enter the annual vehicle-miles of service provided by **ALL** services that provide service to the general public.
4. Click the *Output* tab at the bottom of the spreadsheet. This will bring up the output sheet with the results of the analysis (Figure 21). The table will show the number of trips needed (4) based on the mobility gap method. It will also show the demand for general public rural passenger transportation (5).

Demand – Small City[5] (refer to Figures 22 and 23)

---

[5] For this analysis, Cortland, NY, was used because data were available about the transit system; its population is below the 50,000 threshold; a university is located in the city; and the transit system provided fewer than 20,000 annual vehicle hours of service.

Figure 17.   Demand - Program (Output Tab).

Figure 18.   Demand - Non-Program (Input Tab).

Table 5.   ACS Table B01001 – Bedford County, VA.

	Total:			Bedford County, Estimate	Margin of
				67,697	*****
Male:	33,585	+/-110	Female:	34,112	+/-110
Under 5 years	1,764	+/-69	Under 5 years	1,651	+/-73
5 to 9 years	2,147	+/-215	5 to 9 years	1,869	+/-235
10 to 14 years	2,504	+/-238	10 to 14 years	2,564	+/-230
15 to 17 years	1,403	+/-42	15 to 17 years	1,527	+/-63
18 and 19 years	815	+/-62	18 and 19 years	726	+/-68
20 years	301	+/-106	20 years	330	+/-141
21 years	193	+/-97	21 years	172	+/-86
22 to 24 years	1,002	+/-147	22 to 24 years	898	+/-157
25 to 29 years	1,307	+/-88	25 to 29 years	1,398	+/-96
30 to 34 years	1,671	+/-105	30 to 34 years	1,710	+/-87
35 to 39 years	2,324	+/-313	35 to 39 years	2,221	+/-251
40 to 44 years	2,456	+/-266	40 to 44 years	2,865	+/-240
45 to 49 years	2,890	+/-102	45 to 49 years	2,901	+/-27
50 to 54 years	2,909	+/-114	50 to 54 years	2,883	+/-39
55 to 59 years	2,770	+/-213	55 to 59 years	2,829	+/-236
60 and 61 years	1,056	+/-175	60 and 61 years	1,058	+/-187
62 to 64 years	1,201	+/-180	62 to 64 years	1,057	+/-179
65 and 66 years	737	+/-162	65 and 66 years	924	+/-198
67 to 69 years	921	+/-168	67 to 69 years	1,011	+/-173
70 to 74 years	1,462	+/-174	70 to 74 years	1,202	+/-181
75 to 79 years	939	+/-131	75 to 79 years	1,080	+/-135
80 to 84 years	417	+/-103	80 to 84 years	670	+/-137
85 years and over	396	+/-108	85 years and over	566	+/-129

Table 6.   ACS Table S1810 – Bedford County, VA.

Subject	Bedford County, Virginia					
	Total		With a disability		Percent with a disability	
	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error
Total civilian noninstitutionalized population	68,111	+/-110	8,387	+/-875	12.3%	+/-1.3
Population under 5 years	3,379	+/-153	0	+/-165	0.0%	+/-1.8
With a hearing difficulty	(X)	(X)	0	+/-165	0.0%	+/-1.8
With a vision difficulty	(X)	(X)	0	+/-165	0.0%	+/-1.8
Population 5 to 17 years	11,957	+/-144	836	+/-276	7.0%	+/-2.3
With a hearing difficulty	(X)	(X)	50	+/-57	0.4%	+/-0.5
With a vision difficulty	(X)	(X)	189	+/-110	1.6%	+/-0.9
With a cognitive difficulty	(X)	(X)	631	+/-247	5.3%	+/-2.1
With an ambulatory difficulty	(X)	(X)	182	+/-147	1.5%	+/-1.2
With a self-care difficulty	(X)	(X)	128	+/-132	1.1%	+/-1.1
Population 18 to 64 years	42,102	+/-187	4,239	+/-620	10.1%	+/-1.5
With a hearing difficulty	(X)	(X)	758	+/-216	1.8%	+/-0.5
With a vision difficulty	(X)	(X)	724	+/-235	1.7%	+/-0.6
With a cognitive difficulty	(X)	(X)	1,714	+/-459	4.1%	+/-1.1
With an ambulatory difficulty	(X)	(X)	2,156	+/-424	5.1%	+/-1.0
With a self-care difficulty	(X)	(X)	1,031	+/-335	2.4%	+/-0.8
With an independent living difficulty	(X)	(X)	1,537	+/-353	3.7%	+/-0.8
Population 65 years and over	10,673	+/-157	3,312	+/-403	31.0%	+/-3.7
With a hearing difficulty	(X)	(X)	1,319	+/-249	12.4%	+/-2.4
With a vision difficulty	(X)	(X)	511	+/-181	4.8%	+/-1.7
With a cognitive difficulty	(X)	(X)	958	+/-309	9.0%	+/-2.9
With an ambulatory difficulty	(X)	(X)	1,957	+/-364	18.3%	+/-3.3
With a self-care difficulty	(X)	(X)	715	+/-228	6.7%	+/-2.1
With an independent living difficulty	(X)	(X)	1,527	+/-341	14.3%	+/-3.2
SEX						
Male	33,688	+/-222	4,318	+/-573	12.8%	+/-1.7
Female	34,423	+/-171	4,069	+/-535	11.8%	+/-1.5
RACE AND HISPANIC OR LATINO ORIGIN						
One Race	N	N	N	N	N	N
White alone	62,587	+/-186	7,639	+/-795	12.2%	+/-1.3
Black or African American alone	3,875	+/-254	560	+/-253	14.5%	+/-6.6
American Indian and Alaska Native alone	N	N	N	N	N	N
Asian alone	N	N	N	N	N	N
Native Hawaiian and Other Pacific Islander alone	N	N	N	N	N	N
Some other race alone	N	N	N	N	N	N

1. Select the *Demand – Small City Fixed Rural* box on the *Analysis* tab. This will allow the user to estimate the demand for program trips.
2. Click the *Input* tab at the bottom of the spreadsheet. This will bring up the input sheet with the required inputs needed for this analysis in white (Figure 22).
3. Enter values for
   a. Population of City – 19,257 (1),
   b. University enrollment – 7,358 (2),
   c. Annual revenue-hours or service – 19,857 (3).
      - City population can be accessed using the ACS website.
      - University enrollment can be gathered directly from the college or university in question or found at the College Board website: http://www.collegeboard.org.
      - Revenue-hours of service can be gathered directly from the agency(s) in question or by going to the National Transit Database website: www.ntdprogram.gov.

   NOTE: This analysis is designed for cities with a population under 50,000 with a transit system that operates fewer than 20,000 vehicle-hours of service annually.

Table 7.   ACS Table B08201 – Bedford County, VA.

	Bedford County, Virginia	
	Estimate	Margin of Error
Total:	27,150	+/-410
No vehicle available	1,193	+/-307
1 vehicle available	5,594	+/-454
2 vehicles available	10,406	+/-671
3 vehicles available	6,293	+/-473
4 or more vehicles available	3,664	+/-381
1-person household:	6,112	+/-484
No vehicle available	789	+/-237
1 vehicle available	3,145	+/-341
2 vehicles available	1,685	+/-280
3 vehicles available	369	+/-111
4 or more vehicles available	124	+/-60
2-person household:	11,190	+/-426
No vehicle available	274	+/-147
1 vehicle available	1,503	+/-255
2 vehicles available	4,992	+/-397
3 vehicles available	2,880	+/-307
4 or more vehicles available	1,531	+/-266
3-person household:	4,436	+/-374
No vehicle available	112	+/-87
1 vehicle available	501	+/-141
2 vehicles available	1,627	+/-240
3 vehicles available	1,315	+/-195
4 or more vehicles available	881	+/-158
4-or-more-person household:	5,422	+/-405
No vehicle available	18	+/-21
1 vehicle available	445	+/-155
2 vehicles available	2,102	+/-300
3 vehicles available	1,729	+/-252
4 or more vehicles available	1,128	+/-211

Source: U.S. Census Bureau, 2006-2010 American Community Survey

4. Click the *Output* tab at the bottom of the spreadsheet. This will bring up the output sheet with the result (4) (Figure 23). The resulting one-way passenger trip demand is 187,600.

The following is the manual computation of ridership associated with operating fixed-route service in Cortland, using the *TCRP Project B36 Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation Workbook* to check the spreadsheet values produced.

ANNUAL RIDERSHIP $= 1.07 \times$ Total Population $+ 7.12 \times$ University Enrollment
$+ 5.77 \times$ Annual Revenue-Hours $= 1.07 \times 19,257 + 7.12 \times 7,358 + 5.77 \times 19,857 = 20,604.99$
$+ 52,388.96 + 114,574.89$

ANNUAL RIDERSHIP $\approx 187,600$

Demand – Commuters to Urban Centers (Refer to Figures 24 through 31)

1. Select the *Demand – Commuters to Urban Centers* box on the *Analysis* tab. This will allow the user to estimate the demand for commuter passenger transportation from a rural area to a neighboring urban center.

Figure 19.   Demand - Non-Program (Output).

2. Click the *Input* tab at the bottom of the spreadsheet. This will bring up the input sheet with the required inputs needed for this analysis in white (Figure 24).

3. Enter the number of workers commuting between the rural area to the urban center (1) and the distance between a rural county and urban center (2) and check the box if the urban center is a state capital (3).

4. The information about workers commuting can be found at http://lehd.did.census.gov/led/.

   a. From the front page of the Census' LED page, select *OnTheMap* (4) (Figure 25).

   b. The *OnTheMap* program will appear (Figure 26). Enter the county/city you wish to perform the analysis on in the search field (5). Click *Search.* **Note: The drop-down menu allows for the narrowing of the search field.**

   c. Select the correct study area from the search (6). The area will become highlighted on the map. Select *Perform Analysis on Selection Area* (7) (Figure 27).

   d. Once the correct location has been selected, the *Analysis Settings* window will appear (Figure 28). Select *Home* (8) for the Home/Work Area. Select *Destination* (9) for the Analysis Type, and ensure that *Places* is selected in the drop-down menu. Select the most current year (10). Then select *Primary Jobs* (11) for the Job Type.

Figure 20. Demand – General Public Rural Passenger Transportation (Input Tab).

    e. The *OnTheMap* results map (Figure 29) will appear showing where workers are commuting. The result can be pulled from the bottom right of the screen (12). This area shows the number of commuters commuting to locations in order of largest destination.

5. If the distance the proposed commuter service will travel is known, use this distance. If not, an approximate distance (13) can be pulled from a mapping program (e.g., Google Maps) (Figure 30).

6. Clicking the *Output* tab at the bottom of the spreadsheet will bring up the results from the analysis (14) (Figure 31). According to the spreadsheet, there is a demand of 150 commuter trips daily and 38,800 annually.

The following is the computation of ridership associated with commuters traveling to a major urban center, using the *TCRP Project B36 Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation Workbook* to check the spreadsheet values produced. The method requires two formulas. The first formula produces a proportion of commuters likely to use transit figure, which is then used to produce a number of commuter trips by transit in the second.

PROPORTION USING TRANSIT FOR COMMUTER TRIPS FROM RURAL COUNTY TO URBAN PLACE $= 0.024 + (0.0000056 \times$ *Workers Commuting from Rural County to Urban Place* $)$ $- (0.00029 \times$ *Distance in Miles from Rural County to Urban Place* $) + 0.015$ (*if the Urban Place is a state capital* $) = 0.024 + (0.0000056 \times 2,433) - (0.00029 \times 22) = 0.0312448 \approx 3\%$

COMMUTER TRIPS BY TRANSIT FROM COUNTY TO COUNTY PER DAY $=$ *Proportion using transit for Commuter Trips from Rural County to Urban Place* $\times$ *Number of Commuters* $\times 2 = 0.0312448 \times 2,433 \times 2 = 152.0371968 \approx 150$

ANNUAL COMMUTER TRIPS $= 152.0371968 * 255 = 38,769 \approx 38,800$

Figure 21.   *Demand - General Public Rural Passenger Transportation (Output).*

Table 8.   ACS Table B08201 – Archuleta County, CO.

	Archuleta County, Colorado	
	Estimate	Margin of Error
Total:	3,377	+/-313
No vehicle available	65	+/-38
1 vehicle available	701	+/-169
2 vehicles available	1,738	+/-251
3 vehicles available	627	+/-145
4 or more vehicles available	246	+/-81
1-person household:	727	+/-171
No vehicle available	49	+/-40
1 vehicle available	492	+/-143
2 vehicles available	155	+/-88
3 vehicles available	7	+/-9
4 or more vehicles available	24	+/-30
2-person household:	1,977	+/-172
No vehicle available	16	+/-18
1 vehicle available	143	+/-70
2 vehicles available	1,277	+/-192
3 vehicles available	432	+/-121
4 or more vehicles available	109	+/-57
3-person household:	223	+/-82
No vehicle available	0	+/-123
1 vehicle available	25	+/-26
2 vehicles available	104	+/-53
3 vehicles available	59	+/-38
4 or more vehicles available	35	+/-28
4-or-more-person household:	450	+/-114
No vehicle available	0	+/-123
1 vehicle available	41	+/-31
2 vehicles available	202	+/-85
3 vehicles available	129	+/-71
4 or more vehicles available	78	+/-45

Source: U.S. Census Bureau, 2006-2010 American Community Survey

Figure 22. Demand - Small City (Input Tab).

RURAL TRANSIT NEED/DEMAND ESTIMATION - OUTPUT TABLE

Service Area: Cortland, NY
Analysis Description: Test
Additional Description: Test

Estimation of Transit Need
Total need for passenger transportation service: Persons

Total households without access to a vehicle: Households
State Mobility Gap: Daily 1-Way Psgr.-Trips per Household

Total need based on mobility gap: Daily 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips

General Public Rural Non-Program Demand
Estimate of demand for general public rural transportation
Rural transit trips: Annual 1-Way Passenger-Trips

General Public Rural Passenger Transportation
Estimate of demand for rural transportation
Total Rural Non-Program Demand   Annual 1-Way Passenger-Trips

④

Small City Fixed Route
Annual Ridership: 187,600   Annual 1-Way Passenger-Trips

Demand - Commuter by Transit to an Urban Center
Proportion of Commuters using Transit:
Commuter trips by transit between counties: Daily 1-Way Passenger Trips
   Annual 1-Way Passenger-Trips

Rural Program Demand
Annual Program Trip Estimation
   Annual 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips
   Annual 1-Way Passenger-Trips

Instructions   Analysis Setup   Input   **Output**   Peer Data Worksheet   Macro Instructions

Figure 23.   Demand - Small City (Output).

Figure 24.   Demand – Commuters (Input Tab).

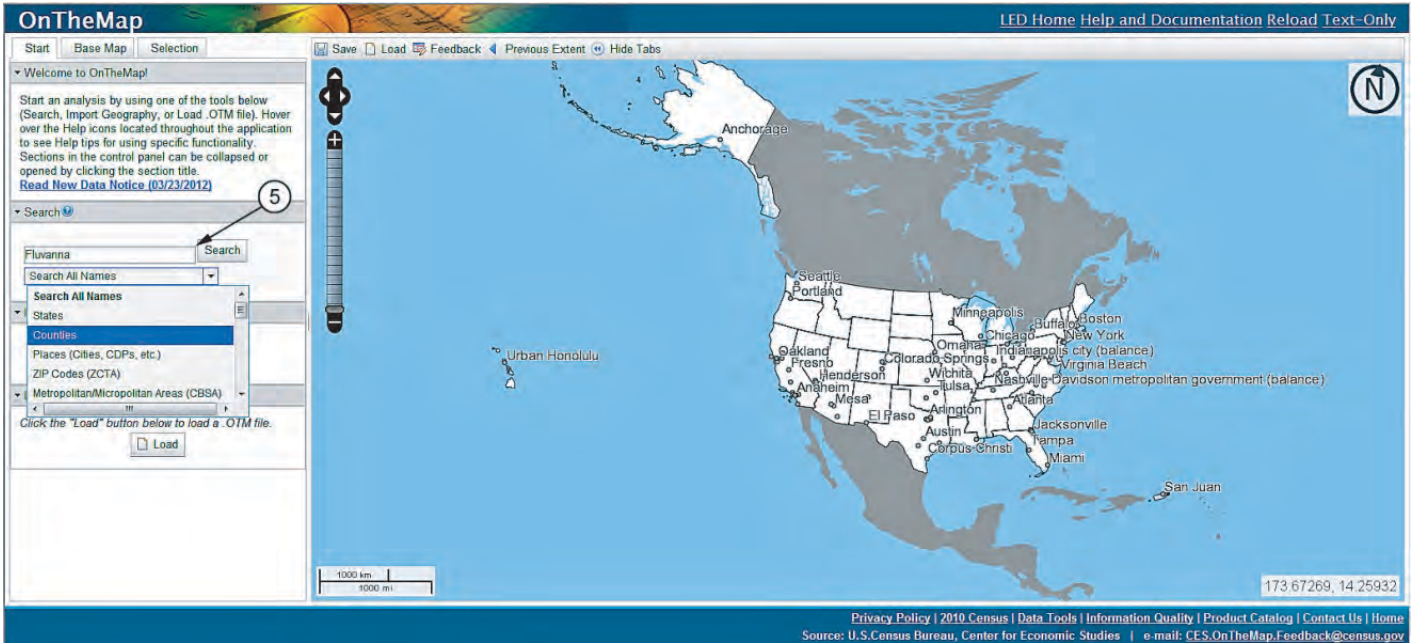**Figure 25.   U.S. Census LEHD Main Page.**

Figure 26.   LEHD OnTheMap Program Search Page.
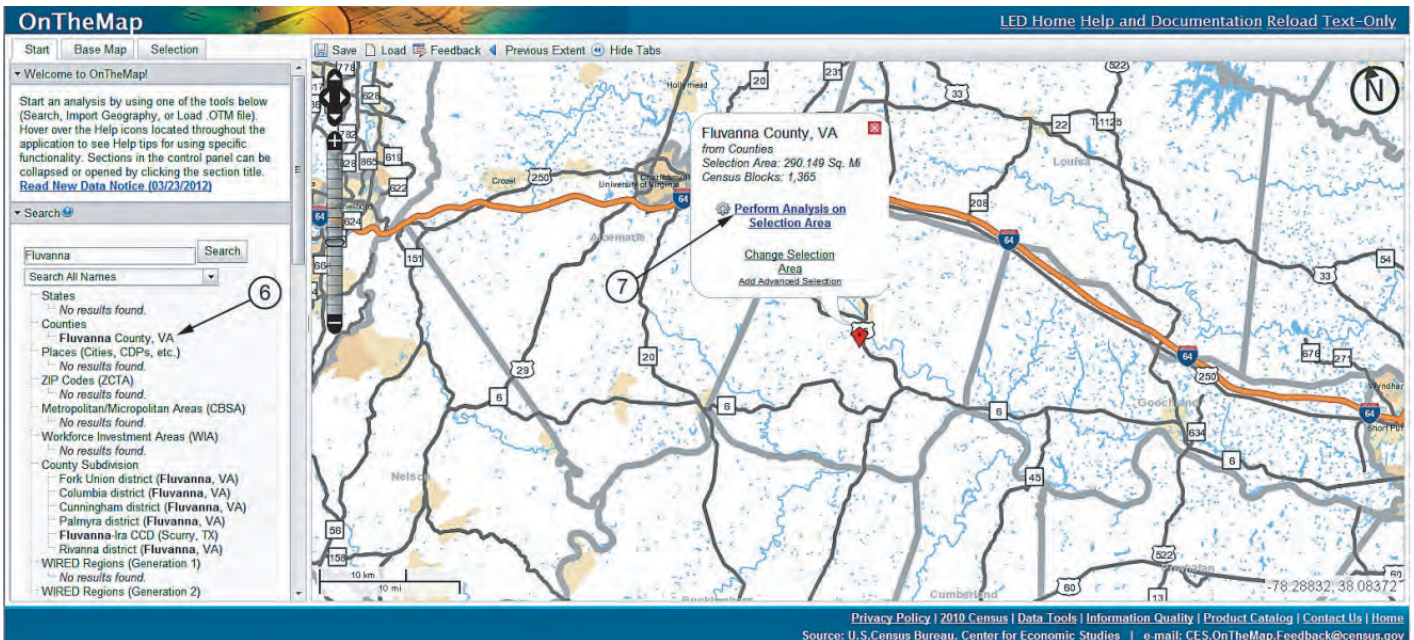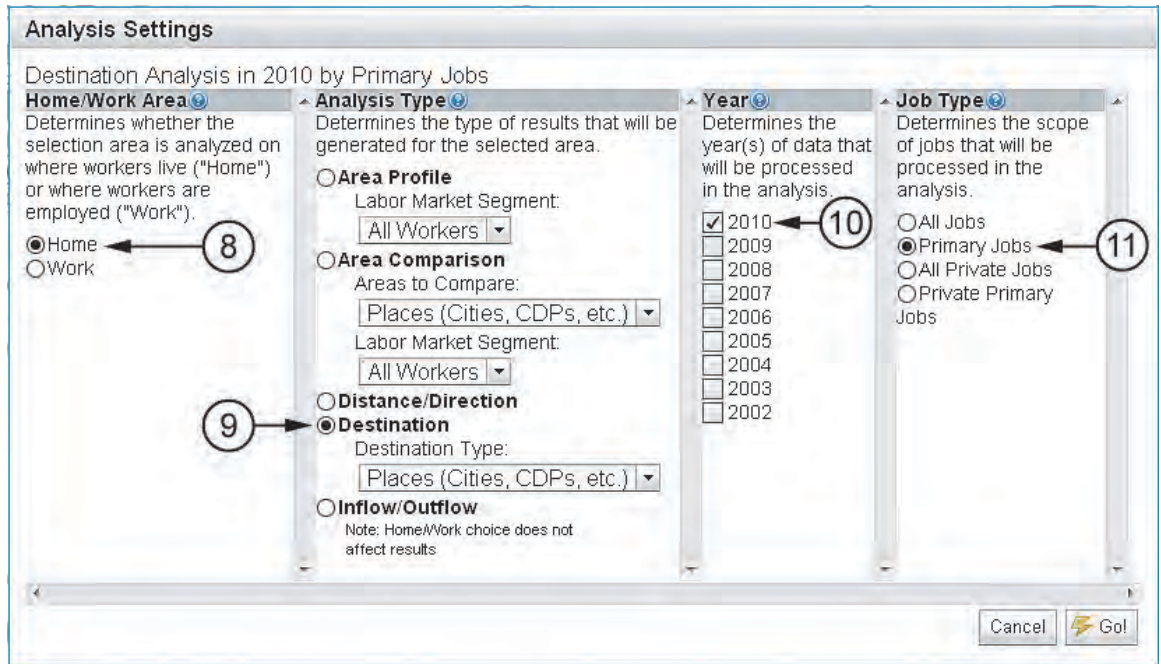

Figure 27.   OnTheMap Select Study Area.

Figure 28.   OnTheMap Analysis Settings.
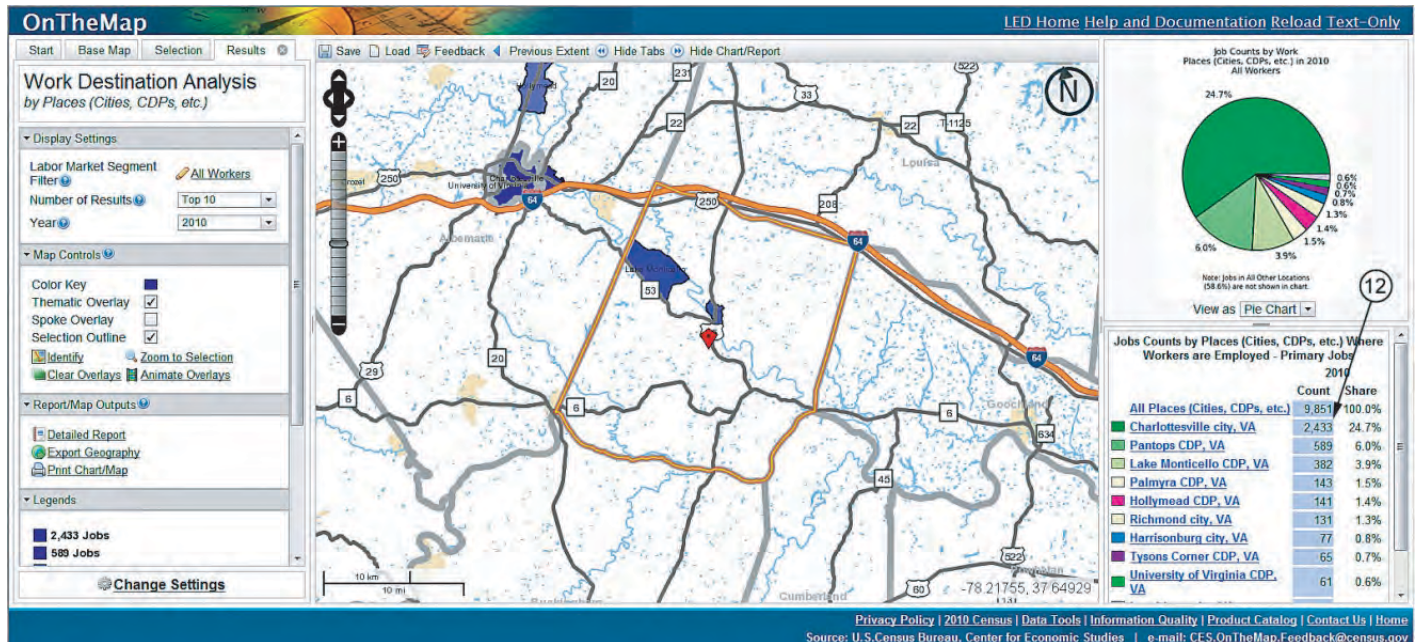

Figure 29.   OnTheMap Results Page.

Figure 30.   Determining Commuter Distance.

Figure 31.   Demand – Commuters (Output Tab).

APPENDIX C

Suggested Guidelines for Data Collection

The Rural National Transit Database specifies data that are to be reported each year by rural systems. These data are necessary for FTA to determine the apportionment of funds made available under specific federal programs properly. However, these data do not provide a complete picture of the operations and use of rural passenger transportation services. Individual states, coordinating councils, or planning agencies may wish to implement more comprehensive data collection programs so as to develop a better understanding of the met and unmet needs in rural communities and the characteristics of the demand for rural passenger transportation services. Such data could be used to (1) identify areas having the greatest unmet need and (2) guide the allocation of state or local funds.

In most rural communities, passenger transportation services are provided by both public transit agencies and human service organizations—because of this, the requirement for Coordinated Public Transportation-Human Service Transportation Plans was developed. Preparation of these plans enables states and agencies to assemble data that can help identify met and unmet needs while systematically building a database that will support analysis of likely demand functions.

Most public transit agencies collect the needed data:

- Service provided–measured in vehicle-miles and/or vehicle-hours
- Size of service area
- Population served–by market segment
- Trips (boardings) by trip purpose

Human service agencies will often have some of these data but may not regularly report them. The following information from each human service agency would provide a more complete picture of transportation services:

- Trips (boardings) served per time period
- Unduplicated riders per time period
- Size of the agency's service area
- Population, by market, of the agency's service area
- For programs offered by the agency:
  - Approximate number of program participants
  - Number of program events per week
  - The proportion of total program participants who attend the program on an average day
  - The proportion of program participants that are transit dependent and do not typically get a ride from family members–therefore requiring public transportation
  - Number of weeks per year that the program is offered

State agencies charged with preparing coordinated plans may also find it useful to request all agencies—public transportation or human service—that receive state or federal assistance for the purchase or operations of vehicles to provide information about the sources of revenues, the amounts received from each route, and all expenditures on transportation.

70

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation