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MINORITY TRANSPORTATION EXPENDITURES
ALLOCATION MODEL (MITRAM)

User Documentation for the
Personal Computer Spreadsheet Version

by

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MASTER

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FOREWORD

In 1979, the U.S. Congress created the Office of Minority Economic Impact (MI) within the U.S. Department of Energy (DOE) out of concern for the effects of energy shortages and rising prices on minority citizens. The legislation (42 U.S.C., Sec. 7141 [c]) defines a minority group as one consisting of black, Oriental, American Indian, Eskimo, or Aleut citizens, or Puerto Rican or other Spanish-speaking citizens of Spanish descent. This law requires MI, among other things, to conduct research to (1) determine the average energy consumption patterns of minority groups relative to other population groups and (2) evaluate the percentage of disposable income spent on energy by minority groups.

As part of its compliance with this mandate, MI commissioned Argonne National Laboratory (ANL) to conduct a multiyear research program to determine energy consumption and expenditures by minority groups. The ANL program consists of three tasks:

- Assemble a data base and develop tools to assess the effects of government energy policies and programs on minority groups,
- Assess the effects of government programs on minorities and identify options for modifying those programs (e.g., through policy, regulatory, or legislative changes) to alleviate possible hardships for minority groups, and
- Assess the effects of key macroeconomic variables on the pattern of U.S. energy demand and expenditures, according to demographic groups.

This report is one of a series produced by ANL in the performance of these tasks. It is directed at transportation and energy researchers, as well as policy analysts and other investigators who share an interest in the characteristics and behavior of minority households.

Further information on the overall MI research program can be obtained from Georgia Johnson, the research project officer for the DOE Office of Minority Economic Impact, or from Argonne National Laboratory. Information on this report may be obtained directly from the authors.

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Several individuals were instrumental in this project and deserve our thanks. First and foremost is Georgia Johnson of the U.S. Department of Energy's Office of Minority Economic Impact, who sponsored the research. Her support and valuable assistance throughout the project are especially appreciated. At Argonne National Laboratory (ANL), we also thank principal investigator David Poyer for his many helpful comments and suggestions during the data analysis and in the presentation and discussion of findings, and Kristine Bindner for her assistance in data analysis and model validation. We also thank the ANL Division of Education Programs for providing partial support for Sheri Marik's summer stay. Finally, at ANL, we thank LaVerne Franek and the Energy and Environmental Systems Division Word Processing Center staff for their diligence and patience in preparing the manuscript, and Phyllis Chen for editing the final document.

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ABSTRACT

The Minority Transportation Expenditures Allocation Model (MITRAM) can project various transportation-related attributes of minority and majority populations. Individual components of the model were developed using time-series data and then validated independently using cross-sectional data. The model projects vehicle ownership, vehicle-miles of travel, workers, new car and on-road fleet fuel economy, amount and share of household income spent on gasoline, and household expenditures on public transit and taxis. These attributes are projected for whites, blacks, and both. This report describes how various components of MITRAM work and how to use MITRAM on an Apple Macintosh or an IBM PC. Two spreadsheet software packages are available: Excel for the Macintosh, and Lotus 1-2-3 for the IBM PC. The Excel version produces a set of graphs showing historical and projected values of the transportation attributes, while the LOTUS version presents only the numbers in the spreadsheets.

1 INTRODUCTION

1.1 OVERVIEW OF THE MODEL

As part of an ongoing research program conducted by Argonne National Laboratory (ANL) for the U.S. Department of Energy's Office of Minority Economic Impact, a transportation-sector model was developed by the ANL Center for Transportation Research. Three major criteria for the model were that it be able to (1) project transportation energy expenditures by minority and majority populations, (2) assess, in a reasonable way, the effects of government energy policies and programs, and (3) evaluate some remedial options to alleviate hardships on minority populations.

The resulting model, called the Minority Transportation Expenditures Allocation Model (MITRAM), uses several inputs to determine differences in majority and minority population behavior with respect to personal vehicular and public transportation. These

inputs include household income, household size, consumer price index, unemployment rate, gasoline prices, population projections, change in the share of large and luxury cars, and corporate average fuel economy (CAFE) standards. The model projects on-road fleet fuel economy, workers per capita, vehicles per capita, vehicle age distribution, vehicle-miles of travel (VMT) per vehicle, gasoline expenditures, and share of income spent on gasoline. The model also projects household expenditures on public transit and taxis.

Several data sources were used during the development of different submodels within MITRAM. Surveys, such as the Nationwide Personal Transportation Studies (NPTS) of 1977 and 1983 and the Residential Transportation Energy Consumption Surveys (RTECS) of 1983 and 1985 were used in cross-sectional analyses. National time series data were obtained from reports published by the Bureau of the Census and the Bureau of Labor Statistics. Households were classified by race and origin of the head. The race/origin category was independently assigned during our analysis of various survey data, while the categories provided in the published reports were assigned by the reporting agency.

In our analysis of surveys, households were classified as white, black, Hispanic, and other. These four categories are mutually exclusive. Whites exclude Hispanics (of Spanish origin) and those households where the head was identified as black or other. The "other" category includes native Americans (American Indian, Eskimo, and Aleut) and Asian and Pacific Islanders. Blacks include black Hispanics.

Data published by the Census Bureau and the Bureau of Labor Statistics use four racial groups: white, black, American Indian (including Eskimo and Aleut), and Asian and Pacific Islander; data are also reported for a separate Spanish-origin (Hispanic) group that may be of any race. Thus, the Hispanic category is overlaid on the four racial categories.

The model development effort covered white, black, and Hispanic households. However, this user manual summarizes a version of the model that covers white and black households only. When data items are supplied or projected by race, the term "race" refers to whites and blacks as defined in our analysis of survey data. The terms "both races" and "for both" refer to a value derived as a weighted sum of a household attribute. Some attributes, such as gasoline price, urban consumer price index, new car rated fuel economy, and new and used car price indexes are not race-specific. These values are applicable to white and black households as well as to households of all race/origin categories listed above.

1.2 ORGANIZATION OF THIS REPORT

A spreadsheet version of MITRAM is available for the Apple MacIntosh, using the Microsoft Excel software package, and the IBM PC, using Lotus 1-2-3. Section 2 of this report provides instructions for using MITRAM with either software package and for generating graphs, using the Excel software, of the input and output data. A full set of sample graphs is provided.

Section 3 presents flow charts of the major submodels comprising MITRAM and describes the submodel equations used. This section is intended for background understanding and need not be read in order to perform the procedures described in Sec. 2. A few comments regarding interpretation of the model results are contained in Sec. 4. The appendix presents a spreadsheet showing the default input and output values for the model.

2 MITRAM OPERATING PROCEDURES

This section describes the hardware and software requirements for using MITRAM and explains how to view the model, produce graphs, and change the input data. Graphs produced using the default values are shown in Sec. 2.4.

2.1 HARDWARE AND SOFTWARE REQUIREMENTS

Hardware requirements for the spreadsheet version of MITRAM are determined by the software package. The Excel version runs on an Apple Macintosh with a minimum memory of 512 kilobytes and two disk drives. One or both disk drives may be substituted by a hard disk. A printer with graphics capability is essential to produce hard copies of the graphs generated by the model. The Excel spreadsheet package is proprietary software and must be purchased by the user. A working knowledge of Macintosh computer operation is necessary and the user should have some familiarity with Excel software.

The Lotus 1-2-3 version runs on an IBM PC, PC/XT, or PC/AT (or a compatible DOS-based system) with a 640-kilobyte memory. A PC without a hard disk drive should have two floppy disk drives. A graphics adapter and a printer with graphics capability should be available. The present MITRAM version is produced on version 3.2 of MS-DOS. An operating knowledge of the PC and of MS-DOS is necessary. Some familiarity with Lotus 1-2-3 spreadsheet software is assumed; the Lotus 1-2-3 is proprietary software and must be purchased by the user.

2.2 EXCEL VERSION

The Excel version operates on an Apple Macintosh that meets the hardware requirements described in Sec. 2.1. The procedures described here are for a Macintosh Plus with two disk drives for 400-kilobyte (or greater capacity) 3.5-inch diskettes. For other Macintosh models and for computers with a hard disk, consult the Macintosh user manual for installation procedures.

2.2.1 Beginning a MITRAM Session

To begin a MITRAM session, do the following:

1. Start the Macintosh with the Excel disk in the internal disk drive and a copy of the MITRAM disk in the external disk drive.
2. Switch to the external drive by double-clicking on the external drive icon in the upper right-hand corner. The MITRAM folder will be displayed on the screen.
3. Double-click on the MITRAM folder icon to open the folder.

4. Double-click on the icon (or name) MITRAM1; it will take a few seconds before the spreadsheet is displayed.

2.2.2 Viewing the Model

Figure 2.1 shows the MITRAM spreadsheet on Excel. The model itself is surrounded by a heavy line. Inputs are shaded in dots, and outputs are shaded in stripes; both can be displayed using the Excel graphic display capabilities and the MITRAM graphics files. The model includes historical data, which are shaded in diamonds. All other boxes are either intermediate data or outputs not used in producing a graphic representation of the model.

To briefly view the model, move the arrow down on the spreadsheet so that rows 36-55 are displayed. Then, move the arrow to the boxed arrow at the bottom right and hold down the button on the mouse. The default values and locations of the model inputs and outputs should be displayed. Table 2.1 lists these inputs and outputs with their spreadsheet locations, and the appendix gives a spreadsheet printout with the default values, which cover the period of 1985-95. Aside from the input and output columns listed in Table 2.1, several other columns on the spreadsheet contain data values. These values represent some historical data and intermediate calculation results.

2.2.3 Generating Graphs

This section explains how to generate graphs using the Excel software. A sample set of graphs is presented in Sec. 2.4.

To generate a graph, perform the following steps:

1. Start the computer with Excel (as described in Sec. 2.2.1).
2. Move the arrow to the FILE menu. Drag the arrow to OPEN and then release the mouse button.
3. Double-click on the icon (or name) of the first graph desired. The graph will be displayed.
4. To obtain a full-size version of the graph, move the arrow to the lower right-hand corner and double-click.
5. To generate another graph, move the arrow to the icon (or name) of the graph desired, then double-click. When the message "Update references to nonresident sheet?" appears, click on OK. The graph will then appear. Repeat step 4 if desired.
6. Repeat step 5 for all subsequent graphs desired.

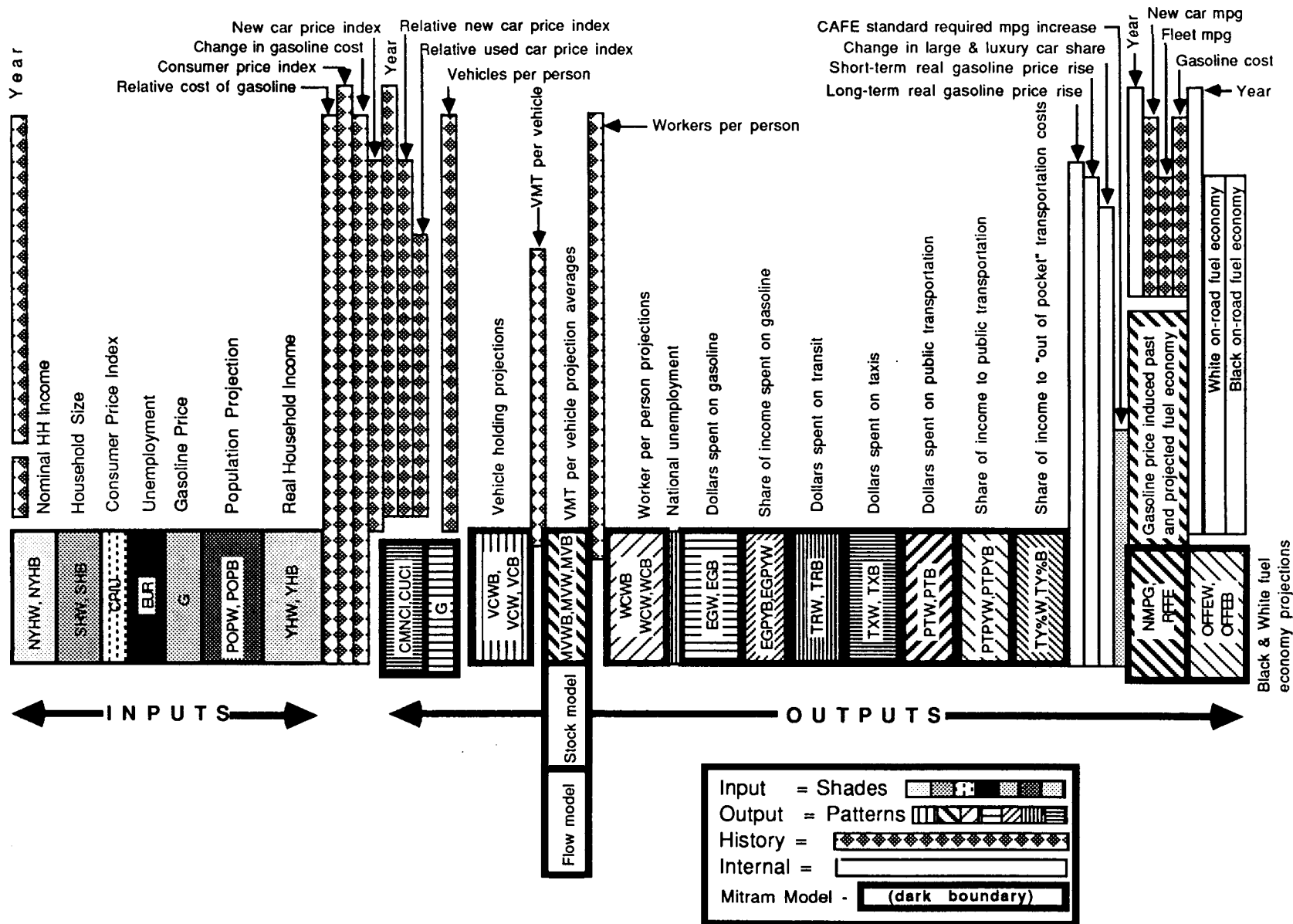


FIGURE 2.1 Overview of the MITRAM Spreadsheet, with Data and Graph Locations

TABLE 2.1 Spreadsheet Locations of MITRAM Inputs and Outputs

Description	Acronym	Column ^a	Rows
<u>Inputs^b</u>			
Nominal household income			
White	NYHW	B	43-53
Black	NYHB	C	43-53
Household size			
White	SHW	E	43-53
Black	SHB	F	43-53
Urban consumer price index (1978 = 100)	CPIU	H	43-53
National unemployment rate	UER	J	43-53
Gasoline price, all grades (1986 ¢/gal)	G	K	43-53
Population projection			
White	POPW	M	43-53
Black	POPB	N	43-53
<u>Outputs</u>			
Real household income ^c			
White and black	YHWP	P	43-53
White	YHW	Q	43-53
Black	YHB	R	43-53
Relative cost of the most popular grade of gasoline (1986 ¢/gal)	PG		
Historical		S	8-42
Projected		S	43-53
Urban consumer price index			
Historical	CPIU	T	8-42
Projected (same as column H)	CPIU	T	43-53
Fractional change in relative gasoline cost			
Historical	-	U	9-42
Projected	-	U	43-53
Historical new car price index	-	V	13-43
Relative new-car price index ^d			
Historical	-	X	13-42
Projected	CMNCI	X	44-54

TABLE 2.1 (Cont'd)

Description	Acronym	Column ^a	Rows
Relative used-car price index ^e			
Historical	-	Y	18-42
Projected	CUCI	Y	44-54
Gasoline price (¢/gal) (same as column K)	G	Z	44-54
Vehicles per capita			
Historical	VC	AA	8-43
Projected			
White and black	VCWB	AC	43-53
White	VCW	AD	43-53
Black	VCB	AE	43-53
VMT (thousands) per vehicle			
Historical	MV	AF	19-42
White and black	MVWP	AH	43-53
White	MVW	AI	43-53
Black	MVB	AJ	43-53
STOCK model results ^c			
White and black	-	AH	55-65
White	-	AI	55-65
Black	-	AJ	55-65
FLOW model results ^c			
White and black	-	AH	67-77
White	-	AI	67-77
Black	-	AJ	67-77
Workers per capita			
Historical	-	AL	8-41
White and black	WCWB	AL	43-53
White	WCW	AN	43-53
Black	WCB	AO	43-53
National unemployment rate (same as column J)	UER	AP	43-53
Household expenditures on gasoline (1986 \$)			
White and black	-	AR	43-53
White	EGW	AS	43-53
Black	EGB	AT	43-53
Share of household income spent on gasoline (%)			
White and black	-	AV	43-53
Black	EGPYB	AW	43-53
White	EGPYW	AX	43-53

TABLE 2.1 (Cont'd)

Description	Acronym	Column ^a	Rows
Household expenditures on public transportation (1986 \$)			
Transit (transit rail and buses)			
White and black	-	AZ	43-53
White	TRW	BA	43-53
Black	TRB	BB	43-53
Taxis			
White and black	-	BD	43-53
White	TXW	BE	43-53
Black	TXB	BF	43-53
Transit and taxis			
White and black	-	BH	43-53
White	-	BI	43-53
Black	-	BJ	43-53
Share of household income spent on personal vehicular and public transportation (%)			
Transit, taxis, and private vehicles			
White and black	-	BP	43-53
White	TY%W	BQ	43-53
Black	TY%B	BR	43-53
Transit and taxis			
White and black	-	BL	43-53
White	-	BM	43-53
Black	-	BN	43-53
Fuel economy (mpg)			
New car			
Historical (domestic cars only)	-	BX	8-43
Projected (all cars)	NMPG	BX	44-54
On-road			
White fleet, based on rated mpg			
Historical	-	BY	24-43
Projected	-	BY	44-54
White fleet, based on actual mpg ^f	OFFEW	CB	44-54
Black fleet, based on actual mpg ^f	OFFEB	CC	44-54
Real cost of the most popular grade of gasoline (same as column S)			
	-	BZ	44-54
Household average vehicle age			
Black	VAB	CD	33-43
White	VAW	CD	44-54

TABLE 2.1 (Cont'd)

Description	Acronym	Column ^a	Rows
Fraction of household vehicle fleet represented by vehicles of various ages ^c			
0-<1 yr old			
Black	PPNB1	CG	33-43
White	PPNW1	CG	44-54
1-<2 yr old			
Black	PPNB2	CH	33-43
White	PPNW2	CH	44-54
2-<3 yr old			
Black	PPNB3	CI	33-43
White	PPNW3	CI	44-54
.	.	.	.
.	.	.	.
.	.	.	.
24-<25 yr old			
Black	PPNB25	DE	33-43
White	PPNW25	DE	44-54
Sum of household fleet shares by vehicles 0-<25 yr old ^c			
Black	-	DF	33-43
White	-	DF	44-54

^aThe years of projection (YR) are repeated at various intervals throughout the spreadsheet for the user's convenience. Most of the columns that do not appear in this table are the ones used for YR (see the appendix).

^bTwo additional data items are used by MITRAM but are not included in this table: (1) changes in the share of large and luxury cars (DLLC), stored in column BU, and (2) the effect of CAFE standards (ECAFE), stored in column BV. Little information is available regarding future values of these two data items.

^cIntermediate output for internal computational purposes only.

^dBased on the CPIU, with adjustments made on the basis of an ANL minority impact assessment.

^eBased on the CPIU.

^fCorrected for driving cycle and degradation.

2.2.4 Printing Graphs

To print a graph, perform the following steps:

1. Move the arrow to the FILE menu.
2. Drag the arrow to the word PRINT and click. A dialogue box will then appear.
3. Make any changes necessary.
4. Click the OK box of the printer menu. The graph will be printed.

2.2.5 Changing Data

Data values for input variables (see Table 2.1) are the only data that should be changed.* New data must be entered by row, i.e., by year, instead of by column due to the nature of the MITRAM formulas. For each row, changes should be made in order, from left to right (i.e., beginning with column B and ending with column N).

The procedure is as follows:

1. Move to cell B43 and click the button on the mouse. Type in a new value if desired. Then press the enter key.
2. Repeat step 1 for each cell in row 43 in which a change is desired.
3. Repeat steps 1 and 2 for rows 44-53.
4. To save the changes, follow the procedure given in Sec. 2.2.6.

If numbers disappear from the spreadsheet and are replaced by error messages, the user should remember the Excel "Undo" command and reread the data entry instructions in the manual. A backup copy of the model should be made on an extra disk.

2.2.6 Saving the Changes

After performing the steps given in Sec. 2.2.5, save the changes as follows:

1. Move the arrow to the FILE menu.
2. Drag the arrow down to the word SAVE and then release the mouse button.

*Two additional data items, in columns BU and BV, may be changed by the user, though likely future values are not available (see Table 2.1, footnote b).

2.3 LOTUS 1-2-3 VERSION

The Lotus 1-2-3 version operates on an IBM PC, PC/XT, or PC/AT (or compatible DOS-based system) that meets the hardware requirements described in Sec. 2.1. The procedures described here are for a PC/XT with hard disk and two disk drives. For a computer that does not have a hard disk, appropriate changes will have to be made.

2.3.1 Beginning a MITRAM Session

To begin a MITRAM session, do the following:

1. Start up the PC/XT. After the disk operating system shows a ready prompt (e.g., "C>" or "C:\DOS>"), change to the directory in which the Lotus 1-2-3 and MITRAM spreadsheets are stored.
2. Type "123" and press Enter. The Lotus 1-2-3 software will be loaded and READY will be displayed in the top right-hand corner.
3. Press "/" to display the Lotus 1-2-3 menu and then "f" to select the file submenu. Type "r" to retrieve a spreadsheet, then type "MITRAM" following the next prompt. The MITRAM spreadsheet will be loaded and READY will be displayed in the top right corner.

2.3.2 Viewing the Model

The MITRAM spreadsheet in Lotus 1-2-3 is identical to the Excel spreadsheet shown in Fig. 2.1. The information given in Table 2.1 is also the same for Lotus 1-2-3.

To briefly view the model, move the cursor down on the spreadsheet so that rows 36-55 are displayed. The model can then be scanned using the Page Up and Page Down keys and the four arrow keys. Pressing the TAB key will display columns to the right, and pressing the SHIFT and TAB keys together will display columns to the left (if any).

The Excel and Lotus 1-2-3 spreadsheets are identical because the model was initially developed on Excel and then converted to Lotus 1-2-3. Because the two software packages have different graphics capabilities, separate graphics files are required for the Lotus 1-2-3 version. However, Lotus 1-2-3 graphics files have not yet been created for the latest version of MITRAM.

2.3.3 Changing Data

As in the case of the Excel spreadsheet software, data changes desired by the user should be limited only to the input variables and to the projection years (1985-95). When the values of input variables are changed, Lotus 1-2-3 will recompute values for the modeled variables using the MITRAM formulas already stored. These MITRAM formulas use lagged values of variables, which means that new values of all input variables must be entered starting from the earliest projection year to the last projection

year, one year at a time. Each year is represented by a row in the spreadsheet, and therefore data should be entered by row. For each row, changes should be made in the input variables in order, from left to right, as described in Sec. 2.2.5. The basic procedure is as follows (users familiar with the software may use faster procedures):

1. Move the cursor to cell B43. Type in a new value if desired. Then press the enter key.
2. Repeat step 1 for each cell in row 43 in which a change is desired.
3. Repeat steps 1 and 2 for rows 44-53.
4. To save the changes, follow the procedure given in Sec. 2.3.4.

2.3.4 Saving the Changes

After performing the steps given in Sec. 2.3.3, save the changes as follows:

1. Press "/" to display the Lotus 1-2-3 menu.
2. Type "f" for FILE and then "s" for SAVE.
3. Type a new name for the revised spreadsheet. The software will display a WAIT message while it saves the changes.
4. To exit the MITRAM spreadsheet, press "/" and the Lotus 1-2-3 main menu will reappear, with other spreadsheet selections. To exit Lotus 1-2-3, type "q" for QUIT and then "y" in response to the next question.

2.4 INPUT AND OUTPUT GRAPHIC DISPLAYS

This section presents a sample set of the graphs that can be produced by the Excel spreadsheet software for MITRAM input and output variables. The locations of these variables on the spreadsheet have already been identified in Table 2.1. The graphs shown reflect the default values listed on the spreadsheet in the appendix. Thus, the input graphs are direct plots of the default input data, while the output graphs show the values that would be computed if the default input data are used. The output graphs typically show a variable plotted against an input variable or another output variable or as a trend over time.

The format of the input and output graphs can easily be changed by a user familiar with the Excel software. The output variables can also be graphed in Lotus 1-2-3 in most cases. However, Excel combination graphs (i.e., those showing more than two variables) cannot be duplicated by Lotus 1-2-3 and must be constructed as separate pairs of graphs.

Also presented in this section are the ranges of selected variables in the spreadsheet version of MITRAM. Some submodels use lagged values of input and/or modeled variables. To allow for this, a series of historical values are included in the spreadsheet version. The historical values are also provided as a point of reference so that users may judge the reasonableness of the input values used and output values produced.

2.4.1 Input Graphs

Nominal Household Income. The graph under the icon labeled "HHY (INPUT)" shows the projected nominal household income of white and black households for 1985-95. The default input graph is shown in Fig. 2.2. The income range compatible with the base model is \$5,000-\$60,000.

Household Size. The graph under the icon labeled "HH Size (INPUT)" shows projected household size for white and black households for 1985-95. The default input graph is shown in Fig. 2.3. The household size range compatible with the base model is 2.2-3.1 persons.

Urban Consumer Price Index. The graph under the icon labeled "CPIU (INPUT)" shows the projected urban consumer price index for 1985-95. The default input graph is shown in Fig. 2.4. The range of index values compatible with the base model is 150-270.

Gasoline Cost and Unemployment Rate. The graph under the icon labeled "Gas Cost & Unemp. Rate (INPUT)" shows projected real costs of gasoline and a projection of the U.S. unemployment rate for 1985-95. The default input graph is shown in Fig. 2.5. The default unemployment data were taken from a Data Resources, Inc., model. Unemployment ranges from 4% to 7.5% while the cost of gasoline ranges from 80¢/gal to 140¢/gal.

Projections of gasoline cost and the unemployment rate are plotted together on this graph because they both affect household spending on gasoline. Gasoline cost affects the amount of travel and consequently household expenditures for gasoline. Unemployment affects household vehicle ownership and thus, indirectly, spending on gasoline.

Population Projections. The graph under the icon labeled "Population Projections (INPUT)" shows projected population, in thousands, for whites and blacks for 1985-95. The default input graph is shown in Fig. 2.6. In the graph, the y-axis scales are adjusted so that the same growth rates would show overlapping lines.

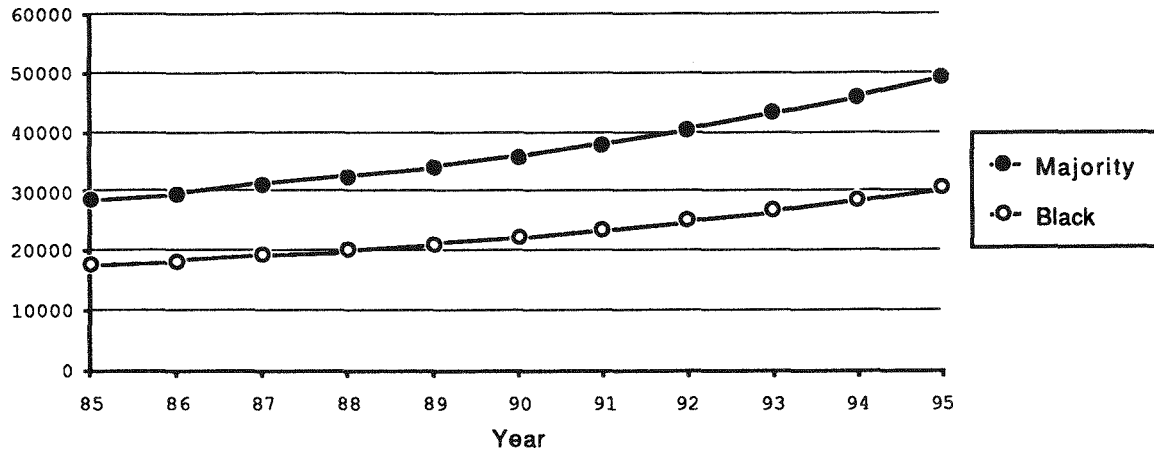


FIGURE 2.2 Default Input Graph: Nominal Household Income (\$)

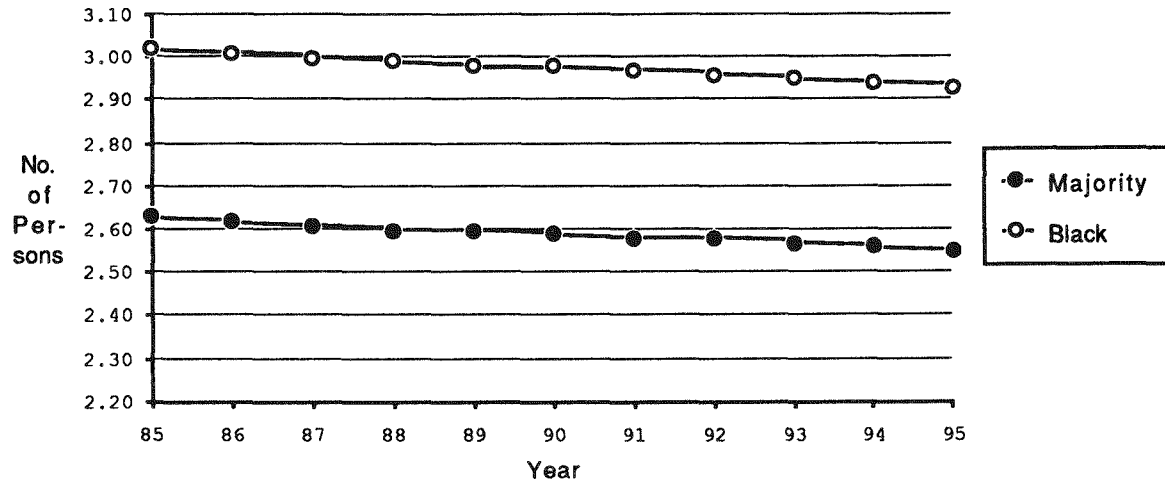


FIGURE 2.3 Default Input Graph: Household Size

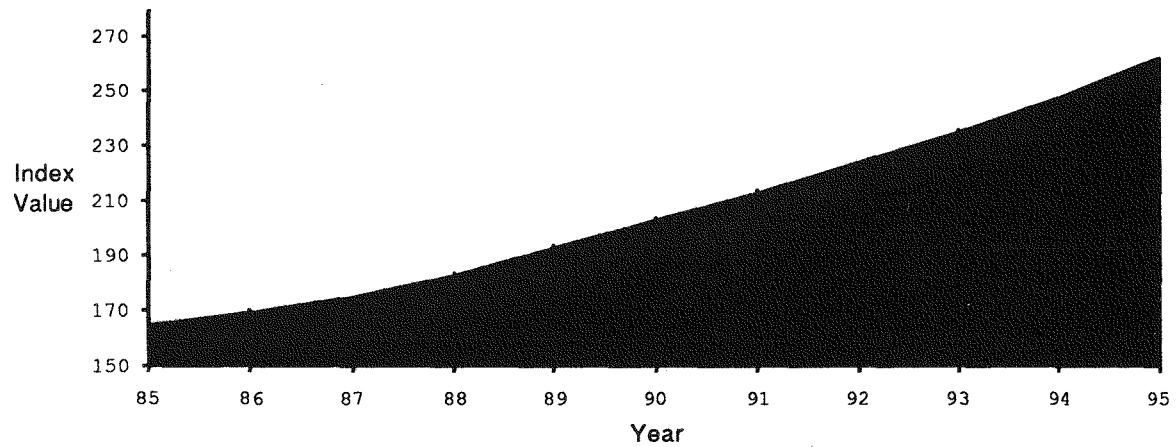


FIGURE 2.4 Default Input Graph: Urban Consumer Price Index (1978 = 100)

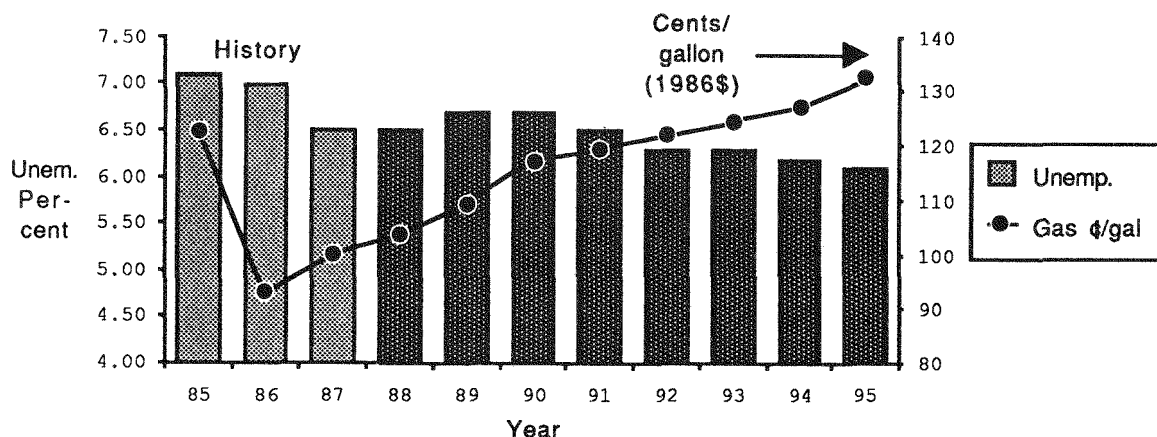


FIGURE 2.5 Default Input Graph: Gasoline Cost and Unemployment Rate

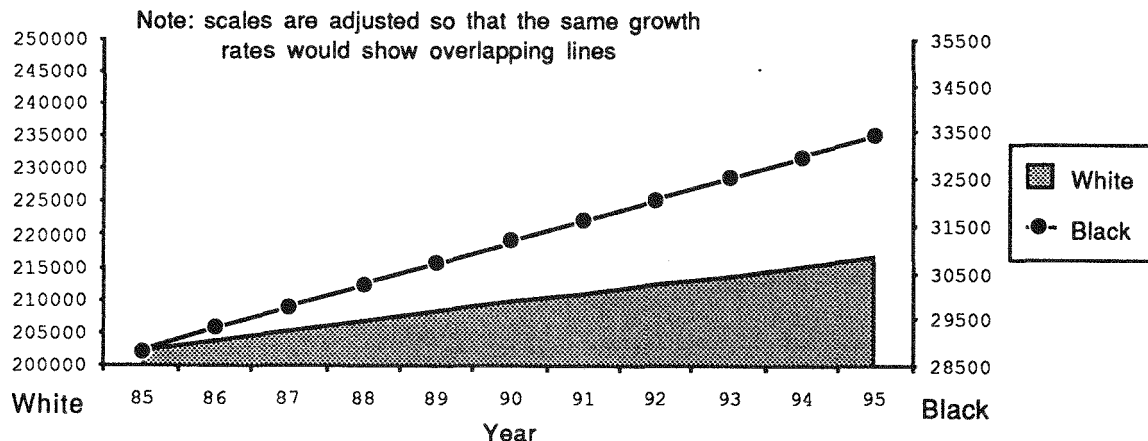


FIGURE 2.6 Default Input Graph: Population Projections (thousands)

Real Household Income. The graph under the icon labeled "Real HH Income (OUTPUT)" shows projected real household income (in 1986 \$) for blacks, whites, and both for 1985-95. The default input graph is shown in Fig. 2.7. Because some inflation (or loss of buying power) is included in the nominal household income projections, conversion to real household income is necessary for many of the submodels. This conversion is done by using the urban consumer price index (CPIU), specifically, by multiplying white and black household incomes (NYHW, NYHB) by a factor of $169.4/\text{CPIU}$. Combined real household income (YHWB) is then computed using population (POPW, POPB) and household size (SHW, SHB) as follows:

$$\text{YHWB} = \frac{169.4 \frac{\text{NYHW}}{\text{CPIU}} \cdot \frac{\text{POPW}}{\text{SHW}} + 169.4 \frac{\text{NYHB}}{\text{CPIU}} \cdot \frac{\text{POPB}}{\text{SHB}}}{\frac{\text{POPW}}{\text{SHW}} + \frac{\text{POPB}}{\text{SHB}}} \quad (2.1)$$

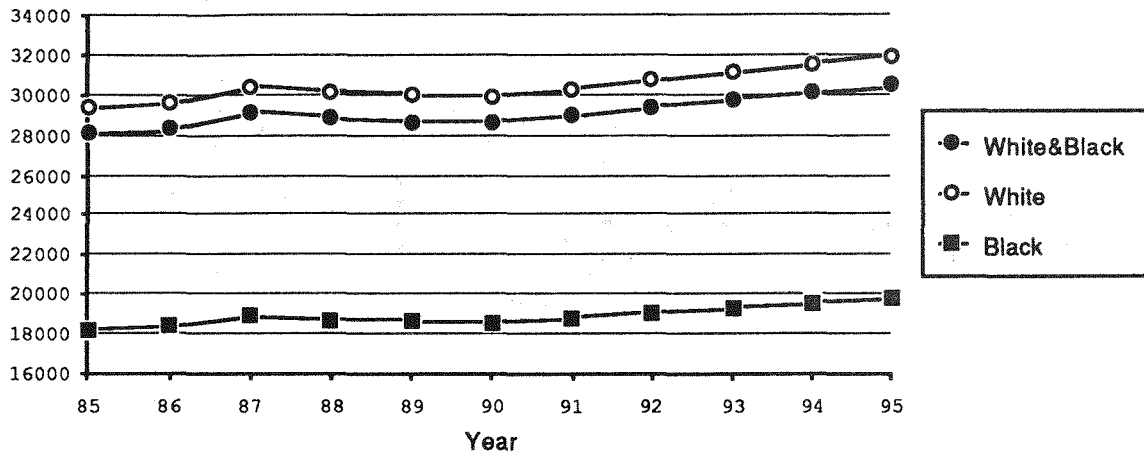


FIGURE 2.7 Default Modified-Input Graph: Real Household Income (1986 \$)

2.4.2 Output Graphs

Fuel Economy and Gasoline Cost. The graph under the icon labeled "Gas Cost Inducing MPG (OUTPUT)" shows new car fuel economy, rated on-road fleet fuel economy, and the price of the most popular grade of gasoline. The graph is shown in Fig. 2.8. Gasoline prices are one of the inputs to the model and are plotted on this graph to show their effect on new car fuel economy. Historical values are shown for 1965-84. Fuel economy ranges from 0 to 30 mpg, and gasoline prices range from 50¢/gal to 160¢/gal in 1986 dollars.

The on-road fleet fuel economy values shown in the graph represent historical fleet fuel economy up to the year 1984 and white on-road fleet fuel economy converted to rated fuel economy for the later years. A factor developed through analysis of the 1985 RTECS is applied to white on-road fleet fuel economy, as estimated by the submodel discussed in Sec. 3.1.

On-Road Fleet Fuel Economy. The graph under the icon labeled "Maj vs. Minority On-Road MPG (OUTPUT)" shows on-road fleet fuel economy for whites and blacks for 1985-95. The default output graph is given in Fig. 2.9. The formulas used for calculating on-road fleet fuel economy are given in Sec. 3.1.

New and Used Car Price Indexes. The graph under the icon labeled "Transportation Costs (OUTPUT)" show projected new and used car price indexes in relation to gasoline prices for 1985-95. The default output graph is shown in Fig. 2.10. The formulas used in projecting these indexes are given in Sec. 3.4.

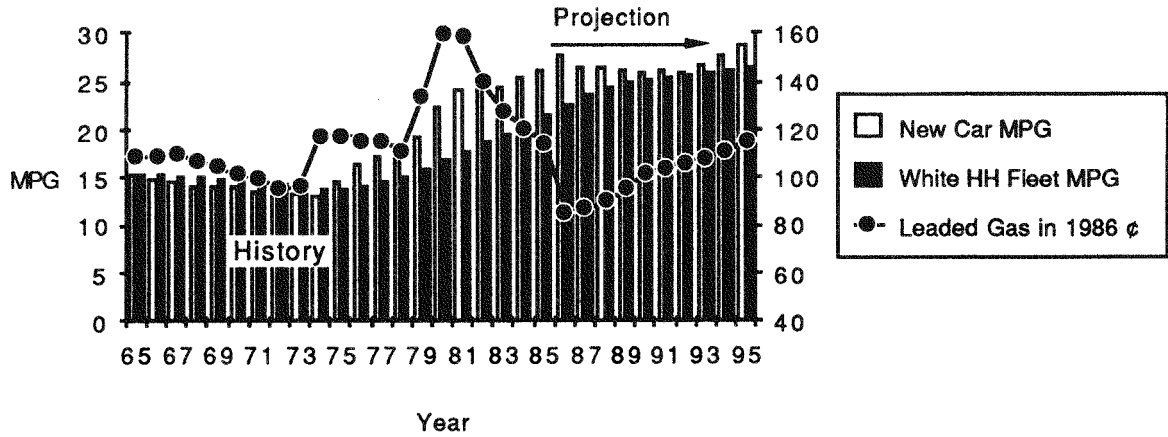


FIGURE 2.8 Default Output Graph: Real Gasoline Prices (1986 \$) and Fuel Economy

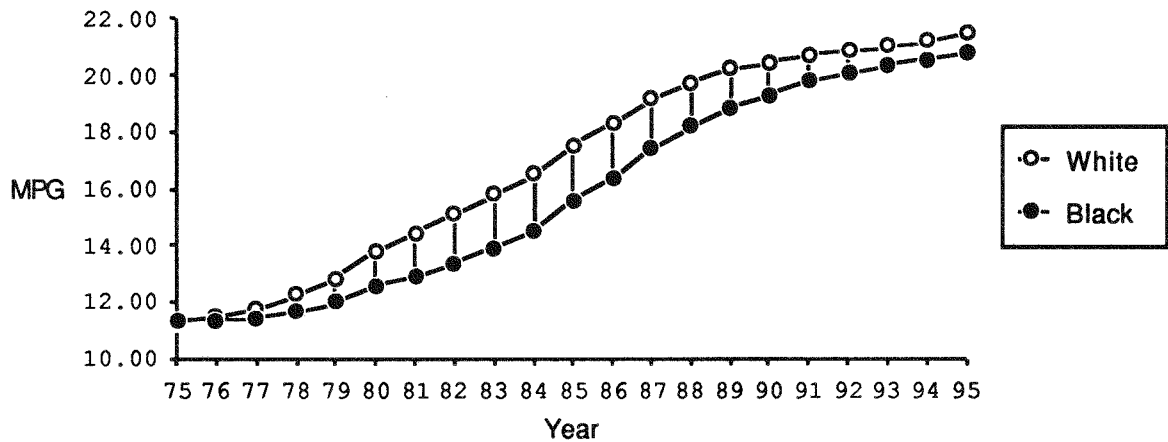


FIGURE 2.9 Default Output Graph: On-Road Fleet Fuel Economy

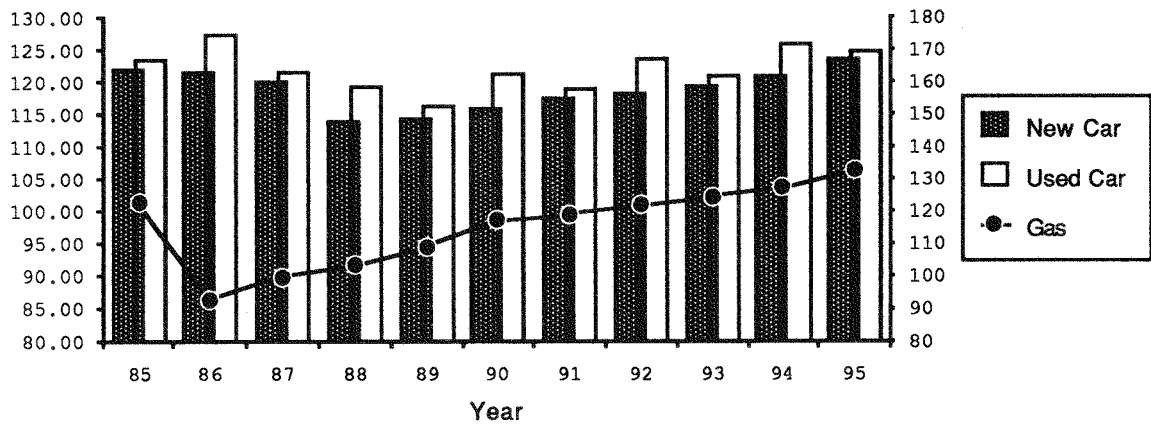


FIGURE 2.10 Default Output Graph: New and Used Car Price Indexes (1978 = 100)

Workers per Capita and Unemployment Rate. The graph under the icon labeled "Workers/Person vs. Unemp. Rate (OUTPUT)" shows projected white and black workers per capita together with the projected unemployment rate for 1985-95. The default output graph is shown in Fig. 2.11. The formulas for projecting workers per capita are given in Sec. 3.3.

Vehicles per Capita. The graph under the icon labeled "Vehicles/Person (OUTPUT)" shows projected vehicles per capita for 1985-19. The default output graph is shown in Fig. 2.12. The formulas for calculating vehicles per capita are given in Sec. 3.5.

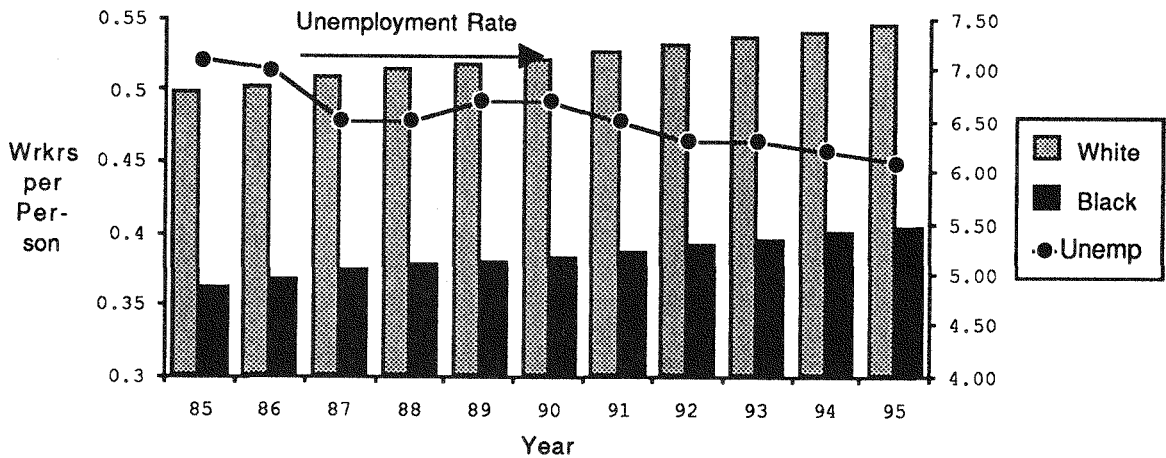


FIGURE 2.11 Default Output Graph: Workers per Capita and Unemployment Rate

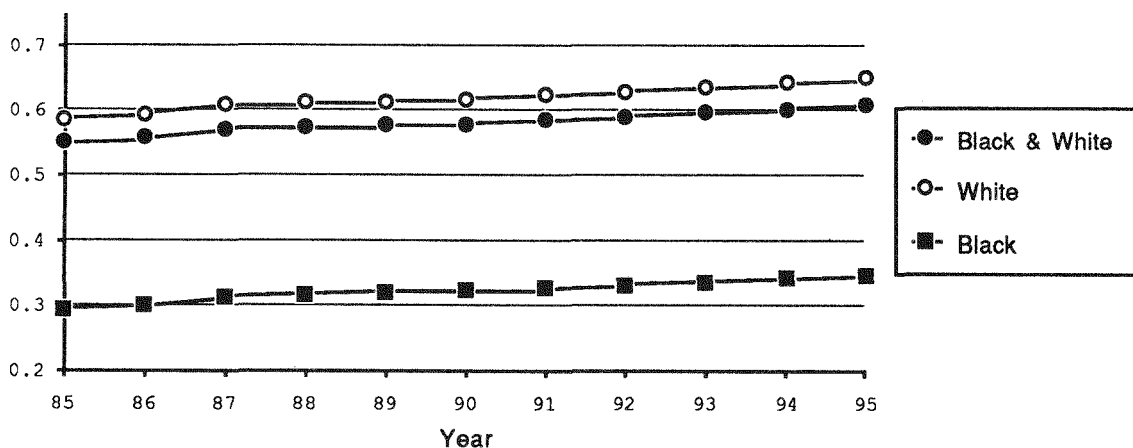


FIGURE 2.12 Default Output Graph: Vehicles per Capita

Annual VMT per Vehicle. The graph under the icon labeled "VMT/Vehicle/Yr (OUTPUT)" shows projected annual VMT for whites, blacks, and both for 1985-95. The default output graph is given in Fig. 2.13. Formulas for calculating the values are given in Sec. 3.6.

Household Expenditures on Gasoline. The graph under the icon labeled "Real Gasoline Spending (OUTPUT)" shows projected gasoline expenditures (in 1986 dollars) for 1985-95. The default output graph is shown in Fig. 2.14. The formulas used in projecting these expenditures are given in Sec. 3.7.

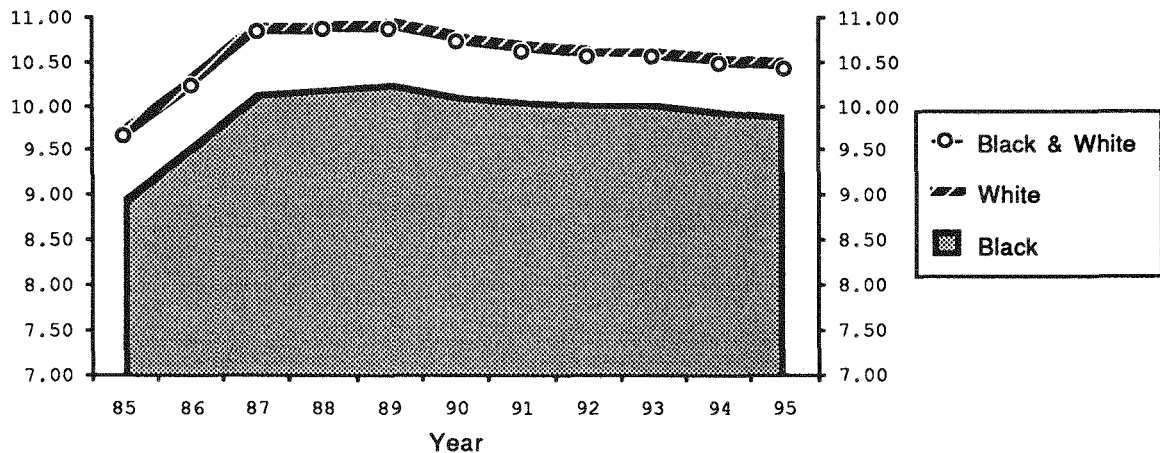


FIGURE 2.13 Default Output Graph: VMT (in thousands) per Vehicle

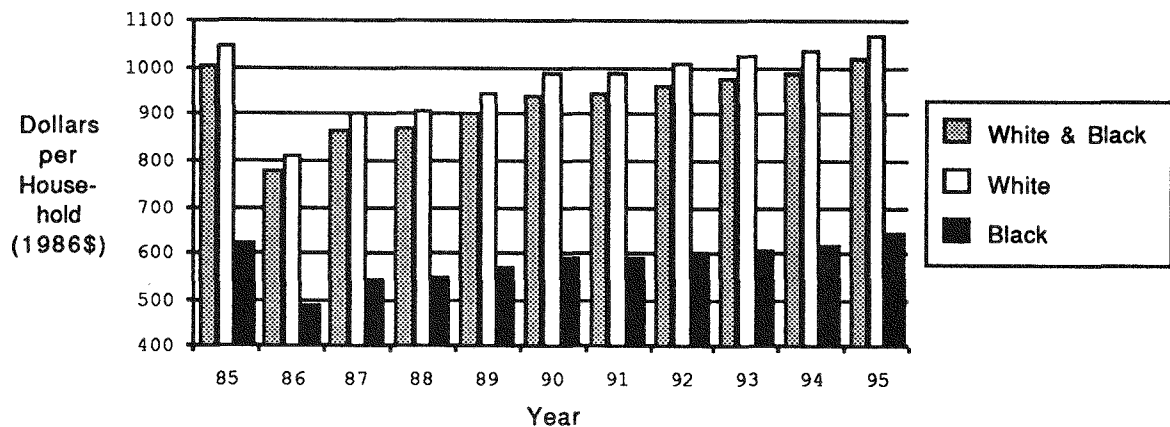


FIGURE 2.14 Default Output Graph: Household Expenditures on Gasoline

Share of Income Spent on Gasoline. The graph under the icon labeled "Share of Income to Gas (OUTPUT)" shows projections of the shares of household income devoted to gasoline by black and white households separately for 1985-95. The default output graph is shown in Fig. 2.15. The formulas used for calculating the shares of income spent on gasoline are given in Sec. 3.7.

Household Expenditures on Transit. The graph under the icon labeled "Trnst & Com Rail Spending (OUTPUT)" shows spending on public transit for 1985-95. The default output graph is given in Fig. 2.16. The formulas used are given in Sec. 3.8.

Household Expenditures on Taxis. The graph under the icon labeled "Taxi Spending (OUTPUT)" shows projected household spending on taxis for 1985-95. The default output graph is shown in Fig. 2.17. The formulas used are given in Sec. 3.9.

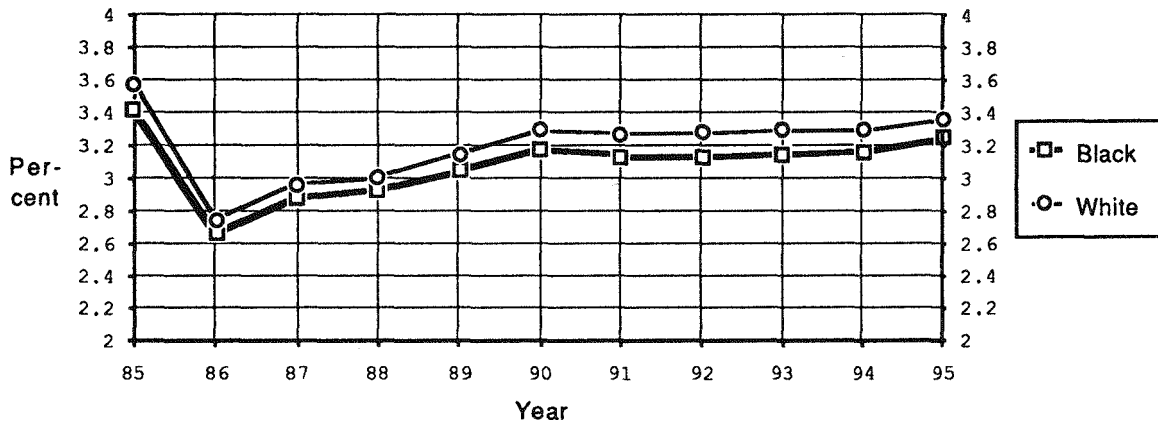


FIGURE 2.15 Default Output Graph: Share of Income Spent on Gasoline

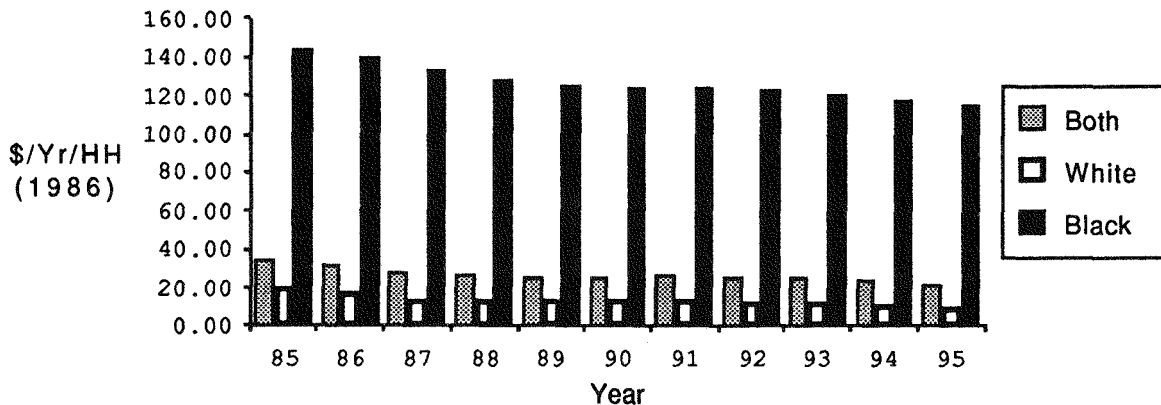


FIGURE 2.16 Default Output Graph: Household Expenditures on Public Transit

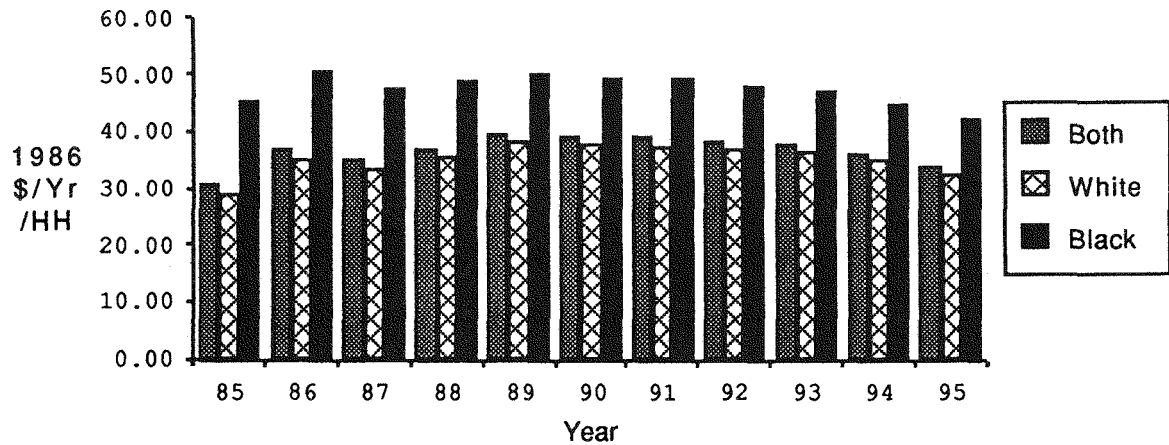


FIGURE 2.17 Default Output Graph: Household Expenditures on Taxes

Total Expenditures on Public Transportation. Total expenditures on public transportation (i.e., rail transit, buses, and taxis), is the sum of expenditures on the transit and taxi categories (see Sec. 3.10). The totals are not graphed.

Share of Income Spent on Public Transportation. The graph under the icon labeled "% Income to Public Transp. (OUTPUT)" shows the shares of income devoted to fares for public transportation. The default output graph is given in Fig. 2.18. The formulas are given in Sec. 3.11.

Share of Household Income Devoted to Personal Vehicular and Public Transportation. The graph under the icon labeled "% Income Out of Pocket (OUTPUT)" shows the share of household income devoted to gasoline, transit, and taxis. The default output graph is given in Fig. 2.19. The formulas used are given in Sec. 3.12.

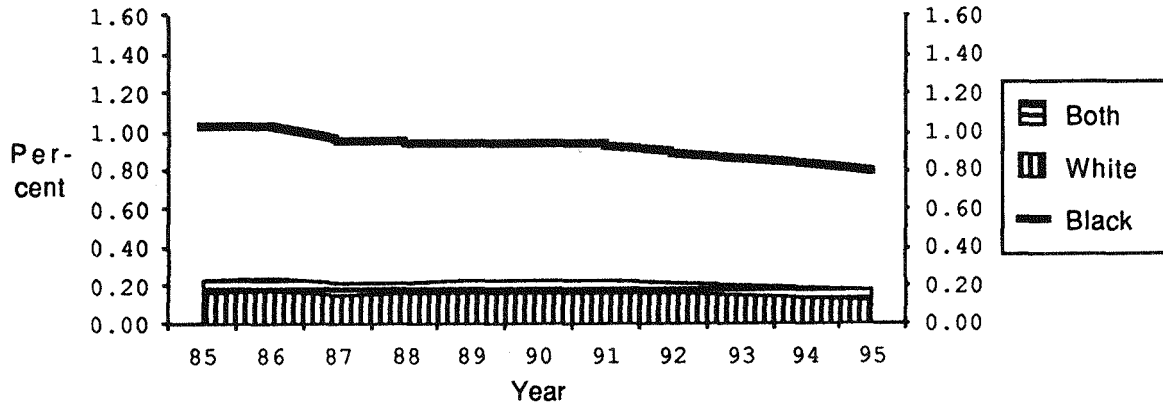


FIGURE 2.18 Default Output Graph: Share of Income Spent on Public Transportation

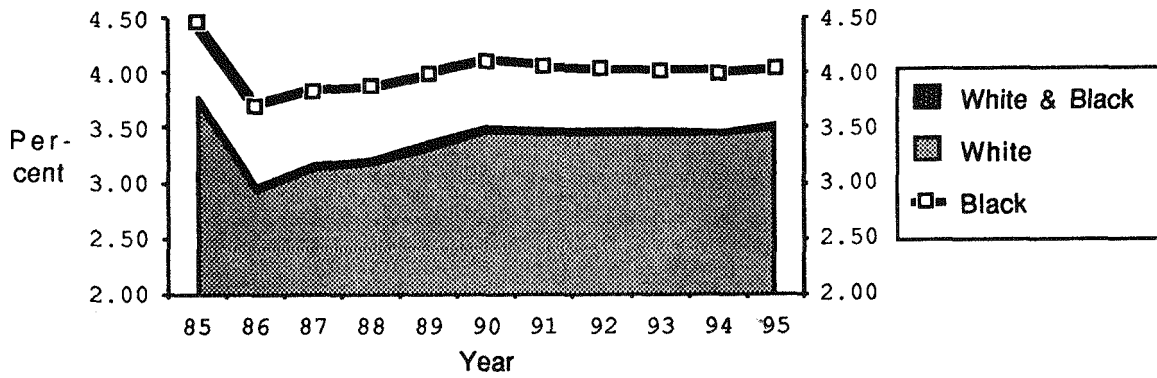


FIGURE 2.19 Default Output Graph: Share of Income Spent on Personal Vehicular and Public Transportation

3 MITRAM SUBMODELS

This section describes the structure of the MITRAM submodels and the flow of data among them. Table 2.1 can be used as a reference, if needed, regarding the acronyms used in the submodel equations below. The theoretical basis for these submodels is explained in *Theoretical Basis and Parameter Estimation for the Minority Transportation Expenditures Allocation Model (MITRAM)*, by D.J. Santini and A.D. Vyas, ANL Report ANL/ES-159.

3.1 ON-ROAD FLEET FUEL ECONOMY

Figure 3.1 shows the MITRAM submodel for estimating on-road fleet fuel economy for whites and blacks (OFFEW, OFFEB). Inputs to the submodel are:

1. Price per gallon of the most popular grade of gasoline in constant 1986 dollars (PG),
2. Effect of CAFE standards (ECAFE), and
3. Fractional change in the share of large and luxury cars (DLLC).

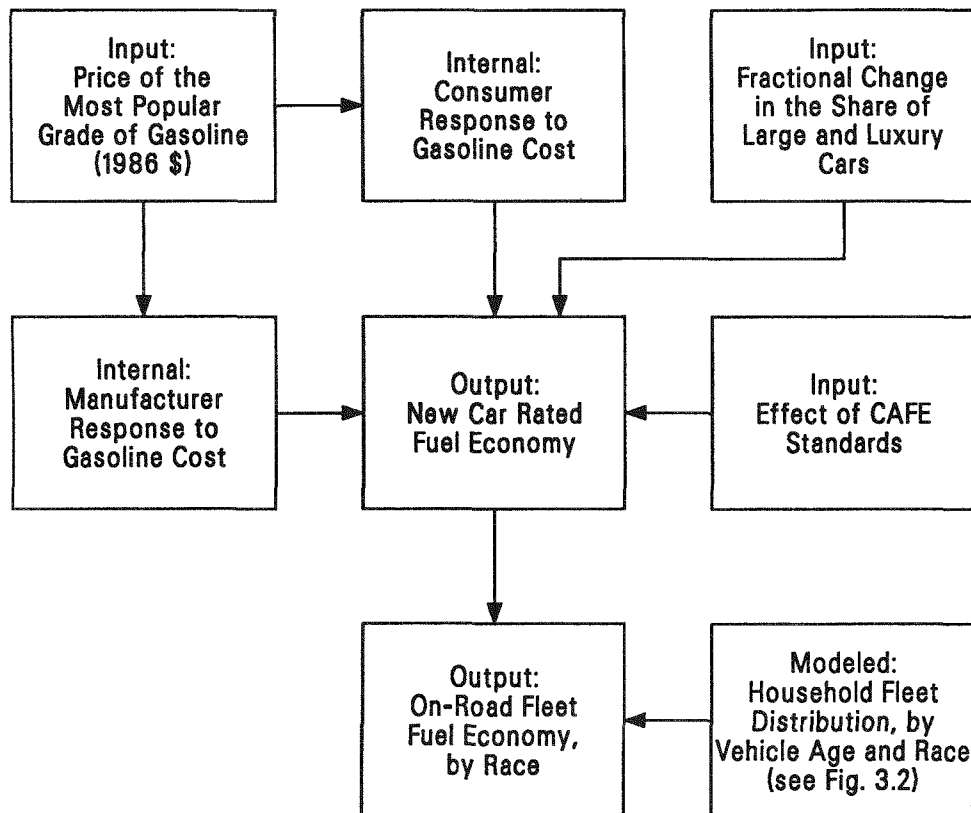


FIGURE 3.1 Submodel for Estimating On-Road Fleet Fuel Economy

The DLLC term is computed as the difference in share between the current and preceeding years, expressed as the fraction of share in the preceeding year. The ECAFE term is computed as the natural logarithm of the ratio of the current-year CAFE standard to the preceding-year CAFE standard, i.e.,

$$ECAFE = \ln \text{CAFE} / \text{CAFE}_{-1} \quad (3.1)$$

where CAFE_{-1} is the value of CAFE one year ago.* The base version of the model assumes that DLLC and ECAFE are zero over the projection period.

The submodel first computes projected new car fuel economy (NMPG) and then combines these results with those of the submodel discussed in Sec. 3.2, which computes projected distributions of household vehicle fleets by vehicle age and race. The formula used for projecting NMPG is as follows:

$$\begin{aligned} \text{NMPG} = \text{Exp} \left(0.005 + 0.301 \text{PGR2}_{-1} + 0.034 \text{RPG}_{-1}^{0.25} \right. \\ \left. - 0.321 \text{DLLC}_{-1} + 0.354 \text{ECAFE} \right) \text{NMPG}_{-1} \end{aligned} \quad (3.2)$$

where PGR2_{-1} and $\text{RPG}_{-1}^{0.25}$ are intermediate values produced by the model as follows:

$$\text{PGR2} = \ln \text{PG}_{-1} / \text{PG}_{-2} \quad (3.3)$$

$$\text{RPG}_{-1}^{0.25} = \text{resigned fourth root of } \ln \text{PG}_{-1} / \text{PG}_{-7} \quad (3.4)$$

These two intermediate values can be taken as surrogates for consumer and manufacturer responses, respectively, to past gasoline costs. Such responses influence current new car fuel economy.

The final formulas used are as follows:

$$\text{OFFEW} = 0.805 \sum_{n=0}^{25} \text{PPNW}_n \cdot \text{NMPG}_n \quad (3.5)$$

$$\text{OFFEB} = 0.799 \sum_{n=0}^{25} \text{PPNB}_n \cdot \text{NMPG}_n \quad (3.6)$$

where 0.805 and 0.799 are the on-road correction factors for whites and blacks, respectively; n is vehicle age (in years); and PPNW_n and PPNB_n are the household fleet distributions by vehicle age for white and black households, respectively.

*In this equation (and all subsequent ones in this report), a subscript indicates the number of years by which the value of the variable is lagged.

3.2 HOUSEHOLD VEHICLE FLEET DISTRIBUTION BY VEHICLE AGE AND RACE

Figure 3.2 shows the submodel for computing average vehicle age for white and black households (VAW, VAB) and the fraction of the white and black household vehicle fleets represented by vehicles of different ages (PPNWn, PPNBn).

The average household vehicle age is computed from input values for income (YHW, YHB) and from the used-car price index (CUCI), which is produced by the submodel discussed in Sec. 3.4. The equation is as follows:

$$VAr = 100(0.822 \text{ CUCI/YHr})^{0.5} \quad (3.7)$$

where r represents W for whites and B for blacks. This equation was developed through the analysis of national time series data and then validated using the 1977 and 1983 NPTS and the 1985 RTECS. The factor of 0.822 was applied to convert mean income to median income and to convert income in 1986 dollars to income in 1983 dollars.

The composition of the household fleet is represented by a chi-square probability distribution with a mean equal to VAr, i.e.,

$$PPNr(n) = \frac{n^{(VAr-2)/2} e^{-n/2}}{2^{VAr/2} \Gamma(VAr/2)} = \frac{n^{(2a-2)/2} e^{-n/2}}{2^a \Gamma(a)} \quad (3.8)$$

where $a = VAr/2$ and the gamma function (Γ) is approximated using Stirling's asymptotic series:

$$\Gamma(a) = a^a e^{-a} [(2\pi/a)^{0.5}] \left(1 + \frac{1}{12a} + \frac{1}{288a^2} - \frac{139}{51840a^3} - \frac{571}{2488320a^4} + \dots \right) \quad (3.9)$$

The values produced for $PPNr(n)$ are used in the submodel described in Sec. 3.1.

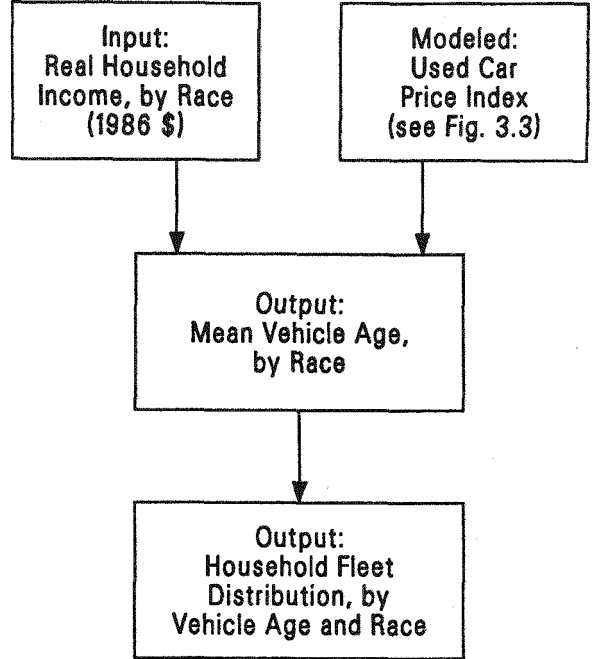


FIGURE 3.2 Submodel for Estimating Household Fleet Distribution by Vehicle Age and Race

3.3 WORKERS PER CAPITA

Figure 3.3 shows the submodel for computing projected workers per capita (WCW, WCB, WCWB), along with the submodel for computing new and used car price indexes, which is discussed in Sec. 3.4. Inputs to the worker submodel are:

1. Population (POPW, POPB),
2. Unemployment rate (UER), and
3. Year of projection (YR).

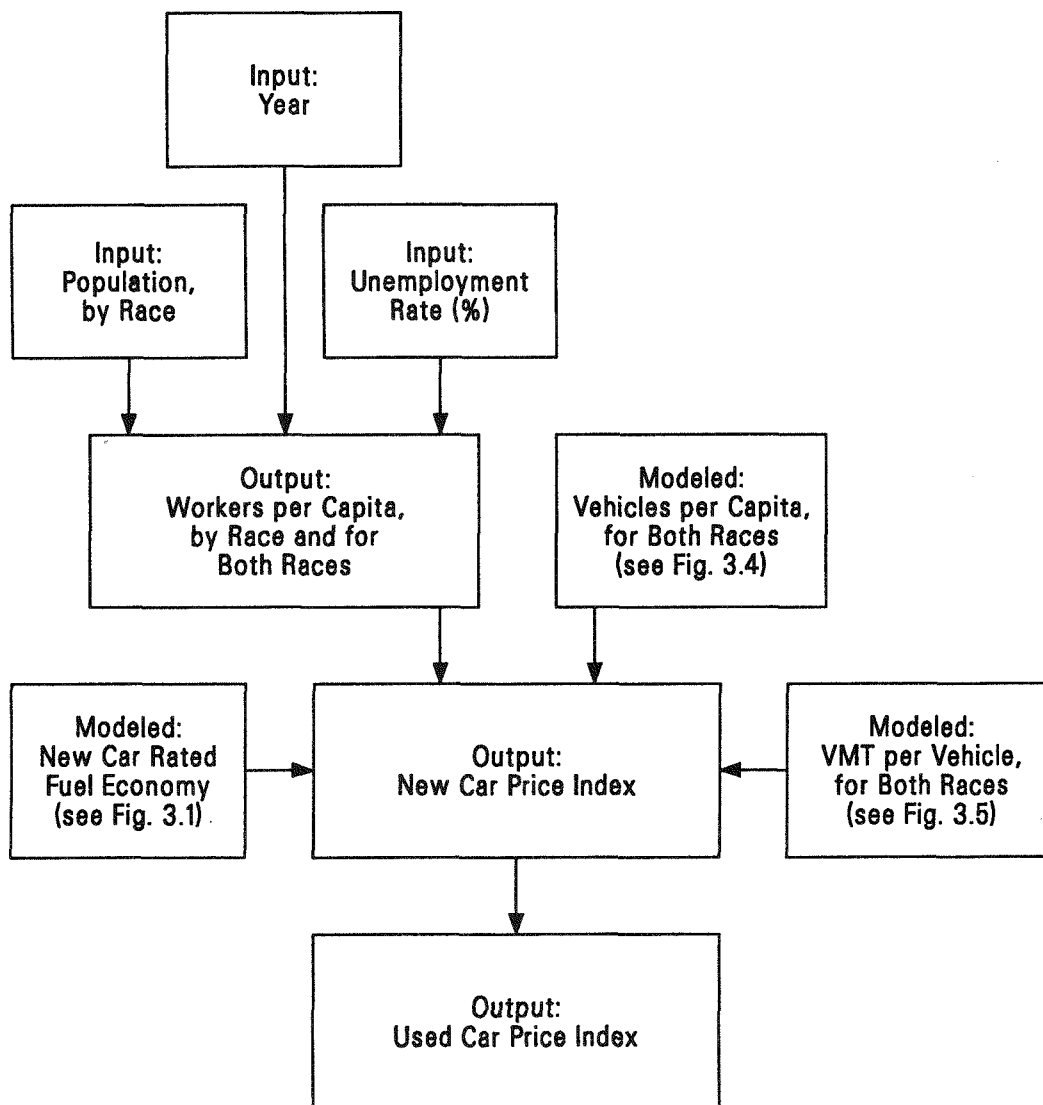


FIGURE 3.3 Submodels for Estimating Workers per Capita and New and Used Car Prices

The equations for projecting workers per capita incorporate past race-specific rates of employment and the national unemployment rate:

$$WCW = 0.01(15.588 + 0.439 \text{ YR} - 0.419 \text{ UER}) \quad (3.10)$$

$$WCB = 0.01(14.06 + 0.333 \text{ YR} - 0.845 \text{ UER}) \quad (3.11)$$

The combined number of black and white workers per capita (WCWB) is obtained as follows:

$$WCWB = \frac{(WCW \cdot POPW) + (WCB \cdot POPB)}{POPW + POPB} \quad (3.12)$$

3.4 NEW AND USED CAR PRICE INDEXES

The submodel for projecting new and used car price indexes (CMNCI and CUCI, respectively) is also shown in Fig. 3.3. These indexes are computed using lagged values produced by other submodels for the following:

1. New car fuel economy (NMPG), explained in Sec. 3.1,
2. Workers per capita for both whites and blacks (WCWB), explained in Sec. 3.3,
3. Vehicles per capita for both whites and blacks (VCWB), explained in Sec. 3.5, and
4. VMT per vehicle for both whites and blacks (MVWB), explained in Sec. 3.6.

The equations are as follows:

$$\begin{aligned} CMNCI = CMNCI_{-1} & \left[0.022 - 1.784 \ln (VCWB_{-1}/VCWB_{-2}) \right. \\ & - 0.394 \ln (MVWB_{-1}/MVWB_{-2}) \\ & \left. + 0.009(NMPG_{-1} - NMPG_{-3}) + 1 \right] \end{aligned} \quad (3.13)$$

$$CUCI = CUCI_{-2} \left[0.919 \ln (CMNCI/CMNCI_{-2}) + 1 \right] \quad (3.14)$$

3.5 VEHICLES PER CAPITA

Figure 3.4 shows the submodel for computing vehicle ownership (VCW, VCB, VCWB). Three input variables are used:

1. Household income (YHW, YHB),
2. Household size (SHW, SHB), and
3. Urban consumer price index (CPIU).

Outputs of three submodels are also used:

1. Workers per capita (WCW, WCB), explained in Sec. 3.3,
2. Lagged value of the new car price index (CMNCI), explained in Sec. 3.4, and
3. Share of income on transit (TRW, TRB), explained in Sec. 3.8.

The equations are as follows:

$$VCW = [-0.567 + 0.61(\ln 0.9014 YHW - \ln 1588) + (0.45 WCW \cdot SHW) - 0.155(CMNCI_{-1}/124.02) - 0.00207 TRW]/SHW \quad (3.15)$$

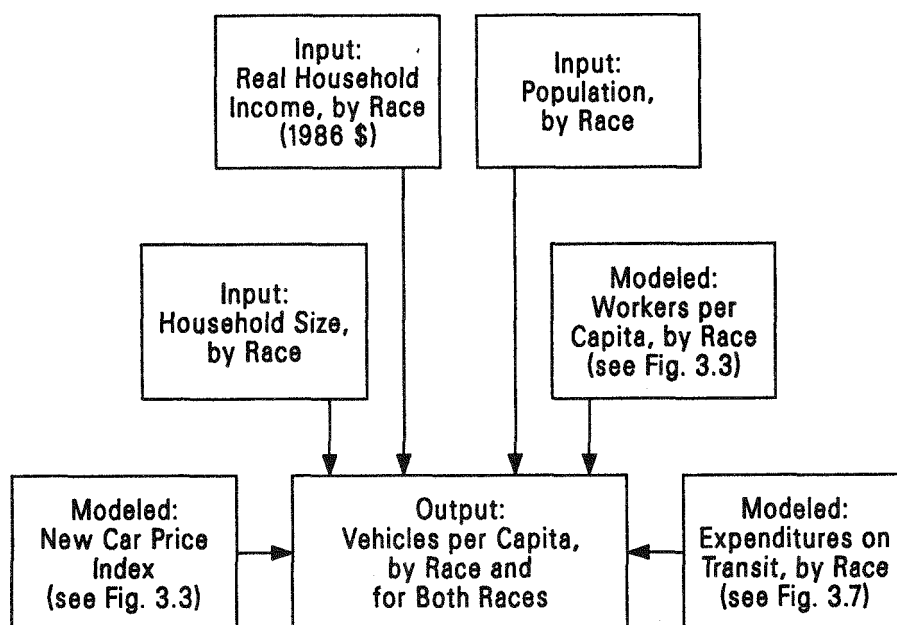


FIGURE 3.4 Submodel for Computing Vehicles per Capita

$$VCB = [-0.228 + 0.52(\ln 0.9014 \text{ YHB} - \ln 1588) + (0.32 \text{ WCB} \cdot \text{SHB}) - 0.555(\text{CMNCI}_{-1}/124.02) - 0.00207 \text{ TRB}] / \text{SHB} \quad (3.16)$$

The value of 124.02 represents the 1983 value of CMNCI, and the value of 0.9014 is an income conversion factor to the year 1983.

Combined vehicle ownership for whites and blacks is derived using population projections (POPW, POPB), as follows:

$$\text{VCWB} = \frac{(\text{VCW} \cdot \text{POPW}) + (\text{VCB} \cdot \text{POPB})}{\text{POPW} + \text{POPB}} \quad (3.17)$$

3.6 VEHICLE-MILES OF TRAVEL PER VEHICLE

Figure 3.5 shows the submodel for estimating VMT per vehicle. Two submodels are actually used: STOCK and FLOW. Each is used to project annual VMT per vehicle for whites, blacks, and both (MVW, MVB, MVWB); the values are then averaged for the final projections.

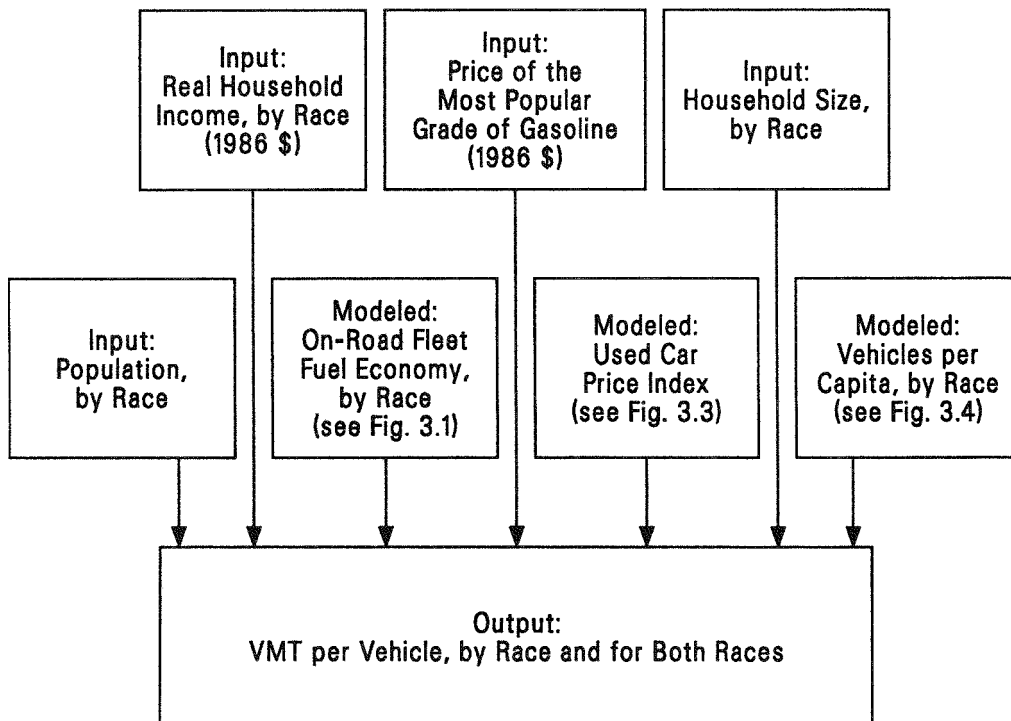


FIGURE 3.5 Submodel for Estimating VMT per Vehicle (STOCK model)

The STOCK model, which is the model shown in Fig. 3.5, uses three input variables:

1. Price of the most popular grade of gasoline (PG),
2. Household income (YHW, YHB), and
3. Household size (SHW, SHB).

Three modeled variables are also used:

1. Used-car price index (CUCI), explained in Sec. 3.4,
2. On-road fleet fuel economy (OFFEW, OFFEB), explained in Sec. 3.1, and
3. Vehicles per capita (VCW, VCB), explained in Sec. 3.5.

The basic STOCK model equation is as follows:

$$\begin{aligned} MV_r = & 12.79 - 0.343 \cdot 0.9014 \frac{PG}{OFFEr} - 0.49 \ln \frac{PG}{PG_{-2}} \\ & - \frac{2.07}{115.47} \frac{CUCI}{SHr} + 0.11 \cdot 0.9014 \frac{0.001 YHr}{SHr} \end{aligned} \quad (3.18)$$

where r represents W for whites and B for blacks. The 0.9014 term in these equations converts 1986 dollars to 1983 dollars, and the 115.47 term represents the 1983 value of CUCI.

The combined total is derived as follows:

$$MVWB = \frac{(POPW \cdot VCW \cdot MVW) + (POPB \cdot VCB \cdot MVB)}{(POPW \cdot VCW) + (POPB \cdot VCB)} \quad (3.19)$$

The FLOW model computes current annual VMT per vehicle by first computing the rate of change in annual VMT using the used car price index and per-mile gasoline costs, and then applying this rate to the preceeding-year VMT per vehicle. The basic equation is as follows:

$$\begin{aligned} MV_r = & MV_{r-1} \left\{ -0.001 - 0.103 \ln CUCI/CUCI_{-2} \right. \\ & \left. - 0.321 \ln \left[(PG_{-1}/OFFEr_{-1}) / (PG_{-2}/OFFEr_{-2}) \right] + 1 \right\} \end{aligned} \quad (3.20)$$

where r represents W for whites and B for blacks. Derivation of the combined total is the same as in Eq. 3.19.

3.7 AMOUNT AND SHARE OF HOUSEHOLD INCOME SPENT ON GASOLINE

Figure 3.6 shows the submodel for estimating expenditures on gasoline (EGW, EGB) and their share of household income (EGPYW, EGPYB). For the first, the following input variables are used:

1. Household size (SHW, SHB), and
2. Sales-weighted cost of all gasoline in 1986 dollars (G).

Three modeled variables are also used:

1. On-road fleet fuel economy (OFFEW, OFFEB), explained in Sec. 3.1,
2. Vehicles per capita (VCW, VCB), explained in Sec. 3.5, and
3. VMT (in thousands) per vehicle (MVW, MVB), explained in Sec. 3.6.

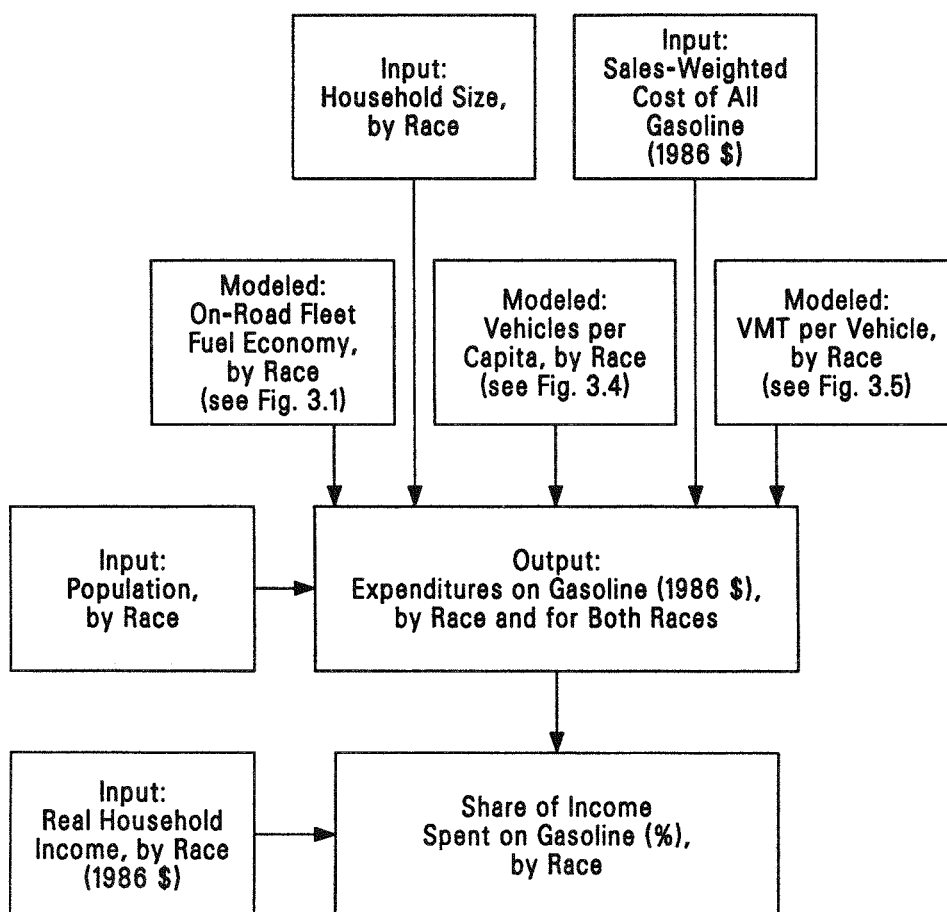


FIGURE 3.6 Submodel for Estimating Gasoline Expenditures and Their Share of Household Income

The basic equation is as follows:

$$EGr = 1000 \frac{MV_r \cdot VCr \cdot SH_r \cdot G}{OFFEr} \quad (3.21)$$

where r represents W for whites and B for blacks. The results are combined with household income (YHW , YHB) to arrive at the share of income spent on gasoline:

$$EGPY_r = \frac{100 \ EGr}{YH_r} \quad (3.22)$$

3.8 HOUSEHOLD EXPENDITURES ON PUBLIC TRANSIT

Figure 3.7 shows the submodel for estimating expenditures on public transit (TRW , TRB , $TRWB$). The following input variables and modeled variables are used:

1. Lagged value of the price of the most popular grade of gasoline (PG),

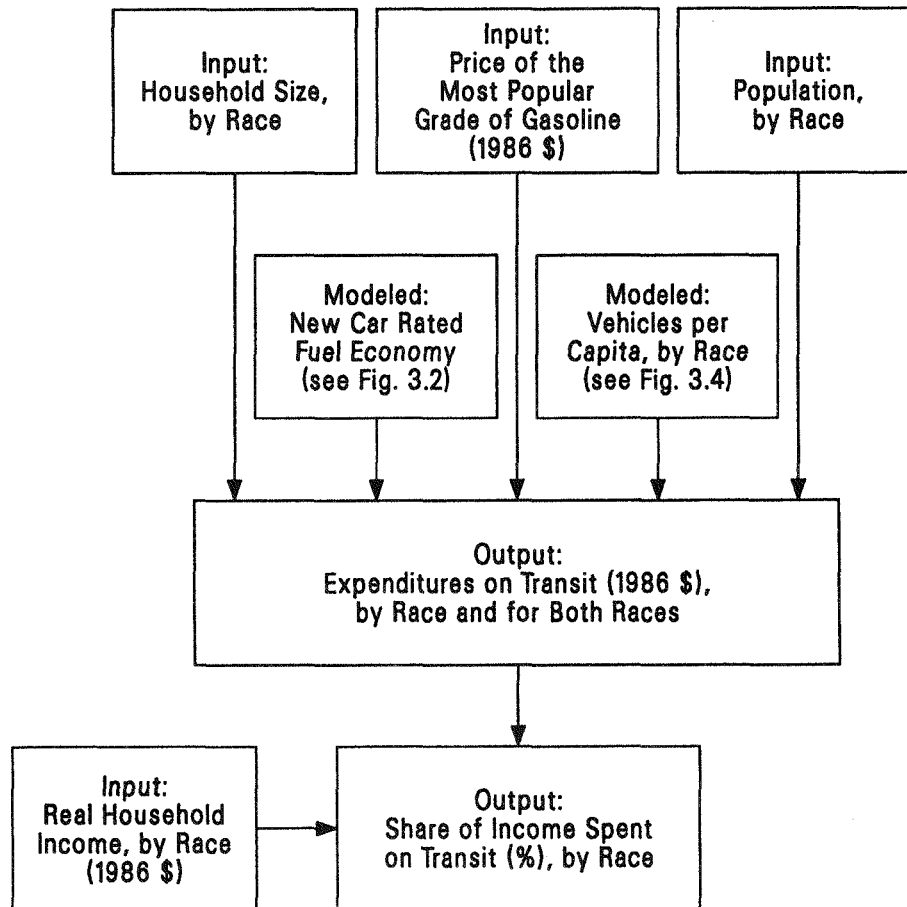


FIGURE 3.7 Submodel for Estimating Household Expenditures on Public Transit

2. Lagged value for new-car rated fuel economy (NMPG), discussed in Sec. 3.1, and
3. Vehicles per capita (VCW, VCB), discussed in Sec. 3.5.

Expenditures by race are calculated as follows:

$$\begin{aligned} \text{TRW} = & \left[-43.11 + (42.35/\text{VCW}) + 0.901(0.063 \text{ PG}_{-1}) \right. \\ & \left. - 0.73 \text{ NMPG}_{-1} \right] / 0.874 \end{aligned} \quad (3.23)$$

$$\begin{aligned} \text{TRB} = & \left[-8.55 + (42.35/\text{VCB}) + 0.901(0.063 \text{ PG}_{-1}) \right. \\ & \left. - 0.73 \text{ NMPG}_{-1} \right] / 0.874 \end{aligned} \quad (3.24)$$

The 0.901 term is used to convert prices in 1986 dollars to 1983 dollars. Combined spending for blacks and whites is derived by using projections for household size (SHW, SHB) and population (POPW, POPB), as follows:

$$\text{TRWB} = \frac{\text{TRW} (\text{POPW}/\text{SHW}) + \text{TRB} (\text{POPB}/\text{SHB})}{\text{POPW}/\text{SHW} + \text{POPB}/\text{SHB}} \quad (3.25)$$

3.9 HOUSEHOLD EXPENDITURES ON TAXIS

Figure 3.8 shows the submodel for estimating household expenditures on taxis (TXW, TXB, TXWB). The following input and modeled variables are used:

1. One-year lagged input value for the price of the most popular grade of gasoline (PG),
2. One-year lagged value for the new-car price index (CMNCI), discussed in Sec. 3.4,
3. Workers per capita (WCW, WCB), discussed in Sec. 3.3, and
4. Vehicles per capita (VCW, VCB), discussed in Sec. 3.6.

The general equation for TXW and TXB is as follows:

$$\begin{aligned} \text{TXr} = & \left[80.23 \text{ WCr}/\text{VCr} + 120.0 \text{ WCr} - 0.24(0.901 \text{ PG}_{-1}) \right. \\ & \left. - (0.91 \text{ NMPG}_{-1}) - 55.04 \text{ CMNCI}_{-1}/124.02 \right] / 0.901 \end{aligned} \quad (3.26)$$

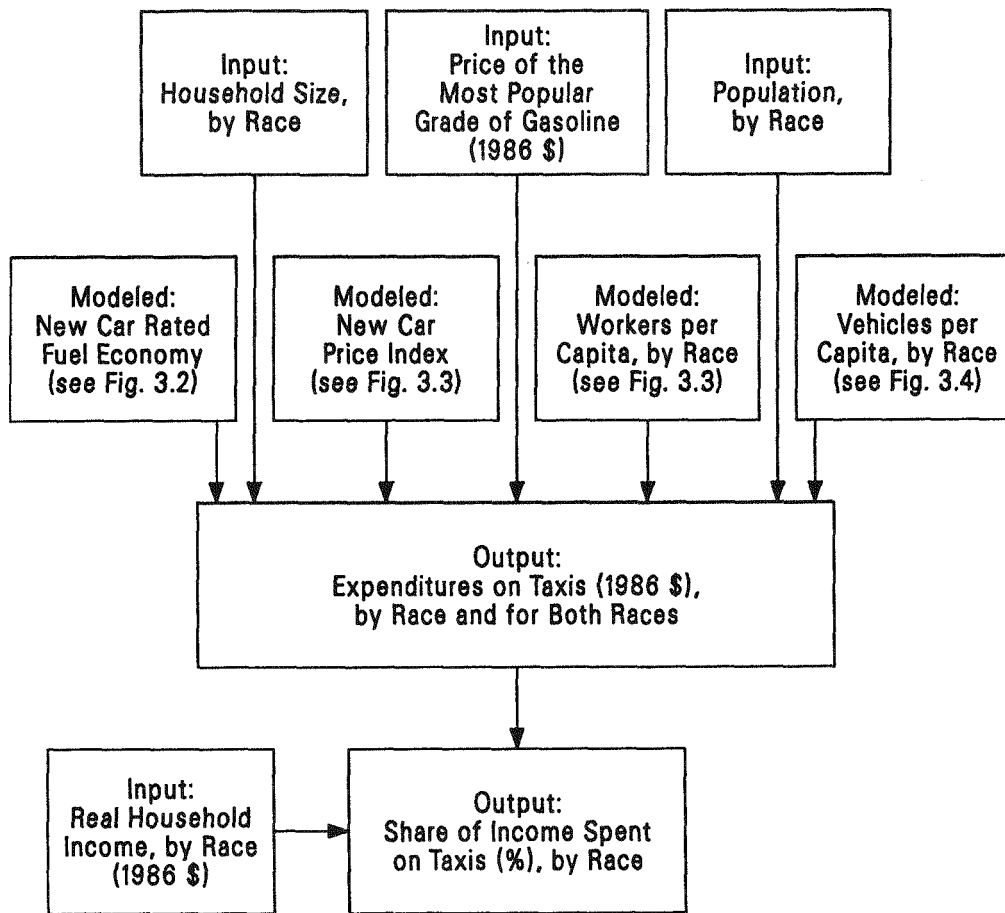


FIGURE 3.8 Submodel for Estimating Household Expenditures on Taxis

where r represents W for whites and B for blacks. The combined total is derived using projections of household size (SHW , SHB) and population ($POPW$, $POPB$), as follows:

$$TXWB = \frac{TXW (POPW/SHW) + TXB (POPB/SHB)}{POPW/SHW + POPB/SHB} \quad (3.27)$$

3.10 TOTAL EXPENDITURES ON PUBLIC TRANSPORTATION

Total spending on public transportation (i.e., rail transit, buses, and taxis) by race is the sum of spending on transit and taxis, i.e., $TR_r + TX_r$, where r represents W for whites and B for blacks. Total spending for both races is likewise the sum of their combined spending on transit and taxis, i.e., $TR_{WB} + TX_{WB}$.

3.11 SHARE OF HOUSEHOLD INCOME SPENT ON PUBLIC TRANSPORTATION

The share of household income, by race, devoted to fares for public transportation ($PTY\%W$, $PTY\%B$) is the sum of the expenditures on the transit (TR_r) and

taxi (TX_r) categories divided by real household income (YHW, YHB). The general formula is as follows:

$$PTY\%_r = \frac{100(TR_r + TX_r)}{YH_r} \quad (3.28)$$

where r represents W for whites and B for blacks. The combined share of income (PTY%WB) is derived using projections for household size (SHW, SHB) and population (POPW, POPB), as follows:

$$PTY\%WB = \frac{100(TXWB + TRWB) (POPW/SHW + POPB/SHB)}{YHW (POPW/SHW) + YHB (POPB/SHB)} \quad (3.29)$$

3.12 SHARE OF HOUSEHOLD INCOME SPENT ON PERSONAL VEHICULAR AND PUBLIC TRANSPORTATION

The share of household income spent on gasoline and public transportation by race (TY%_r) is the sum of the shares spent on these categories separately, i.e., EGPY_r + PTY%_r, where r represents W for whites and B for blacks. The combined share for blacks and whites (TY%WB) is likewise the sum of the combined shares for each category, i.e., EGPYWB + PTY%WB.

4 CLOSING

This user manual presents a set of instructions and descriptions that should allow a user to generate estimates of various out-of-pocket transportation expenditures for black and white households, given a set of projections of key characteristics of those households and an accompanying projection of gasoline prices. While attempts have been made in the development of parameters for the model to ultimately allow the model to create valid estimates of transportation spending for low- and high-income households, the model is now calibrated on characteristics of average U.S. white, black, and total households. Accordingly, it can be expected to provide only reasonable estimates for average households. The user should also recognize that the model is calibrated on historical values. Thus, values of input variables far out of the historical range may well give theoretically impossible results, such as negative public transportation spending. Further, in some cases the model continues recent trends that may lead, over a number of projection years, to unreasonable results.

Where trends exist, it is often a matter of judgment by a modeler to estimate how long they will continue and how pronounced they will remain in the future. The model structure has not been developed so as to rule out nonsense results if unusual inputs are included. The most valid use of the model is expected to be as a basis for comparing the expenditure effects of alternative tax and or subsidy policies for public transportation and/or gasoline and crude oil, under baseline assumptions of historically normal growth in incomes and employment, as well as real gasoline prices within the bounds occurring during 1981-86.

The statistical analyses that established the parameters in the model, together with a critical discussion of what the model does and does not do in its current form, can be found in *Theoretical Basis and Parameter Estimation for the Minority Transportation Expenditure Allocation Model (MITRAM)*, by D.J. Santini and A.D. Vyas, cited at the beginning of Sec. 3.

**DO NOT MICROFILM
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BASE MODEL PRINTOUT

	Q	R	S	T	U	V	W	X	Y	Z
1			Relative cost		Change in	CPIu&MI		CPIu&MI	CPIu	
2			of leaded		gasoline	Combined New		Relative New	Relative Used	
3			gasoline in	CPIu	cost	Car Price		Car Price	Car Price	
4			1986 cents	(78=100)		Index	Year	Index	Index	
5			per gallon	34.2				47	(with mix	(1978=100)
6				36.9				48	shift for the	
7				36.5				49	74-85	
8			122.89	36.9				50	period)	
9			115.54	39.8	-0.0598			51	1978=100	
10			113.95	40.7	-0.0138			52		
11			118.59	41.0	0.0408			53		
12			119.44	41.2	0.0072			54		
13			120.01	41.0	0.0048	56.31		55	137.18	
14			121.74	41.7	0.0144	57.98		56	139.18	
15			121.60	43.1	-0.0012	59.65		57	138.26	
16			116.15	44.3	-0.0448	61.39		58	138.51	
17			115.64	44.7	-0.0044	63.06		59	141.14	
18			116.20	45.4	0.0049	64.73		60	142.60	98.73
19			113.67	45.9	-0.0218	64.54		61	140.76	102.55
20			111.97	46.4	-0.0149	64.30		62	138.67	106.25
21			109.84	46.9	-0.0191	64.11		63	136.61	109.72
22			108.17	47.5	-0.0152	63.92		64	134.46	112.85
23			109.14	48.4	0.0090	62.50		65	129.23	110.19
24			109.28	49.7	0.0012	61.39		66	123.40	104.51
25			109.79	51.2	0.0047	61.94		67	121.04	104.75
26			107.11	53.3	-0.0244	63.68		68	119.41	102.08
27			105.06	56.2	-0.0192	64.67		69	115.08	98.38
28			101.61	59.5	-0.0329	66.65		70	111.98	93.98
29			99.44	62.1	-0.0213	69.38		71	111.76	95.14
30			95.47	64.1	-0.0399	68.76		72	107.22	92.36
31			96.57	68.1	0.0115	68.82		73	101.03	92.59
32			117.49	75.6	0.2166	76.26		74	100.89	86.92
33			117.53	82.5	0.0003	85.60		75	103.76	95.14
34			115.49	87.3	-0.0174	89.99		76	103.14	103.13
35			115.05	92.9	-0.0037	93.71		77	100.89	105.56
36			111.34	100.0	-0.0323	100.00		78	100.00	100
37			133.70	111.3	0.2008	104.86		79	94.25	96.88
38			159.78	126.3	0.1950	119.10		80	94.29	88.31
39			159.41	139.4	-0.0023	143.14		81	102.71	98.84
40			139.95	148.0	-0.1221	167.66		82	113.32	107.41
41			128.38	152.7	-0.0827	189.39		83	124.02	115.74
42	White	Black	120.16	159.2	-0.0640	192.63		84	120.99	126.50
43	29356	18268	114.58	164.9	-0.0464	201.55		New Car	Used Car	Gas
44	29614	18429	85.70	169.4	-0.2521	206.50	85	122.23	123.50	122.67
45	30444	18946	87.25	174.2	0.0181	209.73	86	121.90	127.38	93.11
46	30158	18768	90.20	183.3	0.0339	208.12	87	120.20	121.59	100.12
47	29987	18660	95.33	193.1	0.0568	219.72	88	113.54	119.06	103.51
48	29948	18646	102.15	203.4	0.0716	233.25	89	113.79	115.47	109.39
49	30291	18850	104.09	213.0	0.0189	248.23	90	114.68	120.15	117.22
50	30759	19142	106.27	223.6	0.0210	262.85	91	116.55	118.01	119.44
51	31145	19381	108.56	235.1	0.0216	278.33	92	117.56	122.89	121.95
52	31539	19627	110.81	247.6	0.0207	296.41	93	118.39	119.71	124.58
53	31932	19872	115.50	261.9	0.0423	320.21	94	119.72	124.95	127.16
54							95	122.27	123.26	132.54
55										
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	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
1	Vehicles/					VMT/Vehicle					Workers/
2	person					(*1000)					Person
3											(military &
4											civilian)
5											
6											
7											
8	0.2659										0.4101
9	0.2767										0.4019
10	0.2791										0.3958
11	0.2909										0.3948
12	0.2984										0.3919
13	0.3155										0.3934
14	0.3223										0.3957
15	0.3264										0.3907
16	0.3268										0.3885
17	0.3357										0.3886
18	0.3411										0.3851
19	0.3452					9.45					0.3836
20	0.3542					9.47					0.3784
21	0.3647					9.44					0.3795
22	0.3752					9.24					0.3809
23	0.3873					9.29					0.3832
24	0.3974					9.39					0.3854
25	0.4044					9.51					0.3891
26	0.4166			NPTS sample vehicles per		9.53					0.3923
27	0.4285			person		9.63					0.3983
28	0.4351			White	Black	9.78					0.4036
29	0.4464		1977	0.6120	0.3140	9.98					0.4063
30	0.4625		1983	0.6750	0.3310	10.12					0.4146
31	0.4813		Population, 80	188372	26495	10.18					0.4222
32	0.4902		Mean =	1977	0.5753	9.99					0.4299
33	0.4941		national proxy	1983	0.6326	9.45					0.4341
34	0.5055		Ratio to national	for whites	1.065	9.63					0.4411
35	0.5161		value	for blacks	0.535	9.76					0.4494
36	0.5237		Note: the NPTS sample excluded retirees			9.84					0.4593
37	0.5262					10.05					0.4663
38	0.5343					9.48					0.4694
39	0.5363		Vehicle Holding Projections			9.14					0.4721
40	0.5320		Vehicles per person			9.00					0.474
41	0.5397		Black & White	White	Black	9.53		VMT per Vehicle			0.4751
42	0.5405		0.5405	0.5759	0.2889	9.65		Black & White	White	Black	0.4789
43	0.5510	85	0.5509	0.5874	0.2945	9.79	85	9.67	9.72	8.96	0.4825
44		86	0.5575	0.5944	0.3003		86	10.22	10.27	9.55	0.5015
45		87	0.5712	0.6086	0.3126		87	10.84	10.89	10.14	0.4842
46		88	0.5738	0.6113	0.3170		88	10.86	10.91	10.20	
47		89	0.5772	0.6149	0.3214		89	10.88	10.93	10.25	
48		90	0.5797	0.6178	0.3232		90	10.72	10.77	10.12	
49		91	0.5852	0.6238	0.3273		91	10.63	10.68	10.06	
50		92	0.5906	0.6294	0.3327		92	10.57	10.61	10.02	
51		93	0.5964	0.6357	0.3378		93	10.56	10.60	10.02	
52		94	0.6033	0.6431	0.3436		94	10.47	10.52	9.95	
53		95	0.6102	0.6504	0.3495		95	10.43	10.47	9.90	
54											
55							85	9.67	9.72	8.96	
56							86	10.30	10.34	9.66	
57							87	10.45	10.49	9.82	
58						Stock	88	10.32	10.37	9.72	
59						Model	89	10.32	10.36	9.74	
60							90	10.13	10.18	9.56	
61							91	10.20	10.24	9.63	
62							92	10.13	10.17	9.57	
63							93	10.18	10.23	9.63	
64							94	10.09	10.13	9.52	
65							95	10.08	10.13	9.51	
66											
67							85	9.67	9.72	8.96	
68							86	10.14	10.19	9.44	
69							87	11.23	11.29	10.47	
70						Flow	88	11.41	11.46	10.68	
71						Model	89	11.45	11.50	10.76	
72							90	11.31	11.36	10.68	
73							91	11.07	11.12	10.48	
74							92	11.01	11.06	10.47	
75							93	10.93	10.97	10.42	
76							94	10.86	10.90	10.37	
77							95	10.77	10.81	10.29	

	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW
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18												
19												
20												
21												
22												
23												
24												
25												
26			NPTS sample	workers per								
27			person									
28			White	Black								
29	1977		0.4083	0.3110								
30	1983		0.4927	0.3412								
31	Population, 80		188372	26495								
32	Mean =		1977	0.3963								
33	national proxy		1983	0.4740								
34	Ratio to national		for whites	1.035								
35	value		for blacks	0.752								
36	Note: the NPTS sample excluded retirees											
37												
38	Black&White		White	Black			1986 Dollars Spent on Gasoline (per hh)			Share of income spent on gasoline(%)		
39	workers		workers	workers	Nat		White&	White	Black	White&		Black
40	per Person		per Person	per Person	Un		Black			Black		
41		84	0.4956	0.3603	Rate							
42	0.4789		White	Black	Unemp		White & Black	White	Black			Black
43	0.4824	85	0.4993	0.3637	7.10	85	1005	1052	627	3.571	85	3.430
44	0.4870	86	0.5041	0.3678	7.00	86	779	815	492	2.746	86	2.669
45	0.4935	87	0.5106	0.3754	6.50	87	865	905	547	2.960	87	2.889
46	0.4976	88	0.5150	0.3787	6.50	88	869	910	551	3.011	88	2.936
47	0.5008	89	0.5185	0.3804	6.70	89	903	946	569	3.148	89	3.050
48	0.5049	90	0.5229	0.3837	6.70	90	943	988	593	3.290	90	3.179
49	0.5100	91	0.5281	0.3887	6.50	91	945	992	591	3.263	91	3.134
50	0.5151	92	0.5334	0.3937	6.30	92	982	1010	600	3.271	92	3.137
51	0.5192	93	0.5378	0.3971	6.30	93	979	1028	611	3.289	93	3.153
52	0.5238	94	0.5426	0.4012	6.20	94	991	1040	622	3.288	94	3.17

[illegible]

	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS
1											
2											resigned{4th
3											root absolute
4											fln(G-1/G-7
5											
6											
7											
8											
9											
10											
11											
12											0.43621
13											0.265920
14											-0.431130
15											-0.311110
16											0.475401
17											0.372046
18											-0.398525
19											-0.407242
20											-0.482777
21											-0.537769
22											-0.564767
23											-0.516580
24											-0.490395
25											-0.497887
26											-0.431556
27											-0.458957
28											-0.459222
29											-0.500151
30											-0.552362
31											-0.606210
32											-0.598535
33											0.551386
34											0.578698
35											0.598185
36											0.617998
37											0.626227
38	pent on Public Transp. (per hh)			Percent of HH Income Spent on Public Transp.				Percent of out of pocket Income Spent on Transportation			0.755259
39	White	Black		White&	White	Black		White&	White	Black	0.744648
40				Black				Black			0.743025
41											0.662079
42	White	Black		Both	White	Black		White & Black	White	Black	0.575346
43	50.38	189.72	85	0.23	0.17	1.04	85	3.80	3.75	4.47	0.525374
44	53.86	190.85	86	0.24	0.18	1.04	86	2.99	2.93	3.70	-0.626803
45	48.08	181.70	87	0.22	0.16	0.96	87	3.18	3.13	3.85	-0.888411
46	49.52	177.68	88	0.22	0.16	0.95	88	3.23	3.18	3.88	-0.881103
47	51.95	176.98	89	0.23	0.17	0.95	89	3.38	3.33	4.00	-0.814095
48	51.54	174.87	90	0.23	0.17	0.94	90	3.52	3.47	4.12	-0.738639
49	51.60	174.45	91	0.23	0.17	0.93	91	3.49	3.44	4.06	-0.634771
50	50.08	171.34	92	0.22	0.16	0.90	92	3.49	3.44	4.03	-0.556716
51	49.33	168.16	93	0.21	0.16	0.87	93	3.50	3.46	4.02	0.681067
52	46.53	163.36	94	0.20	0.15	0.83	94	3.49	3.45	4.00	0.683757
53	42.72	157.38	95	0.18	0.13	0.79	95	3.54	3.49	4.04	0.6

	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD
1		Change in	Effect of Cafe	Year	Rated New Car	Estimated	Relative cost		White	Black	Mean Vehicle
2		share of	Standard	for	MPG	Rated MPG	of leaded		On-road	On-road	Age Estimate
3		large and		Cols	(MVMA	of the Fleet	gasoline in		Fleet	Fleet	For Blacks
4	1}	luxury cars	ln(Cafe/Cafe-	BX +	Domestic	of Vehicles	1986 cents	Year	Fuel	Fuel	(CF33-
5		(MVMA,		4.7	Fleet	Held by Whites	per gallon	4.7	Economy	Economy	CF43)
6	ln(G-1/G-2)	no data before		4.8	1974/86)	(Estimated for		4.8			and Whites
7		1970)		4.9		1965-84 by		4.9			(CF44-
8				5.0	16	methods used	123	5.0			CF54)
9				5.1	16	here for 1985	116	5.1			
10				5.2	16	through 1995	114	5.2			
11				5.3	16	The estimates	119	5.3			
12				5.4	16	were made	119	5.4			
13	0.00714			5.5	16	on a separate	120	5.5			
14	0.00477			5.6	15.9	spreadsheet	122	5.6			
15	0.01430			5.7	15.8	and entered	122	5.7			
16	-0.00117			5.8	15.7	here to save	116	5.8			
17	-0.04583			5.9	15.6	recomputation	116	5.9			
18	-0.00444			6.0	15.5	every time the	116	6.0			
19	0.00486			6.1	15.5	model is	114	6.1			
20	-0.02205			6.2	15.5	opened.)	112	6.2			
21	-0.01501			6.3	15.4		110	6.3			
22	-0.01927			6.4	15.4		108	6.4			
23	-0.01531				New Car MPG	White HH Fleet	Leaded Gas in	6.5		12.50	
24	0.00894			6.5	15.4	15.5	109	6.6	12.43		
25	0.00125			6.6	15	15.4	109	6.7	12.32		
26	0.00471			6.7	14.6	15.3	110	6.8	12.18		
27	-0.02469			6.8	14.2	15.1	107	6.9	12.03		
28	-0.01938			6.9	14.1	14.9	105	7.0	11.89		
29	-0.03341	0.011		7.0	14.1	14.8	102	7.1	11.72		
30	-0.02157	-0.016		7.1	13.7	14.6	99	7.2	11.57	11.75	
31	-0.04071	-0.055		7.2	13.6	14.4	95	7.3	11.40	11.60	
32	0.01142	-0.073		7.3	13.3	14.2	97	7.4	11.25	11.45	
33	0.19608	-0.038		7.4	13.2	14.0	117		White	Black	9.07
34	0.00034	0.009	0.06524	7.5	14.8	14.0	118	7.5	11.28	11.34	9.17
35	-0.01752	0.019	0.06524	7.6	16.6	14.3	115	7.6	11.47	11.35	8.84
36	-0.00375	-0.014	0.06524	7.7	17.2	14.6	115	7.7	11.74	11.42	8.79
37	-0.03279	-0.034	0.05409	7.8	18.7	15.2	111	7.8	12.27	11.68	8.68
38	0.18301	-0.050	0.05129	7.9	19.3	16.0	134	7.9	12.84	12.03	8.85
39	0.17818	-0.005	0.09531	8.0	22.6	17.1	160	8.0	13.79	12.59	8.73
40	-0.00233	0.039	0.08701	8.1	24.2	17.9	159	8.1	14.42	12.89	8.84
41	-0.13017	-0.006	0.08004	8.2	25	18.8	140	8.2	15.12	13.36	8.67
42	-0.08632	0.005	0.03774	8.3	24.6	19.7	128	8.3	15.82	13.91	8.80
43	-0.06618	-0.021	0.01835	8.4	25.6	20.5	120	8.4	16.52	14.51	8.69
44	-0.04754	-0.005	0.00000	8.5	26.3	21.7	115	8.5	17.51	15.60	6.94
45	-0.29042	-0.017	0.00000	8.6	27.8	22.7	86	8.6	18.27	16.34	7.02
46	0.01792	0.000	0.05609	8.7	26.6	23.8	87	8.7	19.15	17.40	6.76
47	0.03330	0.000	0.00000	8.8	26.6	24.5	90	8.8	19.74	18.16	6.72
48	0.05525	0.000	0.00000	8.9	26.3	25.1	95	8.9	20.20	18.86	6.64
49	0.06913	0.000	0.00000	9.0	26.2	25.4	102	9.0	20.44	19.27	6.78
50	0.01876	0.000	0.00000	9.1	26.3	25.7	104	9.1	20.70	19.77	6.68
51	0.02080	0.000	0.00000	9.2	26.1	25.9	106	9.2	20.82	20.04	6.76
52	0.02134	0.000	0.00000	9.3	27.0	26.1	109	9.3	20.99	20.36	6.63
53	0.02050	0.000	0.00000	9.4	27.9	26.3	111	9.4	21.17	20.54	6.73
54				9.5	28.9	26.6	116	9.5	21.45	20.80	6.65
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31	Age for use in ORFFE	0 to 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
32	Age for Chi Square Model	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
33	Black fleet share by age	85	0.002	0.015	0.038	0.064	0.086	0.099	0.104	0.101	0.093	0.082	0.069	0.057	0.046	0.036	0.028
34	Black fleet share by age	86	0.002	0.014	0.036	0.062	0.084	0.098	0.103	0.101	0.093	0.082	0.07	0.058	0.047	0.037	0.029
35	Black fleet share by age	87	0.003	0.018	0.043	0.070	0.091	0.102	0.105	0.101	0.091	0.079	0.067	0.054	0.043	0.034	0.026
36	Black fleet share by age	88	0.003	0.018	0.044	0.071	0.092	0.103	0.106	0.101	0.091	0.079	0.066	0.054	0.043	0.033	0.026
37	Black fleet share by age	89	0.003	0.02	0.046	0.073	0.094	0.105	0.106	0.1	0.09	0.078	0.065	0.053	0.042	0.032	0.025
38	Black fleet share by age	90	0.003	0.017	0.043	0.069	0.09	0.102	0.105	0.101	0.091	0.08	0.067	0.055	0.044	0.034	0.026
39	Black fleet share by age	91	0.003	0.019	0.045	0.072	0.093	0.104	0.106	0.101	0.091	0.078	0.065	0.053	0.042	0.033	0.025
40	Black fleet share by age	92	0.003	0.018	0.043	0.070	0.091	0.102	0.105	0.101	0.091	0.079	0.067	0.055	0.043	0.034	0.026
41	Black fleet share by age	93	0.003	0.02	0.047	0.074	0.094	0.105	0.106	0.1	0.09	0.078	0.065	0.053	0.042	0.032	0.025
42	Black fleet share by age	94	0.003	0.018	0.044	0.070	0.091	0.103	0.105	0.101	0.091	0.079	0.066	0.054	0.043	0.034	0.026
43	Black fleet share by age	95	0.003	0.02	0.046	0.073	0.094	0.104	0.106	0.101	0.09	0.078	0.065	0.053	0.042	0.032	0.025
44	White fleet share by age	85	0.017	0.057	0.095	0.117	0.123	0.117	0.104	0.087	0.071	0.056	0.043	0.032	0.024	0.017	0.012
45	White fleet share by age	86	0.016	0.055	0.092	0.115	0.122	0.117	0.104	0.088	0.072	0.057	0.044	0.033	0.025	0.018	0.013
46	White fleet share by age	87	0.020	0.063	0.100	0.121	0.125	0.117	0.102	0.085	0.068	0.053	0.04	0.03	0.022	0.016	0.011
47	White fleet share by age	88	0.021	0.064	0.102	0.122	0.125	0.116	0.102	0.084	0.068	0.053	0.04	0.03	0.022	0.016	0.011
48	White fleet share by age	89	0.022	0.067	0.104	0.123	0.126	0.116	0.101	0.083	0.066	0.051	0.039	0.029	0.021	0.015	0.011
49	White fleet share by age	90	0.020	0.063	0.100	0.120	0.124	0.117	0.102	0.085	0.068	0.053	0.041	0.03	0.022	0.016	0.012
50	White fleet share by age	91	0.021	0.066	0.103	0.123	0.125	0.116	0.101	0.084	0.067	0.052	0.039	0.029	0.021	0.015	0.011
51	White fleet share by age	92	0.020	0.063	0.100	0.121	0.124	0.117	0.102	0.085	0.068	0.053	0.04	0.03	0.022	0.016	0.011
52	White fleet share by age	93	0.022	0.067	0.105	0.124	0.126	0.116	0.101	0.083	0.066	0.051	0.039	0.029	0.021	0.015	0.011
53	White fleet share by age	94	0.020	0.064	0.101	0.121	0.125	0.116	0.102	0.085	0.068	0.053	0.04	0.03	0.022	0.016	0.011
54	White fleet share by age	95	0.022	0.067	0.104	0.123	0.125	0.116	0.101	0.083	0.067	0.052	0.039	0.029	0.021	0.015	0.011
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31	15	16	17	18	19	20	21	22	23	24	
32	16	17	18	19	20	21	22	23	24	25	Sum
33	0.021	0.016	0.012	0.009	0.006	0.005	0.0033	0.0023	0.0016	0.0012	0.9975
34	0.022	0.017	0.012	0.009	0.007	0.005	0.0034	0.0025	0.0017	0.0012	0.9973
35	0.02	0.015	0.011	0.008	0.006	0.004	0.0029	0.0021	0.0014	0.001	0.9978
36	0.019	0.014	0.011	0.008	0.006	0.004	0.0028	0.002	0.0014	0.001	0.9979
37	0.019	0.014	0.01	0.007	0.005	0.004	0.0027	0.0019	0.0013	0.0009	0.9980
38	0.02	0.015	0.011	0.008	0.006	0.004	0.0029	0.0021	0.0015	0.001	0.9978
39	0.019	0.014	0.01	0.008	0.005	0.004	0.0028	0.0019	0.0014	0.0009	0.9980
40	0.02	0.015	0.011	0.008	0.006	0.004	0.0029	0.0021	0.0014	0.001	0.9978
41	0.019	0.014	0.01	0.007	0.005	0.004	0.0027	0.0019	0.0013	0.0009	0.9980
42	0.019	0.015	0.011	0.008	0.006	0.004	0.0029	0.002	0.0014	0.001	0.9979
43	0.019	0.014	0.01	0.007	0.005	0.004	0.0027	0.0019	0.0013	0.0009	0.9980
44	0.009	0.006	0.004	0.003	0.002	0.001	0.001	0.0007	0.0004	0.0003	0.9996
45	0.009	0.006	0.005	0.003	0.002	0.001	0.001	0.0007	0.0005	0.0003	0.9995
46	0.008	0.006	0.004	0.003	0.002	0.001	0.0009	0.0006	0.0004	0.0003	0.9996
47	0.008	0.006	0.004	0.003	0.002	0.001	0.0008	0.0006	0.0004	0.0003	0.9996
48	0.008	0.005	0.004	0.003	0.002	0.001	0.0008	0.0005	0.0004	0.0002	0.9997
49	0.008	0.006	0.004	0.003	0.002	0.001	0.0009	0.0006	0.0004	0.0003	0.9996
50	0.008	0.005	0.004	0.003	0.002	0.001	0.0008	0.0005	0.0004	0.0002	0.9997
51	0.008	0.006	0.004	0.003	0.002	0.001	0.0009	0.0006	0.0004	0.0003	0.9996
52	0.008	0.005	0.004	0.003	0.002	0.001	0.0008	0.0005	0.0004	0.0002	0.9997
53	0.008	0.006	0.004	0.003	0.002	0.001	0.0008	0.0006	0.0004	0.0003	0.9996
54	0.008	0.005	0.004	0.003	0.002	0.001	0.0008	0.0005	0.0004	0.0002	0.9997
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