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Update of Fleet Characterization Data for Use In MOBILE6 - Final Report

UPDATE OF FLEET CHARACTERIZATION DATA FOR USE IN MOBILE6

Final Report

11 May 1998

PREPARED FOR

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SECTION 1

INTRODUCTION

The U.S. Environmental Protection Agency's (USEPA) highway emissions factor model, MOBILE, is the primary model used by state and local agencies to simulate mobile source emissions generated in their areas. In order to model emissions from motor vehicles, MOBILE must incorporate data characterizing the fleet of vehicles in use in the United States. The vehicle population is characterized by the total number of vehicles in operation within certain vehicle weight categories, the age distribution and fuel type (gasoline or diesel) within each weight category, and the mileage accumulation rates specific to vehicle age, fuel type, and weight category. The characterization for a given calendar year is based on a July 1 "snapshot".

Due to changes in economic and demographic conditions in recent years, there have been significant changes in the age distribution, vehicle-type distribution, and mileage accumulation rates for the current national motor vehicle fleet since the last version of the model (MOBILE5a) was released in March 1993. As such, the fleet characterization data currently used in MOBILE must be updated to reflect these changes.

This study utilized the latest available data to update the characterization of the national fleet of vehicles used in the MOBILE5a model. The results of this study may be used in MOBILE6, currently under development. ARCADIS Geraghty & Miller reviewed potential sources of information and analyzed the most relevant and useful data sources. The results of this study, as well as a description of the data and methodologies used to obtain the results, are presented in this document.

Table 1-1 lists the individual vehicle type categories included in the study. Registrations and average annual mileage as functions of vehicle age were developed for each of these categories. Registrations were also summed for the entire set of vehicles and certain subsets.

With respect to registrations, ARCADIS Geraghty & Miller attempted to use 1996 as the base year for the characterization. Transit bus registrations are the exception, for which the base year is 1994. Similarly, it was not possible to use 1996 as the base year for annual mileage accumulation rates, since sources of these data were developed prior to 1996. The base year for each of these data sources will be identified in the relevant subsections of Section 3.

Table 1-1. Vehicle Types

Designation	Description	Gross Vehicle Weight (lb)
LDGV	Light-duty gasoline vehicles	0 - 6,000
LDDV	Light-duty diesel vehicles	0 - 6,000
LDGT1	Light-duty gasoline trucks	<6,000
LDGT2	Light-duty gasoline trucks	6,001-8,500
LDDT1	Light-duty diesel trucks	<6,000
LDDT2	Light-duty diesel trucks	6,001-8,500
HDGV (classes 2B-3)	Heavy-duty gasoline vehicles	8,501-14,000
HDGV (classes 4-8)	Heavy-duty gasoline vehicles	>14,000
HDDV (class 2B)	Light heavy-duty diesel trucks	8,501-10,000
HDDV (class 3)	Light heavy-duty diesel trucks	10,001-14,000
HDDV (classes 4-5)	Light heavy-duty diesel trucks	14,001-19,500
HDDV (classes 6-7)	Medium heavy-duty diesel trucks	19,501-33,000
HDDV (class 8A)	Heavy heavy-duty diesel trucks	33,001-60,000
HDDV (class 8B)	Heavy heavy-duty diesel trucks	>60,000
HDGB (school)	Heavy-duty gasoline school buses	all
HDGB (transit)	Heavy-duty gasoline transit buses	all
HDDB (school)	Heavy-duty diesel school buses	all
HDDB (transit)	Heavy-duty diesel transit buses	all

SECTION 2

REVIEW OF DATA SOURCES

To develop a fleet characterization, ARCADIS Geraghty & Miller reviewed numerous data sources for relevant and accurate content. In this section, both the data sets analyzed, and those that were reviewed but not used (or used minimally), are described. A description of the data sources reviewed but not used is found in Section 2.1. A description of the data sources used for this study is found in Section 2.2. Analysis methodologies are described in Section 3. Results of the analysis are found in Section 4.

2.1 SECONDARY DATA SOURCES

Most of the sources used minimally by ARCADIS Geraghty & Miller were tables and charts listed in popular industry publications. In most cases, ARCADIS Geraghty & Miller found that either pertinent data from these sources were missing or provided in a format that could not be translated into the weight class/age/fuel type breakdowns required for this study. For example, often vehicles were tabulated according to location instead of weight or age. In these cases, the total vehicle data from these sources were used only to verify the final results obtained from other data sources. These sources have been called "secondary data sources".

The Gallup Organization Final Report for the Motor Vehicle Manufacturers Association, 1993

The Gallop Organization study was conducted to determine private light-duty vehicle driving patterns to help make estimations of emissions and fuel economy. It consisted of two samples, one taken by telephone and the other by mail. The total number of respondents to both surveys was approximately 8,300. The data recorded includes a number of different items such as driver profile, vehicle make and model, cargo carried, the number and purpose of trips, and the type of road utilized.

Vehicle age and mileage were recorded, but the results were not published in a cross-correlated fashion. In other words, it was not possible to associate the vehicle's age with the miles it drove. Further, to define a vehicle's classification, Gallup used their own definitions that generally were not consistent with the vehicle categories required for this study. For example, Gallup divided vehicles into either passenger cars or vans/trucks, with no reference to weight. Finally, the resultant data was not expanded to national levels, but instead reported in percentages of the overall sample. Given these limitations, ARCADIS Geraghty & Miller felt that such data were not applicable for use in the present study.

1995 Motor Vehicles Facts & Figures (American Automobile Manufacturers Association)

The *1995 Motor Vehicles Facts & Figures* by the American Automobile Manufacturers Association (AAMA) is a compendium of tables and graphs sorted into several categories, such as production, retail sales, registrations, ownership, travel trends, and automobile related fatalities. It has a wealth of information pertaining to the motor vehicle industry, and was used by ARCADIS Geraghty & Miller as a point of departure for exploring other potential sources. It was not used for raw data itself because it breaks vehicles out into categories that are different from those used in this study. One table does categorize passenger cars by model year, but it does so only for LDVs, and only back to model year 1979. The data on vehicle registrations presented in this publication was derived from data maintained by R.L Polk & Company (which was used extensively in this study). ARCADIS Geraghty & Miller used the AAMA publication to verify total numbers of vehicles on the road.

Automotive Fleet 1994 Fact Book (Bobit Publication)

In this annual publication, a number of quantitative tables characterizing the various vehicle fleets in the United States are presented. Information about truck market share, yearly model registrations, operating costs, and fleet size is provided, but few data referring to fleet age or mileage are included. ARCADIS Geraghty & Miller did not use information from this source.

School Bus Fleet 1997 Fact Book Issue (Bobit Publication)

The Fact Book Issue of the magazine *School Bus Fleet* presents statistical data regarding the United States school bus fleet, including total registrations, annual mileage, students transported, and fatalities. This issue was used for one important statistic: average school bus annual mileage. Since annual mileage data by model year were unavailable from other sources, this value (9,939 miles per year) was used as the mileage for every model year.

1996 Highway Statistics (Federal Highway Administration)

The *1996 Highway Statistics* book is a compilation of statistics in several categories, with most data items in the areas of highway finance and road characteristics. The Federal Highway Administration (FHWA) records this information from various state and local administrative agencies and publishes the *Highway Statistics* annually. While the document does contain some substantial registration information according to vehicle type, registration data was not specified by vehicle age. Further, the statistics contain no information regarding fuel type. Thus, in most cases, ARCADIS Geraghty & Miller was not able to use these data for this study. However, information on total vehicle miles traveled in the United States was used to verify the numbers generated using more detailed. Also, certain statistics indicated that the number of government owned vehicles are insignificant compared to the total number of vehicles on the road. This supported the application of private vehicle annual mileage rates (provided in the NPTS database - see Section 2.2) to both public and private vehicles as sufficiently accurate for this study.

1995 Transit Passenger Vehicle Fleet Inventory (American Public Transit Association)

This American Public Transit Association (APTA) inventory categorizes and lists passenger vehicles according to the fleet in which they are operated. It provides counts of vehicles in a variety of categories, namely manufacturer, city of construction, specification, cost, ownership, and seating capacity. The book also includes a section listing transit buses by age but not by fuel type. Since data from the Federal Transit Administration (see Section 2.2) did contain both model year and fuel type, it was chosen to provide data for this study over that presented in the APTA document. ARCADIS Geraghty & Miller used this publication mainly to verify the registration data obtained from the Federal Transit Administration.

The 100-Year Almanac and 1996 Market Data Book (The Automotive News)

The 100-Year Almanac provides a historical representation of the automotive industry since the turn of the century by highlighting key events and following manufacturer sales on a yearly basis. The 1996 Market Data section of the magazine compiles statistics related to production, sales, and new registrations for the year. The data contained in this source is extensive with respect to vehicle make, model, and fuel type, but has very limited data categorizing vehicles by weight or model year. Therefore, ARCADIS Geraghty & Miller was unable to incorporate this source of data into the study results.

2.2 PRIMARY DATA SOURCES

The following data sources were used extensively in this study and are referred to as "primary data sources." The data sources found most useful were contained in electronic databases from the R.L. Polk & Company (Polk), the 1992 Truck Inventory and Use Survey (TIUS), the 1995 Nationwide Personal Transportation Survey (NPTS), and in databases from the Federal Transit Administration (FTA).

Primary data sources used for each vehicle type registration and annual mileage accumulation are listed below in Table 2-1 and described below.

Table 2-1. Data Sources and Base Years

Vehicle Type	Vehicle Registrations		Annual Mileage Accumulation	
	Source	**Base Year**	**Source**	**Base Year**
Light Duty Vehicle	Polk	1996	NPTS	1995
Light & Heavy Duty Truck	Polk	1996	TIUS	1992
School Buses	Polk	1996	Bobit	1996
Transit Buses	FTA	1994	FTA	1994

R.L. Polk & Company

The only centralized source of nationwide vehicle registration data of the type needed for this study is assembled by R.L. Polk & Company. Polk compiles Department of Motor Vehicle registration information from each state into their database on a quarterly basis. These data include, for each vehicle, information describing make, model year, fuel type, and gross vehicle weight.

Data from two databases at Polk were required for this study. The first database records light-duty vehicles and truck registrations according to make, model year, fuel type, and gross vehicle weight. Information was available from this database as of July 1, 1996.

The second database contains heavy-duty trucks and school buses, again recording make, model year, fuel type, and gross vehicle weight. ARCADIS Geraghty & Miller received two sets of heavy-duty vehicle data from Polk: Oct 1, 1996 and Jan 1, 1997. In Section 3, the methodology used to convert data from these dates to a July 1, 1996 snapshot is described.

For consistency, ARCADIS Geraghty & Miller defined Age 1 vehicles to be model year 1996 for all Polk registrations. Mileage accumulation rates were not acquired from this source.

Truck Inventory and Use Survey

The Truck Inventory and Use Survey was conducted during the 1992-1993 time frame by the U.S. Bureau of the Census. The database, which was supplied to ARCADIS Geraghty & Miller on CD-ROM, compiles a statistically significant sample of on-road light-duty and heavy-duty trucks. Each record is the equivalent of one vehicle. Data for each record is extensive, and includes the required attributes of age, gross vehicle weight, and fuel type. Most importantly, the database records miles driven in calendar year 1992 by these vehicles. This data was used to determine mileage accumulation for light-duty and heavy-duty trucks.

Model year 1992 was designated as Age 1 vehicles for the TIUS data.

Nationwide Personal Transportation Survey

Data recorded in the Nationwide Personal Transportation Survey was developed by a consortium of Department of Transportation agencies to characterize the nature of personal travel (as opposed to commercial and institutional travel). The 1995 survey, the fifth in the NPTS series, consists of 42,033 individual telephone interviews. The survey asked interviewees about their travel habits, including trip length, number and purpose of trips, and time of day. Also, information related to the subjects' personal background and vehicle characteristics was recorded during the study. Of relevance to the ARCADIS Geraghty & Miller study, the NPTS contains data regarding light-duty vehicle type, age and annual mileage. Annual mileage was supplied both as a self-estimated value and one determined by annualizing two odometer readings taken during the year. The second odometer reading was taken from 2 to 6 months after the first. The NPTS data, however, does not contain data recording fuel type or vehicle weight. Like the TIUS data, ARCADIS Geraghty & Miller received the NPTS data on CD-ROM.

Age 1 vehicles in the NPTS data are defined as model year 1995 vehicles.

Federal Transportation Administration

The Federal Transit Administration supplied transit bus inventory data to ARCADIS Geraghty & Miller in electronic form. The FTA helps fund transit districts across the nation; as part of this program, funded agencies are required to submit revenue and vehicle inventory forms to the FTA on a yearly basis. Included among the data recorded on these forms (Form 408) is the vehicle mileage traveled during the previous year and the model year of the bus. This allowed calculation of transit bus mileage by age in addition to total vehicle counts.

The latest available version of this data was recorded in 1994. Thus Age 1 is defined as model year 1994 for this data set.

SECTION 3

DATA ANALYSIS METHODOLOGIES

ARCADIS Geraghty & Miller performed an analysis of both vehicle registrations and annual mileage data sources. The following subsections describe the methodologies used to determine the values for these tasks. The data sources and methodologies used for registration purposes are described in Section 3.1, those used to characterize annual mileage data are described in Section 3.2. Results of these an analysis can be found in Section 4.

3.1 VEHICLE REGISTRATIONS

As required under Work Assignment Tasks 1, 2, and 3, ARCADIS Geraghty & Miller determined total vehicle registrations and vehicle registrations as a function of age for all vehicle types listed in Table 1-1. The primary source of this data was the Polk database, while information on transit bus registrations was taken from the FTA database.

3.1.1 R.L. Polk & Company Database

Several manipulations were required to the data provided by Polk in tabular, electronic form as an EXCEL spreadsheet.

First, ARCADIS Geraghty & Miller divided Class 8 heavy-duty diesel vehicle registrations in the Polk database into Class 8A and Class 8B subclasses, since these breakdowns were not available from Polk. Using registration data from the TIUS database, the percent of Class 8 vehicles below 60,000 pounds gross vehicle weight rating (GVWR) for each model year was calculated. These percentages were then applied to the Polk data for Class 8 trucks to estimate total registrations of Class 8A and Class 8B vehicles. For model years not included in the TIUS data (1993 - 1996), ARCADIS Geraghty & Miller assumed 26.5% of Class 8 vehicles are Class 8A. This value represents the average percentage of all vehicles in model years 1983 to 1992.

After splitting the data in this fashion, ARCADIS Geraghty & Miller translated the heavy-duty vehicle October 1, 1996, and January 1, 1997 data to July 1, 1996. The two data sets allowed calculation of attrition rates of registered vehicles between October 1, 1996 and January 1, 1997 specific to each model year, for all heavy trucks combined, but not for individual weight classes. ARCADIS Geraghty & Miller used these attrition rates to "backcast" estimated registrations as of July 1, 1996, using linear extrapolation (Linear extrapolation of attrition rates is a reasonable approximation considering the difficulty of obtaining and analyzing attrition data on monthly or shorter periods, and is consistent with EPA's treatment and use of attrition information in MOBILE5a and earlier versions of the model). The same attrition rate calculated for all heavy trucks of each model year

was applied to each weight class for that model year. Note that the number of model year 1995 and 1994 trucks registered increased in the fourth quarter of 1996. This, according to Polk personnel, is not unusual and reflects stored inventory of one- and two-year old vehicles continuing to be sold through 1996.

For model year 1996 heavy-duty vehicles, ARCADIS Geraghty & Miller performed a different procedure to include new registrations. The values used for the July 1, 1996 snapshot for the 1996 model year are one-half of the values provided originally from Polk as of January 1, 1997. These are the number of vehicles sold halfway through the year, assuming an even introduction throughout the year (For the same reason as described in the previous paragraph regarding attrition rates, use of linear extrapolation for sales data is appropriate in the MOBILE model series).

Internal USEPA review of the vehicle registration data reported by the R.L. Polk Company identified apparent errors in some of the vehicle weight categories. Several USEPA reviewers noted that the Polk-reported registration counts for light-duty diesel class 2 trucks (LDDT2) were far too large. Discussions with several staff members at the R. L. Polk company revealed that Polk defines light-duty class 2 trucks as having GVWRs of 6,001-10,000 lbs. USEPA defines light-duty class 2 trucks as having GVWRs of 6,001 to 8,500 lbs and heavy-duty class 2B trucks as having GVWRs of 8,501 to 10,000 lbs. As a result, data reported by Polk for LDDT2 include data for both USEPA LDDT2 and HDDV(2B). Thus a methodology to split the Polk-reported class 2 truck registrations into USEPA LDDT2 and HDDV(2B) needed to be developed. To do this, USEPA staff consulted Polk staff, several USEPA experts on truck populations, industry-published market data books, and the Internet to determine the ratio of diesel-fueled light-duty class 2 trucks to diesel-fueled heavy-duty class 2B trucks. These investigations resulted in an estimate of 10% of the diesel-fueled vehicles with GVWRs of 6,001-10,000 lbs actually have GVWRs of 6,001-8,500 lbs. This estimate was further supported by discussions with staff at General Motors (which is the only manufacture currently selling such trucks). Therefore, it was assumed that 10% of the Polk-reported registered trucks weighing 6,001-10,000 lbs actually weighed 6,001-8,500 lbs.

Further discussion with Polk staff indicated that these excess vehicles should not be added to reported heavy-duty diesel class 2B category because this data was derived from a separate data source which *does* separately define trucks 8,501-10,000 lbs GVWR. Therefore, the excess 90% of the Polk-reported class 2 trucks were discarded, and the reported heavy-duty class 2B registrations were maintained.

Another reviewer of the preliminary data noted that registrations of heavy-duty gasoline trucks class 2B-3 were under reported. This was verified by comparing the reported 1995 registration total (which is assumed to be a close representation of the number of vehicle sold in that year, due to expected low scrappage rates for trucks 6 months to 1.5 years old) to the actual sales of these trucks (as reported in the 1997 American Automobile Manufacturers Association 'Motor Vehicle Facts and Figures' report). Given reports from Polk that their reported light-duty gasoline class 2 includes trucks that USEPA would define as heavy-duty gasoline class 2B trucks, is was noted that the light-duty gasoline truck 2 category was being over estimated. Because sales of heavy-duty gasoline class 3 trucks are negligible, it was assumed that splitting the registrations that were being reported as LDGT2 by some ratio would more accurately represent LDGT2 and HDGV (class 2B-3) vehicles. USEPA analysis of manufacturer-supplied sales data derived a ratio of 75:25 for these two categories.

Once the manipulations of the data described above were completed, the resulting tabular data was transferred to new spreadsheets and graphs were created. Where data was available from other sources like MOBILE5a, these data were plotted along side the Polk data for comparison purposes. The results of these comparisons are described in Section 4.

3.1.2 Federal Transit Administration Database

Transit bus registration data for urban buses was obtained from the Federal Transit Administration as an EXCEL spreadsheet. It was saved as a dBASE file for processing. The structure of the dBASE data file is shown in Table 3-1 below:

Table 3-1. BUSDATA.DBF Data Structure

Field Name	Description
NUMVEH	Number of buses in fleet
TYPE	Bus type code
MY	Bus Model Year
NUMACTVEH	Number of active buses in fleet
FUELTYPE	Bus fuel type
SEATING	Seating capacity of the bus
ANNMILES	Total Fleet annual mileage

Registration information for urban transit buses was determined from this data. Only vehicle type codes listed in Table 3-2 were used in the analysis.

Table 3-2. Vehicle Type Codes Used in the Analysis

Code	Bus Type
AB	Articulated motor bus
BA	Motor bus with > 35 seats
BB	Motor bus with 25-35 seats
BC	Motor bus with < 25 seats
DB	Double-decker bus

Vehicle types codes other than those listed in Table 3-2 refer to non-bus transit vehicles, and these records were eliminated from the database. As an urban bus is defined in the Code of Federal Regulations (§86.093-2) as "a passenger carrying vehicle powered by a heavy heavy-duty diesel engine, or of a type normally powered by a heavy heavy-duty diesel engine, with a load capacity of fifteen or more passengers ...", records which indicated that a bus had less than a 15 seat capacity were eliminated from the database. Buses designated as inactive in the FTA database were not included in this calculation, even though they still exist within the inventory. (Inactive buses accounted for

approximately 4% of the inventory.) Even though gasoline-powered buses are not technically designated urban buses, the data set also contained a set of gasoline-powered buses that carried 15 or more passengers. For consistency, gasoline-powered urban bus registrations were also documented in this report. No attempt was made to translate the 1994 FTA data to the 1996 baseline.

The program BUSES.PRG, used to calculate bus registrations and mileage accumulation, is listed in Appendix A. Bus registrations and comparisons to other data sets are discussed in Section 4. Discussion of the calculation of mileage accumulation rates for transit buses can be found in Section 3.2.3.

3.2 ANNUAL MILEAGE ACCUMULATION

ARCADIS Geraghty & Miller acquired and analyzed information regarding the annual mileage accumulation of all vehicle types by age as stated in Work Assignment Task 5. The methodologies applied to each of these source are described in the subsections below.

3.2.1 Truck Inventory and Use Survey

To provide the best analysis of the TIUS data for the purposes needed by this work assignment, ARCADIS Geraghty & Miller manipulated the TIUS data on a record-by-record basis. To do this, pertinent data from the TIUS data file TI92MDF.DAT was converted into a comma-delimited file using the C program TIUSCONV.C listed in the appendices. The comma-delimited file was then read into a dBASE file following the structure presented in Table 3-3.

Two additional fields were added to TIUSDAT.DBF to further help in the manipulation of the data for this work assignment. They are listed in Table 3-4.

Of the 247,282 records that comprised the original data set and were appended from TI92MDF.DAT to TIUSDAT.DBF, 1,612 were deleted because they had no model year designation and 3,694 records were deleted because they designated fuels other than gasoline or diesel (liquefied gas or other). This left 241,976 records.

Each TIUS data record (representing one truck from the survey) had several different weight and weight class fields. MAXWT represented the maximum gross weight at which the vehicle or vehicle/trailer combination was operated. TIUGVW represented the gross vehicle weight (GVW) of the vehicle based on the average weight and is recoded to TIUS specifications. While this is based on average weight, it is probably a good indication of the GVW of large trucks. PKGVW represents the GVW class based upon the vehicle identification number (VIN) and is obtained from the manufacturer. PKRWGT represents the gross vehicle registered weight which comes from state registration data. The PKGVW and PKRWGT are the same values used by Polk to determine weight classes.

Table 3-3. TIUSDAT.DBF Data Structure

Field Name	Description
EXPANF	Expansion factor
MDLYR	Model year
ACQMON	Acquired month
ACQYR	Acquired year
OBTAIN	How was vehicle obtained?
DISPOZ	Was the vehicle disposed of?
DISMON	Month the vehicle was disposed
DISYR	Year the vehicle was disposed
HOWRID	How was the vehicle disposed?
BODTYP	Vehicle body type
MAXWT	Maximum gross weight
ENGTYP	Fuel type
ANNMIL	Annual mileage during 1992
TIUGVW	TIUS gross vehicle weight class
PKGVW	Polk gross vehicle weight class
PKRWGT	Polk registered weight
VEHSZE	Vehicle size

Table 3-4. Additional Fields in TIUSDAT.DBF

Field Name	Description
VEHTYPE	Vehicle class description
FUELTYPE	Fuel type

In reviewing the data, inconsistencies between the various weight class designations and weights were found. For example, a single record (1 truck) could list a registered weight (PKRWGT) of 4,000 pounds GVWR but also list a gross vehicle weight class (PKGVW) of 8, indicating a registered weight of 33,000 pounds or greater. Discussions with Census Bureau staff provided an explanation for these inconsistencies. The two types of weights, PKGVW and PKRWGT, are based on truck registrations, and are often entered into databases based on the VIN. Prior to 1983, VIN coding was not uniform, and, as a result, incorrect interpretations of gross vehicle weight may have occurred during data entry. Therefore, discrepancies between the PKRWGT and PKGVW data fields should be more prevalent for trucks older than model year 1983. The recommendation of Census Bureau staff was to use the PKRWGT and PKGVW for comparison to TIUGVW as a check for this parameter's accuracy. TIUGVW gives an average gross weight value rather than the manufacturers gross vehicle weight, but Census Bureau staff felt that the TIUGVW data was of high quality and, for

large trucks especially, would be a good indication of the gross vehicle weight rating. While ARCADIS Geraghty & Miller did not find that post-1983 data was necessarily more consistent than pre-1983 data, the methodology recommended by the Census Bureau staff was applied to determine which records were valid for use in this study. Only data records which met one of the following criteria were retained:

- Records where the Polk class (PKGVW) and weight (PKRWGT) were consistent
- Records where the TIUS class (TIUGVW) and the Polk Weight (PKRWGT) were consistent
- Records where the TIUS class (TIUGVW) and Polk Class (PKGVW) were consistent

This resulted in 220,544 records for the analysis, approximately 90% of the original data set.

These records were used to characterize average annual mileage accumulation as a function of vehicle age and weight class. The TIUS data was not used to characterize vehicle registrations; instead, Polk data was used as was described in Section 3.1. TIUS data could not be used to characterize registrations because records were for survey responses only. The database does incorporate an "expansion factor" (EXPANF) which is used as a multiplier on the survey response records to expand the data to be representative of the entire national truck fleet. However, the expansion factors are specific only to each of five vehicle strata within each state: pickups, vans, single-unit light (26,000 pounds GVWR or less), single unit heavy, and truck tractor. Because the expansion factors are not intended to, and the trucks surveyed were not selected to, correctly represent a model year- and weight class-specific breakdown of the national truck fleet, the TIUS data could not be used to characterize national truck registrations by model year and weight class. Census Bureau staff agreed that it would be inappropriate to use the expansion factors in this way.

ARCADIS Geraghty & Miller calculated average annual mileage accumulations by averaging the ANNMIL data for each weight class and model year. (The expansion factors were not applied to the data records in the calculation of average annual mileage accumulation, since this calculation is also specific by model year and weight class.)

To compensate for trucks used less than 12 months in the year due to acquisition or disposal during 1992, months of operation for each record were determined. It was assumed that the acquisition or disposal happened mid month. Thus a truck purchased in June of 1992 (ACQYR = 92 and ACQMON = 6) was assumed to operate for 6.5 months in 1992, while a truck disposed of in June of 1992 (DISYR = 92 and DISMON = 6) was assumed to have operated for 5.5 months prior to disposal. Months of operation were then averaged for each model year and class and the annual mileage accumulation for that case was then extrapolated linearly to 12 months of operation.

The TIUS data model year designations are only given for vehicles with model years of 1983 or newer. Vehicles 11 years of age and older are categorized together as model year 11. To characterize mileage accumulation for vehicles 11 years of age and older, records with model year 11 and OBTAIN = 1 (purchased new) were placed in a separate database (TIUS11.DBF) with the same structure as TIUSDAT.DBF. In those cases, model year was assumed to be the same as acquired year

(ACQYR) and average mileage was determined for each of the classes for all acquired years 1982 and earlier. Data records for trucks of model year 11 purchased as used vehicles could not be incorporated into the analysis because there was no data to indicate the specific model year of the truck.

Curve fits were made through the first set of data (model years 1983 through 1992). Only points in the second set (model years earlier than 1983) that did not change the shape of the curve generated by the first set of data more than 5% were used to produce the final curve fits. Two different curve fits were applied, exponential and 2nd order polynomial. The one that produced the highest coefficient of determination (R^2) was chosen.

No adjustments were made to translate the 1992 TIUS data to the 1996 baseline year for this study. This is because total VMT calculated from the 1992 TIUS mileage estimates and the Polk 1996 registrations closely approximated other data sources (see Section 3.1).

The program TIUS.PRG, used to calculate mileage accumulation, is listed in the appendices. Results of this analysis are given in Section 4.

In addition to the above analysis, the TIUS data was further analyzed to determine if mileage accumulation of specific types of light-duty trucks were statistically significant from the aggregated light-duty truck classes. Specifically, data for the LDGT1 class (0-6,000 lbs GVWR) was divided into sports utility vehicles (SUVs), minivans (MVs), pickup trucks (PUs) and other light-duty trucks (OTH). A statistical t-test (difference between two means) was run for each of the four categories of light-duty trucks compared against the aggregated LDGT1 class data. The test showed within a 95% confidence interval that none of the four categories were statistically significant from the aggregated class. This test was also run for the LDGT2, LDDT1 and LDDT2 vehicle classes and similar results were found. Thus the light-duty truck class mileage accumulations were not disaggregated further beyond weight class and fuel type. A chart showing curve-fit mileage accumulation for the four categories of LDGT1 (SUVs, MVs, PUs, and OTH), plotted together with the aggregate LDGT1 curve fit mileage accumulation, can be found in Appendix A. While the shape of some of the curves look different from others, no one curve is statistically significant from the others.

3.2.2 Nationwide Personal Transportation Survey

The data on CD-ROM from the Nationwide Personal Transportation Survey was supplied in dBASE format along with other formats that were not used in this study. The dBASE file structure for the data file used in this study is shown in Table 3-5.

Two mileage estimates are listed in the 1995 version of the NPTS data base. The first is a self-reported estimate of annual mileage accumulation reported by the interviewee. The second is an annualized mileage calculated from two separate odometer readings taken by the interviewee on two distinct days within the year. The two odometer readings are generally spaced from 2 to 6 months. Of the 75,217 vehicles sampled, 47,874 relate to passenger cars and 22,864 relate to light trucks. The remaining records relate to other vehicle types such as motorcycles, recreational vehicles and unknown. Of the 70,738 passenger car and light truck samples, 70,486 had self-reported annual mileage, 47,677 for passenger cars and 22,809 for light-trucks. Only 31,252 of the vehicles sampled had valid annualized odometer readings. Of those, 21,154 were for passenger cars and 10,098 were for light

trucks. While the data set contained much fewer valid annualized odometer readings than self-reported annual mileage readings, it was decided upon discussions with NPTS staff that the odometer readings should be used for determining annual mileage accumulation.

Table 3-5. VEHICL95.DBF Data Structure

Field Name	Description
ANNMILES	Self-reported annualized mileage
MODLCODE	Model code
VEHTYPE	Type of Vehicle
VEHYEAR	Model Year of vehicle
WTHHFIN	Registrations per record
ANNUALZD	Odometer based annualized mileage
FLAGODO	Flag identifying missing ANNUALZD values
FLAGOUT	Flag identifying outlier ANNUALZD values

To better define the vehicle classes in the NPTS data, another field was added to the data base which defined vehicle class (VEHCLASS). Using model codes, vehicle classes shown in Table 3-6 were defined. Vehicle model codes come from the National Accident Sampling System, a major database of the National Highway Traffic Safety Administration.

Table 3-6. Vehicle Class Definitions

Vehicle Class	Model Codes
Passenger car (CAR)	1 - 47, 398, 399
Sports utility vehicle (SUV)	401, 402, 403, 404, 421
Minivan (MV)	441, 442, 443
Pick-up truck (PU)	471, 472
Other light truck (OTH)	431, 461, 470, 481, 482, 461, 470, 498, 499

In discussions with NPTS, it was decided that the mileage (ANNUALZD) should be averaged using the expansion factor (WTHHFIN) for each vehicle class (VEHCLASS) and model year (VEHYEAR). The expansion factor, which is specific to each record, is a multiplier applied to expand the survey responses to represent the national fleet. The expansion factors are based on several attributes of the survey respondent and help eliminate geographic bias in the data (since much more data comes from some states than others). NPTS staff strongly recommended that the expansion

factors be applied as part of the calculations. Since this data did not differentiate between gasoline and diesel, the same mileage accumulation curve was generated for both[1]. The data was then curve fit using the both a 2nd order polynomial and an exponential curve. The curve fit with the highest coefficient of determination (R^2) was chosen. This data was only used for determining mileage accumulation for light-duty automobiles because the TIUS data, which includes light-duty trucks, provided additional information on the type of fuel used and the gross vehicle weight of each vehicle.

The program LDVS.PRG to calculate mileage accumulation is listed in Appendix A. Results of these an analysis are given in Section 4.

The NPTS data was also analyzed to determine if there was any statistically significant difference between mileage accumulations of various light-duty truck types. Since the NPTS data was 3 years newer than the TIUS data, trends in SUVs might show up in this data set which might not show up in the older TIUS data. A t-test was run for each light-duty truck type (SUVs, MVs, PUs and others) listed in Table 3-6 and compared against an aggregate NPTS light-duty truck category. As with the TIUS data, within a 95% confidence interval, none of the various truck type mileage accumulation data were statistically significant from the aggregated light-duty truck category.

3.2.3 Federal Transit Administration Database

Mileage accumulation data for urban buses was calculated using the program BUSES.PRG as discussed in Section 3.1.2. For each fuel type and model year, annual fleet mileage was summed and divided by the total number of buses. Buses designated as inactive in the FTA database were not included in the denominator for this calculation. This results in a higher average annual miles per bus than if both active and inactive buses were counted and used in the denominator.

The program BUSES.PRG to calculate mileage accumulation is listed in Appendix A. Results from these calculations are given in Section 4.

[1] According to USEPA, light-duty vehicles, whether gas or diesel, are generally used as personal transportation and so are typically driven in patterns (annual mileage, trip frequencies, etc.) that are determined by parameters other than fuel type.

SECTION 4

RESULTS

Work Assignment Task 6 specifies that the results of this study be compared to the previous data derived during development of MOBILE5a. The results of this study are presented herein as graphs and tables. In all cases, data from Polk and FTA are utilized for *registration* counts, and TIUS, NPTS, FTA and Bobit data are used for *mileage* accumulation by age. Table 2-1 in Section 2.2 indicates which data source is used for each vehicle type. On some of the graphs at the end of this section, additional data series from other sources are presented for comparative purposes only.

The Polk registration data presented in the following graphs does not perfectly coincide with the previous characterization performed during the development of MOBILE5a. Absolute values for vehicle counts almost always differ by some discrete amount, as is to be expected when comparing data sources developed with different methodologies. In most cases, it is extremely difficult to find explanations that would account for the differences. In light of this, the following discussion attempts to point out where the two (or more) data series either coincide or diverge in terms of relative *trends* (peaks and valleys), rather than absolute difference. An attempt was made, however, to point out where absolute values significantly differ and the possible reasons for these discrepancies.

The same attempt has been made with the annual mileage accumulation graphs. Here, however, a curve fit was placed through the related data set. This has been done to smooth the results generated from data sets that, especially within certain weight classes, do not contain enough data points to avoid some dramatic model year variation in the averaged results. ARCADIS Geraghty & Miller believes that while the graphs sometimes indicate highly erratic mileage differences from one model year to the next (for the raw data), the curve fits are generally of the appropriate magnitude.

To compare results from this study to other sources, ARCADIS Geraghty & Miller multiplied the vehicle registrations from each weight class and model year with the respective curve fit mileage, and then summed the products to obtain the total vehicle miles traveled (VMT) for the entire U.S. fleet in 1996 (see Table 4-1). This VMT figure (~2.130 trillion miles) was cross-checked with an independent number generated by the *1996 Highway Statistics* (~2.472 trillion miles). The *1996 Highway* Statistics calculated total VMT and registrations from a number of independent sources including state registration data, the 1995 NPTS report, and the 1992 TIUS report.

Table 4-1. Total VMT, Registrations, and Annual Mileage

TOTAL VMT

	US Highway Statistics 96	Current Study	% Difference
LDVs and LDTs	2,283,005,000,000	1,894,165,618,859	-17.03%
HDVs	182,756,000,000	230,289,095,076	26.01%
Buses	6,535,000,000	5,804,509,986	-11.18%
Total	2,472,296,000,000	2,130,259,223,921	-13.83%

REGISTRATIONS

	US Highway Statistics 96	Current Study	% Difference
LDVs and LDTs	198,662,139	176,385,176	-11.21%
HDVs	7,006,408	11,428,172	63.11%
Buses	696,609	469,689	-32.58%
Total	206,365,156	188,283,036	-8.76%

ANNUAL MILEAGE

	US Highway Statistics 96	Current Study	% Difference
LDVs and LDTs	11,492	10,739	-6.55%
HDVs	26,084	20,151	-22.75%
Buses	9,381	12,358	31.73%
Average	11,980	11,314	-5.56%

Comparison of these two figures indicates that the current study projects 13.9% less total VMT than the FHWA *1996 Highway Statistics* study. This is most likely due to a number of factors. First, the source of registration information differ. In the current study, registration data was supplied by R.L. Polk Company for 1996. According the FHWA *1996 Highway Statistics* report, vehicle registration data was collected directly from the fifty states. A given state's reported vehicle registration data is often incompatible with other states' data. For example, in some states a minivan, which by USEPA regulations is defined as a light-duty truck, would be classified as a passenger car. Both FHWA and Polk have addressed this problem, and both data sources are corrected for this. However, FHWA reports that "in some states, it is also possible that contrary to the FHWA reporting instructions, vehicles which have been registered twice in the same state may be reported as two vehicles." This may account of some of the difference between the two studies' counts.

A second source of deviation between the two registration estimates arises from the adjustments that were made to the Polk registration data to address comments made by various USEPA personnel (see Section 3.1.1). This adjustment decreased light-duty truck registrations by approximately 6.1 million vehicles and increased heavy-duty truck registrations by approximately 2.5 million vehicles resulting in a total decrease of approximately 3.6 million vehicles in the total U.S. vehicle fleet in this study.

A difference in vehicle weight category definition is the primary source of the variation in the heavy-duty vehicle registration counts. FHWA defines light-duty trucks as having GVWRs up to 10,000 lbs and heavy-duty trucks as having a GVWR greater than 10,000 lbs. In accordance with USEPA definitions, ARCADIS Geraghty & Miller defined light-duty trucks to include GVWRs only up to 8,500 lbs and heavy-duty trucks as having GVWRs greater than 8,500 lbs.

Furthermore, the bus category in Table 4-1 considers only considers school and transit buses for the current study whereas the *1996 Highway Statistics* probably includes buses in addition to school and transit buses. Buses other than school or transit buses were treated as heavy-duty trucks in the current study. Polk school bus registration data used in the current study tracked quite well with other sources, such as the *1997 School Bus Fleet* Fact Book and transit bus registrations from FTA used in the current study tracked very closely with information from the APTA *1995 Transit Passenger Vehicle Fleet Inventory*.

The average mileage accumulation rates derived in this study were higher than the *1996 Highway Statistics* for buses and lower for all other classes. For LDVs, this study used annualized odometer readings which were found to be approximately 10% lower than the self-estimated values which were most likely used by FHWA. Also, the heavy-duty vehicles in this study included class 2B vehicles (GVWR 8,500 - 10,000 lbs) which have higher mileage accumlation rates than LDVs but lower than heavy-duty trucks. Since Class 2B vehicles account for approximately 50% of the heavy-duty vehicles in this study, much of the difference in mileage accumulation rates between this study and the *1996 Highway Statistics* for heavy-duty vehicles results from the addition in this study of a significant number of vehicles with lower mileage accumulation rates in the heavy-duty class.

Bus mileage accumulations were significantly higher than those listed in the *1996 Highway Statistics* mostly due to inclusion of other bus types (other than transit and school) in the bus category as defined by the *1996 Highway Statistics*.

The differences between data obtained under this study and other sources for each weight class are discussed below for both registrations and annual mileage accumulations.

4.1 REGISTRATIONS

4.1.1 LDVs

Light-duty registration data obtained from Polk (Figure 4-1) appear to follow the same trend as the other sources of available registration data. In general, NPTS counts follow Polk data closely. This further supports the suggestion mentioned above that the R.L. Polk data is probably more accurate than the *1996 Highway Statistics* shown in Table 4-1. MOBILE5a data indicates slightly higher counts than Polk, however, MOBILE5a data represents registrations as of July 1, 1992 and vehicle attrition between 1992 and 1996 could account for the differences.

4.1.2 LDTs

Light-duty gasoline trucks (Figures 4-2 and 4-3) also appear to follow relatively similar patterns. The major difference lies in model years 1976-1982, where peaks in the MOBILE5a data

either do not appear or do not coincide with the Polk data. Since LDDTs were not separated into classes 1 and 2 during development of MOBILE5a, discussion of this vehicle type is described below under Aggregated Classes in subsection 4.1.5.

4.1.3 Heavy-Duty Trucks and School Buses

Comparison data could not be found in other sources for these vehicle classes (Figures 4-4 to 4-16). In the heavy duty classes, TIUS data was found to be inconclusive for purposes of registration counts, as was discussed above. Also, MOBILE5a contains no easily reproduced block data for the heavy-duty truck fleet. Thus, only the Polk data is provided in the charts for these vehicles types.

4.1.4 Transit Buses

The data provided by the FTA (Figure 4-17) very closely follows the comparison APTA data. This further supports the suggestion mentioned above that the apparent large discrepancy between bus registrations in Table 4-1 is questionable.

4.1.5 Aggregated Classes

Certain aggregations of vehicle classes have been included here upon request of the USEPA. Aggregated classes are: LDGTs (Figure 4-18) which include LDGT1 and LDGT2, LDDTs (Figure 4-19) which include LDDT1 and LDDT2, LDTs (Figure 4-20) which include LDGT1, LDGT2, LDDT1 and LDDT2, HDGVs (Figure 4-21) which include HDGV1 and HDGV2, HDGB (Figure 4-22) which includes gasoline transit and school buses, HDDVs(3-5) (Figure 4-23) which includes HDDV(3) and HDDVs(4-5), HDDVs(8) (Figure 4-24) which includes HDDV(8A) and HDDV(8B), HDDVs (Figure 4-25) which includes HDDV(2B), HDDV(3), HDDV(4-5), HDDV(6-7), HDDV(8A) and HDDV(8B), and HDDBs (Figure 4-26) which include diesel transit and school buses. The registration data presented in these charts is simply the sum of the registrations in the classes indicated in the chart's title. Of particular note is the comparison between data sources of LDDTs (Figure 4-19). As mentioned above, MOBILE5a did not discriminate between LDDT1s and LDDT2s. For all LDDTs, MOBILE5a shows a peak in model year 1981, with registrations tapering off thereafter. The Polk data shows significantly more LDDTs in the 1980s and 1990s, as well as a smaller peak in 1974. The reason for the discrepancy between these two sources is unknown.

4.2 ANNUAL MILEAGE

4.2.1 LDVs

As shown in Figure 4-27, the annual mileage accumulation data provided from the NPTS shows perhaps the most consistent data series of all the weight classes. Deviation of the data points from the curve fit is generally small. The graph shows that mileage accumulation rates developed in this study from 1995 NPTS data are higher than the rates incorporated into MOBILE5a, which was based on the 1983 NPTS study. This is consistent with recent trends indicating that people drive more miles each year than they used to.

4.2.2 LDTs

Light-duty truck mileage provided by the TIUS fairly closely tracks MOBILE5a data (Figures 4-28 to 4-31). TIUS data for LDGTs indicates somewhat higher accumulation rates for the newer vehicles and lower rates for older vehicles. For LDDTs, the data indicates that mileage accumulation is somewhat higher than previously modeled for all vehicle ages, especially in the younger vehicles.

4.2.3 HDGVs

Heavy-duty gasoline trucks follow the same pattern as LDTs. However, the TIUS data indicates that the older, heavier HDGV2s acquire fewer annual miles than MOBILE5a indicates (Figures 4-32 and 4-33)

4.2.4 HDGBs

ARCADIS Geraghty & Miller could not obtain suitable annual mileage rates for the gasoline transit buses on an age basis. The *1997 School Bus Fleet Fact Book Issue* provides information placing *average* school bus accumulation rates at 9,939 miles per year (for both gasoline and diesel school buses).

4.2.5 HDDVs

For the lighter heavy-duty diesel classes (2B and 3), the TIUS data indicates the same trends as both LDTs and HDGVs (Figures 4-36 and 4-37) However, the relative difference compared to MOBILE5a is greater for these vehicle classes than the others, up to as much as 50% greater than the previously used value.

Classes 4 and 5 (Figure 4-38) show an altogether different pattern. Here, TIUS annual accumulation rates are significantly greater than previous MOBILE values for all vehicle ages. This is especially true at about Age 10, where there is about a 100% increase in mileage. One possible reason may partly explain this occurrence. Note that the MOBILE5a curve is the same for both Figures 4-37 and 4-38. This is because, in MOBILE5a, mileage rates were accumulated for Classes 3 through 5 as an aggregate sum. Since there are nearly twice as many vehicles in Class 3 as there are in both 4 and 5 combined, the average mileage accumulation rate would tend to be lower, closer to the individual Class 3 average. Thus the MOBILE5a curve plotted here for Classes 4 and 5 is probably too low to properly characterize these weight classes.

Classes 6 and 7 (Figure 4-39) indicate the opposite; TIUS mileage values are slightly less than older MOBILE5a values.

Classes 8A and 8B (Figures 4-40 and 4-41) mileage rates developed in this study are slightly lower and higher, respectively, than MOBILE5a. This is due partly to the same reason as explained for Classes 4 and 5. MOBILE5a only tracked Class 8 mileage accumulation rates. That curve, which appears on both these figures, lies in between the two TIUS data sets, since it is the average accumulation rate for all the vehicles in both sets (although weighted about 3 to 1 toward the 8B class, since there are about 3 times as many 8B vehicles as there are 8A trucks.)

4.2.6 HDDBs

Like gasoline school buses, diesel school buses have an *average* mileage accumulation for all vehicles of 9,939 miles per year. Heavy-duty diesel transit bus mileages have been derived from an analysis of the FTA Form 408 data set (Figure 4-42). Comparison data from other sources is not available for this class.

4.3 TABLES

Additional information is provided in Tables 4-2 to 4-8 at the end of this report. Each is categorized by weight class, fuel type and model year. Table 4-2 shows the total registrations received from Polk and modified by ARCADIS Geraghty & Miller as described above. Table 4-3 shows the raw annual mileage data available from the various sources listed above, while Table 4-4 is the annual mileage curve fit for each weight class. Table 4-5 lists the mileage accumulation curve fit equations used for each weight class. In Table 4-6, the percentage of vehicles in each model year as a fraction of the total vehicles in the weight class is shown. Both total vehicles and percentages are also displayed for aggregated weight classes in Tables 4-7 and 4-8. Finally, Table 4-9 is the gasoline/diesel sales fraction of light-duty vehicles and trucks from 1985 to 1996, as requested in Work Assignment Task 4.

Figure 4-1. Registration Comparison by Model Year
LDV

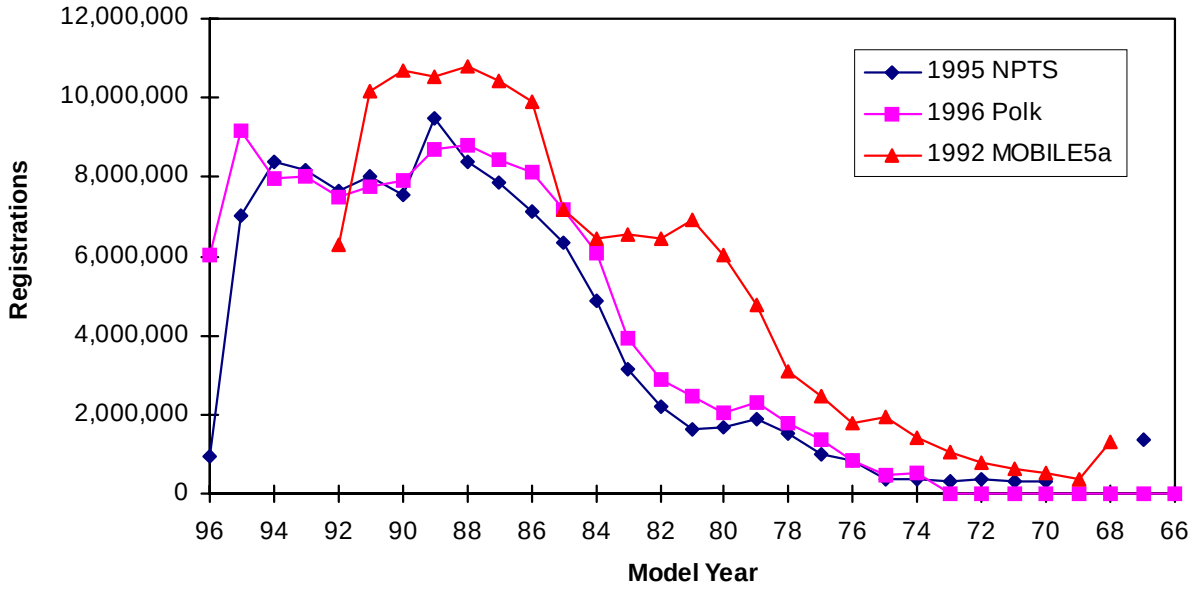


Figure 4-2. Registration Comparison by Model Year
LDGT1

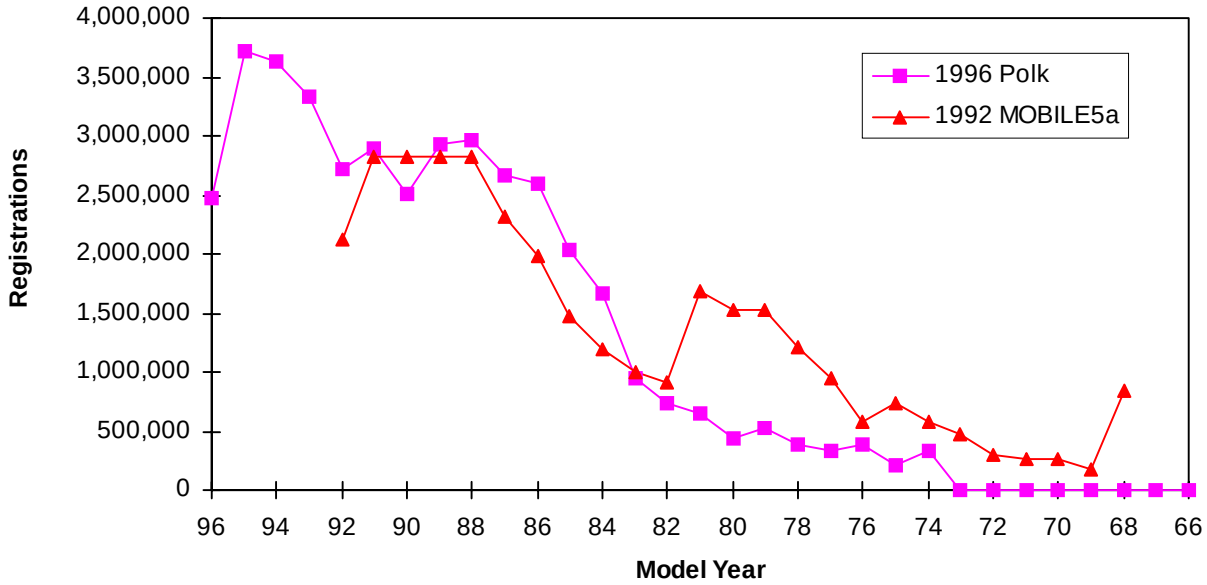


Figure 4-3. Registration Comparison by Model Year
LDGT2

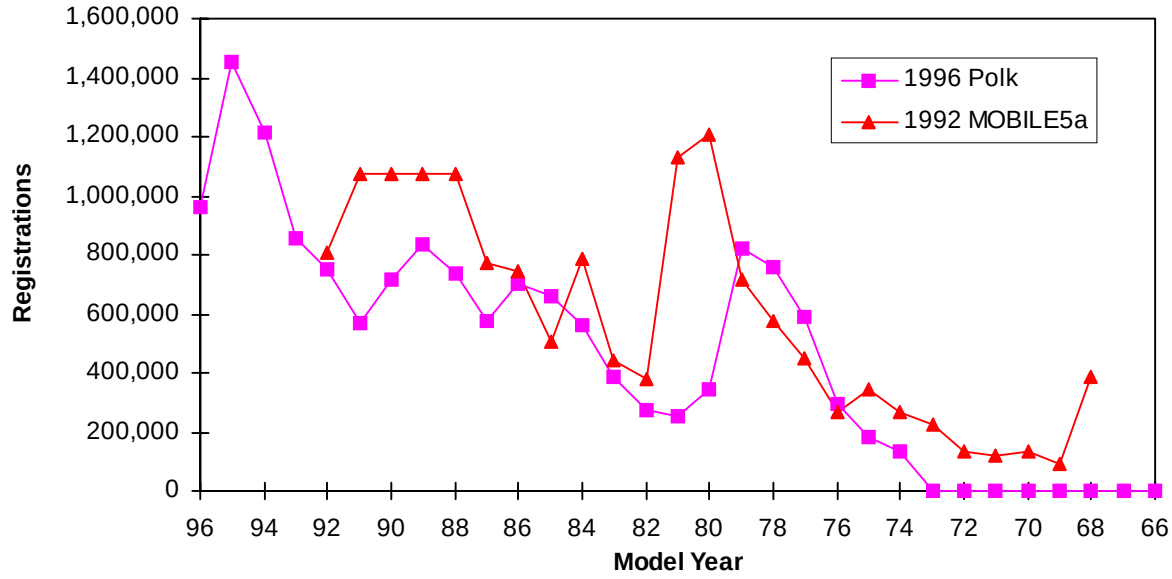


Figure 4-4. Registration Comparison by Model Year
LDDT1

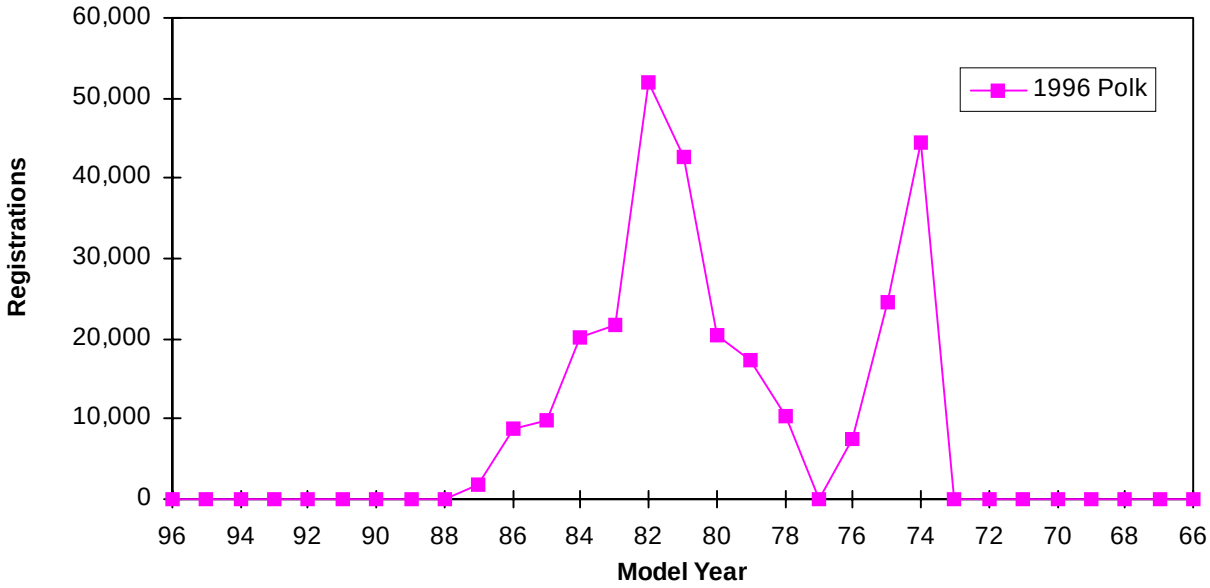


Figure 4-5. Registration Comparison by Model Year
LDDT2

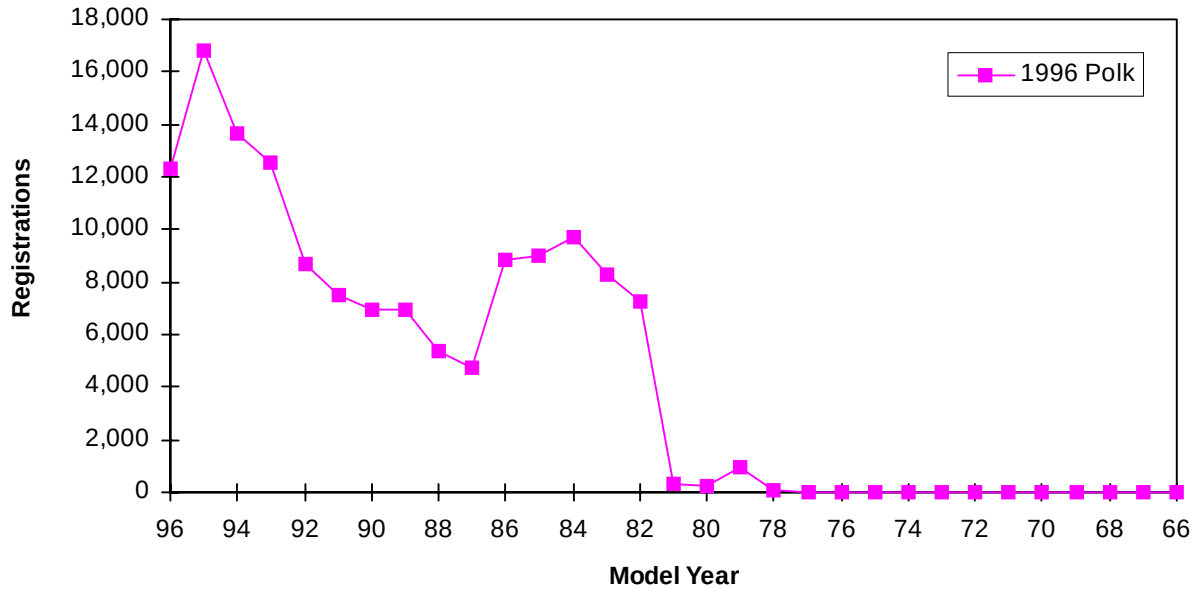


Figure 4-6. Registrations by Model Year
HDGV(2B-3)

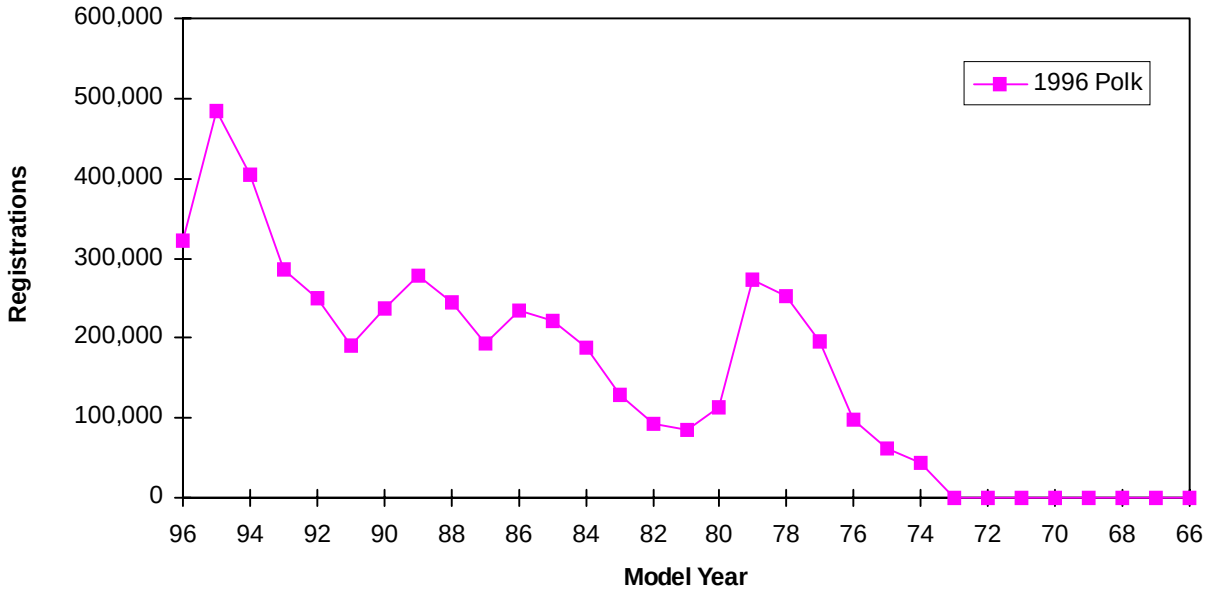


Figure 4-7. Registrations by Model Year
HDGV(4-8)

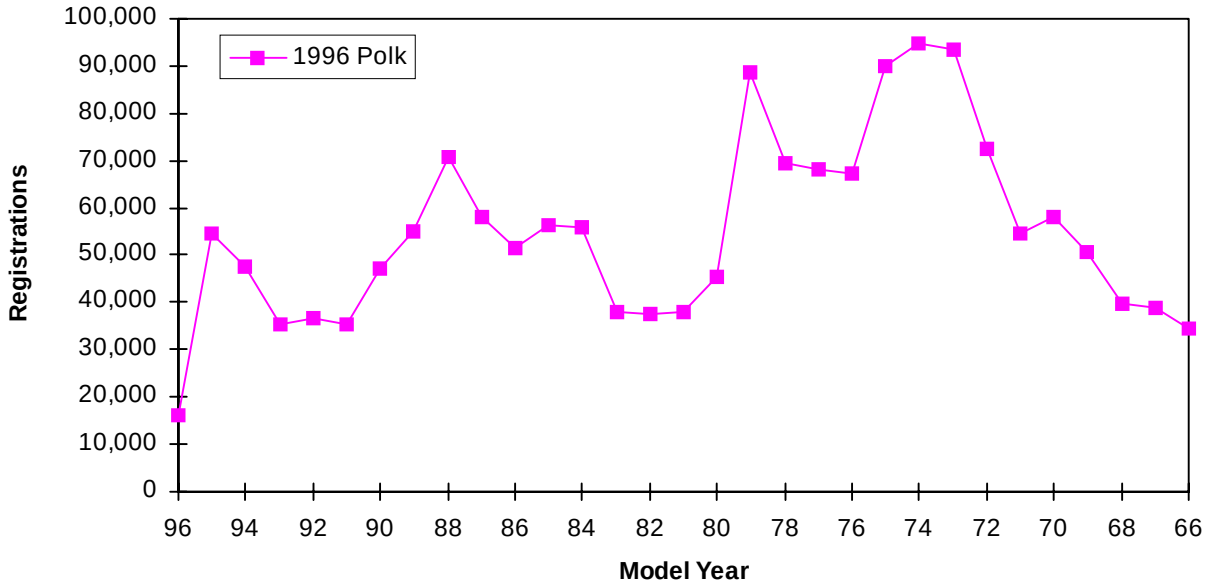


Figure 4-8. Registrations by Model Year
HDGB School

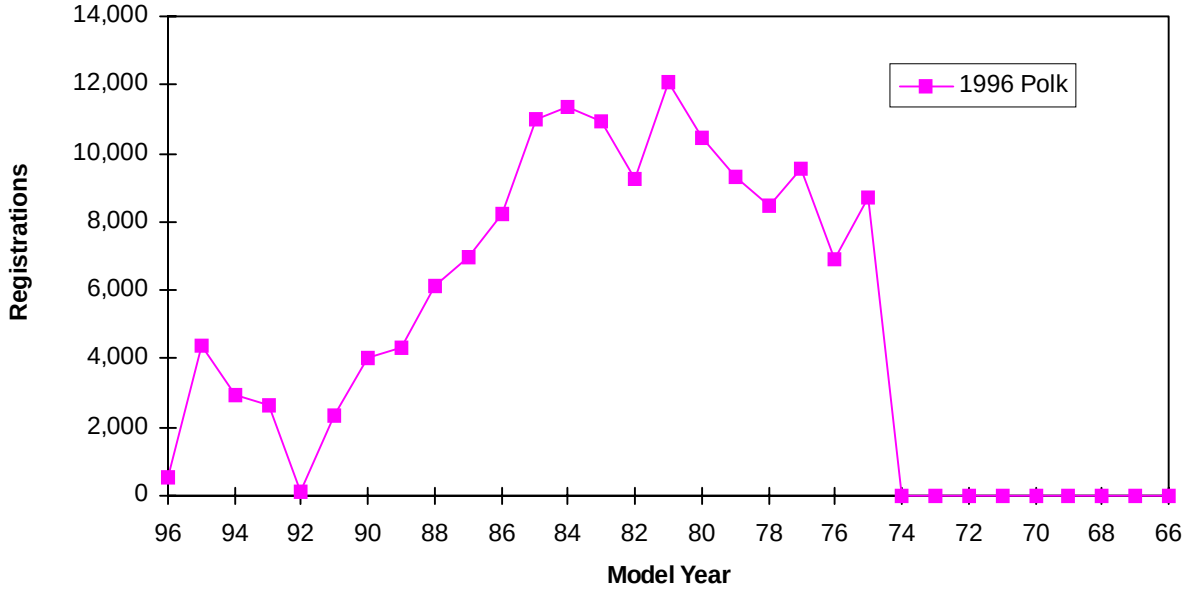


Figure 4-9. Registrations by Model Year
HDGB Transit

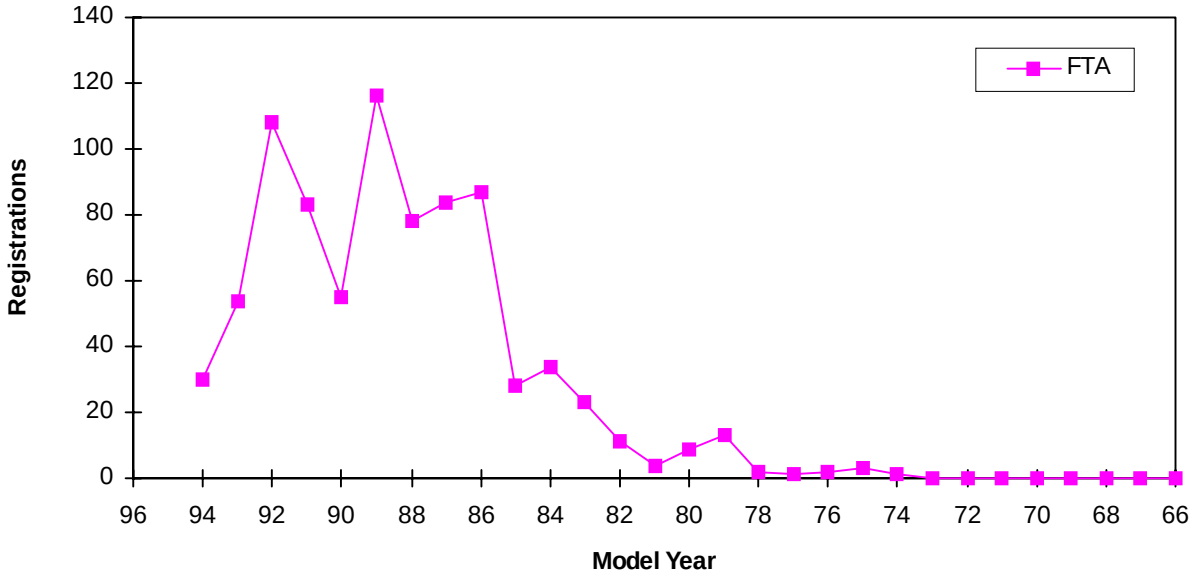


Figure 4-10. Registrations by Model Year
HDDV(2B)

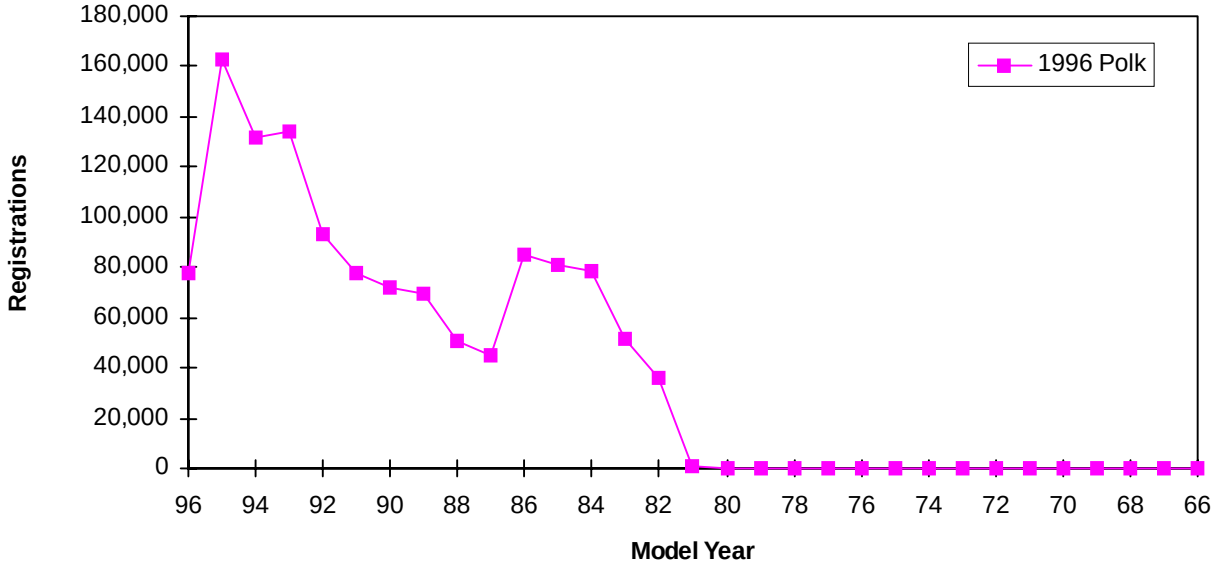


Figure 4-11. Registrations by Model Year
HDDV(3)

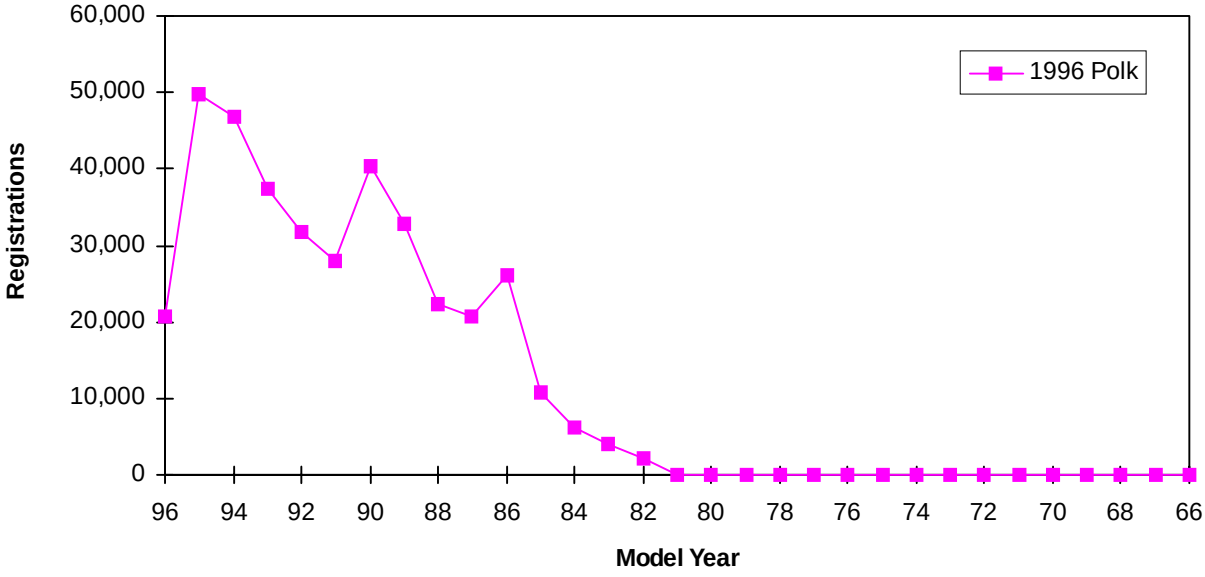


Figure 4-12. Registrations by Model Year
HDDV(4-5)

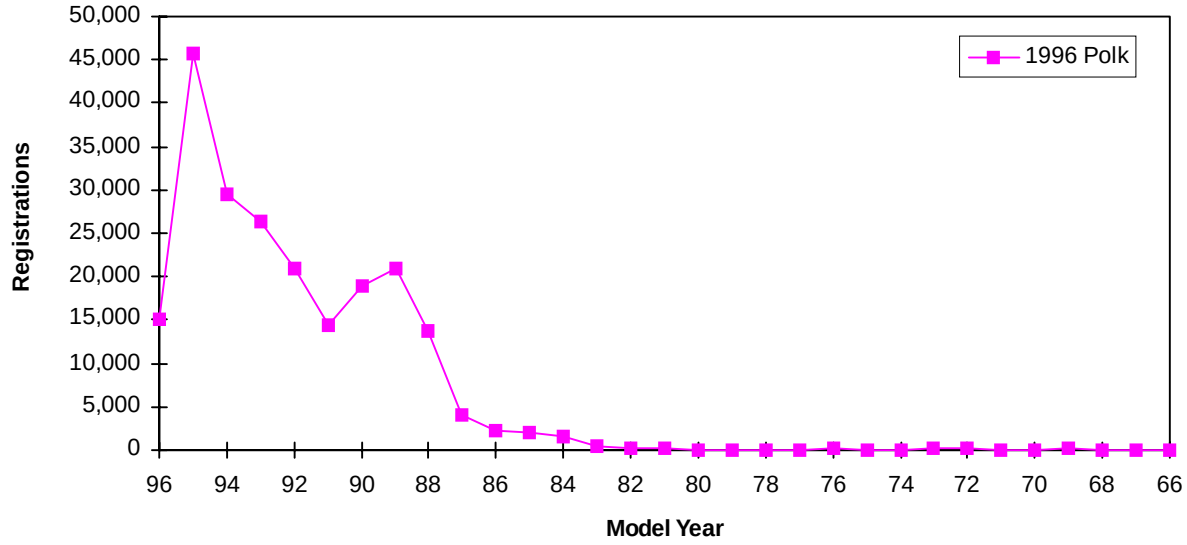


Figure 4-13. Registrations by Model Year
HDDV(6-7)

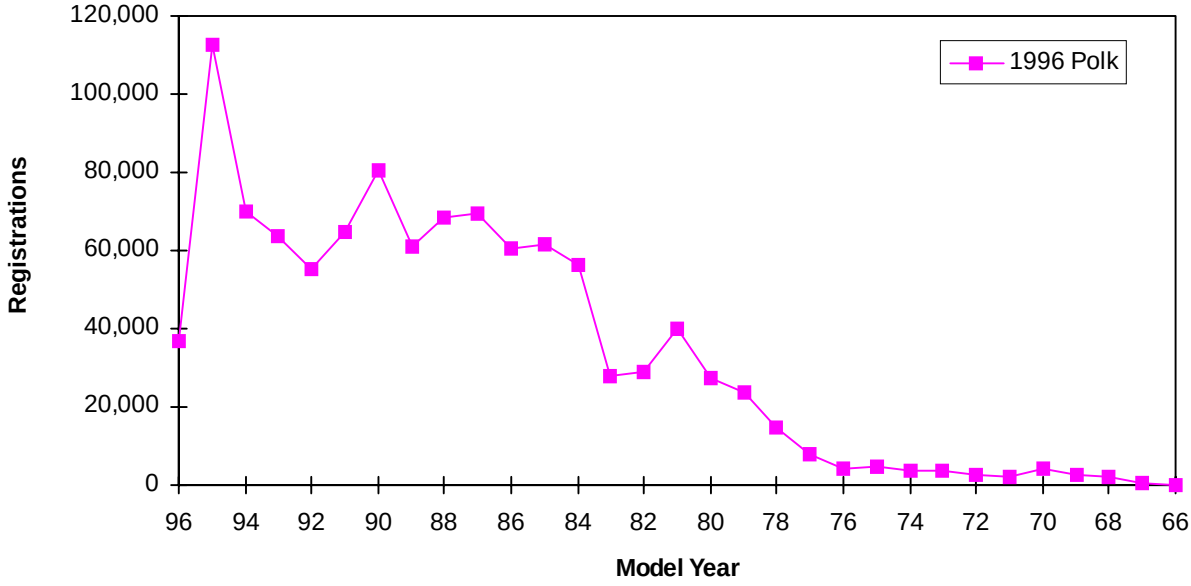


Figure 4-14. Registrations by Model Year
HDDV(8A)

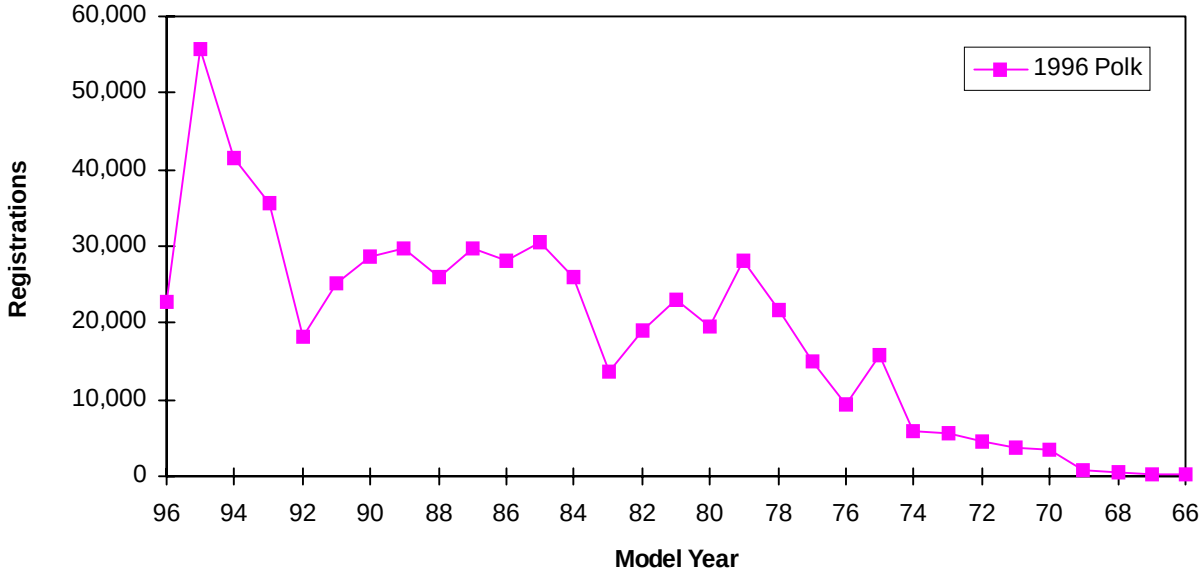


Figure 4-15. Registrations by Model Year
HDDV(8B)

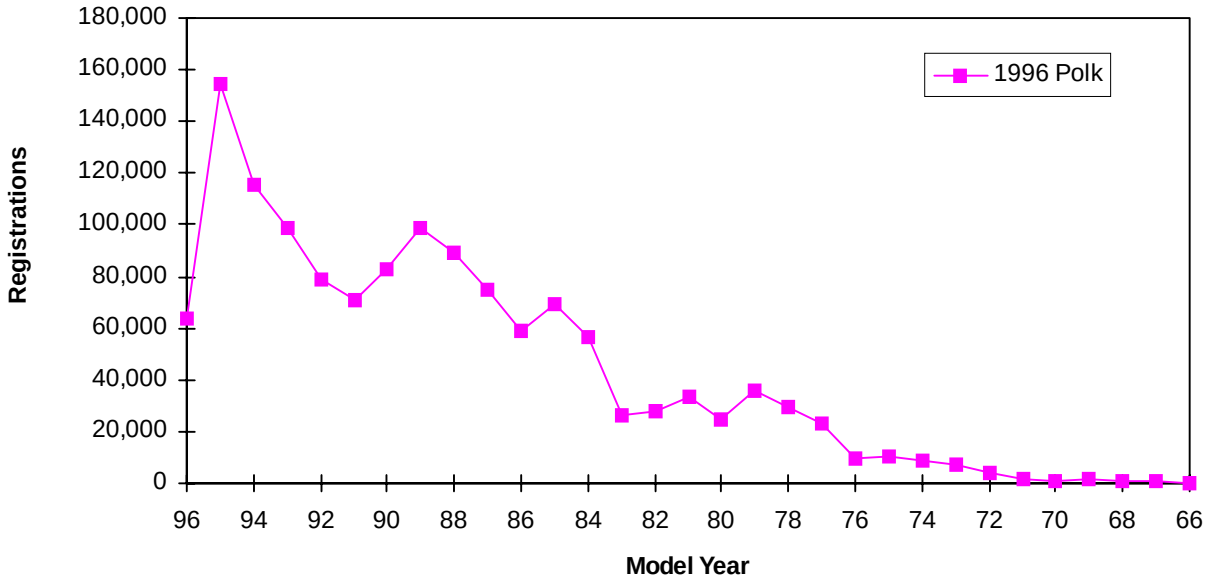


Figure 4-16. Registrations by Model Year
HDDB School

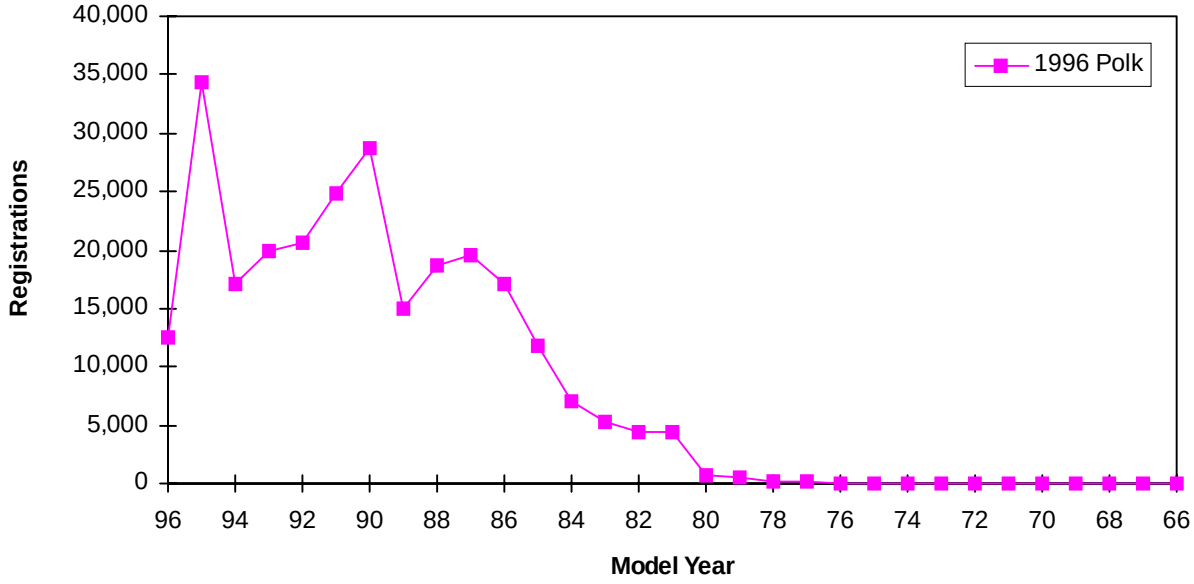


Figure 4-17. Registrations by Model Year
HDDB Transit

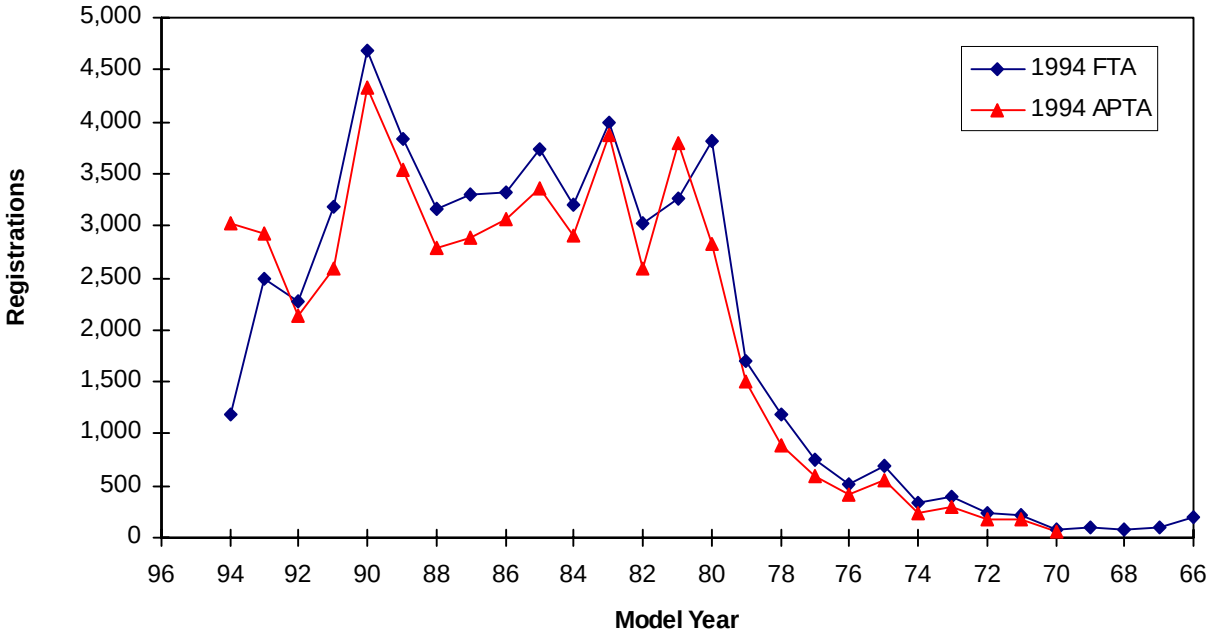


Figure 4-18. Registrations by Model Year
Aggregated LDGT

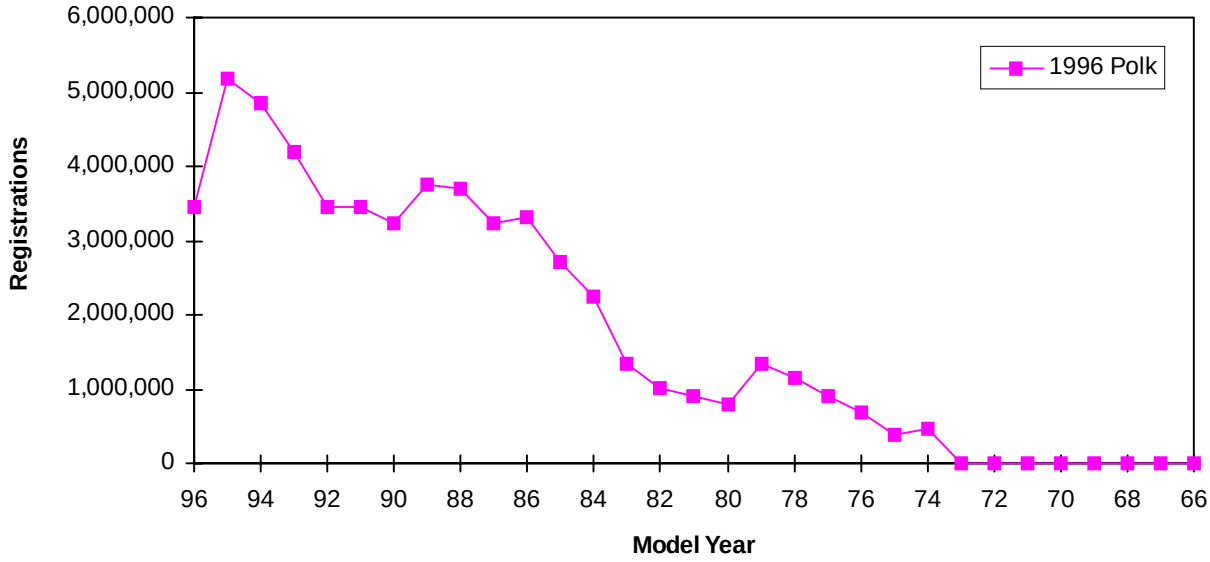


Figure 4-19. Registrations by Model Year
Aggregated LDDT

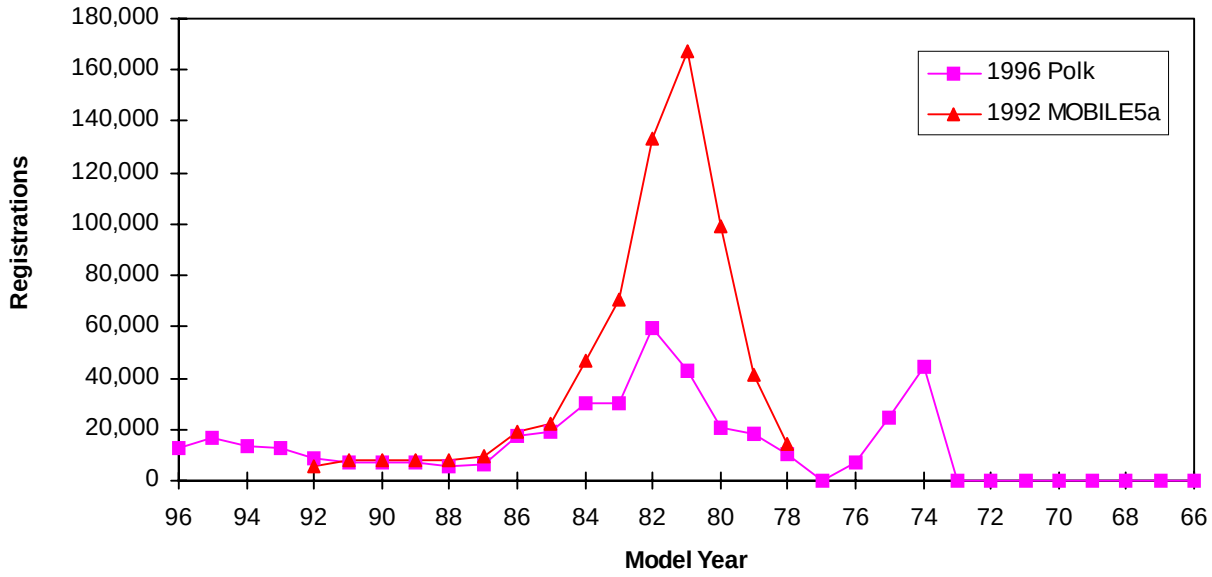


Figure 4-20. Registrations by Model Year
Aggregated LDT

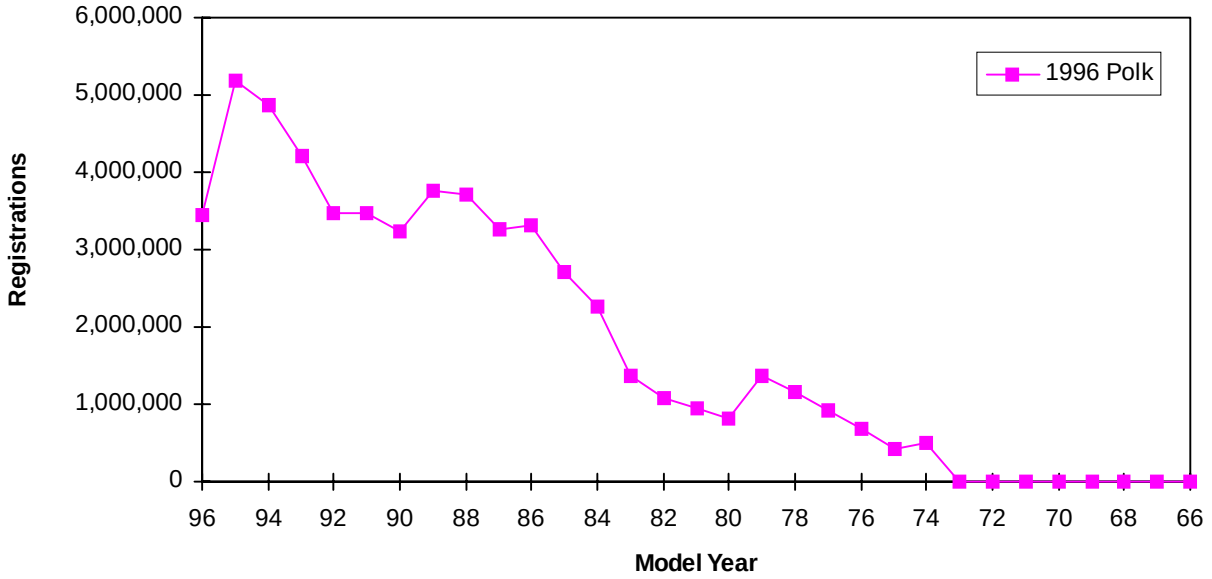


Figure 4-21. Registrations by Model Year
Aggregated HDGV

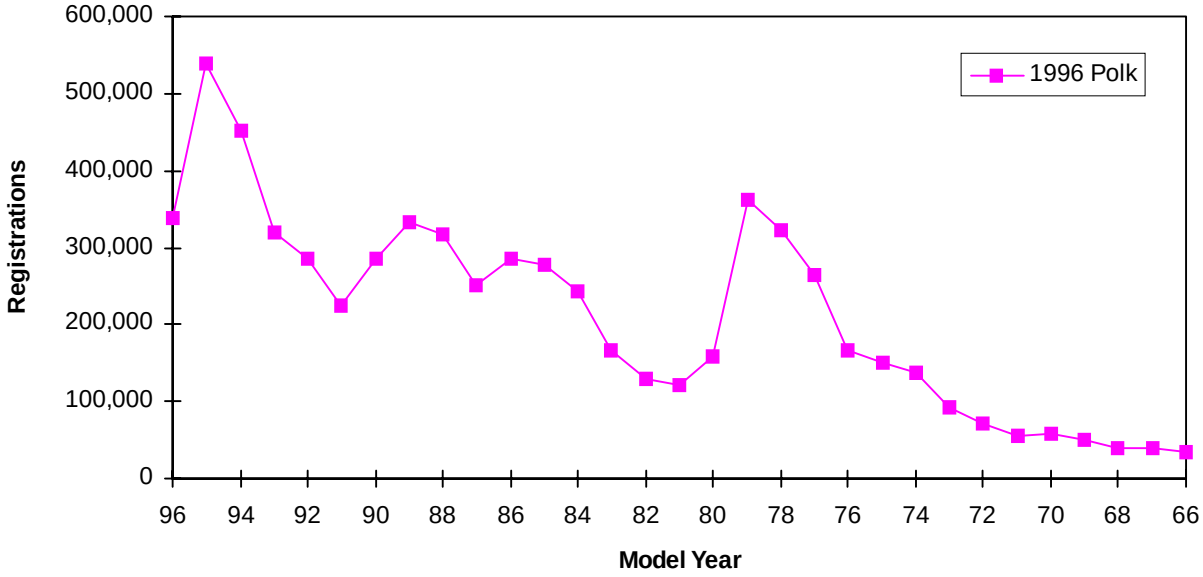


Figure 4-22. Registrations by Model Year
Aggregated HDGB

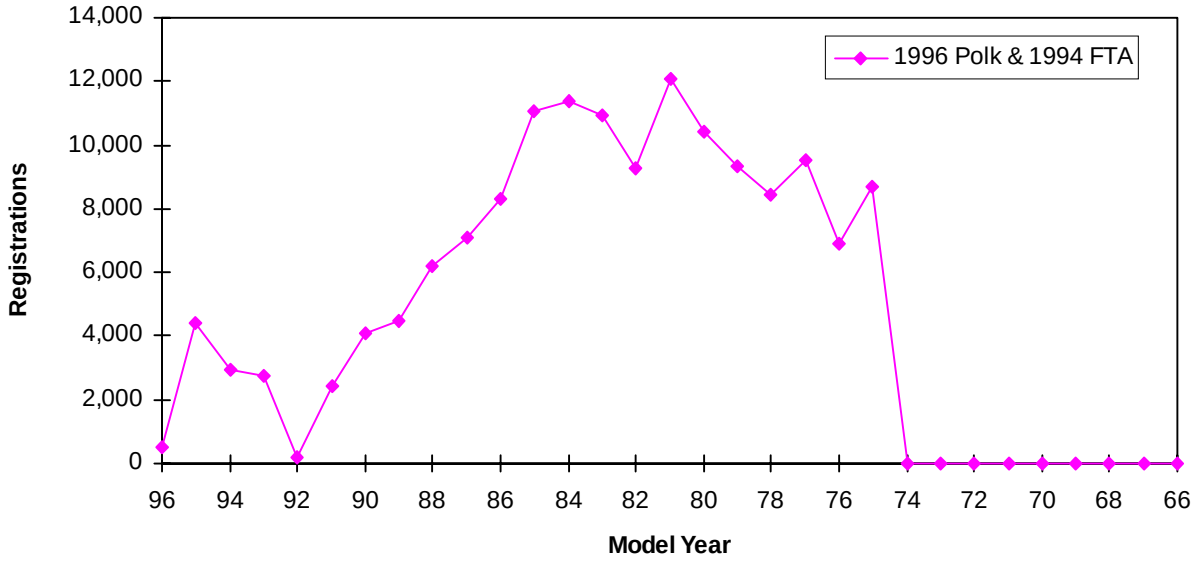


Figure 4-23. Registrations by Model Year
Aggregated HDDV(3-5)

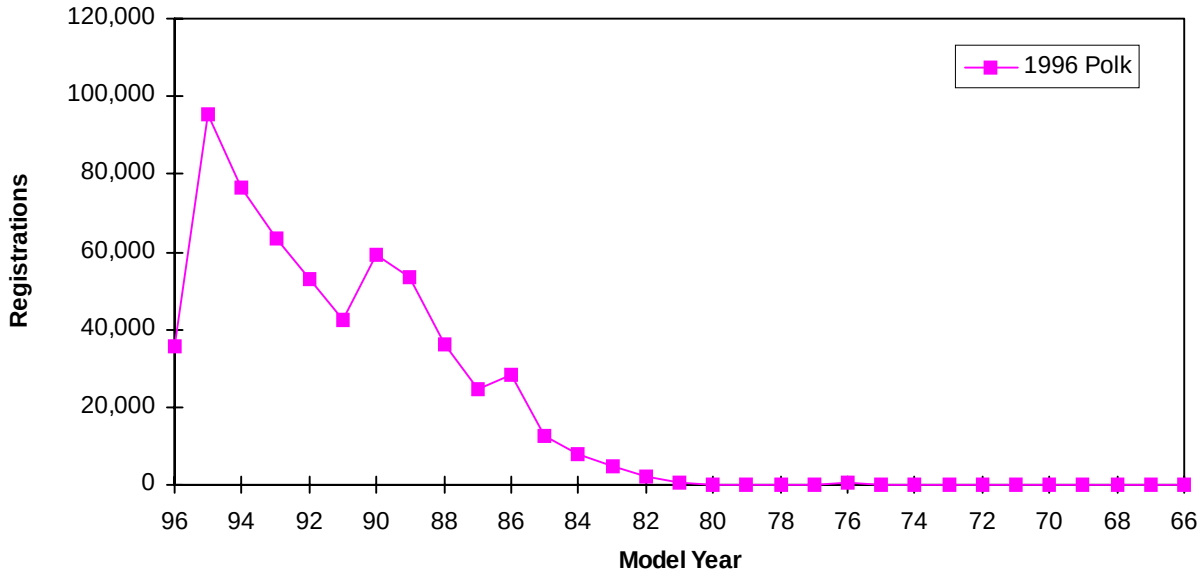


Figure 4-24. Registrations by Model Year
Aggregated HDDV(8)

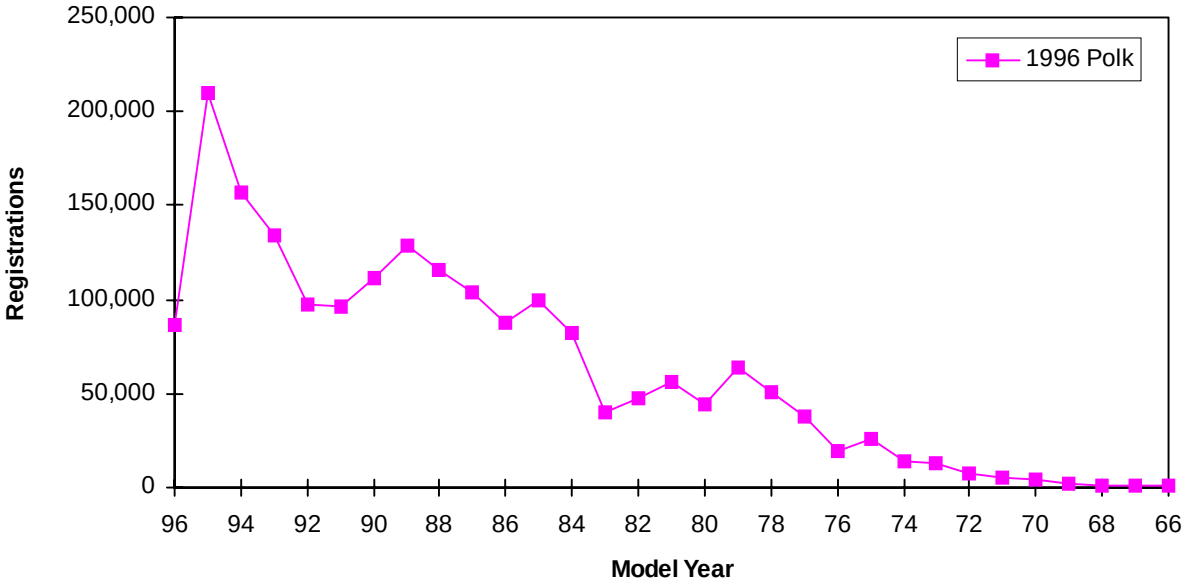


Figure 4-25. Registrations by Model Year
Aggregated HDDV All

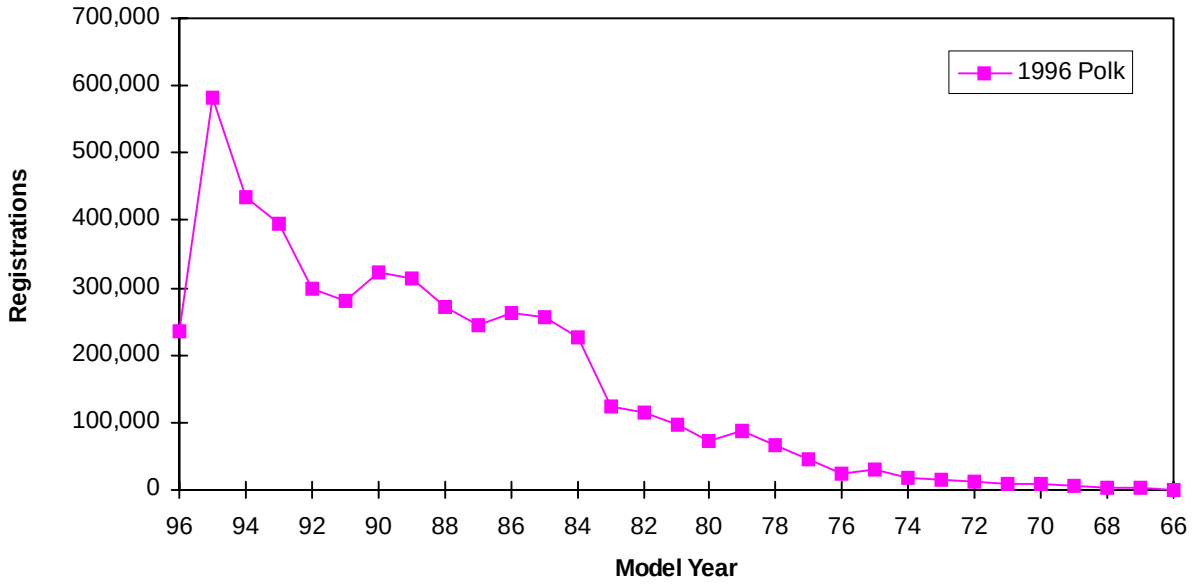


Figure 4-26. Registrations by Model Year
Aggregated HDDB

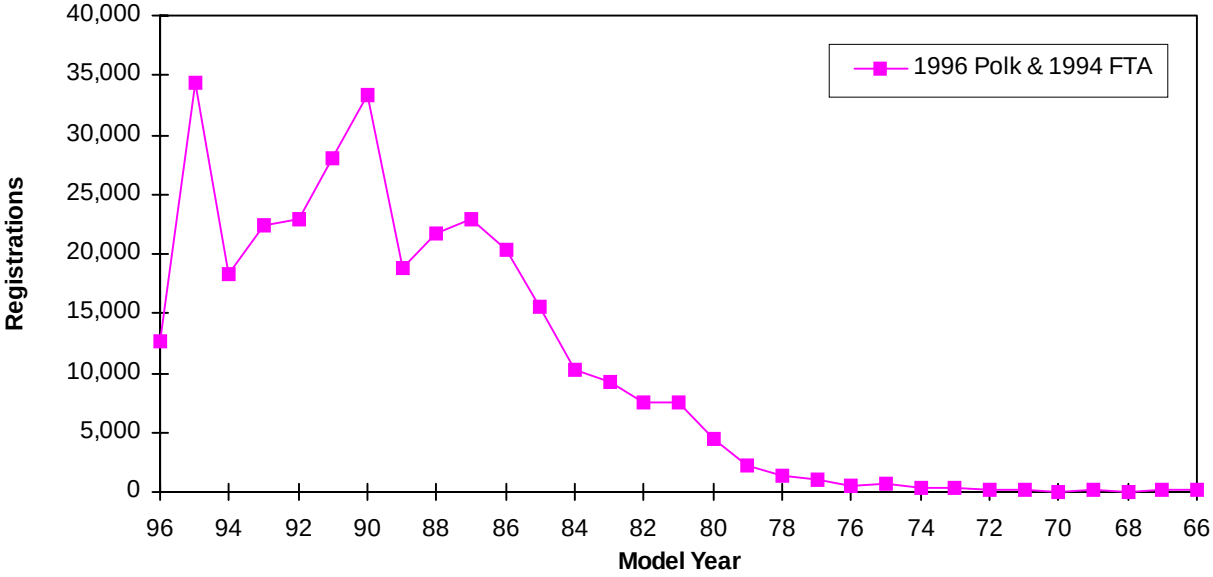


Figure 4-27. Annual Miles by Age
LDV

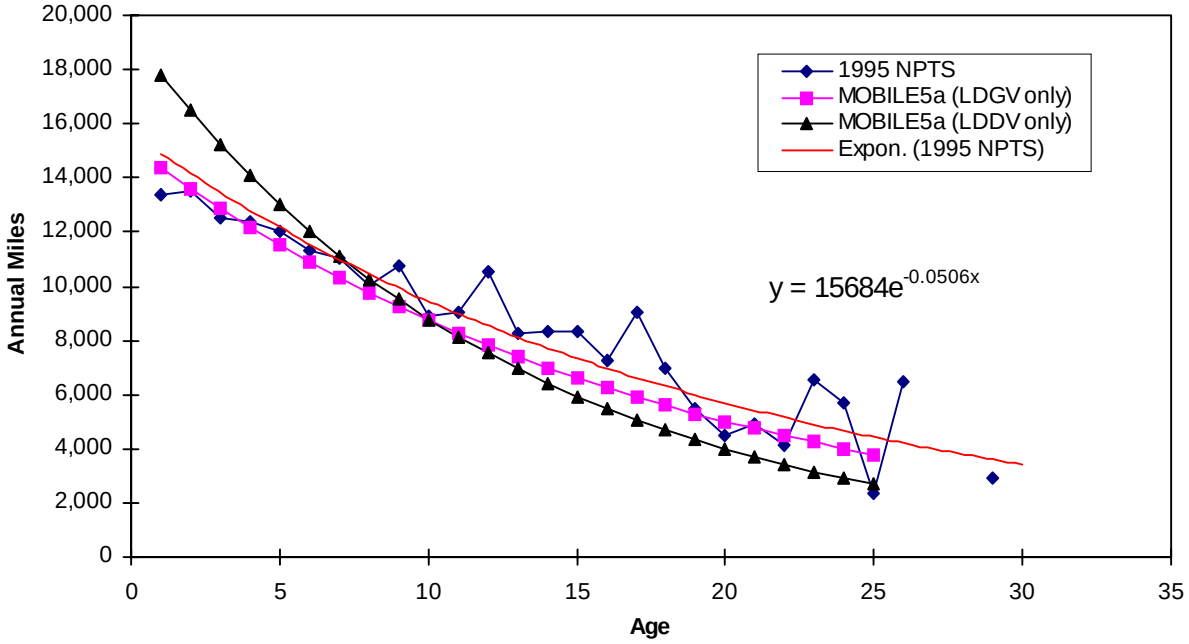


Figure 4-28. Annual Miles by Age
LDGT1

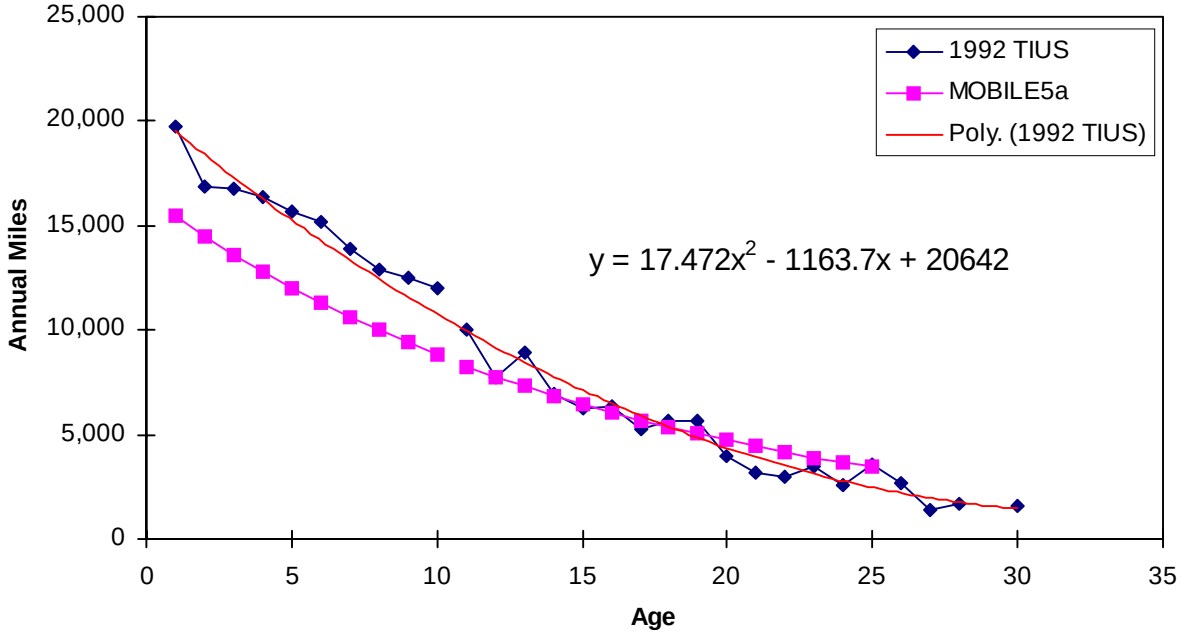


Figure 4-29. Annual Miles by Age
LDGT2

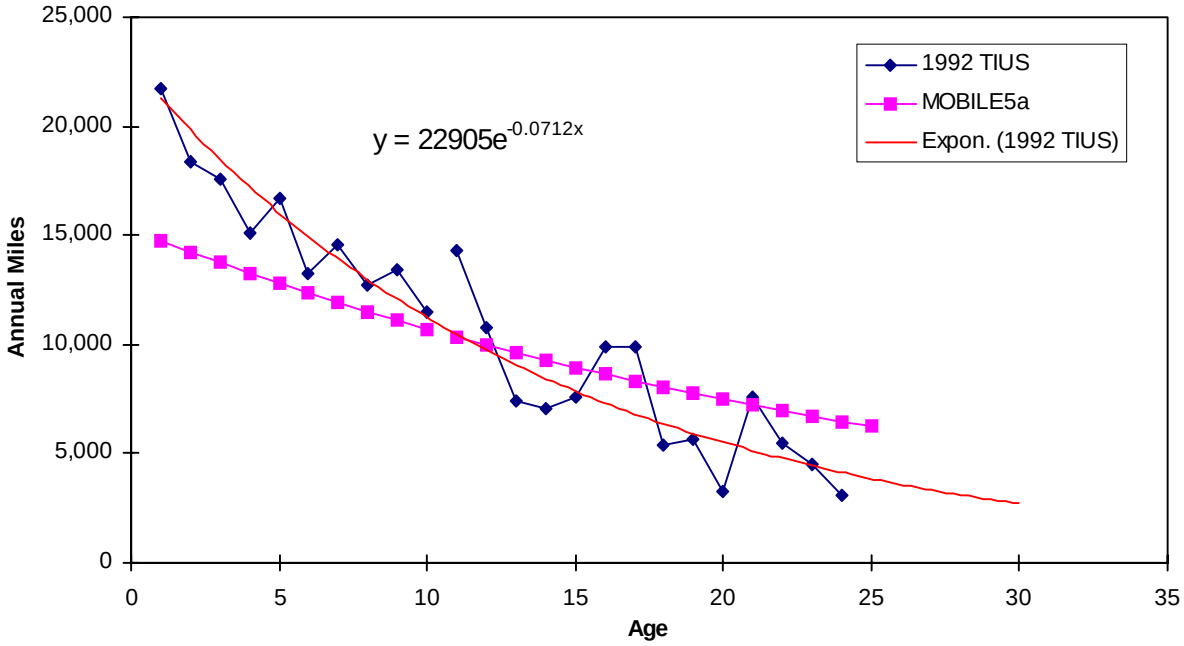


Figure 4-30. Annual Miles by Age
LDDT1

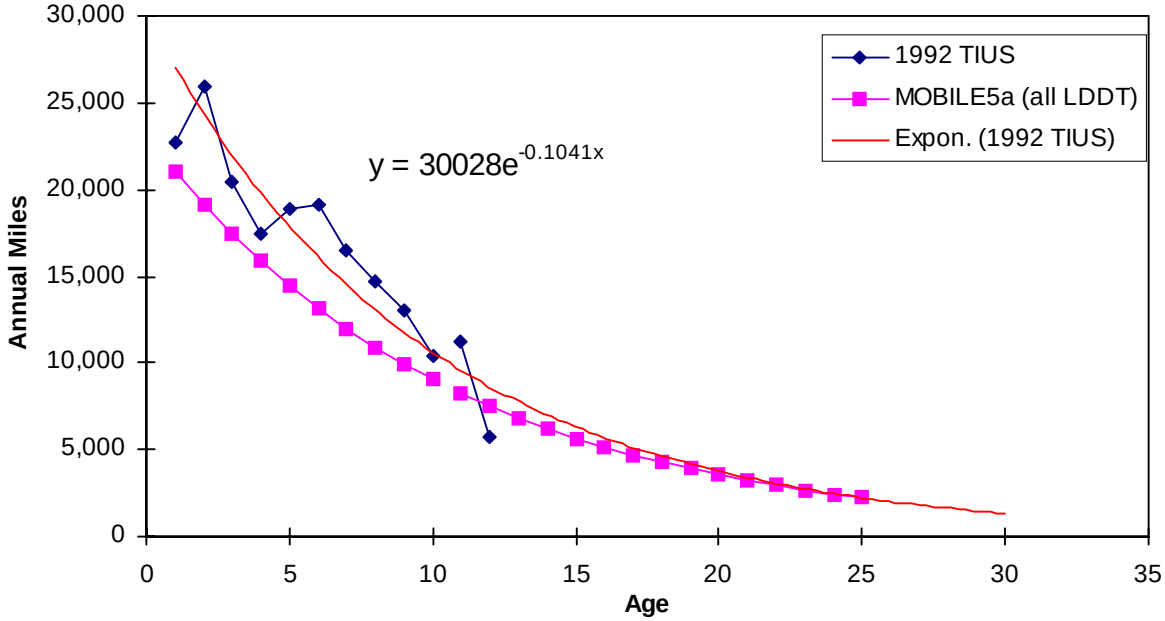


Figure 4-31. Annual Miles by Age
LDDT2

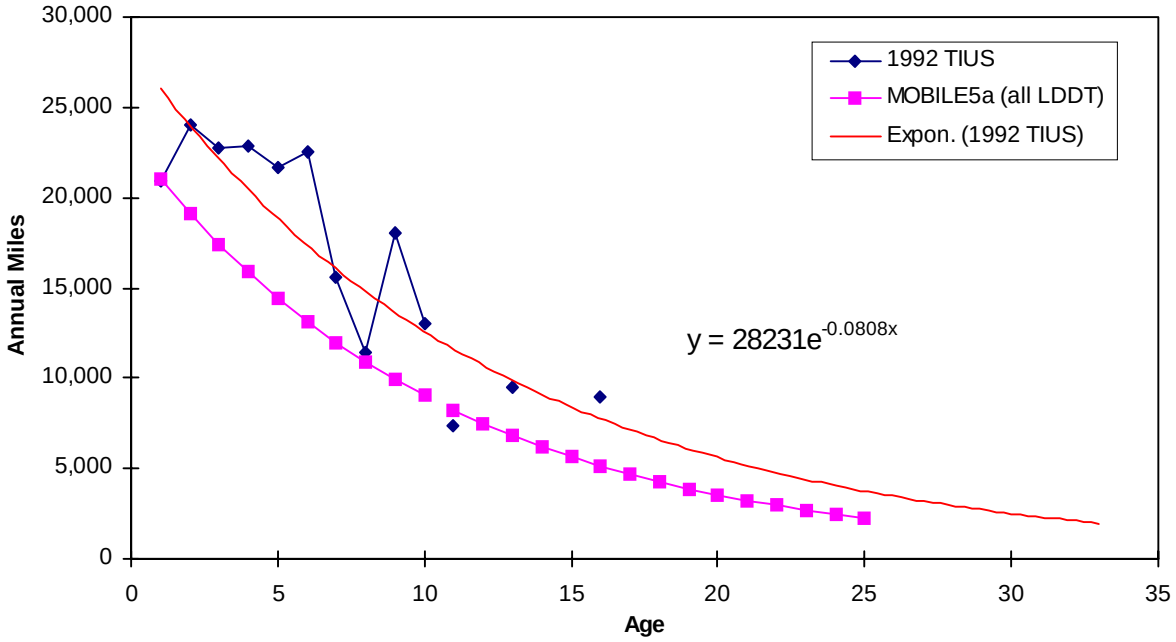


Figure 4-32. Annual Miles by Age
HDGV(2B-3)

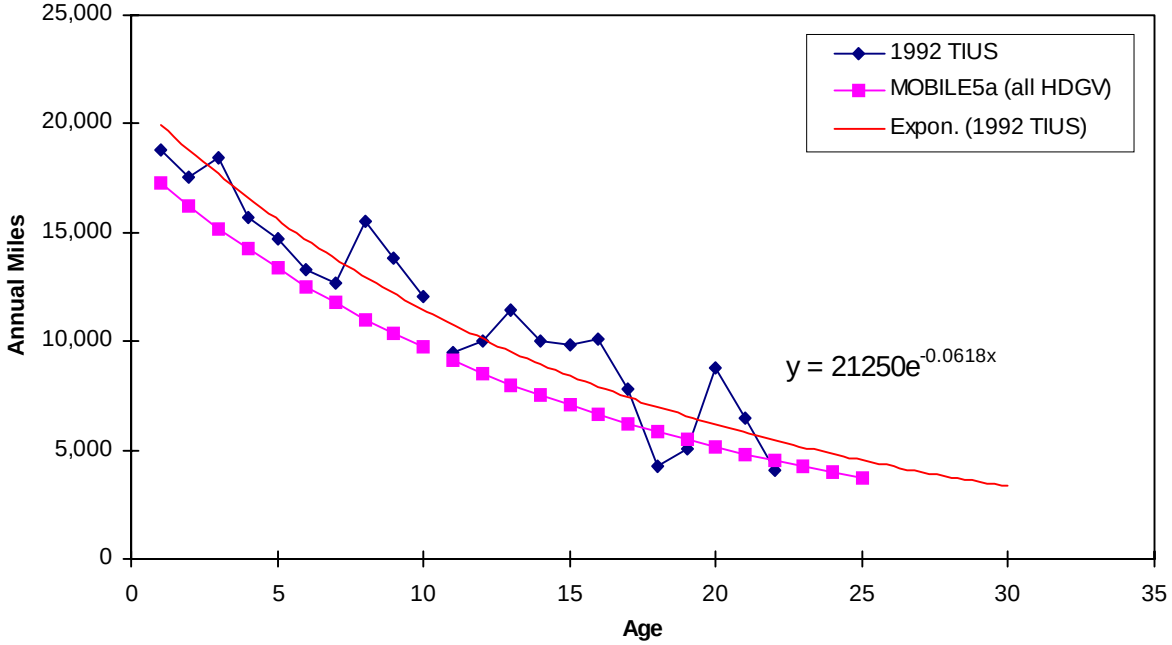


Figure 4-33. Annual Miles by Age
HDGV(4-8)

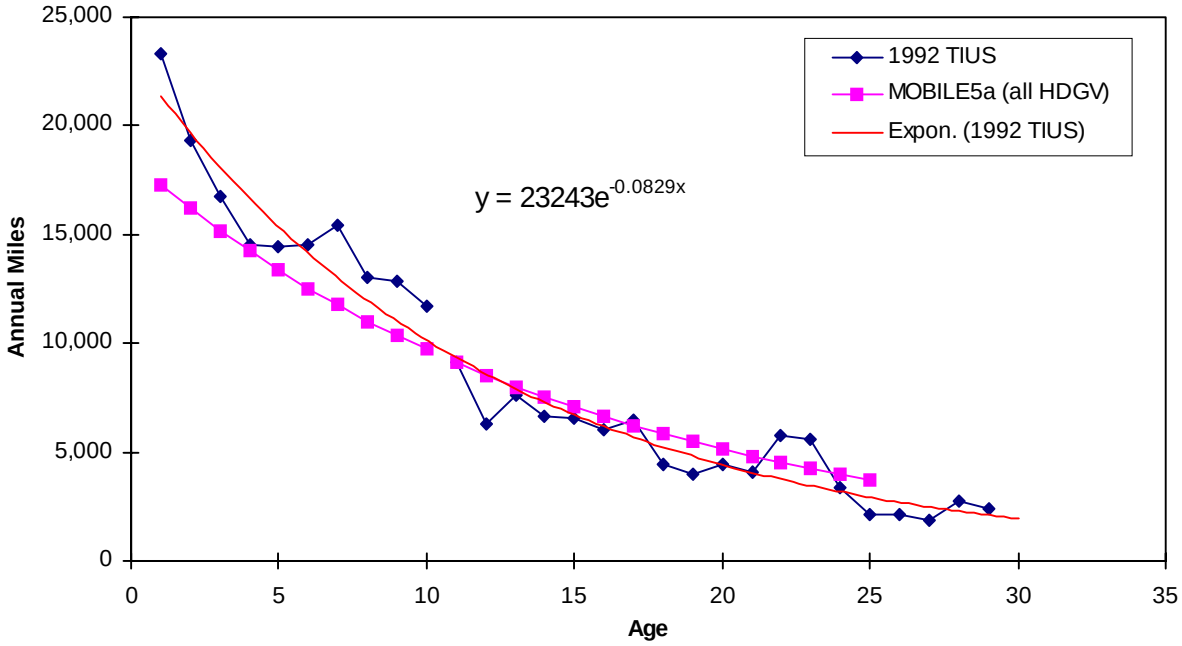


Figure 4-34. Annual Miles by Age
HDGB School

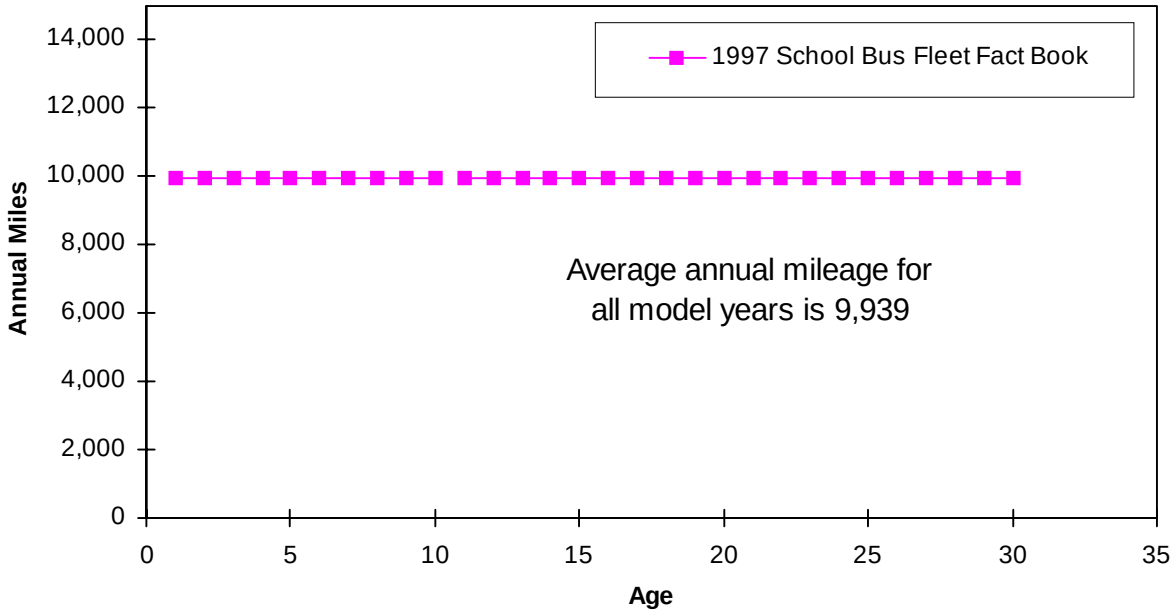


Figure 4-35. Annual Miles by Age
HDGB Transit

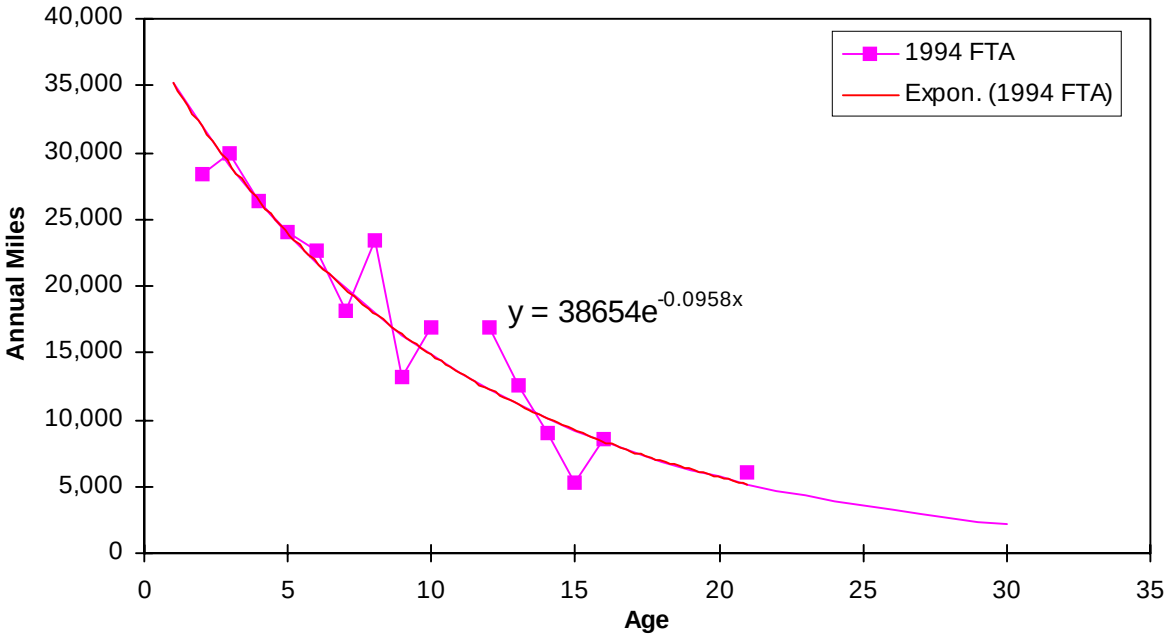


Figure 4-36. Annual Miles by Age
HDDV(2B)

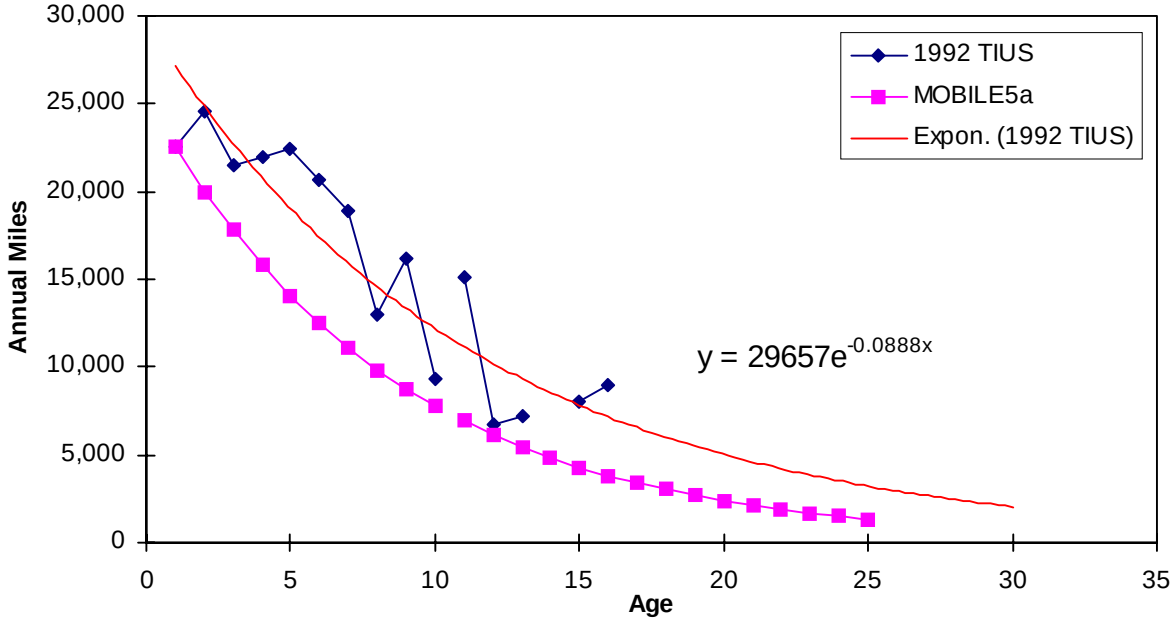


Figure 4-37. Annual Miles by Age
HDDV(3)

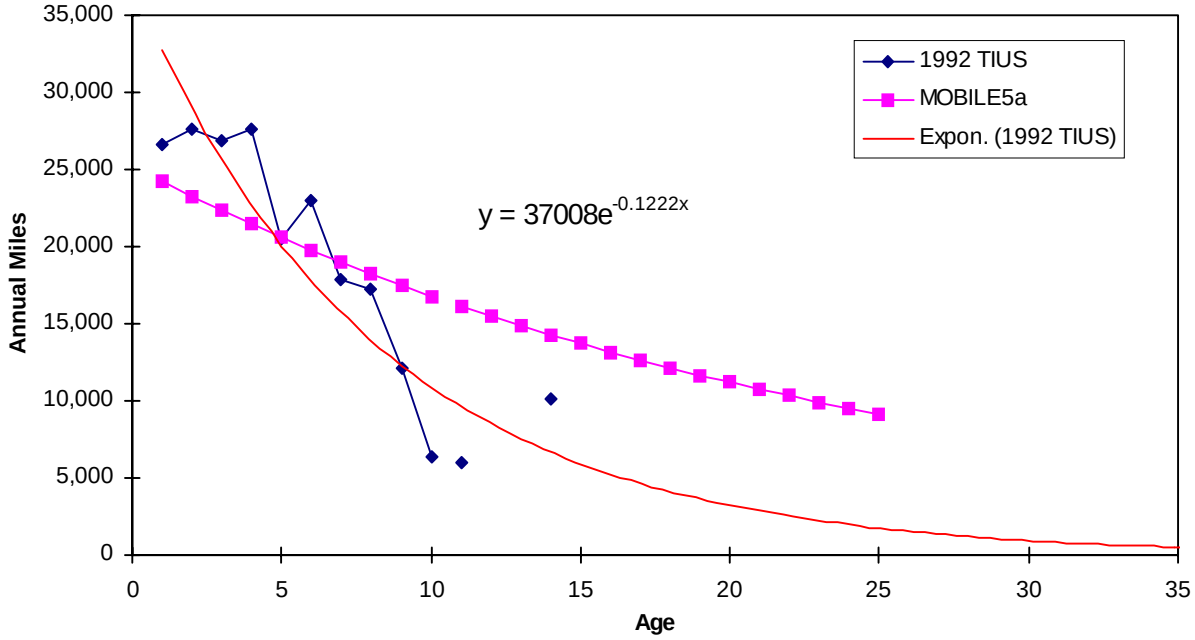


Figure 4-38. Annual Miles by Age
HDDV(4-5)

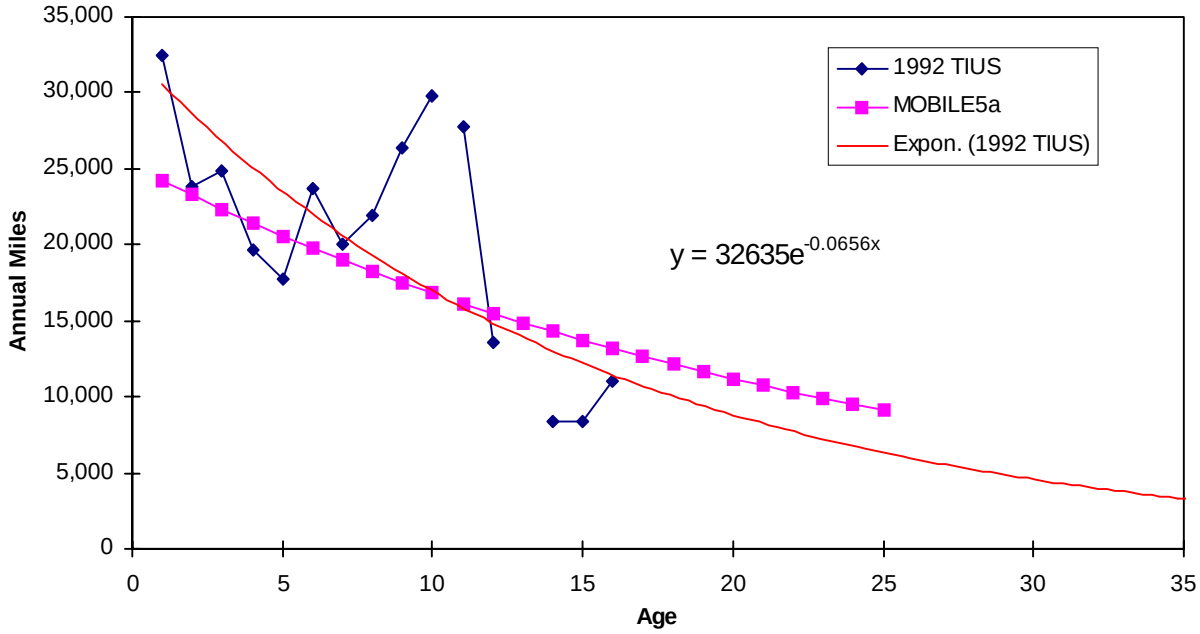


Figure 4-39. Annual Miles by Age
HDDV(6-7)

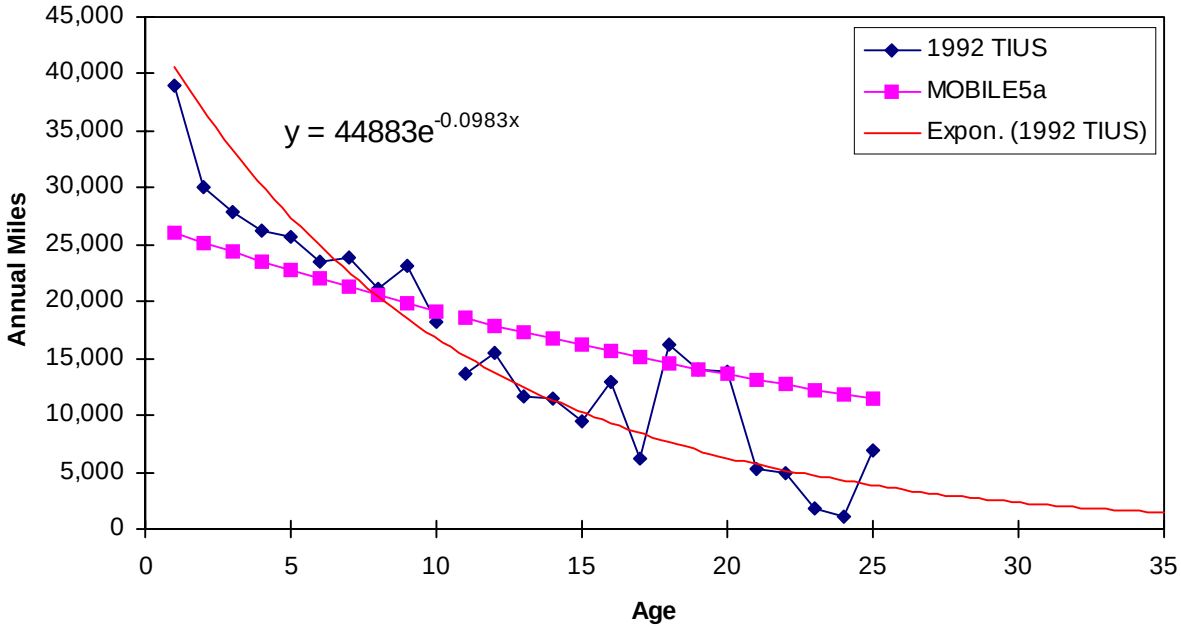


Figure 4-40. Annual Miles by Age
HDDV(8A)

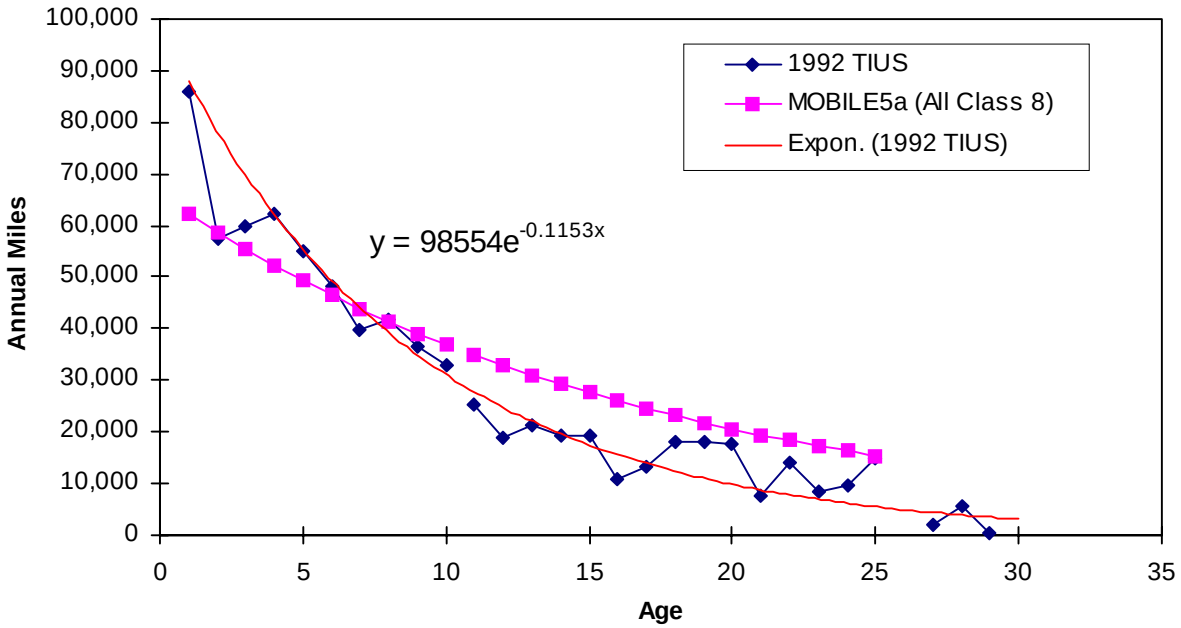


Figure 4-41. Annual Miles by Age
HDDV(8B)

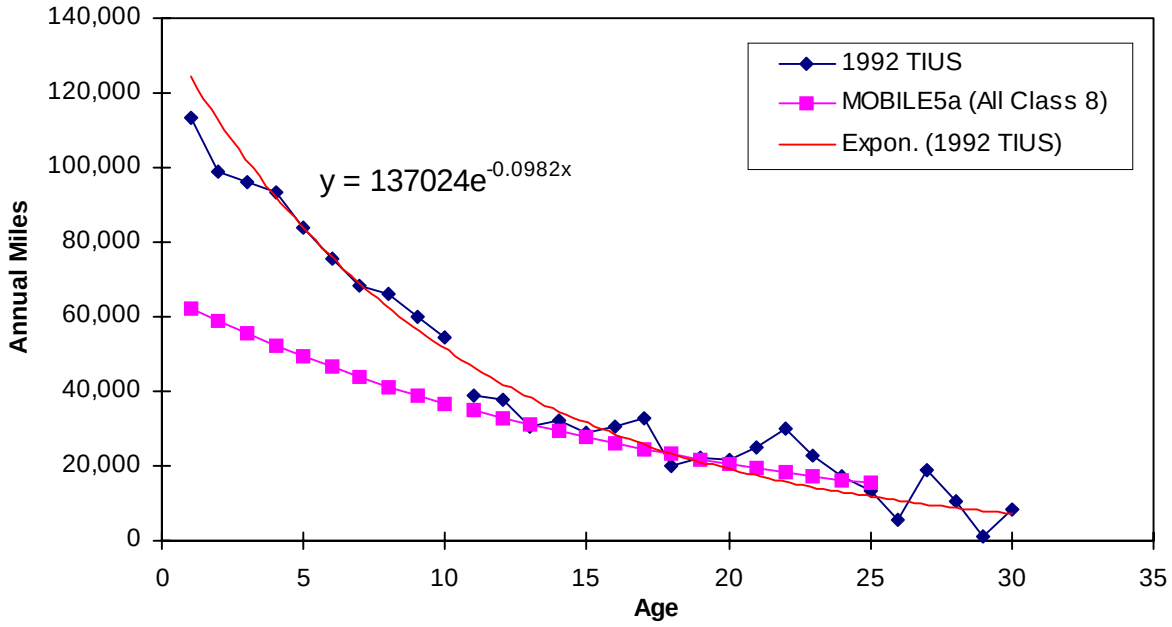


Figure 4-42. Annual Miles by Age
HDDB School

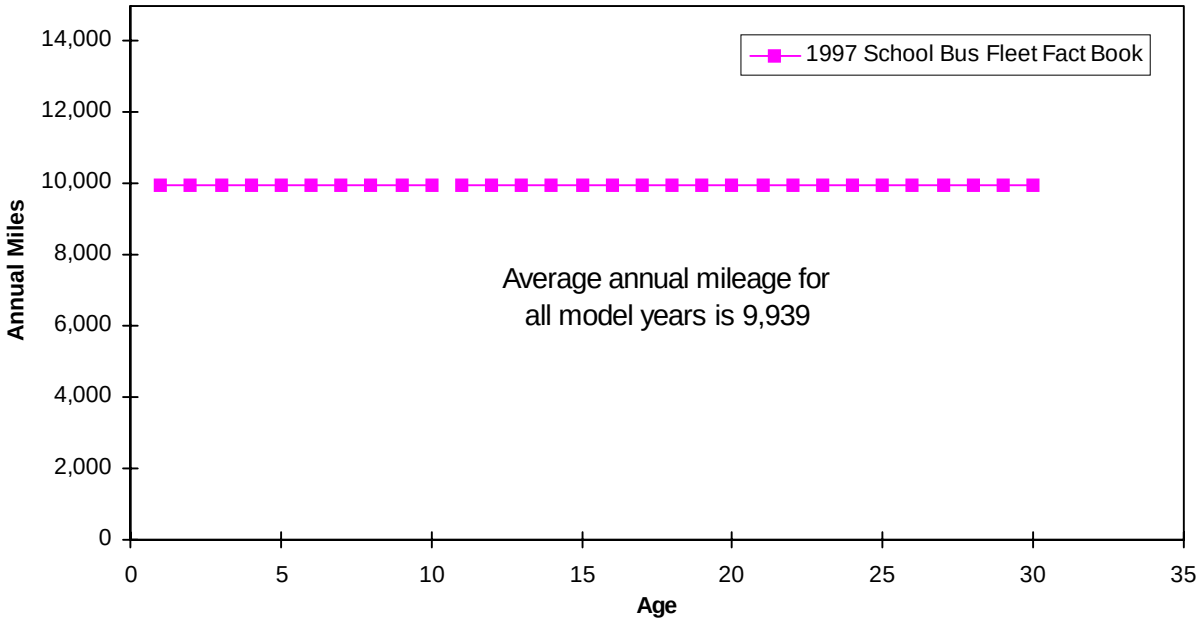


Figure 4-43. Annual Miles by Age
HDDB Transit

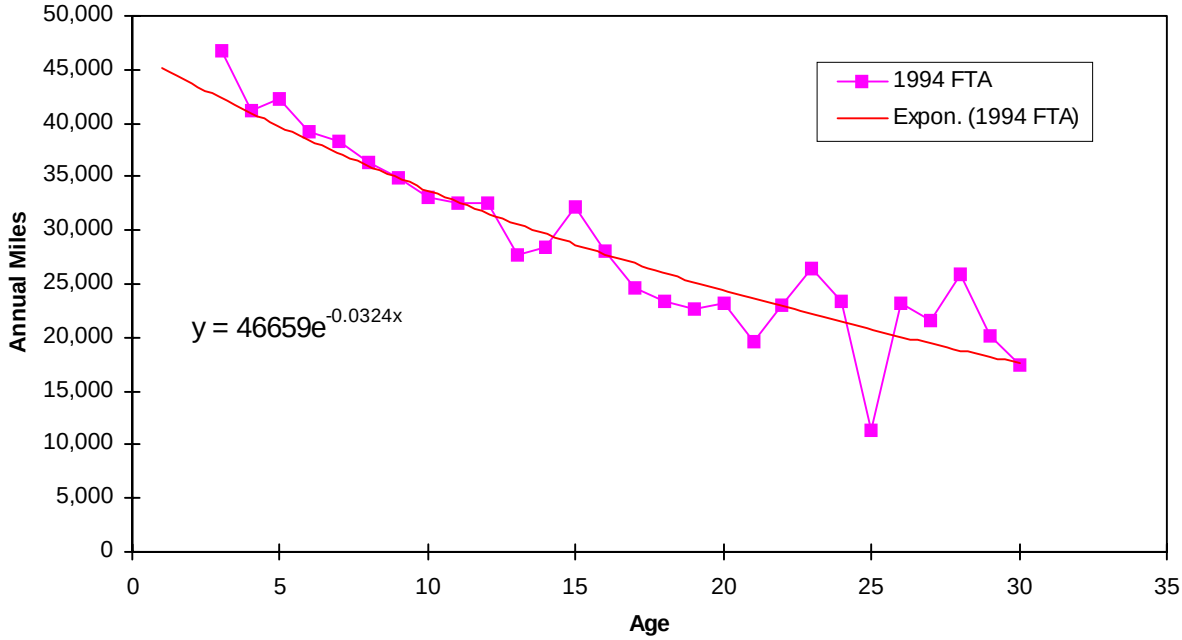


Table 4-2. Vehicles in Operation as of July 1996
U.S. Levels

	LDV		LDGT		LDDT		HDGV		HDGB	
Model Year	LDGV	LDDV	LDGT1 <6000	LDGT2 6001-8500	LDDT1 <6000	LDDT2 6001-8500	2B-3 8501-14000	4-8 >14000	S.BUS ANY WGT.	T.BUS ANY WGT.
96	5999331	5330	2475332	963616	0	12298	321205	16273	516	0
95	9166694	5425	3723979	1450819	0	16827	483606	54732	4408	0
94	7966182	630	3636380	1214578	1	13634	404859	47587	2926	30
93	8027524	2715	3338741	855812	0	12582	285271	35154	2673	54
92	7468105	4432	2716821	748099	0	8703	249366	36885	102	108
91	7742072	9746	2893672	570854	0	7481	190285	35345	2368	83
90	7927068	3280	2517145	712943	0	6943	237648	47336	4009	55
89	8687143	3676	2922994	833087	0	6934	277696	55083	4342	116
88	8800821	568	2961942	737315	0	5338	245772	70682	6115	78
87	8403556	23000	2666470	576923	1937	4760	192308	58113	6980	84
86	8093892	26380	2600147	701241	8701	8808	233747	51373	8209	87
85	7090963	69659	2040755	661168	9754	9038	220389	56147	11009	28
84	5978688	98664	1670540	564080	20230	9680	188027	55959	11363	34
83	3831635	94461	948999	388127	21601	8271	129376	37983	10931	23
82	2710825	145689	739107	277091	51916	7279	92364	37446	9270	11
81	2305351	175194	651163	251737	42762	329	83912	37952	12053	4
80	1953647	79200	446378	340398	20482	217	113466	45494	10434	9
79	2237823	61862	529703	820584	17283	917	273528	88619	9290	13
78	1785913	20597	384720	756833	10222	93	252278	69373	8459	2
77	1335445	12593	328772	587410	0	21	195803	67918	9547	1
76	824579	11453	389724	295581	7408	12	98527	67102	6915	2
75	477882	7505	210964	181913	24441	8	60638	90069	8715	3
74	532240	3599	335900	130161	44505	7	43387	94921	0	1
73	0	0	0	0	0	0	0	93372	0	0
72	0	0	0	0	0	0	0	72328	0	0
71	0	0	0	0	0	0	0	54597	0	0
70	0	0	0	0	0	0	0	57955	0	0
69	0	0	0	0	0	0	0	50761	0	0
68	0	0	0	0	0	0	0	39588	0	0
67	0	0	0	0	0	0	0	38887	0	0
66	0	0	0	0	0	0	0	34371	0	0
TOTAL	**119347379**	**865658**	**41130348**	**14620369**	**281243**	**140179**	**4873456**	**1699401**	**150634**	**826**

LDV Light duty vehicle
LDGV Light duty gasoline vehicle
LDDV Light duty diesel vehicle
LDGT Light duty gasoline truck
LDDT Light duty diesel truck
HDGV Heavy duty gasoline vehicle
HDGB Heavy duty gasoline bus

Table 4-2. Vehicles in operation as of July 1996 (continued)
U.S. Levels

Model Year	HDDV						HDDB		ALL VEHICLES TOTAL
	2B 8501-10000	3 10001-14000	4-5 14001-19500	6-7 19501-33000	8A* 33001-60000	8B* >60000	S.BUS ANY WGT.	T.BUS** ANY WGT.	
96	77760	20611	15084	36848	22858	63398	12592		10043049
95	162857	49894	45619	112777	55767	154674	34395		15522473
94	131869	46825	29457	69815	41561	115272	17088	1186	13739879
93	133923	37278	26359	63675	35682	98966	19899	2496	12978803
92	93290	31827	20855	55070	18191	79092	20696	2278	11553918
91	77685	28002	14467	64578	25051	71036	24920	3188	11760833
90	72117	40421	18977	80650	28786	83175	28698	4682	11813932
89	69774	32708	20834	60814	29759	98894	15007	3829	13122690
88	50752	22387	13770	68499	25953	89567	18602	3167	13121329
87	45383	20704	4064	69454	29736	74622	19539	3299	12200932
86	84934	25966	2184	60684	28204	59103	17097	3330	12014086
85	80761	10736	2066	61696	30539	69423	11743	3741	10439615
84	78286	6075	1565	56347	25970	56621	7120	3206	8832456
83	51681	4005	454	28033	13613	26483	5245	3989	5604910
82	35845	2110	198	29110	18921	28273	4488	3017	4192960
81	1135	21	246	39861	23076	33078	4324	3270	3665466
80	0	0	2	27106	19685	24454	659	3811	3085441
79	0	0	0	23784	28160	36212	448	1695	4129922
78	0	1	0	14891	21616	29266	253	1182	3355700
77	0	2	0	7938	14940	23464	235	760	2584847
76	0	3	268	4459	9327	9767	60	510	1725698
75	0	5	106	4534	15695	10430	77	682	1093667
74	0	34	6	3740	5779	8590	0	338	1203209
73	0	20	127	3497	5492	7013	0	393	109914
72	0	0	118	2601	4445	3650	0	247	83389
71	0	0	60	1905	3799	1980	0	211	62551
70	0	0	38	4447	3386	791	0	73	66691
69	0	0	116	2618	850	1205	0	106	55655
68	0	0	95	2007	655	605	0	78	43028
67	0	0	94	321	186	946	0	90	40524
66	0	4	71	261	277	298	0	189	35470
TOTAL	**1248050**	**379639**	**217303**	**1062021**	**587955**	**1360346**	**263185**	**55043**	**188283036**

HDDV Heavy duty diesel vehicle
HDDB Heavy duty diesel bus

* in MY 93-96, assumed 26.5% of Class 8 vehicles are Class 8A; for all other MY, percentage based upon 1992 TIUS data
** transit bus registrations are from FTA data

Table 4-3. Annual Mileage Accumulation (Raw Data)
U.S. Levels

Vehicle Age	LDV		LDGT		LDDT		HDGV		HDGB	
	LDGV	LDDV	LDGT1 <6000	LDGT2 6001-8500	LDDT1 <6000	LDDT2 6001-8500	2B-3 8501-14000	4-8 >14000	S.BUS ANY WGT.	T.BUS ANY WGT.
1	13386	13386	19698	21694	22653	20882	18815	23355	(a)	(b)
2	13488	13488	16825	18416	25994	24072	17574	19328		28426
3	12496	12496	16770	17576	20482	22784	18405	16790		29869
4	12351	12351	16386	15141	17448	22879	15697	14549		26386
5	12059	12059	15677	16733	18890	21633	14700	14475		24000
6	11343	11343	15132	13229	19068	22558	13281	14502		22708
7	11067	11067	13883	14587	16500	15628	12662	15391		18205
8	10004	10004	12938	12677	14710	11402	15497	13001		23463
9	10718	10718	12522	13392	13016	18014	13804	12847		13141
10	8910	8910	12026	11527	10347	13072	12067	11745		16905
11	9046	9046	10008	14292	11272	7357	9484	9122		(b)
12	10527	10527	7726	10784	5738		10058	6287		16882
13	8268	8268	8940	7411		9470	11476	7621		12600
14	8330	8330	6904	7026			10011	6662		9000
15	8337	8337	6238	7597			9862	6519		5250
16	7241	7241	6365	9852		9000	10138	5997		8583
17	9015	9015	5278	9895			7763	6464		(b)
18	6966	6966	5662	5365			4234	4397		(b)
19	5479	5479	5704	5660			5009	3999		(b)
20	4460	4460	4011	3239			8798	4412		(b)
21	4940	4940	3127	7557			6501	4062		6000
22	4125	4125	2994	5500			4122	5736		
23	6531	6531	3465	4471				5628		
24	5719	5719	2556	3124				3356		
25	2357	2357	3616					2149		
26	6470	6470	2639					2091		
27			1382					1820		
28			1685					2714		
29	2921	2921						2356		
30			1622							

LDV Light duty vehicle
LDGV Light duty gasoline vehicle
LDDV Light duty diesel vehicle
LDGT Light duty gasoline truck
LDDT Light duty diesel truck
HDGV Heavy duty gasoline vehicle
HDGB Heavy duty gasoline bus

(a) Average school bus mileage for all ages = 9,939
(b) Indicates data point was removed as an abnormality

Table 4-3. Annual Mileage Accumulation (Raw Data) (continued)
U.S. Levels

Vehicle Age	HDDV						HDDB	
	2B 8501-10000	3 10001-14000	4-5 14001-19500	6-7 19501-33000	8A 33001-60000	8B >60000	S.BUS ANY WGT.	T.BUS ANY WGT.
1	22533	26616	32471	39017	85794	113141	(a)	(b)
2	24591	27581	23791	30011	57498	98673		(b)
3	21502	26920	24800	27931	59784	95977		46791
4	21973	27678	19624	26190	62189	93147		41262
5	22448	20526	17776	25680	55199	84050		42206
6	20624	22980	23767	23481	48350	75736		39160
7	18932	17816	20066	23955	39863	68358		38266
8	12949	17268	21918	21071	41742	66294		36358
9	16151	12186	26337	23124	36635	60231		34935
10	9320	6333	29844	18216	32963	54245		33021
11	15151	6000	27830	13646	25153	39068		32540
12	6750		13571	15412	18800	37879		32605
13	7200			11618	21244	30798		27722
14		10159	8341	11487	19149	32119		28429
15	8000		8400	9458	19386	28777		32140
16	9000		11000	12977	10912	30416		28100
17				6269	13256	32813		24626
18				16296	17975	19820		23428
19				14115	18036	22471		22575
20				13844	17712	21928		23220
21				5297	7459	25033		19588
22				5000	13934	30084		22939
23				1805	8493	22559		26413
24				1053	9452	17363		23366
25				7000	14818	13278		11259
26						5538		23228
27					2088	19040		21515
28					5533	10417		25939
29					502	1350		20117
30						8443		17515

HDDV Heavy duty diesel vehicle
HDDB Heavy duty diesel bus

(a) Average school bus mileage for all ages = 9,939
(b) Indicates data point was removed as an abnormality

Table 4-4. Annual Mileage Accumulation (Curve Fit Data)
U.S. Levels

Vehicle Age	LDV		LDGT		LDDT		HDGV		HDGB	
	LDGV	LDDV	LDGT1 <6000	LDGT2 6001-8500	LDDT1 <6000	LDDT2 6001-8500	2B-3 8501-14000	4-8 >14000	S.BUS ANY WGT.	T.BUS ANY WGT.
1	14910	14910	19496	21331	27059	26040	19977	21394	(a)	35123
2	14174	14174	18384	19865	24384	24018	18779	19692		31914
3	13475	13475	17308	18500	21973	22154	17654	18125		28999
4	12810	12810	16267	17228	19801	20434	16596	16683		26350
5	12178	12178	15260	16044	17843	18848	15601	15356		23942
6	11577	11577	14289	14942	16079	17385	14666	14134		21755
7	11006	11006	13352	13915	14490	16036	13787	13010		19768
8	10463	10463	12451	12959	13057	14791	12961	11975		17962
9	9947	9947	11584	12068	11766	13643	12184	11022		16321
10	9456	9456	10752	11239	10603	12584	11454	10145		14830
11	8989	8989	9955	10466	9555	11607	10768	9338		13475
12	8546	8546	9194	9747	8610	10706	10122	8595		12244
13	8124	8124	8467	9077	7759	9875	9516	7911		11126
14	7723	7723	7775	8453	6992	9109	8946	7282		10109
15	7342	7342	7118	7872	6301	8402	8409	6703		9186
16	6980	6980	6496	7331	5678	7749	7905	6169		8347
17	6636	6636	5909	6827	5116	7148	7432	5679		7584
18	6308	6308	5356	6358	4610	6593	6986	5227		6891
19	5997	5997	4839	5921	4155	6081	6568	4811		6262
20	5701	5701	4357	5514	3744	5609	6174	4428		5690
21	5420	5420	3909	5135	3374	5174	5804	4076		5170
22	5152	5152	3497	4782	3040	4772	5456	3752		4698
23	4898	4898	3120	4454	2740	4402	5129	3453		4268
24	4656	4656	2777	4148	2469	4060	4822	3178		3879
25	4427	4427	2470	3863	2225	3745	4533	2926		3524
26	4208	4208	2197	3597	2005	3454	4261	2693		3202
27	4001	4001	1959	3350	1807	3186	4006	2479		2910
28	3803	3803	1756	3120	1628	2939	3766	2281		2644
29	3616	3616	1589	2905	1467	2711	3540	2100		2402
30	3437	3437	1456	2706	1322	2500	3328	1933		2183

LDV Light duty vehicle
LDGV Light duty gasoline vehicle
LDDV Light duty diesel vehicle
LDGT Light duty gasoline truck
LDDT Light duty diesel truck
HDGV Heavy duty gasoline vehicle
HDGB Heavy duty gasoline bus

(a) Average school bus mileage for all ages = 9,939

Table 4-4. Annual Mileage Accumulation (Curve Fit Data) (continued)
U.S. Levels

Vehicle Age	HDDV						HDDB	
	2B 8501-10000	3 10001-14000	4-5 14001-19500	6-7 19501-33000	8A 33001-60000	8B >60000	S.BUS ANY WGT.	T.BUS ANY WGT.
1	27137	32751	30563	40681	87821	124208	(a)	45171
2	24831	28984	28622	36872	78257	112590		43731
3	22721	25650	26805	33420	69735	102060		42337
4	20791	22699	25103	30291	62141	92514		40987
5	19024	20088	23509	27455	55374	83861		39681
6	17407	17778	22016	24885	49343	76017		38416
7	15928	15733	20618	22555	43970	68907		37191
8	14575	13923	19309	20443	39181	62462		36005
9	13336	12321	18083	18529	34915	56620		34857
10	12203	10904	16935	16795	31112	51324		33746
11	11166	9650	15860	15222	27724	46523		32670
12	10217	8540	14853	13797	24705	42172		31629
13	9349	7557	13910	12505	22015	38228		30620
14	8555	6688	13026	11335	19617	34652		29644
15	7828	5919	12199	10273	17481	31411		28699
16	7163	5238	11425	9312	15577	28473		27784
17	6554	4635	10699	8440	13881	25810		26898
18	5997	4102	10020	7650	12369	23396		26041
19	5488	3630	9384	6933	11022	21208		25211
20	5021	3213	8788	6284	9822	19224		24407
21	4595	2843	8230	5696	8752	17426		23629
22	4204	2516	7707	5163	7799	15796		22875
23	3847	2227	7218	4679	6950	14319		22146
24	3520	1971	6760	4241	6193	12979		21440
25	3221	1744	6331	3844	5518	11765		20757
26	2947	1543	5929	3484	4918	10665		20095
27	2697	1366	5552	3158	4382	9667		19454
28	2468	1209	5200	2862	3905	8763		18834
29	2258	1070	4869	2594	3480	7944		18234
30	2066	947	4560	2352	3101	7201		17652

HDDV Heavy duty diesel vehicle
HDDB Heavy duty diesel bus

(a) Average school bus mileage for all ages = 9,939

Table 4-5. Annual mileage accumulation curve fit equations

Vehicle Class	Equation
LDGV	$y = 15684e^{-0.0506x}$
LDDV	$y = 15684e^{-0.0506x}$
LDGT1	$y = 17.472x^2 - 1163.7x + 20642$
LDGT2	$y = 22905e^{-0.0712x}$
LDDT1	$y = 30028e^{-0.1041x}$
LDDT2	$y = 28231e^{-0.0808x}$
HDGV (2B-3)	$y = 21250e^{-0.0618x}$
HDGV (4-8)	$y = 23243e^{-0.0829x}$
HDGSB	$y = 9939$
HDGTB	$y = 38654e^{-0.0958x}$
HDDV (2B)	$y = 29657e^{-0.0888x}$
HDDV (3)	$y = 37008e^{-0.1222x}$
HDDV (4-5)	$y = 32635e^{-0.0656x}$
HDDV (6-7)	$y = 44883e^{-0.0983x}$
HDDV (8A)	$y = 98554e^{-0.1153x}$
HDDV (8B)	$y = 137024e^{-0.0982x}$
HDDSB	$y = 9939$
HDDTB	$y = 46659e^{-0.0324x}$

x = Model year - 1900
y = Annual mileage (miles)

Table 4-6. Vehicles in Operation as Percent of Class as of July 1996
U.S. Levels

Model Year	LDV		LDGT		LDDT		HDGV		HDGB	
	LDGV	LDDV	LDGT1 <6000	LDGT2 6001-8500	LDDT1 <6000	LDDT2 6001-8500	2B-3 8501-14000	4-8 >14000	S.BUS ANY WGT.	T.BUS ANY WGT.
96	5.03%	0.62%	6.02%	6.59%	0.00%	8.77%	6.59%	0.96%	0.34%	0.00%
95	7.68%	0.63%	9.05%	9.92%	0.00%	12.00%	9.92%	3.22%	2.93%	0.00%
94	6.67%	0.07%	8.84%	8.31%	0.00%	9.73%	8.31%	2.80%	1.94%	3.63%
93	6.73%	0.31%	8.12%	5.85%	0.00%	8.98%	5.85%	2.07%	1.77%	6.54%
92	6.26%	0.51%	6.61%	5.12%	0.00%	6.21%	5.12%	2.17%	0.07%	13.08%
91	6.49%	1.13%	7.04%	3.90%	0.00%	5.34%	3.90%	2.08%	1.57%	10.05%
90	6.64%	0.38%	6.12%	4.88%	0.00%	4.95%	4.88%	2.79%	2.66%	6.66%
89	7.28%	0.42%	7.11%	5.70%	0.00%	4.95%	5.70%	3.24%	2.88%	14.04%
88	7.37%	0.07%	7.20%	5.04%	0.00%	3.81%	5.04%	4.16%	4.06%	9.44%
87	7.04%	2.66%	6.48%	3.95%	0.69%	3.40%	3.95%	3.42%	4.63%	10.17%
86	6.78%	3.05%	6.32%	4.80%	3.09%	6.28%	4.80%	3.02%	5.45%	10.53%
85	5.94%	8.05%	4.96%	4.52%	3.47%	6.45%	4.52%	3.30%	7.31%	3.39%
84	5.01%	11.40%	4.06%	3.86%	7.19%	6.91%	3.86%	3.29%	7.54%	4.12%
83	3.21%	10.91%	2.31%	2.65%	7.68%	5.90%	2.65%	2.24%	7.26%	2.78%
82	2.27%	16.83%	1.80%	1.90%	18.46%	5.19%	1.90%	2.20%	6.15%	1.33%
81	1.93%	20.24%	1.58%	1.72%	15.20%	0.23%	1.72%	2.23%	8.00%	0.48%
80	1.64%	9.15%	1.09%	2.33%	7.28%	0.15%	2.33%	2.68%	6.93%	1.09%
79	1.88%	7.15%	1.29%	5.61%	6.15%	0.65%	5.61%	5.21%	6.17%	1.57%
78	1.50%	2.38%	0.94%	5.18%	3.63%	0.07%	5.18%	4.08%	5.62%	0.24%
77	1.12%	1.45%	0.80%	4.02%	0.00%	0.02%	4.02%	4.00%	6.34%	0.12%
76	0.69%	1.32%	0.95%	2.02%	2.63%	0.01%	2.02%	3.95%	4.59%	0.24%
75	0.40%	0.87%	0.51%	1.24%	8.69%	0.01%	1.24%	5.30%	5.79%	0.36%
74	0.45%	0.42%	0.82%	0.89%	15.82%	0.01%	0.89%	5.59%	0.00%	0.12%
73	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.49%	0.00%	0.00%
72	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.26%	0.00%	0.00%
71	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.21%	0.00%	0.00%
70	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.41%	0.00%	0.00%
69	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.99%	0.00%	0.00%
68	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.33%	0.00%	0.00%
67	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.29%	0.00%	0.00%
66	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.02%	0.00%	0.00%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

LDV Light duty vehicle
LDGV Light duty gasoline vehicle
LDDV Light duty diesel vehicle
LDGT Light duty gasoline truck
LDDT Light duty diesel truck
HDGV Heavy duty gasoline vehicle
HDGB Heavy duty gasoline bus

Table 4-6. Vehicles in Operation as Percent of Class as of July 1996 (continued)
U.S. Levels

Model Year	HDDV						HDDB		ALL VEHICLES TOTAL
	2B 8501-10000	3 10001-14000	4-5 14001-19500	6-7 19501-33000	8A* 33001-60000	8B* >60000	S.BUS ANY WGT.	T.BUS** ANY WGT.	
96	6.23%	5.43%	6.94%	3.47%	3.89%	4.66%	4.78%	0.00%	5.33%
95	13.05%	13.14%	20.99%	10.62%	9.48%	11.37%	13.07%	0.00%	8.24%
94	10.57%	12.33%	13.56%	6.57%	7.07%	8.47%	6.49%	2.15%	7.30%
93	10.73%	9.82%	12.13%	6.00%	6.07%	7.28%	7.56%	4.53%	6.89%
92	7.47%	8.38%	9.60%	5.19%	3.09%	5.81%	7.86%	4.14%	6.14%
91	6.22%	7.38%	6.66%	6.08%	4.26%	5.22%	9.47%	5.79%	6.25%
90	5.78%	10.65%	8.73%	7.59%	4.90%	6.11%	10.90%	8.51%	6.27%
89	5.59%	8.62%	9.59%	5.73%	5.06%	7.27%	5.70%	6.96%	6.97%
88	4.07%	5.90%	6.34%	6.45%	4.41%	6.58%	7.07%	5.75%	6.97%
87	3.64%	5.45%	1.87%	6.54%	5.06%	5.49%	7.42%	5.99%	6.48%
86	6.81%	6.84%	1.01%	5.71%	4.80%	4.34%	6.50%	6.05%	6.38%
85	6.47%	2.83%	0.95%	5.81%	5.19%	5.10%	4.46%	6.80%	5.54%
84	6.27%	1.60%	0.72%	5.31%	4.42%	4.16%	2.71%	5.82%	4.69%
83	4.14%	1.06%	0.21%	2.64%	2.32%	1.95%	1.99%	7.25%	2.98%
82	2.87%	0.56%	0.09%	2.74%	3.22%	2.08%	1.71%	5.48%	2.23%
81	0.09%	0.01%	0.11%	3.75%	3.92%	2.43%	1.64%	5.94%	1.95%
80	0.00%	0.00%	0.00%	2.55%	3.35%	1.80%	0.25%	6.92%	1.64%
79	0.00%	0.00%	0.00%	2.24%	4.79%	2.66%	0.17%	3.08%	2.19%
78	0.00%	0.00%	0.00%	1.40%	3.68%	2.15%	0.10%	2.15%	1.78%
77	0.00%	0.00%	0.00%	0.75%	2.54%	1.72%	0.09%	1.38%	1.37%
76	0.00%	0.00%	0.12%	0.42%	1.59%	0.72%	0.02%	0.93%	0.92%
75	0.00%	0.00%	0.05%	0.43%	2.67%	0.77%	0.03%	1.24%	0.58%
74	0.00%	0.01%	0.00%	0.35%	0.98%	0.63%	0.00%	0.61%	0.64%
73	0.00%	0.01%	0.06%	0.33%	0.93%	0.52%	0.00%	0.71%	0.06%
72	0.00%	0.00%	0.05%	0.24%	0.76%	0.27%	0.00%	0.45%	0.04%
71	0.00%	0.00%	0.03%	0.18%	0.65%	0.15%	0.00%	0.38%	0.03%
70	0.00%	0.00%	0.02%	0.42%	0.58%	0.06%	0.00%	0.13%	0.04%
69	0.00%	0.00%	0.05%	0.25%	0.14%	0.09%	0.00%	0.19%	0.03%
68	0.00%	0.00%	0.04%	0.19%	0.11%	0.04%	0.00%	0.14%	0.02%
67	0.00%	0.00%	0.04%	0.03%	0.03%	0.07%	0.00%	0.16%	0.02%
66	0.00%	0.00%	0.03%	0.02%	0.05%	0.02%	0.00%	0.34%	0.02%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

HDDV Heavy duty diesel vehicle
HDDB Heavy duty diesel bus

Table 4-7. Vehicles in Operation as of July 1996
Aggregated Classes, U.S. Levels

Model Year	LDV all	LDGT all <8500	LDDT all <8500	LDT all <8500	HDGV all >8500	HDGB all any	HDDV 3 to 5 10001-19500	HDDV 8 >33000	HDDV all >8501	HDDB all any
96	6004661	3438948	12298	3451246	337478	516	35695	86256	236558	12592
95	9172119	5174798	16827	5191624	538338	4408	95514	210440	581588	34395
94	7966812	4850958	13635	4864593	452446	2956	76282	156833	434799	18274
93	8030239	4194553	12582	4207136	320424	2727	63637	134648	395882	22395
92	7472537	3464920	8703	3473623	286251	210	52681	97282	298324	22974
91	7751818	3464526	7481	3472007	225630	2451	42469	96087	280820	28108
90	7930348	3230088	6943	3237031	284983	4064	59398	111961	324127	33380
89	8690819	3756081	6934	3763014	332779	4458	53542	128653	312783	18836
88	8801389	3699257	5338	3704595	316453	6193	36157	115520	270929	21769
87	8426556	3243393	6697	3250090	250420	7064	24768	104358	243963	22838
86	8120272	3301388	17509	3318897	285120	8296	28150	87306	261075	20427
85	7160622	2701923	18792	2720715	276536	11037	12802	99962	255220	15484
84	6077352	2234620	29910	2264530	243986	11397	7640	82591	224864	10326
83	3926096	1337126	29872	1366998	167358	10954	4460	40096	124269	9234
82	2856514	1016198	59195	1075393	129809	9281	2308	47194	114457	7505
81	2480545	902900	43091	945991	121864	12057	267	56154	97416	7594
80	2032847	786776	20699	807475	158960	10443	2	44139	71247	4470
79	2299685	1350287	18200	1368487	362147	9303	0	64371	88155	2143
78	1806510	1141553	10315	1151869	321650	8461	1	50883	65775	1435
77	1348038	916182	21	916203	263721	9548	2	38403	46343	995
76	836032	685305	7420	692725	165629	6917	272	19095	23825	570
75	485387	392877	24449	417326	150707	8718	111	26125	30770	759
74	535839	466061	44512	510573	138308	1	40	14369	18149	338
73	0	0	0	0	93372	0	147	12504	16149	393
72	0	0	0	0	72328	0	118	8095	10814	247
71	0	0	0	0	54597	0	60	5778	7744	211
70	0	0	0	0	57955	0	38	4177	8663	73
69	0	0	0	0	50761	0	116	2054	4789	106
68	0	0	0	0	39588	0	95	1260	3362	78
67	0	0	0	0	38887	0	94	1132	1547	90
66	0	0	0	0	34371	0	75	575	911	189
TOTAL	**120213037**	**55750717**	**421422**	**56172139**	**6572857**	**151460**	**596942**	**1948301**	**4855315**	**318228**

LDV Light duty vehicle
LDGV Light duty gasoline vehicle
LDDV Light duty diesel vehicle
LDGT Light duty gasoline truck
LDDT Light duty diesel truck
HDGV Heavy duty gasoline vehicle
HDGB Heavy duty gasoline bus
HDDV Heavy duty diesel vehicle
HDDB Heavy duty diesel bus

Table 4-8. Vehicles in Operation as Percent of Class as of July 1996

Aggregated Classes, U.S. Levels

Model Year	LDV all	LDGT all <8500	LDDT all <8500	LDT all <8500	HDGV all >8500	HDGB all any	HDDV 3 to 5 10001-19500	HDDV 8 >33000	HDDV all >8501	HDDB all any
96	5.00%	6.17%	2.92%	6.14%	5.13%	0.34%	5.98%	4.43%	4.87%	3.96%
95	7.63%	9.28%	3.99%	9.24%	8.19%	2.91%	16.00%	10.80%	11.98%	10.81%
94	6.63%	8.70%	3.24%	8.66%	6.88%	1.95%	12.78%	8.05%	8.96%	5.74%
93	6.68%	7.52%	2.99%	7.49%	4.87%	1.80%	10.66%	6.91%	8.15%	7.04%
92	6.22%	6.22%	2.07%	6.18%	4.36%	0.14%	8.83%	4.99%	6.14%	7.22%
91	6.45%	6.21%	1.78%	6.18%	3.43%	1.62%	7.11%	4.93%	5.78%	8.83%
90	6.60%	5.79%	1.65%	5.76%	4.34%	2.68%	9.95%	5.75%	6.68%	10.49%
89	7.23%	6.74%	1.65%	6.70%	5.06%	2.94%	8.97%	6.60%	6.44%	5.92%
88	7.32%	6.64%	1.27%	6.60%	4.81%	4.09%	6.06%	5.93%	5.58%	6.84%
87	7.01%	5.82%	1.59%	5.79%	3.81%	4.66%	4.15%	5.36%	5.02%	7.18%
86	6.75%	5.92%	4.15%	5.91%	4.34%	5.48%	4.72%	4.48%	5.38%	6.42%
85	5.96%	4.85%	4.46%	4.84%	4.21%	7.29%	2.14%	5.13%	5.26%	4.87%
84	5.06%	4.01%	7.10%	4.03%	3.71%	7.52%	1.28%	4.24%	4.63%	3.24%
83	3.27%	2.40%	7.09%	2.43%	2.55%	7.23%	0.75%	2.06%	2.56%	2.90%
82	2.38%	1.82%	14.05%	1.91%	1.97%	6.13%	0.39%	2.42%	2.36%	2.36%
81	2.06%	1.62%	10.23%	1.68%	1.85%	7.96%	0.04%	2.88%	2.01%	2.39%
80	1.69%	1.41%	4.91%	1.44%	2.42%	6.89%	0.00%	2.27%	1.47%	1.40%
79	1.91%	2.42%	4.32%	2.44%	5.51%	6.14%	0.00%	3.30%	1.82%	0.67%
78	1.50%	2.05%	2.45%	2.05%	4.89%	5.59%	0.00%	2.61%	1.35%	0.45%
77	1.12%	1.64%	0.01%	1.63%	4.01%	6.30%	0.00%	1.97%	0.95%	0.31%
76	0.70%	1.23%	1.76%	1.23%	2.52%	4.57%	0.05%	0.98%	0.49%	0.18%
75	0.40%	0.70%	5.80%	0.74%	2.29%	5.76%	0.02%	1.34%	0.63%	0.24%
74	0.45%	0.84%	10.56%	0.91%	2.10%	0.00%	0.01%	0.74%	0.37%	0.11%
73	0.00%	0.00%	0.00%	0.00%	1.42%	0.00%	0.02%	0.64%	0.33%	0.12%
72	0.00%	0.00%	0.00%	0.00%	1.10%	0.00%	0.02%	0.42%	0.22%	0.08%
71	0.00%	0.00%	0.00%	0.00%	0.83%	0.00%	0.01%	0.30%	0.16%	0.07%
70	0.00%	0.00%	0.00%	0.00%	0.88%	0.00%	0.01%	0.21%	0.18%	0.02%
69	0.00%	0.00%	0.00%	0.00%	0.77%	0.00%	0.02%	0.11%	0.10%	0.03%
68	0.00%	0.00%	0.00%	0.00%	0.60%	0.00%	0.02%	0.06%	0.07%	0.02%
67	0.00%	0.00%	0.00%	0.00%	0.59%	0.00%	0.02%	0.06%	0.03%	0.03%
66	0.00%	0.00%	0.00%	0.00%	0.52%	0.00%	0.01%	0.03%	0.02%	0.06%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

LDV Light duty vehicle
LDGV Light duty gasoline vehicle
LDDV Light duty diesel vehicle
LDGT Light duty gasoline truck
LDDT Light duty diesel truck
HDGV Heavy duty gasoline vehicle
HDGB Heavy duty gasoline bus
HDDV Heavy duty diesel vehicle
HDDB Heavy duty diesel bus

Table 4-9. Gasoline/Diesel Sales Faction*

Model Year	LDV		LDT	
	LDGV	LDDV	LDGT	LDDT
96	99.91%	0.09%	99.64%	0.36%
95	99.94%	0.06%	99.68%	0.32%
94	99.99%	0.01%	99.72%	0.28%
93	99.97%	0.03%	99.70%	0.30%
92	99.94%	0.06%	99.75%	0.25%
91	99.87%	0.13%	99.78%	0.22%
90	99.96%	0.04%	99.79%	0.21%
89	99.96%	0.04%	99.82%	0.18%
88	99.99%	0.01%	99.86%	0.14%
87	99.73%	0.27%	99.79%	0.21%
86	99.68%	0.32%	99.47%	0.53%
85	99.03%	0.97%	99.31%	0.69%

* Assumes that scrappage rates are equivalent for diesel and gasoline vehicles

APPENDIX A

BUSES.PRG

```
*
* Determines total registrations and average annual mileage for transit buses
*   using the FTA database
*
set talk off
use BUSDATA alias DATA
select 2
use BUSOUT alias OUT
index on FUEL+str(MY,4) to BUS
set index to BUS
select DATA
do while .not. eof()
    select OUT
    seek DATA->FUELTYPE+str(DATA->MY,4)
    if .not. found()
        append blank
        replace FUEL with DATA->FUELTYPE
        replace MY with DATA->MY
    endif
    replace TOTALREGS with TOTALREGS + DATA->NUMVEH
    replace AMREG with AMREG + DATA->NUMACTVEH
    replace AMTOT with AMTOT + DATA->ANNMILES*1000
    select DATA
    skip
enddo
select OUT
go top
do while .not. eof()
    if AMREG > 0
        replace ACTMIL with AMTOT/AMREG
    endif
    if TOTALREGS > 0
        replace AVEMIL with AMTOT/TOTALREGS
    endif
    skip
enddo
select 2
use
select 1
use
```

TIUSCONV.C

```
/* TIUSCONV
   Converts the TIUS dataset TI92MDF.DAT to a comma delimited file for
    importing into dBASE file TIUSDAT
*/
#include <stdio.h>
#include <ctype.h>

#define comma   44
char buffer[625];
char bufout[70];
FILE *fin,*fout;
int count;
int idex,odex;

void main()
{
    fin = fopen("E:TI92MDF.DAT","rb");
    fout = fopen("C:TIRED.DAT","wb");
    while (fgets(buffer,625,fin)) {
       odex = 0;
       idex = 14;
       /* EXPANF    15-21  */
       for (count=1; count <=7; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
       }
       bufout[odex] = comma;
       odex++;
       idex = 23;
       /* MDLYR    24-25  */
       for (count=1; count <=2; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
       }
       bufout[odex] = comma;
       odex++;
       /* ACQMON  26-27  */
      for (count=1; count <=2; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
       }
       bufout[odex] = comma;
       odex++;
       /* ACQYR  28-29  */
       for (count=1; count <=2; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
       }
       bufout[odex] = comma;
       odex++;
       /*  OBTAIN 30  */
       bufout[odex] = buffer[idex];
       idex++;
       odex++;
       bufout[odex] = comma;
       odex++;
       /* DISPOZ  42  */
       idex = 41;
```

```
bufout[odex] = buffer[idex];
idex++;
odex++;
bufout[odex] = comma;
odex++;
/* DISMON 43-44 */
for (count=1; count <=2; count++) {
  bufout[odex] = buffer[idex];
  odex++;
  idex++;
}
bufout[odex] = comma;
odex++;
/* DISYR 45-46 */
for (count=1; count <=2; count++) {
  bufout[odex] = buffer[idex];
  odex++;
  idex++;
}
bufout[odex] = comma;
odex++;
/* HOWRID 47 */
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* BODTYP 58-59 */
idex = 57;
for (count=1; count <=2; count++) {
  bufout[odex] = buffer[idex];
  odex++;
  idex++;
}
bufout[odex] = comma;
odex++;
/* MAXWT  105-110  */
idex = 104;
for (count=1; count <=6; count++) {
  bufout[odex] = buffer[idex];
  odex++;
  idex++;
}
bufout[odex] = comma;
odex++;
/* EngTyp  112  */
idex = 111;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* ANNMIL  155-160 */
idex = 154;
for (count=1; count <=6; count++) {
  bufout[odex] = buffer[idex];
  odex++;
  idex++;
}
bufout[odex] = comma;
odex++;
/* TIUGVW  421-422 */
idex = 420;
for (count=1; count <=2; count++) {
```

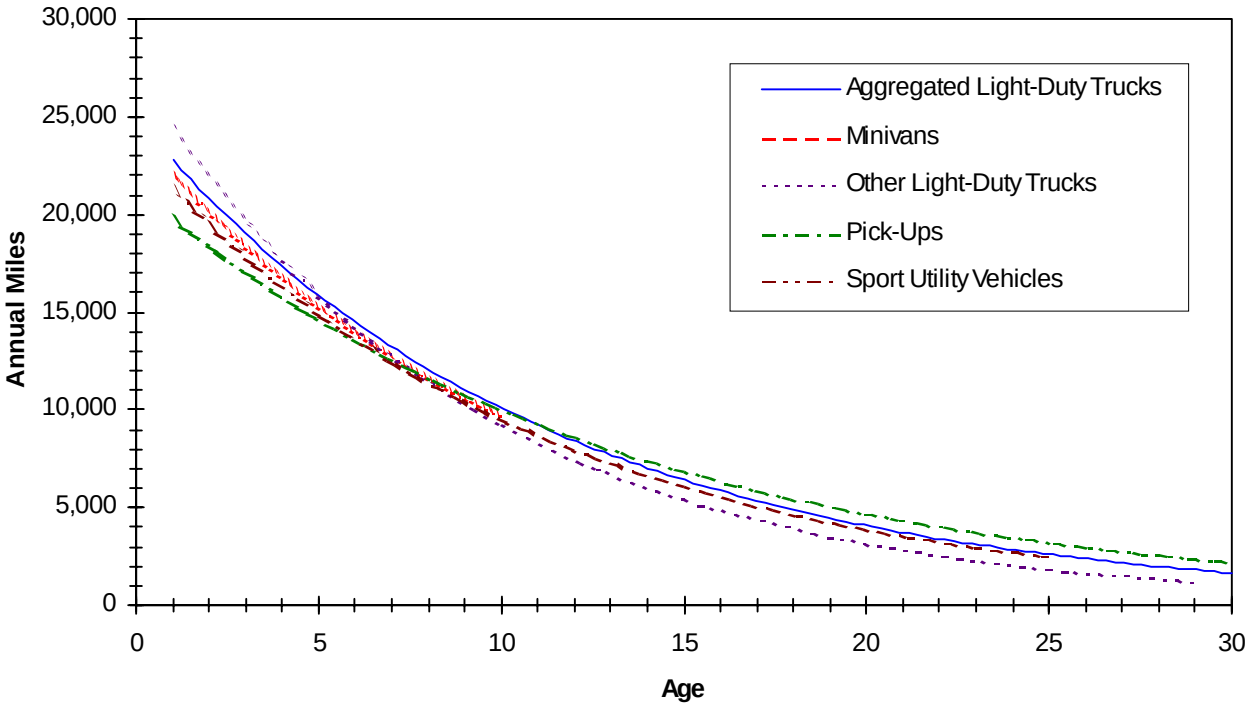
```
          bufout[odex] = buffer[idex];
          odex++;
          idex++;
        }
        bufout[odex] = comma;
        odex++;
        /* PKGVW  423 */
        bufout[odex] = buffer[idex];
        odex++;
        idex++;
        bufout[odex] = comma;
        odex++;
        /* PKRWGT  424-429  */
        for (count=1; count <=6; count++) {
          bufout[odex] = buffer[idex];
          odex++;
          idex++;
        }
        bufout[odex] = comma;
        odex++;
        /* VehSze 430 */
        bufout[odex] = buffer[idex];
        odex++;
        bufout[odex] = '\n';
        odex++;
        bufout[odex] = '\0';
        fputs(bufout,fout);
    }
    fclose(fin);
    fclose(fout);
    puts("\nfile written");
}
```

TIUS.PRG

```
*
*   Determines average annual mileage accumulation rates for trucks using TIUSDAT
*   created from the 1992 TIUS data set using TIUSCONV.C
*
set talk off
use TIUSDAT alias Data
select 2
use TIUSRES alias Res
ZAP
select Data
go top
V = Vehtype
MDY = 93 - Mdlyr
F = Fueltype
Recs = 0
Store 0.00 to Recs,Regs,MRec,AMARec,MTotRecs
do while .not. eof()
    M = 93 - MDLYR
    if M <> MDY .or. Fueltype <> F .or. Vehtype <> V
        select Res
        append blank
        replace VEHTYPE with V
        replace MY with MDY
        replace Fueltype with F
        replace TotalRecs with Recs
        replace TotalRegs with Regs
        replace MiRecs with MRec
        replace Annmiles with AMARec*12/MtotRecs
        select Data
        V = Vehtype
        MDY = M
        F = Fueltype
        Recs = 0
        Store 0.00 to Recs,Regs,MRec,AMARec,MTotRecs
    endif
    Regs = Regs + Data->EXPANF
    Recs = Recs + 1
    if Data->ANNMIL <> SPACE(6)
        MI = val(Data->ANNMIL)
        MRec = MRec + 1
        AMARec = AMARec + MI
        if Data->ACQYR = 92 .AND. Data->ACQMON > 0;
               .and. Data->ACQMON <= 12
            MTotRecs = MTotRecs + 12.5-Data->ACQMON
        else
            if Data->DISYR = 92 .and. Data->DISMON > 0;
                  .and. Data->DISMON <= 12
                MTotRecs = MTotRecs + Data->DISMON-0.5
            else
                MTotRecs = MTotRecs + 12
            endif
        endif
    endif
    select Data
    skip
```

```
enddo
select Res
append blank
replace VEHTYPE with V
replace MY with MDY
replace Fueltype with F
replace TotalRecs with Recs
replace TotalRegs with Regs
replace MiRecs with MRec
replace Annmiles with AMARec*12/MtotRecs
Go Top
Select Data
Go Top
store 0.00 to N,var
Do While .not. eof()
    M = 93 - MDLYR
    if M <> Res->MY .or. Fueltype <> Res->FuelType .or. Vehtype <> Res->Vehtype
        select Res
        if N > 0.00
            replace STDEV_ANMI with SQRT(Var/N)
        endif
        skip
        select Data
    endif
    if Data->ANNMIL <> SPACE(6)
        MI = val(Data->ANNMIL)
        n = N + 1
        if Data->ACQYR = 92 .AND. Data->ACQMON > 0;
               .and. Data->ACQMON <= 12
            Mons = 12.5-Data->ACQMON
        else
            if Data->DISYR = 92 .and. Data->DISMON > 0;
                  .and. Data->DISMON <= 12
                Mons = Data->DISMON-0.5
            else
                Mons = 12
            endif
        endif
        Diff = MI*12/Mons - Res->AnnMiles
        Var = Var + Diff*Diff
    endif
    skip
enddo
select Res
if N > 0.00
    replace STDEV_ANMI with SQRT(Var/N)
endif
```

Figure A-1. Segregated Light-Duty Truck Types
Annual Miles by Age for LDGT1



LDVS.PRG

```
*
*   Calculates average annual mileage accumulation rates from the
*    1995 NPTS dataset VEHICL95
*
set talk off
use VEHICL95 alias LDVS
select 2
use NPTS alias ANS
ZAP
select LDVS
VC = VehClass
MY = VehYear
Store 0.0 to Regs,Recs,Reco,TotSE,SERegs,TotOD,ODRegs
do while .not. eof()
    if VehClass <> VC .or. VehYear <> MY
        select ANS
        append blank
        replace VehClass with VC
        replace VehYear with MY
        replace RECSE with Recs
        replace RECOD with Reco
        replace REGISTR with Regs
        If SERegs > 0.00
            replace AnnMiles with TotSE/SERegs
        endif
        if ODRegs > 0
            replace ANNUALZD with TotOD/ODRegs
        endif
        select LDVs
        VC = VehClass
        MY = VehYear
        Store 0.0 to Regs,Recs,Reco,TotSE,SERegs,TotOD,ODRegs,ODSE
    endif
    Regs = Regs + WTHHFIN
    if ANNMILES > 0 .and. ANNMILES <= 115000
        TotSE = TotSE + ANNMILES*WTHHFIN
        SERegs = SERegs + WTHHFIN
        Recs = Recs + 1
    endif
    if ANNUALZD > 0 .and. ANNUALZD <= 513292 .and. FLAGODO = "94" .and. FLAGOUT =
"94"
        TotOD = TotOD + ANNUALZD*WTHHFIN
        ODRegs = ODRegs + WTHHFIN
        Reco = Reco + 1
    endif
    skip
enddo
select ANS
append blank
replace VehClass with VC
replace VehYear with MY
replace RECSE with Recs
replace RECOD with Reco
replace REGISTR with Regs
If SERegs > 0.00
```

```
    replace AnnMiles with TotSE/SERegs
endif
if ODRegs > 0
    replace ANNUALZD with TotOD/ODRegs
endif
select LDVS
go top
Select ANS
go top
Select LDVs
store 0.00 to SEREGs,ODOREGs,SEVAR,ODOVAR
do while .not. eof()
    if VehClass <> ANS->VehClass .or. VehYear <> ANS->VehYear
        Select ANS
        If SERegs > 0.00
            replace STDEV_SE with SQRT(SEVAR/SEREGs)
        endif
        If ODORegs > 0.00
            replace STDEV_ODO with SQRT(ODOVAR/ODOREGs)
        endif
        store 0.00 to SEREGs,ODOREGs,SEVAR,ODOVAR
        skip
        Select LDVs
    endif
    if ANNMILES > 0 .and. ANNMILES <= 115000
        SEVar = SEVar + (ANNMILES-ANS->ANNMILES)*(ANNMILES-ANS->ANNMILES)*WTHHFIN
        SERegs = SERegs + WTHHFIN
    endif
    if ANNUALZD > 0 .and. ANNUALZD <= 513292 .and. FLAGODO = "94" .and. FLAGOUT =
"94"
        ODOVar = ODOVar + (ANNUALZD-ANS->ANNUALZD)*(ANNUALZD-ANS->ANNUALZD)*WTHHFIN
        ODORegs = ODORegs + WTHHFIN
    endif
    skip
enddo
Select ANS
If SERegs > 0.00
    replace STDEV_SE with SQRT(SEVAR/SEREGs)
endif
If ODORegs > 0.00
    replace STDEV_ODO with SQRT(ODOVAR/ODOREGs)
endif
```