UMTRI-88-17

ANALYSIS OF ACCIDENT RATES OF HEAVY-DUTY VEHICLES

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The University of Michigan
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Ann Arbor, Michigan 48109-2150

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FINAL REPORT

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16. Abstract

This report presents an analysis of factors associated with the risk of involvement in a fatal accident for large trucks. The data are from two UMTRI surveys: one of Trucks Involved in Fatal Accidents (TIFA), and a companion travel survey, the National Truck Trip Information Survey (NTTIS). The research approach and survey methods are briefly described. Estimates of the U.S. large-truck population and average annual mileages from the travel survey (NTTIS) are compared with estimates from the 1982 Truck Inventory and Use Survey (TIUS).

The factors addressed in the risk analysis are: truck type, travel category (road type, rural/urban, and day/night), and gross combination weight (GCW). The results illustrate that the risk of involvement in a fatal accident varies by multiples of 3 to 5 over the different travel categories. In addition, the different truck types have quite different distributions of travel across the categories. Consequently, aggregate involvement rates by factors such as truck type are often misleading, in that the differences observed are primarily due to factors associated with the travel categories, as opposed to any characteristics of the truck itself. An adjusted rates method is used to remove the influence of travel differences in the computation of aggregate rates. The results of this method indicate that the risk of fatal accident involvement would be greater for doubles, and for singles weighing over 65,000 pounds, *if* their travel patterns were comparable to that for all large trucks.

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Preface

Since 1980, the efforts of the Statistical Research Group at UMTRI have been directed at establishing a national survey of Trucks Involved in Fatal Accidents (TIFA), and a companion national survey of large-truck travel, the National Truck Trip Information Survey (NTTIS). The objective of this survey program was to support an analysis of the factors associated with the risk of involvement in a fatal accident for large trucks. This report presents our first attempt at such an analysis. As such, the material is illustrative rather than comprehensive. Our objective at this time is to demonstrate the potential for such data and appropriate analytic techniques to substantially advance our understanding of the causes of large-truck accidents.

Acknowledgements

The UMTRI large-truck survey files are the product of the dedicated efforts of many people. Brian O'Keefe, Linda Muszalski, Ray Masters, and Blane McLane were collectively responsible for the day-to-day nurturing of the National Truck Trip Information Survey. John Attarian prepared the maps showing the boundaries of all urban areas in the United States with a population of 5,000 or more, and was responsible for mapping out every trip taken by a survey truck on the maps. Dan Blower was responsible for the editing of the NTTIS data, and reviewed every single form before sending them out for keying. Brian O'Keefe, Jill Fogg, and Steve Hilmy were responsible for the survey of Trucks Involved in Fatal Accidents for various periods over the past six years. However, all of us recognize that the survey data are the result of the conscientious effort of the many interviewers who did the real work of the survey. Without the interviewers, we would have no data to map, edit, and analyze. We would also like to recognize our friend of many years now, Oliver Carsten, who contributed immeasurably to all aspects of this research.

The UMTRI survey program also recognizes its debt to the truck owners and everyone else who provided the detailed information requested. The fact that they were willing to spend the time talking to our interviewers speaks very positively about the commitment to safety of literally tens of thousands of members of the trucking industry.

We also wish to gratefully acknowledge the sponsors of this research. The analytic work was supported by the National Highway Traffic Safety Administration and the Federal Highway Administration. The survey program has benefited from the insight and foresight of Ernst Meyer. The survey program was supported by the Motor Vehicle Manufacturers Association, the American Trucking Associations, the Western Highway Institute, Freightliner Corporation, and the Transportation Safety Equipment Institute. Special recognition must go to Peter Griskivitch for getting this program started in the first place, and for keeping us going ever since.

This work would not have been possible without the support of all of these people. The authors gratefully acknowledge their contributions.

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ANALYSIS OF ACCIDENT RATES OF HEAVY-DUTY VEHICLES

Introduction

Fatal accidents involving large trucks are a continuing problem on the nation's highways. More effective safety programs to address this concern depend on a better understanding of the causes of large-truck accidents. The issue of truck safety demands, more than anything else, an authoritative source of knowledge to permit careful, objective research efforts to proceed at an orderly pace. The single most significant obstacle to this research has been the lack of adequate *quantitative* information on which to base judgments. Historically, prevailing viewpoints have been based on the positions of various lobby groups, on partial or conflicting information, or on the investigation of single issues rather than a study of all components of the problem. An overall research approach is needed to improve the chances for progress on these issues over time.

The overview of such an approach seems clear. First the physical mechanisms, or events, leading to the accident must be determined. If the physical mechanism responsible for the accident is known, countermeasures can be developed to prevent these events from leading to an accident in the future. Past approaches to the accident causation problem have generally tried to go directly to the cause. Sometimes only one issue was addressed at a time, such as fatigue or the condition of the vehicle. A more general approach has been the "in-depth" investigation of individual accidents, on the supposition that expert and detailed investigations would identify the physical cause of that and other similar accidents. Another approach has been to study the longitudinal experience of drivers or vehicles on the premise that a subset can be identified as being more prone to accident involvement. Such approaches have had limited or no success. The reasons why past studies have not been more productive are not clear.

It is clear, however, that there a large number of candidate factors for study. Large numbers of factors require a large sample size for study. The high cost of in-depth accident investigation limits this approach to samples that are generally too small. Furthermore, with a large number of factors, interactions are more likely to occur. This means that a combination of factors may be involved rather than single factors acting independently.

What is needed is a more efficient procedure to determine the major factors. Because resources are limited, priorities must be established. In order to effectively allocate resources it is necessary to know both how large a particular problem is and how serious it is. Since in-depth investigations are very expensive and not well suited to identifying interactions of multiple factors, the UMTRI program adopted a statistical assessment of candidate factors. Large-scale surveys can generate substantial sample sizes at a small fraction of the cost of on-scene data collection methods. In addition, statistical methods are well-suited to multivariate problems involving interactions of the factors.

The statistical approach also begins with collection of accident data. However, the data collection process is much less demanding, because it is not necessary to identify the cause or causes of each individual accident, or make any interpretation or reconstruction of the events at all. As with any research program, the factors for study must be identified at the outset. For the statistical approach, this can generally take the form of a listing of the descriptive characteristics of all the relevant aspects of the event: roadway, vehicles, occupants, and environment. The factors should be amenable to objective measurement, such as vehicle weight, lane width, or number of axles, rather than subjective assessments such as "driving too fast for conditions" or "poorly maintained."

Two types of information influence the importance, or priority, that should be assigned to any particular problem area. The first is the prevalence, and the second is the risk. For traffic safety issues, prevalence is simply the proportion of accidents involving a particular factor. For any traffic safety program, the ultimate measure of success is based on whether accidents decrease or not. Countermeasures aimed at a factor associated with a large proportion of accidents have a greater potential for impact than those aimed at something that occurs very infrequently. However, the accidents that occur are a consequence of the exposure to accident for any particular factor and the risk of accident per unit of exposure. It seems appropriate that countermeasures for high-risk factors should take priority over those for low-risk factors.

As a simple illustration, suppose one had a choice between only two countermeasures, one directed at truck accidents on limited access roads, and the other directed at truck accidents at night. These two were chosen because each accounts for about 30 percent of all large trucks involved in fatal accidents. Ignore, for purposes of this illustration, the fact that these two groups overlap. On the basis of prevalence, then the two factors are of equal concern. However, the risk of accident involvement at night is about four times greater than the risk on limited access roads. The basis for this risk estimate is the knowledge that only about 15 percent of the truck travel is at night (resulting in 30 percent of the fatal involvements), whereas nearly 60 percent of the travel is on limited access roads (also resulting in 30 percent of the involvements). Thus, the risk of fatal accident involvement is four times higher at night than on limited access roads.

Thus, the risk of accident involvement is useful in establishing priorities for competing countermeasures. However, the primary objective of the statistical assessment of risk is to quantify the factors, and combinations of factors, associated with elevated risk. By using multiple variables to fully describe an event—in this case, accidents and travel—statistical methods can be usefully employed to analyze the cross-classified data. The result is a means of identifying the factors associated with an elevated risks of accident involvement. Of course, this statistical association between accident occurrence and the measured factors does not necessarily identify the physical causes of accidents.

Accidents at night illustrate this. The statistical approach will identify an elevated risk for accidents at night if this factor is included in the study. However, "night" is not really the direct physical cause of these accidents. We can hypothesize at this point that factors such as visibility or fatigue are more likely to directly influence the occurrence of an accident at night. The object of this statistical assessment of accident risk in actual highway travel is to identify subsets of the total highway system (highways, vehicles, drivers, and the environment) that merit more detailed studies based on this statistical identification of elevated risk. In general, more direct methods such as in-depth investigations would be required to identify the actual physical causes. The statistical determination of increased risk provides a limited focus for more costly research methods, and the factors associated with the risk provide a basis for hypotheses as to the actual physical cause(s).

The first requirement for the statistical approach is a sample of the accidents occurring on the highway. The companion requirement is to establish a corresponding data set of truck travel. Trucks do not operate in a uniform environment. They are of different sizes and configurations, carry different loads on varying road types, and operate both within states and across state lines. Trucks also travel at all times of the day and in varying traffic conditions. What is needed is a means of accurately sampling the real-world operating experience of trucks on the road.

Since highway travel is a continuous event, a measure for the opportunity for accident involvement is needed in order to study accident risk. This quantity is generally referred to as the *exposure* of vehicles to the possibility of an accident. In terms of highway exposure, the term is synonymous with travel as measured in vehicle-miles. Exposure, then, is the denominator used to estimate the risk of accident involvement. This probability is a function of many factors. There is, for example, a different risk associated with travel at night as opposed to day. So also on divided highways as opposed to undivided, or in congested traffic instead of the open road. In general, it is not sufficient to simply estimate the total travel. It is also necessary to be able to cross-classify the travel by the factors that distinguish the differing risks for different types of travel. The combinations of these factors are referred to as travel categories in this report.

Such a research approach has been followed in the program conducted at UMTRI in recent years. The Statistical Research Group has collected accident and travel data to identify those factors that are associated with an increased risk of large-truck accident involvement. Of even more importance is that the survey data will support multivariate statistical methods that can identify combinations of factors, or interactions, that have the potential to have larger influences on the risk of accident involvement than any of the factors independently. Priorities in countermeasure development are a natural by-product of this type of research. If subsets of accident information can be identified where the risk is high, then we can isolate the areas in which an increased attention to safety countermeasures is required.

The remainder of this report is organized as follows. The next section describes the survey methods for the survey of Trucks Involved in Fatal Accidents, and for the National Truck Trip Information Survey. The next section presents a comparison of truck population estimates from the 1983 National Truck Trip Information Survey and the 1982 Truck Inventory and

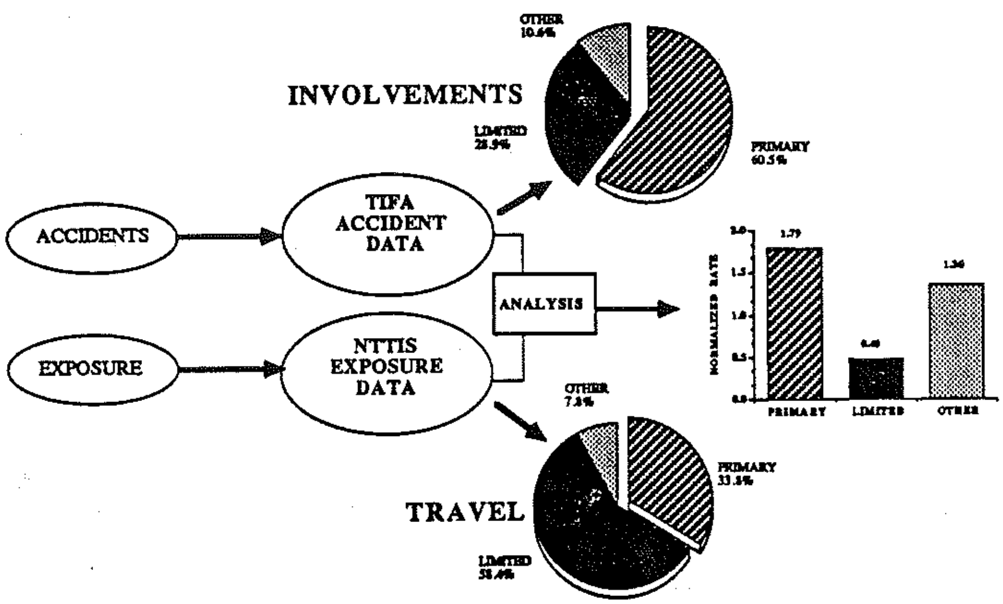
Use Survey. The later half of this section compares average annual mileages from the two travel surveys. Three analyses of fatal accident rates are presented next. The first analysis focuses on five basic truck configurations that comprise the entire large truck population. These are straight trucks without trailers, straight trucks with trailers, tractors without trailers (bobtail), tractors with a single semitrailer, and tractors with two trailers. The five configurations are observed to have differing distributions across 8 travel categories. The 8 categories are formed by the combinations of limited access roads/non-limited access roads, day/night, and rural/urban. The adjusted rates method is presented in this section as a means to make comparisons across groups with differing travel distributions. The second section analyzes fatal accident involvement rates for four different collision types. The section is limited to two truck types; straight trucks without trailers and tractors pulling a single semitrailer. A 12-category travel distribution is used in this section. The categories are based on three road types (limited access, primary, other), rural/urban, and day/night. The last of the analysis sections addresses differences in fatal accident involvement rates for tractor-semitrailer combinations by gross combination weight (GCW). Implications of these results and future work are discussed in the last two sections. Tabular data for all of the figures presented in the report are included in a section at the end. Tables 26-30 and 41-47 present additional, more detailed cross-tabulations not referenced in the report.

RESEARCH APPROACH

A few years ago, the first national program was initiated at UMTRI to collect the necessary data for a multivariate assessment of the accident risk of large trucks. The emphasis in this program is on the relationship of vehicle configuration to risk. Highway accidents and the use of large trucks are being studied to see if there is evidence that the accident risk is influenced by the configuration of the vehicle. This program represents the current state of accident risk assessment. Figure 1 illustrates the overall approach to estimating risk.

Figure 1

NORMALIZED RATES BY ROAD TYPE TRACTOR-SEMITRAILERS



The accident data and exposure data are being collected through independent surveys. In order to get sufficient sample sizes, all fatal accidents involving large trucks in the United States have been surveyed for a five-year period, 1980-1985. A parallel survey has also been conducted on a national sample of just over 5,000 registered trucks. Thus, independent surveys gather accident and exposure information cross-classified by the same configuration and use factors. This information allows the calculation and analysis of the matrix of involvement rates associated with all the possible combinations of independent variables and levels. Normalized rates can be calculated as the ratio of the proportion of the accident involvements to the proportion of the travel for any particular factor and level. This calculation is illustrated in Figure 1 for a three-level distribution by road type.

The objective of this study, then, is to relate the configuration, size, and use of large trucks to their accident experience. Knowing the kinds and types of trucks operating on the road, their weights and dimensions, and how and where these vehicles operate is essential if anything is to be understood about their involvement in accidents.

A new approach is taken with the current research, an approach that relies on a large-scale statistical analysis of the actual experience of such vehicles in the road environment, and that includes for the first time both accident data and travel data. The UMTRI Large-Truck Survey Program combines both sets of data and provides a database from which statistical analyses may proceed.

Identification of Candidate Factors

The first step in this approach was the identification of what can be termed "candidate" factors—the vehicle and operational characteristics that can be expected to influence the accident experience of these large trucks. These characteristics were selected to provide a much more detailed picture of the U.S. experience. The candidate factors that have been addressed in the past five years of the study can be divided into three categories, *vehicle, environment*, and *driver* factors, as shown in the table below.

CANDIDATE FACTORS

VEHICLE	ENVIRONMENT	DRIVER
Cab Style	Road Class	Age
Number of Units	Rural/ Urban	Years of Experience
Cargo Body Style	Day/ Night	Hours Driving
Cargo Type		Carrier Type
Weight		
Length		
Number of Axles		

The methodology employed here led from this identification of factors to an effort to determine the incidence of these factors in both accidents and in travel. The next step was a review of existing data sources for information on the candidate factors.

Existing Data Sources

Existing data sources for accidents are the NHTSA Fatal Accident Reporting System (FARS), the Office of Motor Carrier Safety (OMCS) file of accidents reported by interstate carriers, the National Accident Sampling System (NASS), which contains a statistical sample on trucks, and state files of police-reported accidents. These files provide a great deal of information, but they all lack key elements that are essential to the problem at hand.

FARS does not contain a sufficient description of the trucks with the kind of detail that is needed. It does, however, include *all* fatal accidents, and it provides a rather full account of the event and the environment. Driver age is also included.

The OMCS file, on the other hand, has all of the vehicle information and driver data, but it does not provide a full accident description. In addition, OMCS doesn't cover intrastate-only carriers, and suffers from serious under-reporting by private interstate carriers.

The NASS file is limited to a small sample of large trucks and it is otherwise quite incomplete in its truck description. This is, of course, because its primary focus is directed toward injury processes.

The most complete inventory of accidents are the state files containing information on all police-reported accidents. While these files generally have more limited information than any of the other sources mentioned, they do provide identification of the owners and drivers involved, the investigating officer, and others that were at the scene of the accident. This information provides a starting point for the UMTRI survey follow-up described in the next section.

Estimates of the number of large trucks in the United States, and their annual travel are available from the Truck Inventory and Use Survey (TIUS), an activity of the Bureau of the Census that is conducted every five years. The TIUS study is quite useful for the UMTRI study because it offers information on how the vehicles are used. In addition, it provides a baseline for comparison purposes. But TIUS does not have information on some of the variables important to a detailed statistical study. And it must be pointed out that it is a characterization of the *typical* use of trucks. It is not a sampling of how, in fact, trucks are used each day, but rather a report from people who own trucks who were asked to characterize the typical use of their trucks. There are no details relative to mileage on the differing kinds of roadways where those vehicles are being operated. In addition, the TIUS study is a gross estimate of travel for an entire year. There is a real need for the ability to focus on units smaller than a year. Research on vehicle use requires that knowledge be developed on the details of day-to-day activities, on the details of truck description and use that vary—road class, day/night travel, rural/urban travel, typical body style, the number of trailers, the weights, and similar details. Data needs, then, are primarily in the areas of describing truck types and sizes, the quantification of dimensions and loads, and axle configurations, identifying trailer type and power unit attachment, and in obtaining accurate travel/exposure data.

The two core elements in the research program are the Trucks Involved in Fatal Accidents file (TIFA) and the National Truck Trip Information Survey (NTTIS). In 1981 a survey of all large trucks involved in fatal accidents in the United States was initiated, with 1980 being the initial year covered. This survey combines information from the Fatal Accident Reporting System (FARS) of the U.S. Department of Transportation National Highway Traffic Safety Administration (NHTSA), along with accident data from the Federal Highway Administration Office of Motor Carrier Safety (OMCS) MCS 50T report, copies of the various police accident reports, and comprehensive follow-up telephone surveys conducted by UMTRI research staff to produce the data file called Trucks Involved in Fatal Accidents.

In 1985 the National Truck Trip Information Survey (NTTIS) was initiated. For this survey, the owners of nearly 5,000 large trucks were contacted four times over a twelve-month period to obtain detailed information on the use of the truck. The information collected includes the configuration, cargo, actual weight, and the route the truck followed. The combination of the accident data in TIFA with miles traveled from NTTIS provides estimates of fatal accident involvement *rates* by vehicle type and road class. Each of the survey programs will be described in more detail in the next two sections.

Trucks Involved in Fatal Accidents

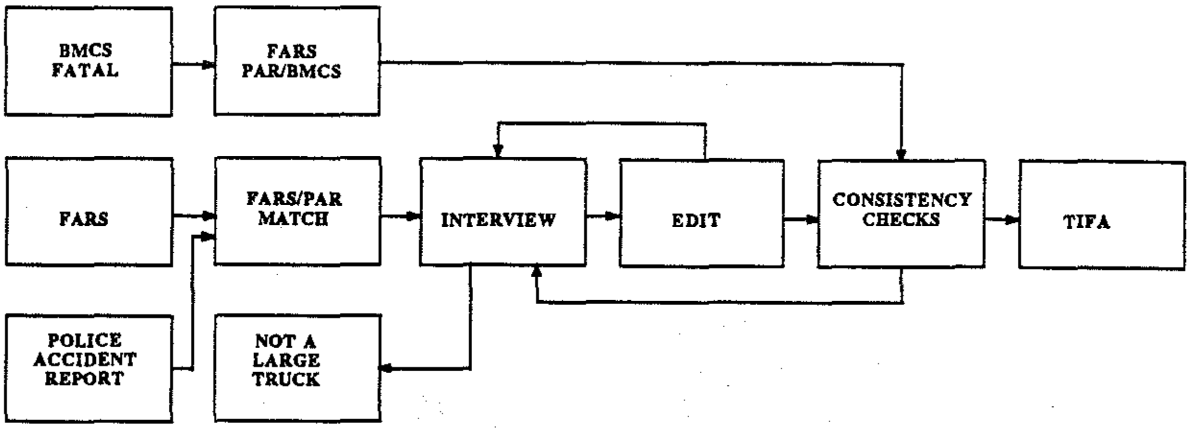
The TIFA database is currently complete for accident years 1980 through 1984. Of the potential sources of data for TIFA, the first is the Fatal Accident Reporting System, FARS. TIFA covers all FARS large trucks. Police Accident Reports (PAR) are obtained from the states for all large trucks involved in fatal accidents each year. The PAR's provide the names of individuals to contact for further information. The information is obtained through extensive follow-up on all large trucks that are recorded by FARS. The data set provides detailed descriptions of all medium and heavy trucks (greater than 10,000 lbs. gross vehicle weight rating) that were involved in a fatal accident in the continental United States, excluding Alaska and Hawaii. Pickup trucks are excluded from the file, as are passenger vehicles (and vans, utility vehicles, buses, and ambulances) and fire trucks.

To produce the TIFA file, OMCS fatal accident reports are first matched to FARS cases. In all instances in which a computerized match is made, the OMCS information is picked up and added to that already in the FARS case, producing a much fuller record for each event. For cases that cannot be matched, the BMCS reports are discarded and the FARS report is used as the base for creating a complete record by means of the TIFA survey method. Telephone interviews are conducted to obtain company and vehicle descriptions. Extensive editing and consistency checking is performed on all information obtained by interview.

First, Vehicle Identification Numbers (VINs), in every PAR and FARS record, are decoded to confirm that the make and model information and the power unit description conform to published model specifications. Edit Data Lists, UMTRI-developed editing manuals, are used to evaluate information obtained from interviews to ascertain the accuracy of the reporting, especially concerning the types of freight hauled, the necessary equipment, and the typical hardware configurations used in such conditions. UMTRI has also developed a database on cargo weights and densities so that a cargo weight can, if necessary, be computed from information on cargo type and volume. The typical case, then is processed as represented in Figure 2.

Figure 2

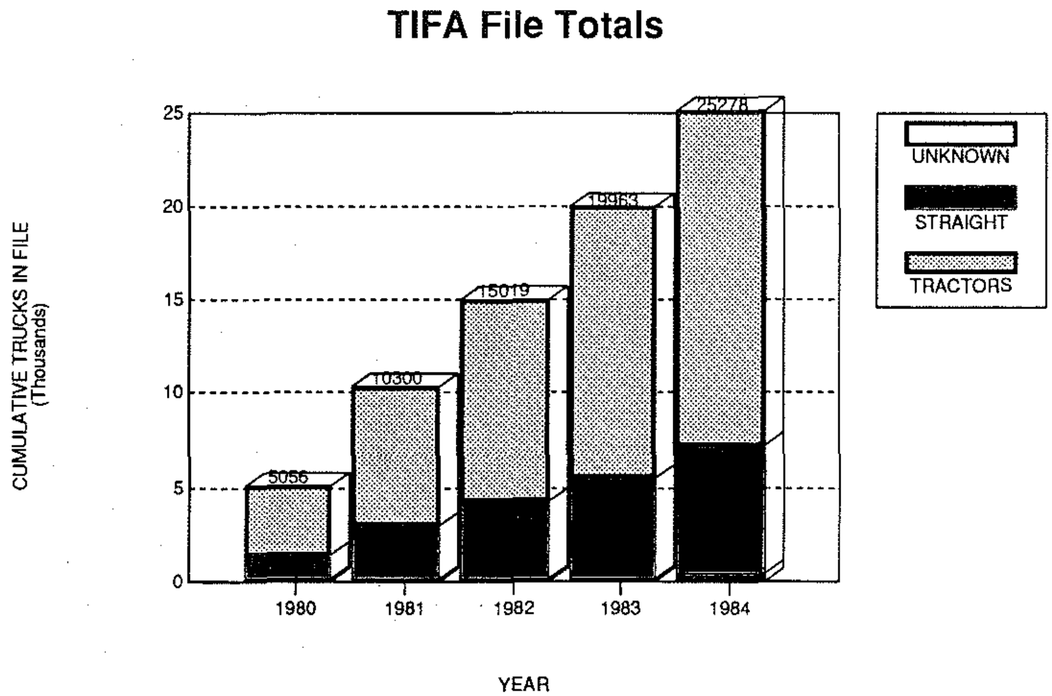
TIFA CASE FLOW



FARS/OMCS matched cases proceed directly to Consistency Checking, where a set of computerized algorithms check for total accuracy of elements in each individual data set. If problems are flagged—number of axles not matching, for example—the case is sent to Interviewing for follow-up calls to gather direct involvement information. This additional data is added to the record and it is forwarded to Editing. If all conflicting information can be reconciled, the record is sent again to Consistency Checking, and, if passed, added to the TIFA database.

FARS/PAR matches follow the same set of procedures, undergoing extensive editing and checking at each stage. The typical case will go through the Interviewer-Edit-Consistency Check loop more than once. It is rare that a case is sufficiently developed to proceed directly to the TIFA file with only one interview. The scrutiny to which each case is subjected assures the accuracy and validity of the information in the final product, TIFA itself. And the use of multiple sources of information for the same accident permits a deeper level of description. A prime benefit of this procedure is that the level of missing data in TIFA is on the order of 1-2 percent for the specific candidate factors of interest, an exceptionally low rate for this kind of data. Even the high-interest factor with the most missing data—weight—is still only 5-6 percent missing. In all, the TIFA files contain information on over 25,000 large trucks involved in fatal accidents during the years 1980 through 1984. Figure 3 illustrates the TIFA file totals and its growth to the present size.

Figure 3



National Truck Trip Information Survey

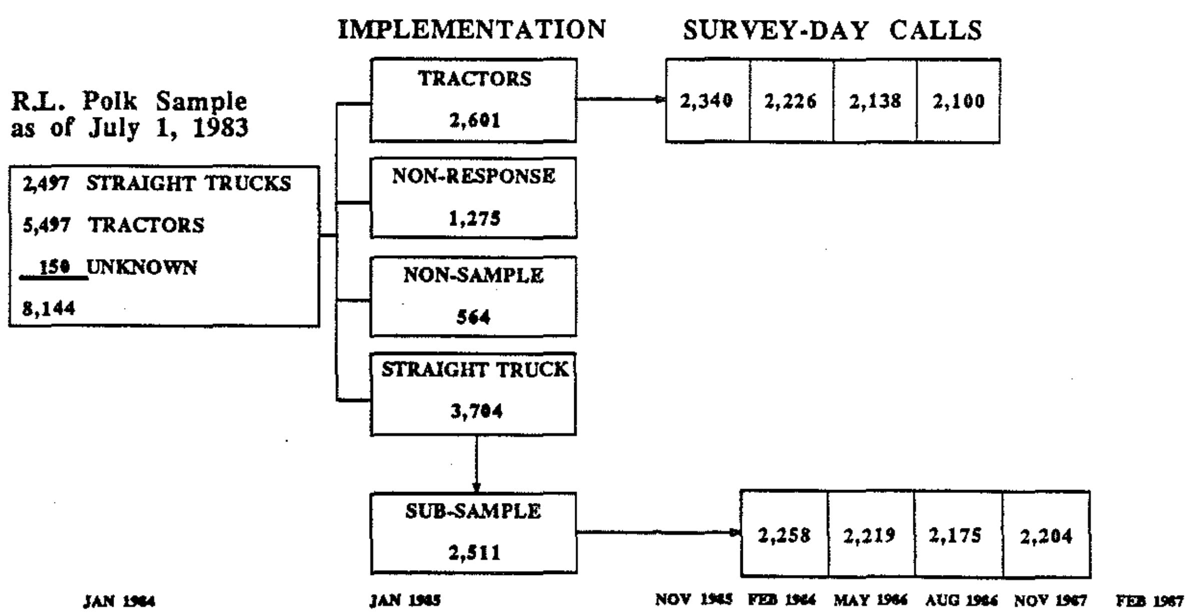
The UMTRI National Truck Trip Information Survey (NTTIS) collects travel data at the *trip* level rather than at the level of a vehicle's annual mileage. This is in contrast to the TIUS practice. The objectives of the NTTIS survey are twofold: to estimate the number of large trucks in the U.S., and to provide detailed mileage data. The survey is built on a probability-based sample of trucks which were registered in the U.S. as of July 1, 1983. The owner of each vehicle was contacted by phone four times over a one-year period and asked about the vehicle's travel on a randomly assigned date. The calls were made as close to the assigned date as possible. For each survey day, the owner was asked to describe every trip made and to provide information on trailer use (if any), cargo and cargo weight, and driver age. The trips were split into daytime and nighttime mileage, and each trip was mapped on special atlases developed by UMTRI. Every county in the United States was mapped individually. Precise boundary definitions were established to distinguish urban from rural highways according to Federal Highway Administration definitions obtained from each state. Roads were also divided into limited access highways, other major or primary highways, and other roads. County level maps were obtained for defining urban boundaries on the state scale layout. This made it possible to exactly map the portion of the mileage that was in different urban density zones. Such mapping techniques capture a level of detail that permits breaking trips down into day and night miles over three road types, with actual loaded weights for each portion of every trip on the survey day. Each individual mile of a surveyed trip can be characterized in terms of the candidate factors.

By summing across trips, travel can be estimated by company type (intrastate or interstate, private or for-hire), power unit type, number of trailers, trailer type and trailer body, cargo, actual cargo weight and actual combination gross weight, driver age, day versus night, and highway type. Thus, safety studies of large trucks can incorporate factors both in the accident data and in the exposure data.

The sample of vehicles was drawn from 1983 state registration files maintained by R.L. Polk, using a data processing and sampling procedure designed by UMTRI. The procedure resulted in the selection of 8,144 vehicles. Contacts were attempted with the owners of all these vehicles, but in 934 cases we were unable to obtain a response. An additional 564 trucks were determined to be non-sample. Most of these had been scrapped or taken out of use. A complete company and vehicle description was obtained on 6,305 trucks. Of these 5,112 were selected for the trip survey, and 4,789 of these responded on at least one of the four survey days. In all, information was obtained on over 17,660 survey days, or 86 percent of the potential survey-day interviews. Travel on the survey days was broken down into more than 13,000 trips, and 862,000 miles of travel were mapped on the specially prepared atlases. These figures are summarized in Figure 4.

Figure 4

NATIONAL TRUCK TRIP INFORMATION SURVEY



NTTIS AND TIUS COMPARISONS

Wherever feasible, NTTIS data elements were designed to be compatible with the TIUS in order to facilitate comparison between the two. The next section compares vehicle population estimates from the two surveys, while the following section compares annual average mileage estimates.

Truck Population

Estimates of the large truck population in the United States from the NTTIS are compared with the corresponding estimates from the 1982 Truck Inventory and Use Survey in the table below. The original samples of registered trucks for both surveys were obtained from R.L. Polk. The 1982 TIUS was drawn from registration as of July 1, 1982, while the NTTIS sample was drawn from registrations as of July 1, 1983, one year later.

NTTIS POPULATION ESTIMATES

	1982 TIUS	1983 NTTIS
Straight Trucks	2,534,973	2,185,630
Tractors	900,884	919,702
TOTAL	3,435,862	3,105,332

(Excludes Alaska and Hawaii)

The population estimates are shown separately by the type of power unit: straight truck or tractor. The distinction between the two is that tractors have a fifth wheel mounted on the back for attaching a semitrailer, while a straight truck must have a cargo body attached and no fifth wheel. Since many trucks are sold as a chassis without fifth wheel or cargo body, this distinction cannot generally be made from the information coded in the Vehicle Identification Number (VIN) by the manufacturer, and must be obtained from the owner. The population estimates show good agreement, particularly for the tractors. NTTIS estimates about 4 percent more tractors than TIUS. The NTTIS population estimate for straight trucks is about 14 percent lower than the TIUS estimate. This difference may be a reflection of the 10,000 pound Gross Vehicle Weight Rating (GVWR) cutoff for inclusion in the NTTIS data. In an effort to improve the accuracy of this cutoff, UMTRI specified models and series for inclusion or exclusion. This difference is also apparent in the distribution by GVWR to follow. The next six figures compare distributions of some common variables describing the national truck population from both the TIUS and the NTTIS files.

The Gross Vehicle Weight Rating (GVWR) is coded in the VIN for almost all trucks. R.L. Polk has developed decoding algorithms to extract this information from the VIN, and this code was included in the data supplied for both the TIUS and the NTTIS surveys, as was the make and model year of the truck. These variables provide a good basis for comparison of the two surveys, since they were part of the original sample. Most of the other information collected comes from the survey respondent, and thus, it is subject to respondent error. The data elements provided with the sample are generally expected to be more consistent and more accurate. A comparison of the distributions of the national truck population by GVWR from TIUS and NTTIS are shown for straight trucks in Figure 5 and for tractors in Figure 6. About the only difference is that TIUS shows a somewhat higher proportion of GVWR class 3-5 straight trucks than NTTIS does. This difference is discussed further in the next paragraph. Otherwise, the agreement in the distributions of GVWR between TIUS and NTTIS is very good.

Many truck models can be ordered over a range of GVWR classes, and when the VIN decoding of GVWR is based on the model identification, the highest GVWR available from the manufacturer (as an option, for example) is assigned. For many specific models, the majority of sales were at lower GVWR's. To improve the accuracy of the 10,000 pound GVWR cutoff, UMTRI specified whether particular models should be included or excluded, in some cases overriding the Polk-derived GVWR. Models and series were identified for inclusion or exclusion based on sales information provided by the manufacturers. If the manufacturers indicated that the majority of sales were at a GVWR of 10,000 pounds or less, then all of that specific model and series were excluded. The objective was to prevent the inclusion of an entire series when only a small fraction was actually rated over 10,000 pounds. The models most influenced by this procedure were the small step vans and pickup truck models sold as a cab and chassis. The later often have a flatbed or stake body added. It was necessary for UMTRI to try to make this distinction in the sampling frame because light trucks were to be excluded from the NTTIS sample. This was not an issue for TIUS since light trucks are included in that sample. This difference in coverage and sampling procedures probably accounts for the differences shown in the straight truck population.

Distributions by model year from TIUS and NTTIS are shown for straight trucks in Figure 7, and for tractors in Figure 8. Since pre-1973 model year trucks are all grouped into a single category in TIUS, model years were combined similarly from NTTIS for these figures. An important observation from these two figures is the relative ages of the straight trucks as compared to the tractors. Nearly 50 percent of the straight trucks are pre-1973, whereas less than 25 percent of the tractors are pre-1973. Based on these distributions, half of the tractor population is contained in the newest 5 or 6 model years. For the straight trucks, the comparable point is 10 model years. In general, the population of straight trucks is twice as old as the tractor population. This is related to the lower average annual travel of the straight trucks, as will be seen in the next section.

Figure 5

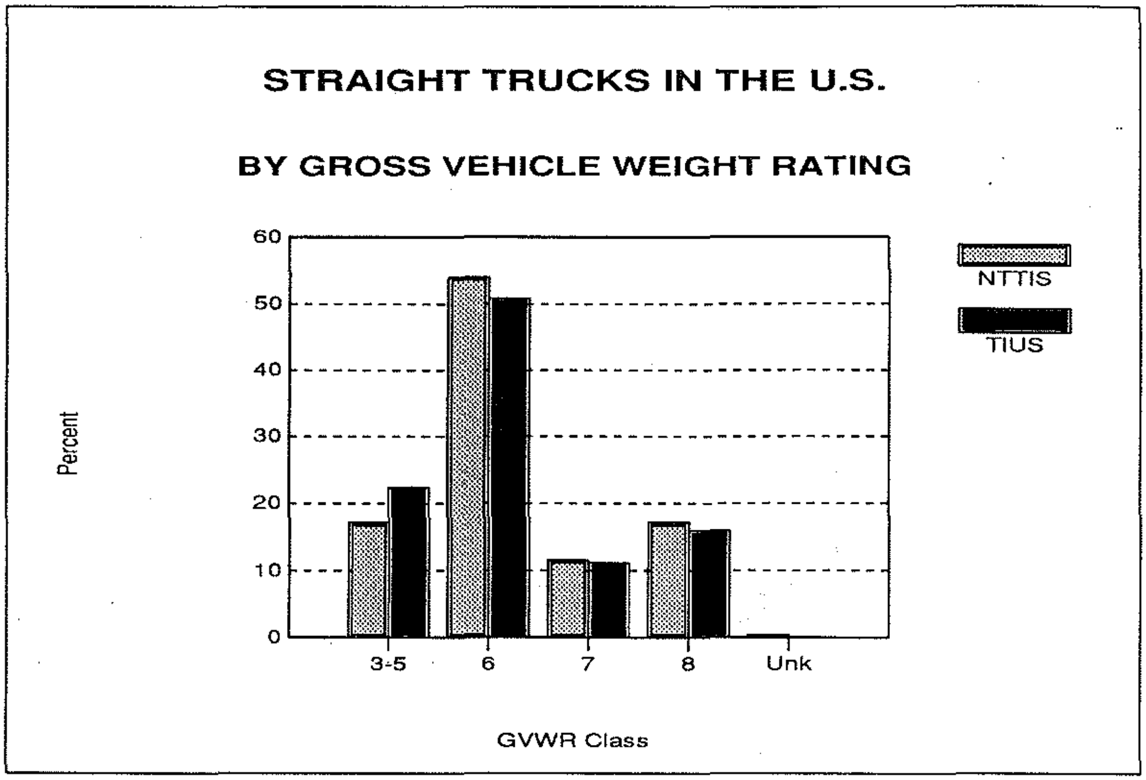


Figure 6

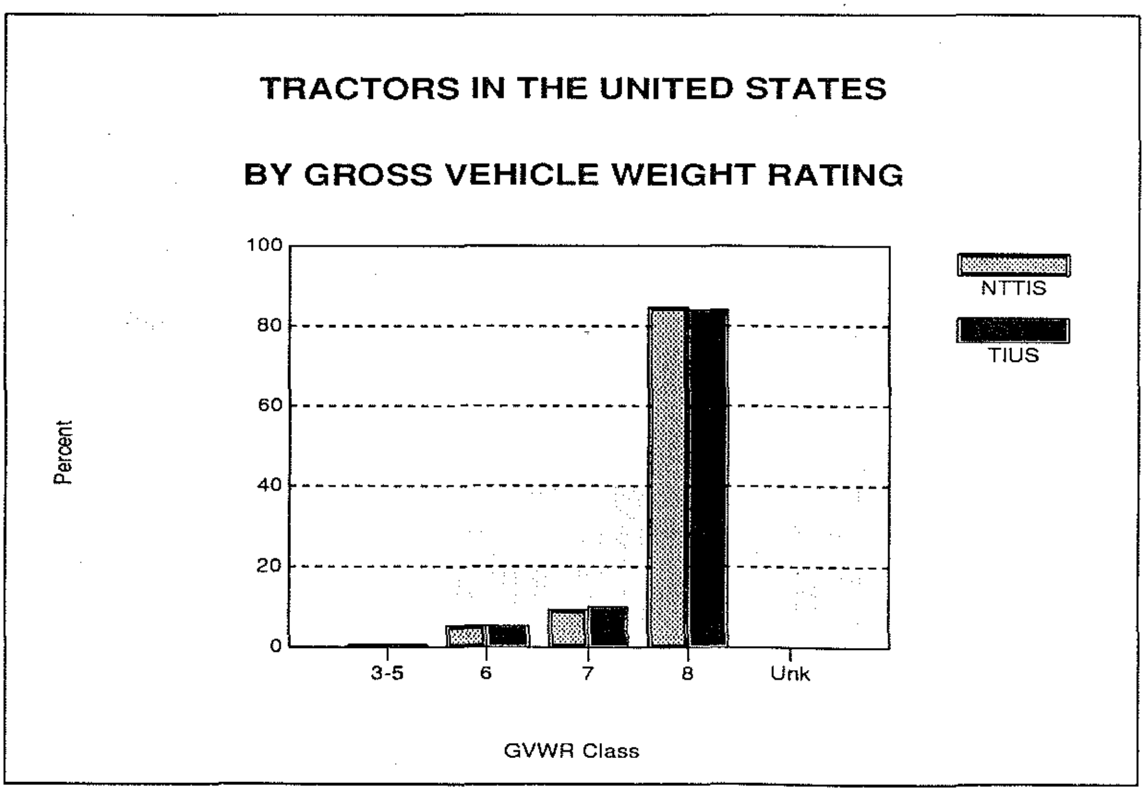


Figure 7

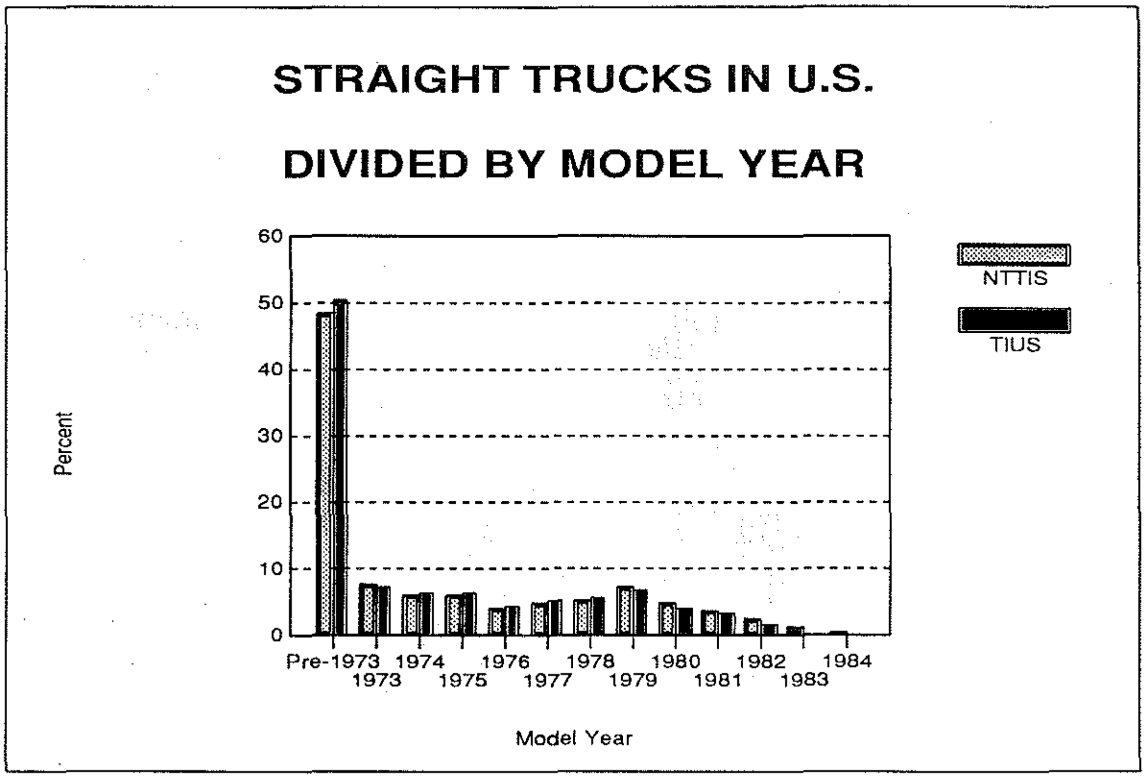
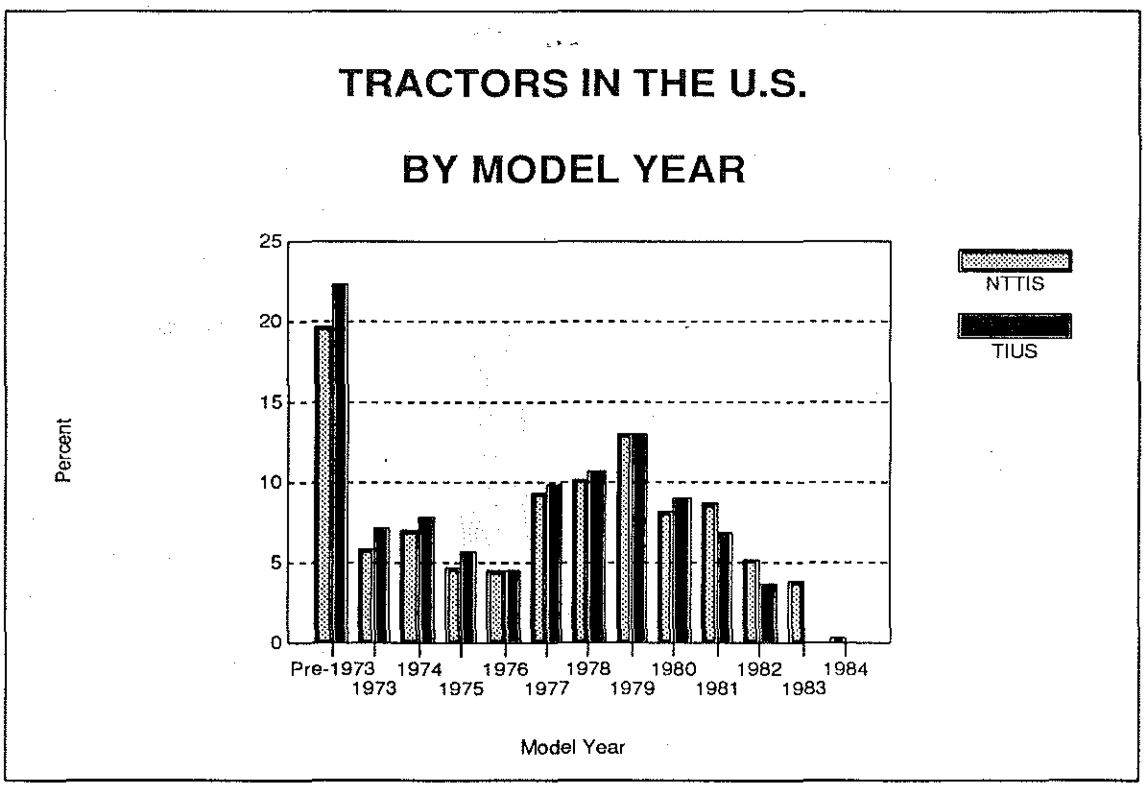


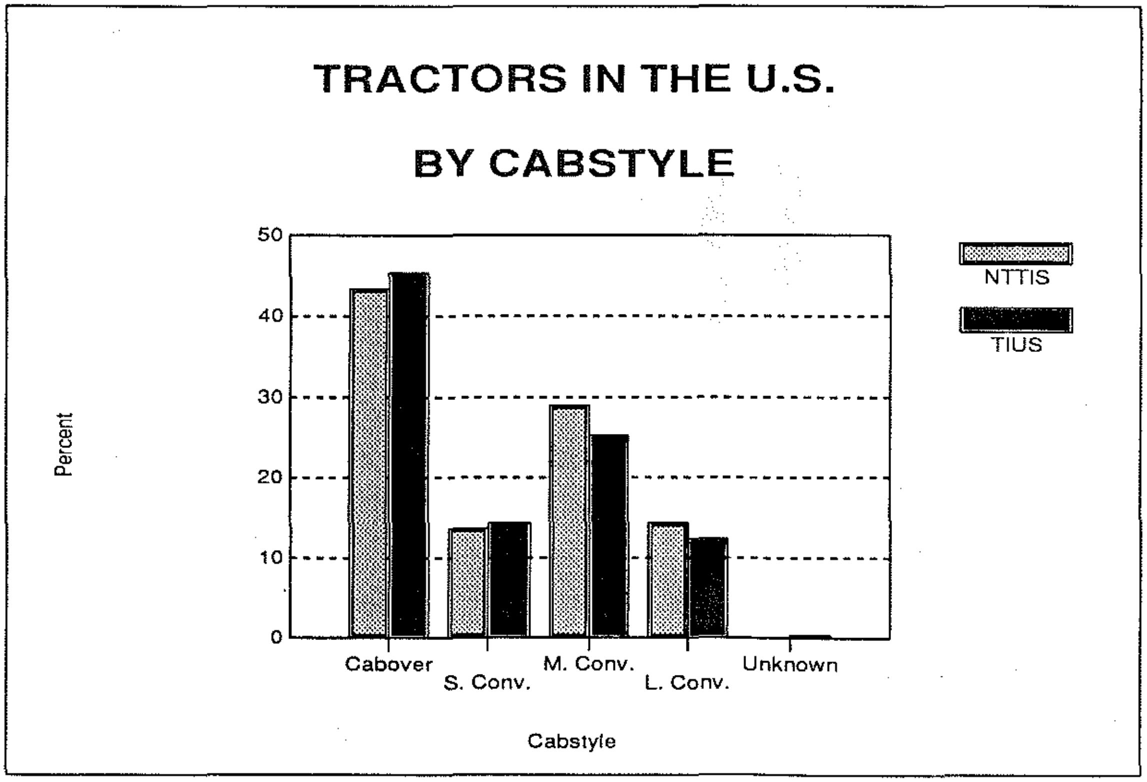
Figure 8



In general, the agreement between the TIUS and the NTTIS population estimates by model year is very good. There are no wide variations in the numbers of tractors in the population for a given year. The fact that the NTTIS sample was drawn a year later is evident from the distributions. NTTIS includes some 1983 and 1984 trucks that are not in TIUS, and in general, NTTIS shows more of the newer models, but fewer of the older ones. Overall, the model year distributions seem consistent with the one-year difference in the sampling frames.

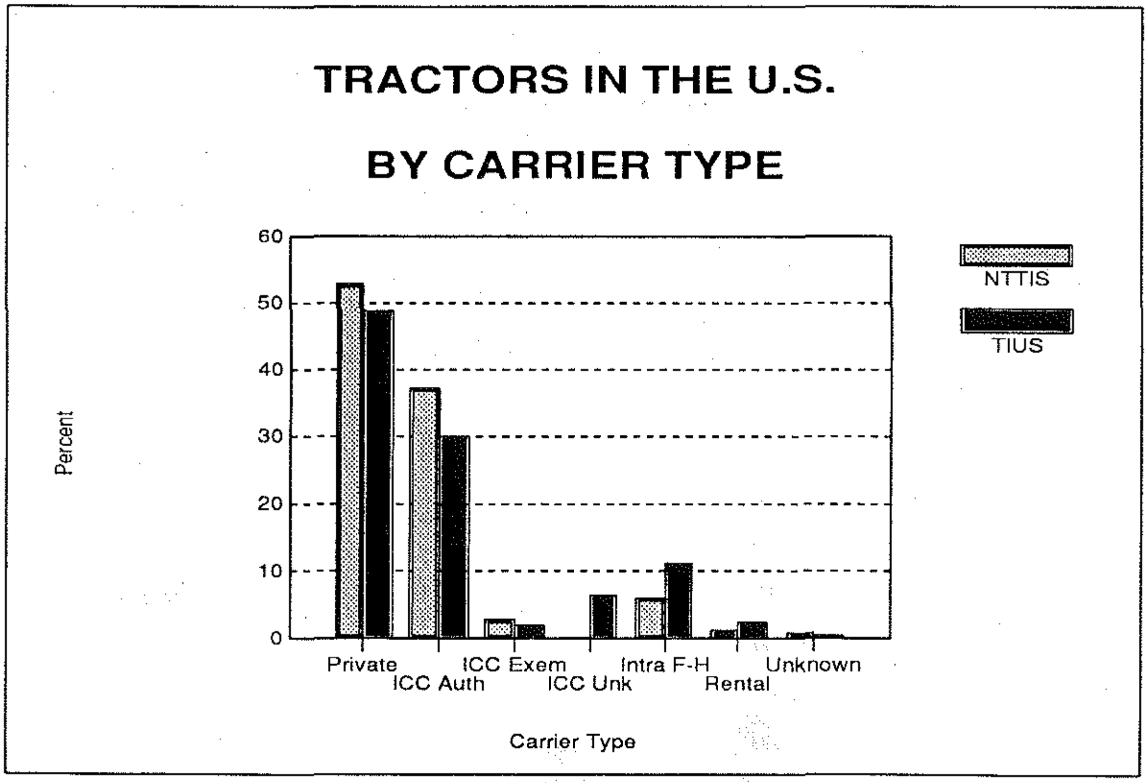
The last two distributions on the vehicle population address cab style and carrier type. This information is obtained from the survey respondent, and for the variables chosen, the definitions of the categories are not precise. These comparisons are limited to tractors. The cab style categories are cabover, short conventional, medium conventional, and long conventional. The agreement between the two sources is, again, extremely good. This is particularly gratifying in view of the lack of a precise definition of what really constitutes a short, medium, or long conventional cab style. Respondents simply choose from short, medium, or long, just as in the TIUS study. Apparently truck owners have a fairly consistent distinction between these categories even if it hasn't been formally quantified in terms of the bumper to the back of the cab, or some other standard dimension.

Figure 9



The last comparison of interest here is carrier type shown in Figure 10. Private carriers operate almost 50 percent of the tractors in TIUS, and 52.4 percent in the NTTIS. In the NTTIS study, a further breakdown of private carriers is made into *inter*state and *intra*state carriers. Interstate private carriers operate 32.5 percent of all tractors and intrastate 19.9 percent in NTTIS. The remainder of the vehicles are for hire in one fashion or another. For-hire vehicles are further broken down into interstate for-hire, in which case they are subject to the Interstate Commerce Commission, and intrastate for-hire, where they are governed by state public service commission regulations. Interstate for-hire are also separated into *authorized* carriers—the common and contract carriers—and those hauling exempt commodities. The small group of *unknown* ICC-regulated carriers are those instances in TIUS where responses did not specify whether they were authorized or exempt carriers. If distributed between authorized and exempt carriers for the TIUS data, it would bring both surveys into fairly good agreement.

Figure 10



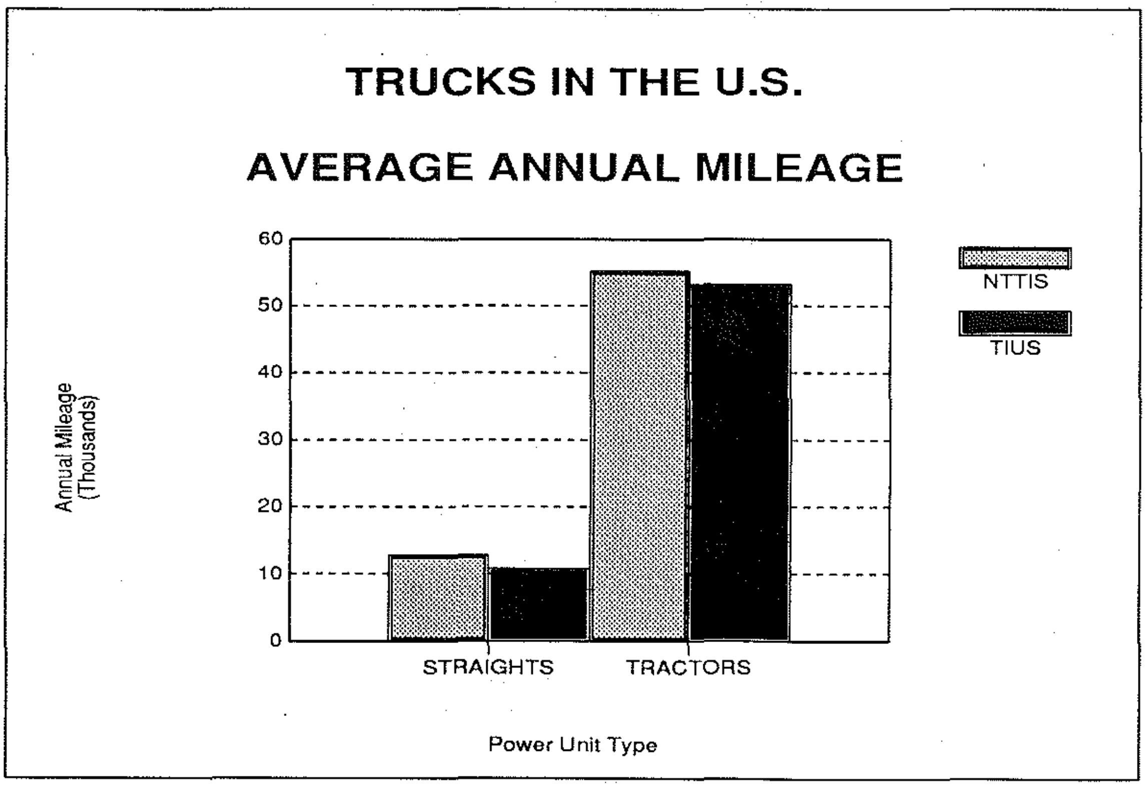
On the other hand, there is some discrepancy shown in the intrastate for-hire and daily rental categories, with NTTIS showing fewer of each. TIUS established a separate category for rental vehicles because they are extremely difficult to classify since the carrier type may change with every new rental. Agencies are reluctant to disclose names and, even if names are obtained, the individuals are difficult to locate and interview regarding carrier type on a particular day. The owners in both of these categories are usually small carriers and difficult to reach except at night and on weekends. These response problems may be partly responsible for the smaller proportion of trucks operated by intrastate for-hire carriers or in daily rental in the NTTIS. Leased, or long-term rental, trucks are classified as if the leaser/renter were the owner.

Average Annual Mileage

In TIUS, the owner is asked how many miles the truck travelled in the past year. The same question was asked of the owners in NTTIS. There is about a two year difference between the two surveys in the asking of this question. The 1982 TIUS was carried out in early 1983, while the NTTIS implementation phase was conducted in early 1985. This owner-reported annual mileage provides a basis for comparison of the travel estimates from the two surveys. The NTTIS survey also estimates travel from odometer readings and from travel on selected days. A comparison of these three estimates is presented at the end of this section.

The average annual mileage reported by the owners is shown in Figure 11 for straight trucks and tractors. Each of the next seven figures compares owner-reported average annual mileage from TIUS and NTTIS. Overall, the agreement between the two surveys is quite good. The NTTIS owner-reported average annual travel is about 18 percent higher for the straight trucks and about 4 percent higher for the tractors.

Figure 11



Average annual mileage is compared by GVWR for straight trucks in Figure 12, and for tractors in Figure 13. The comparison is rather uneven for the straight trucks, with the class 3-6 showing about the same average annual mileage in TIUS and NTTIS, and the class 7-8 showing an average annual mileage about 24 percent higher in NTTIS. The agreement for the tractors is quite good over the GVWR classes.

Figure 12

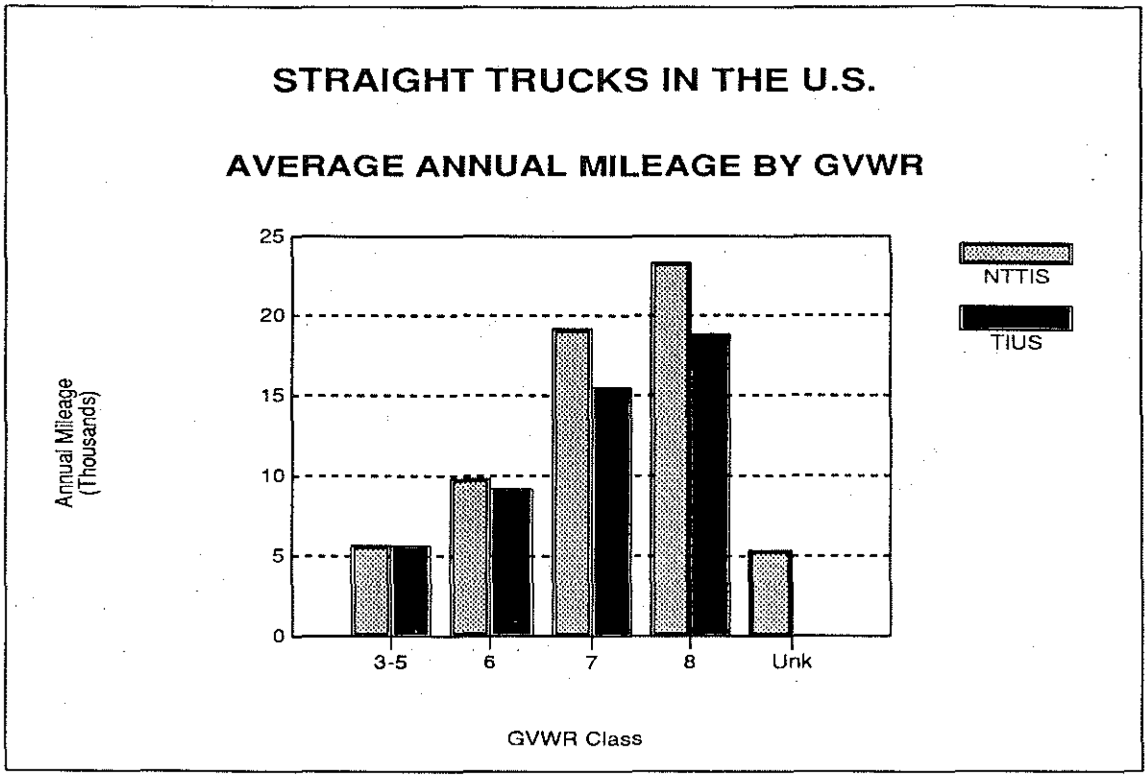
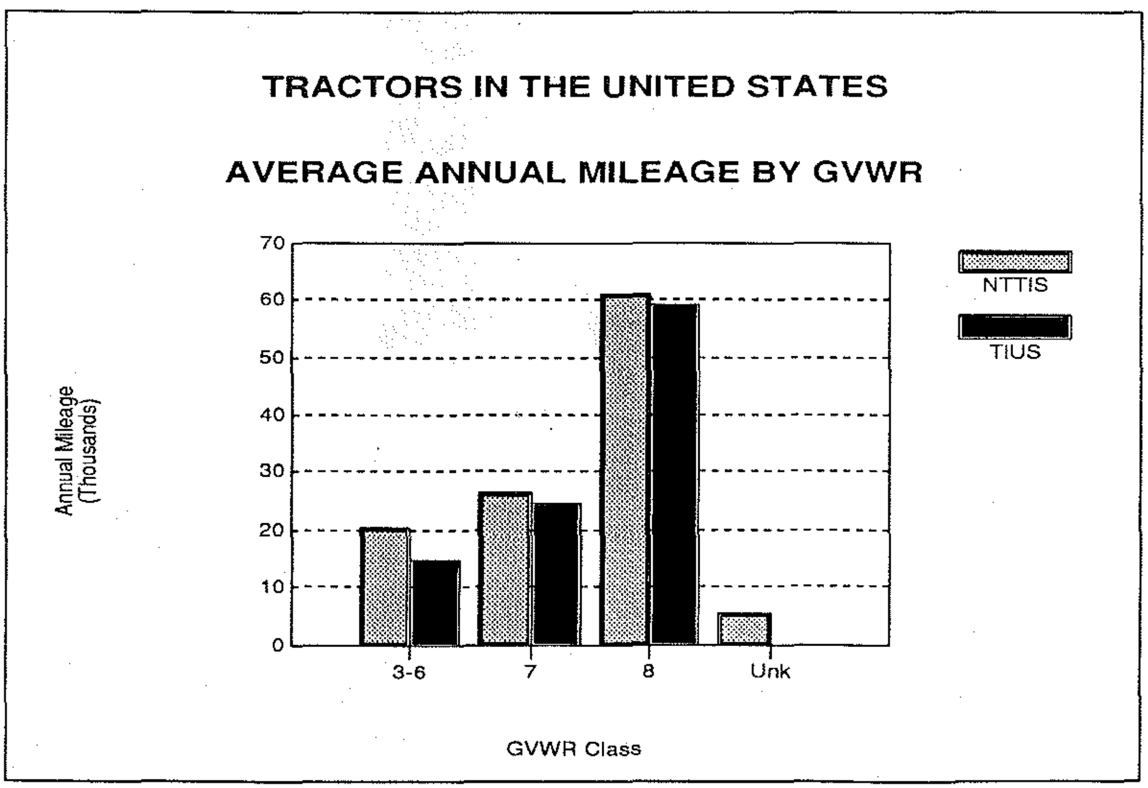
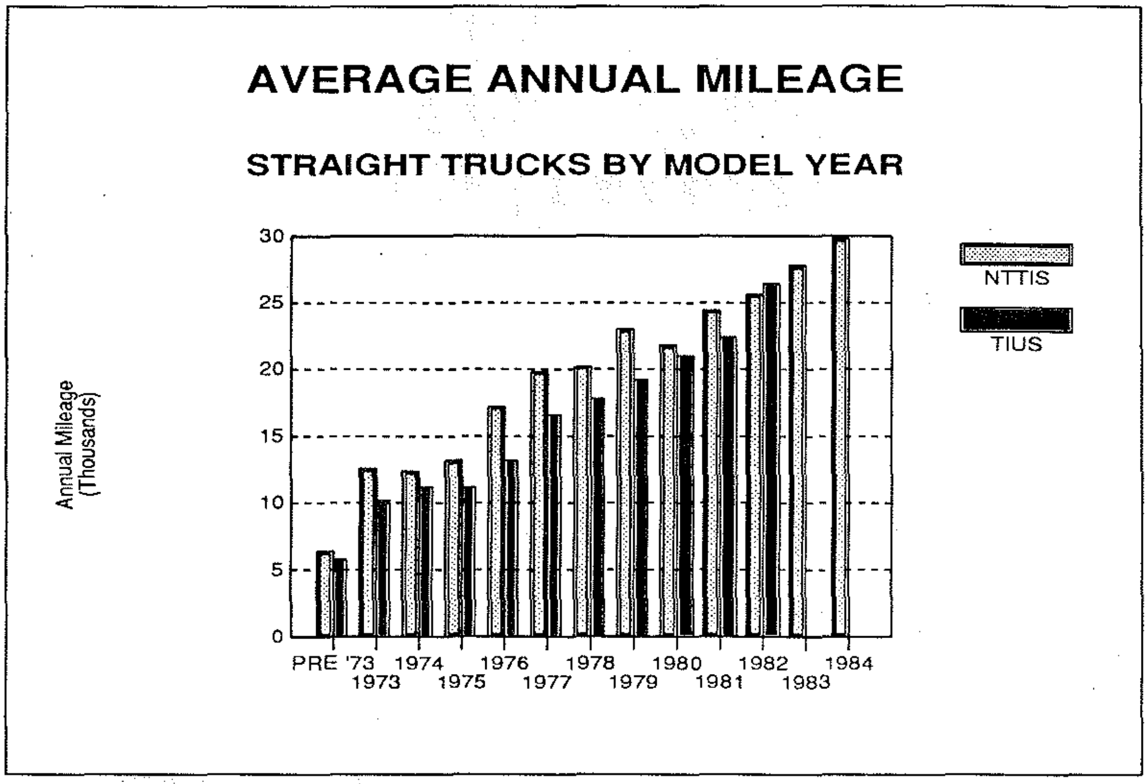


Figure 13



Figures 14 and 15 compare owner-reported travel by model year from TIUS and NTTIS. Figure 14 shows the comparison for straight trucks, and Figure 15 for tractors. These figures also illustrate the strong relationship between model year and travel. The newer trucks generally are assigned to the more severe service. As the trucks get older, they are driven fewer miles per year. One should also recall from Figure 7 that nearly 50 percent of the straight trucks are pre-1973 in both NTTIS and TIUS. The NTTIS average annual mileage is about 10 percent higher for the pre-1973 straight trucks. For the 1973-1979 model years, the NTTIS estimates are 20-30 percent higher, and then the estimates are more comparable for 1980 and newer models. As shown in Figure 15, the agreement by model year is much closer between the two surveys for the tractors.

Figure 14



The last two figures in this series show owner-reported average annual mileage for particular subsets of the truck population. Adjustments were made to the NTTIS file to reconcile the reported daily travel with the odometer readings. These subsets are referred to as the odometer adjustment strata. While neither the TIUS nor the NTTIS owner-reported mileage was used in the adjustment, it is nonetheless relevant to see that there is no bias in the two files across these subsets. The owner-reported annual mileage is the only comparable travel estimate in both the TIUS and the NTTIS files. Figure 16 shows the six adjustment strata used for the straight trucks, and Figure 17 shows the five strata used for the tractors.

Figure 15

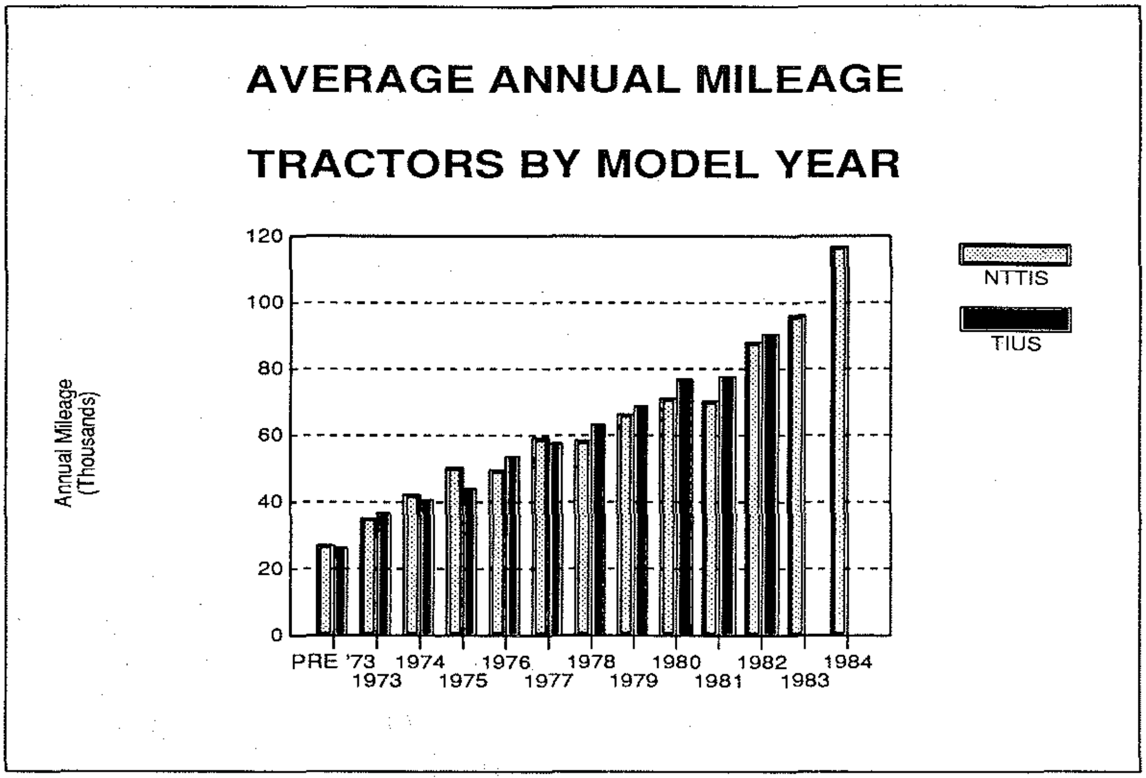


Figure 16

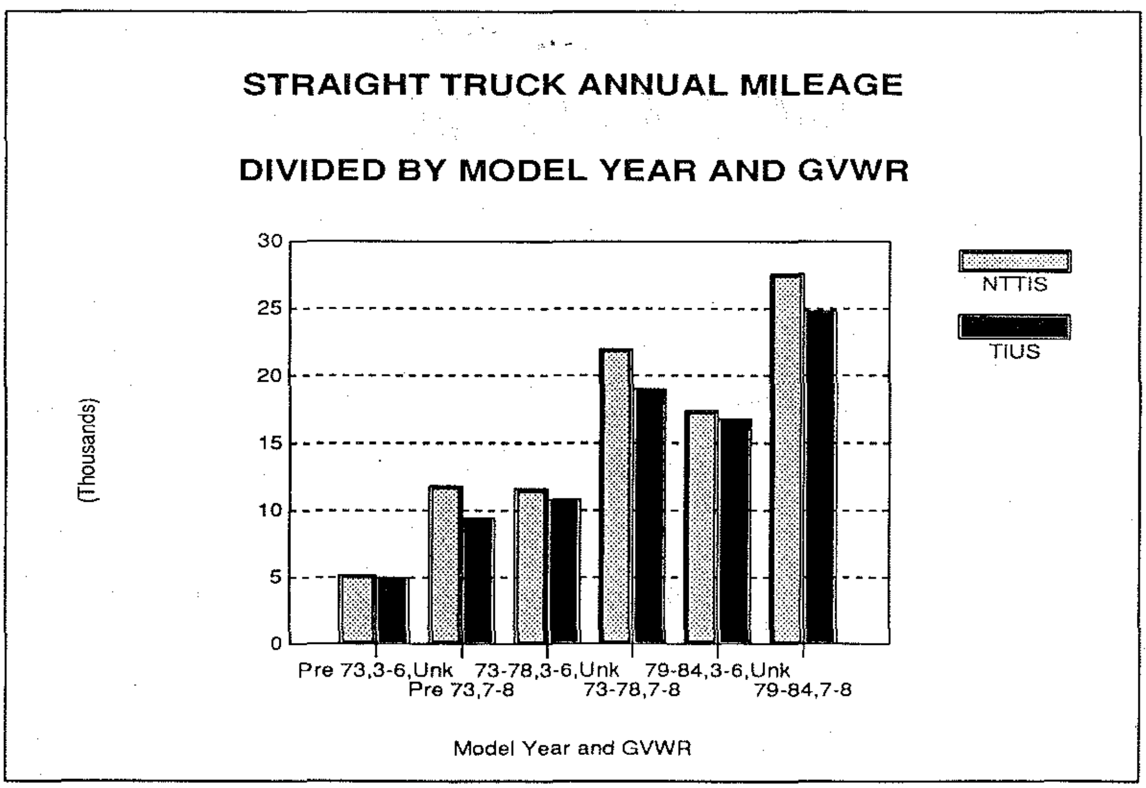
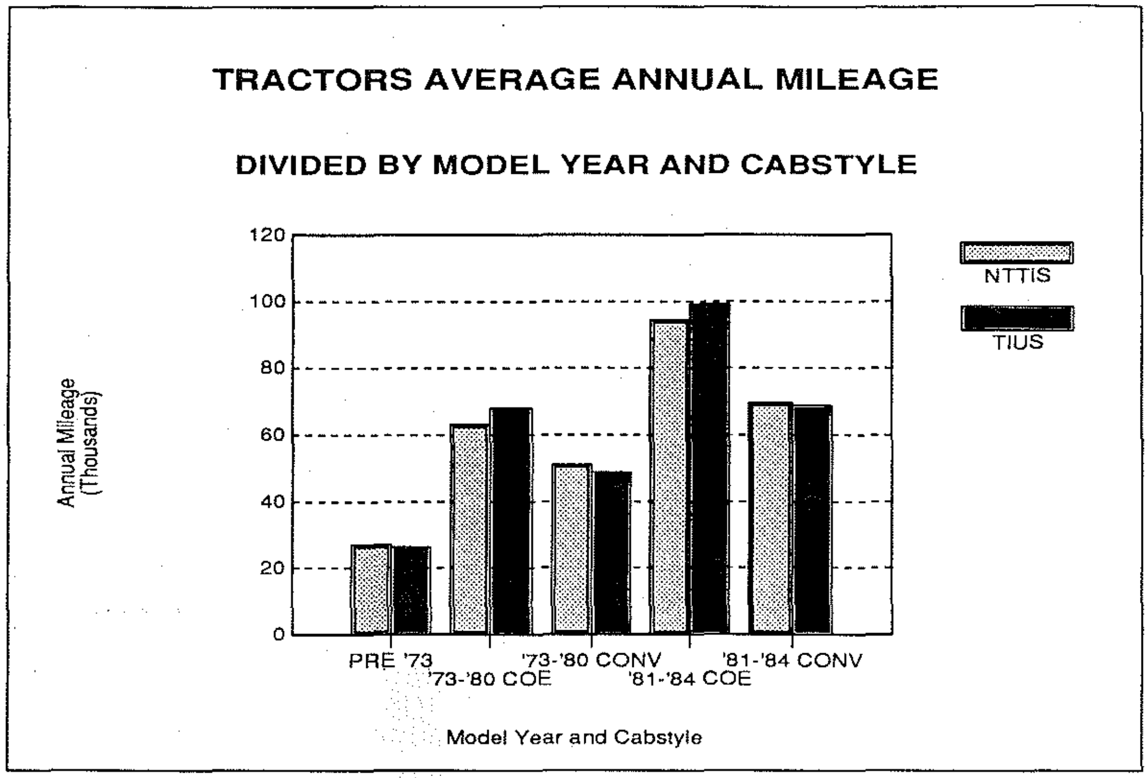


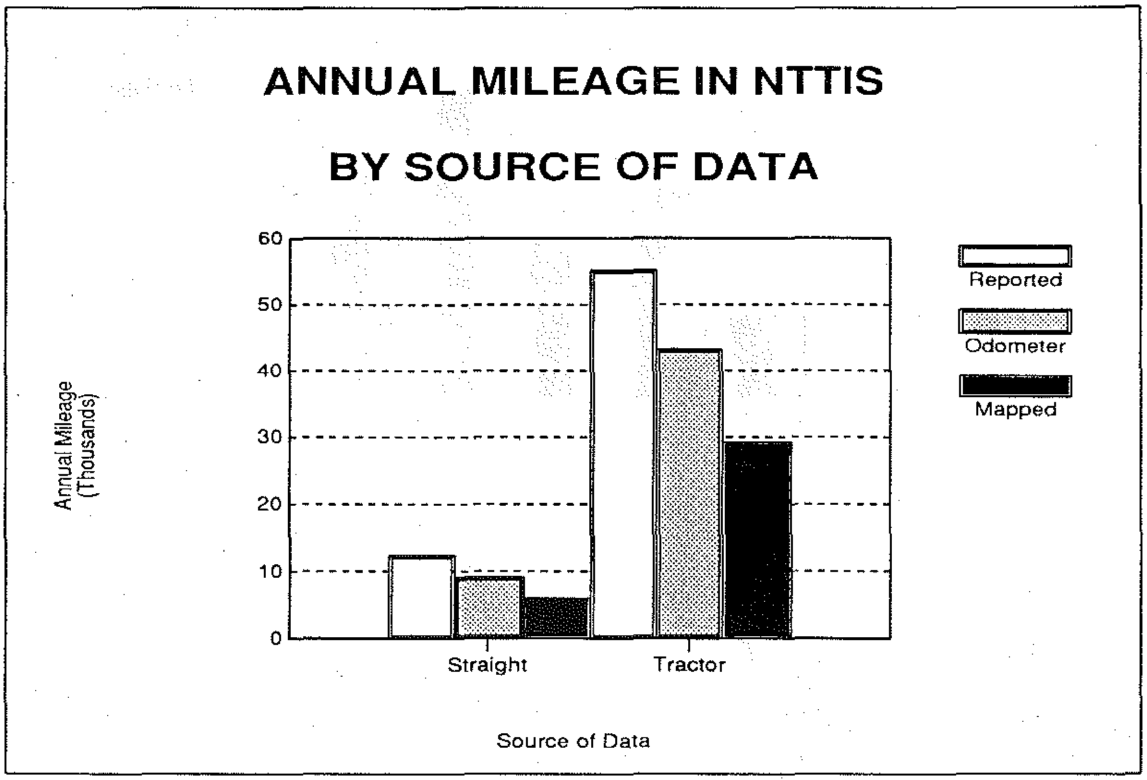
Figure 17



The straight truck adjustment strata are based on model year (pre-1973, 1973-1978, and post-1978) and GVWR (3-6, and 7-8). The strata were selected to separate the trucks on average annual travel, and to have roughly comparable sample sizes. Agreement across the strata, as shown for straight trucks in Figure 16, is relatively uniform, reflecting the approximately 18 percent higher average annual travel for straight trucks in the NTTIS file already observed. The five tractor strata are based on model year and cab style, as these variables were highly correlated with average annual travel. The five strata are: pre-1973, 73-80 COE, 73-80 Conventional cab, post-80 COE, and post-80 Conventional cab. As has been the case throughout, the agreement across the tractor strata is very good.

Three independent estimates of average annual mileage were developed in the NTTIS file. The first is the respondent's estimate of annual travel that we call a "self-reported" annual mileage. The second is calculated from odometer readings supplied for specific dates near the beginning and end of the one-year trip survey period. The third estimate is derived from the travel reported on the individual survey days inflated by the selection weights for these dates. These three estimates are compared in Figure 18. The self-reported average annual mileages agree quite well with the figures in the 1982 TIUS file. The average annual mileage based on the odometer readings is 20-25 percent lower than the self-reported annual mileage, and the estimate based on the survey days (labelled "mapped miles" in the table) is lower by another one third. We generally believe that the odometer readings provide the most accurate estimate, although complete odometer information was only obtained on about two thirds of the trucks that responded to the trip survey. Since the proportion of trucks reported to not be in use on the survey days was rather high (over 50 percent for the tractors), we tend to believe that the respondents sometimes reported that the truck was not in use when it actually was. For this reason, an additional adjustment factor has been developed for the mapped miles so that the total travel estimates produced are comparable to the odometer data.

Figure 18



ACCIDENT RATES ANALYSIS

For the past several years we have been pursuing a data collection goal. This goal was to obtain more detailed accident data accurately identifying the levels of the many factors of interest and with sufficient sample size to tabulate the many combinations of these levels and factors. This goal also included obtaining travel data that could be tabulated by all of the same levels and factors as the accident data. The real objective, of course, was not the data collection, but the analysis such data would make possible. In this section we begin the development of analytical methods that will identify the factors associated with accident risk and quantify their relationship to the risk. These methods promise a more objective approach to many traffic safety issues.

The material in the following three sections addresses many objectives. The first is to illustrate the multivariate nature of the problem. In some respects, this objective provides a final justification for the long and costly data collection program. More importantly, results are presented showing the influence of many of the key factors on accident risk. Risk cannot be studied without a measure of the exposure to risk. Miles travelled is the exposure measure for this study. However, knowing the miles travelled is not sufficient because the risk of accident is different for each mile. Consequently, it is also necessary cross-classify the travel by the factors that are responsible for this variation in risk.

NTTIS focused on three travel factors that had not previously been available in national travel data: road type (limited access, primary, and other), area type (rural or urban), and time of day (day or night). Combination of the levels of these three factors forms 12 travel categories. When sample size is limited, the primary and other road types are combined, producing 8 travel categories. Much of the material presented focuses on the variation in accident risk across these travel categories. Because of the substantial variation in risk across these categories, an equally important result is the distribution of travel across these categories for specific truck types of interest. If the travel distributions are not similar, then the risk of accident is different.

The first section on accident rates is a comparison of five basic types of truck, or configurations. They are: straight trucks with no trailer, straight trucks pulling one or more trailers, tractors with no trailers (bobtail), tractors pulling a single semitrailer (single), and tractors pulling two trailers (double). This section has an objective beyond the comparison of accident risk. The secondary (perhaps primary) objective is to illustrate that aggregate rates can be misleading. The ratio of the total number of vehicles involved in accidents to the total miles travelled is called an aggregate rate. Although aggregate rates *do* take into account the amount of travel, they *do not* take into account differing risk associated with the type of travel. When aggregate rates are compared for subsets with different distributions of travel across the various risk categories, then the aggregate rate includes the influence of these risk factors as well as any risk associated with the subset of interest. While the aggregate rate is an accurate estimate of the overall risk for any group or subset, it often does not provide insight as to the factors responsible for that risk. The objective of this analysis is to identify the factors associated with risk. In order to facilitate comparisons among subsets that may have differing amounts of travel among the various risk categories, a method of adjusted rates is employed. This method calculates the aggregate rates that *would* result if each subset of interest had the same distribution of travel across the various risk categories. Thus, the section comparing the five configurations begins by showing why the aggregate rates can be misleading, and it ends with the application of the adjusted rates method as a basis for comparison of the configurations.

The second section on accident rates focuses on the difference in risk for different types of collisions. Again, risk is shown to vary with the travel categories. Aggregate rates have the same problem in this application. Adjusted rates are calculated again in order to compare the risk of different types of collisions for two configurations. For reasons of sample size, this section is limited to the two most common configurations, straight trucks without trailers and tractors pulling a single semitrailer. This restriction allows use of the full 12 travel categories.

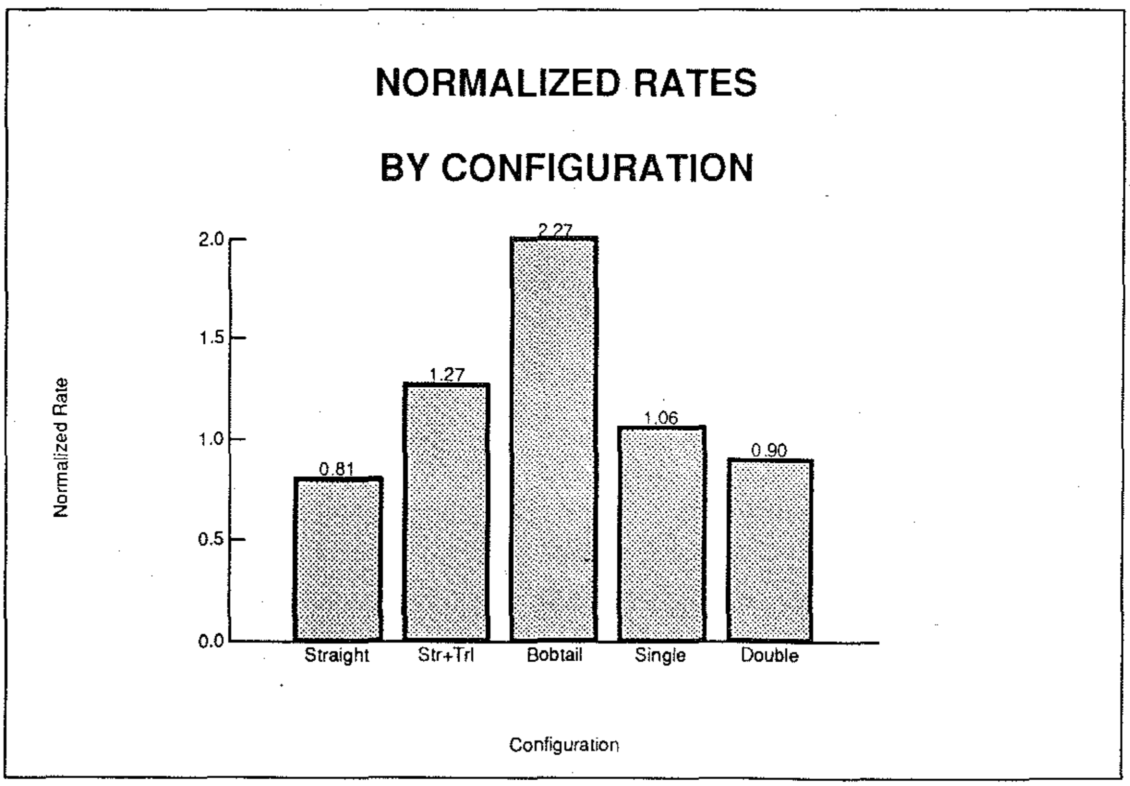
Finally, the third section on accident rates applies the results of the first two to an analysis that attempts to determine the relationship of the gross weight of a tractor-semitrailer combination to the risk of accident. This section illustrates the need to develop multivariate modeling techniques as a method for quantifying the relationship of many factors with accident risk.

Comparison of Five Truck Configurations

Fatal accident involvement rates are usually calculated by dividing the number of trucks involved in fatal accidents (involvements) by the total travel in vehicle-miles for the comparable group of trucks. This rate has the units of involvements per vehicle mile travelled, and is referred to as a "raw rate." While the raw rate is a direct estimate of the risk of involvement in a fatal accident, it does not facilitate comparisons across many subsets or categories because the reader must always compare the individual rate for a particular category with the overall rate, making a mental calculation of the ratio of the two. To facilitate comparison, normalized rates are presented throughout this report. The normalized rates are calculated by dividing the raw rates for every subset by the overall raw rate. The normalized overall rate is 1.0, and normalized rates for particular subsets can easily be compared to this figure. Subsets with normalized rates less than 1.0 are under-involved in comparison to the overall rate, and subsets with normalized rates greater than 1.0 are over-involved. The normalized rate is also equal to the proportion of involvements for the subset divided by the proportion of travel for the subset. For example, if a subset has 10 percent of the involvements and 5 percent of the travel, the normalized rate is 10/5, or 2.0. Tables are included at the end of the report showing the actual number of involvements and estimated travel for each category.

Normalized fatal accident involvement rates for five basic truck configurations are presented in Figure 19. These five categories comprise the entire large-truck population (GVWR greater than 10,000 pounds). The rates are based on the five-year TIFA file (1980-1984) and the 1983 NTTIS file. Since the travel survey was mostly conducted in 1986, the time period for the exposure does not match the time period of the accidents, although the vehicle population in terms of distribution by model year is fairly comparable for the TIFA and the NTTIS files. Obviously, it would have been more desirable to have travel data for the exact same period of time as the involvements, but the availability of funding and other problems preclude a better match at this time. It will be another year before the 1986 TIFA file is complete, and several years of accident data are needed to produce sufficient sample sizes. When considering possible conclusions based on the results of these analyses, the reader must remember the mismatch in time periods between the involvements and the travel. The analysis has been carried out to illustrate the methods that cross-classified data can support. Furthermore, the authors believe that the percent distributions across the factors presented are quite stable over time. Although the raw rates may vary, the normalized rates should be more stable.

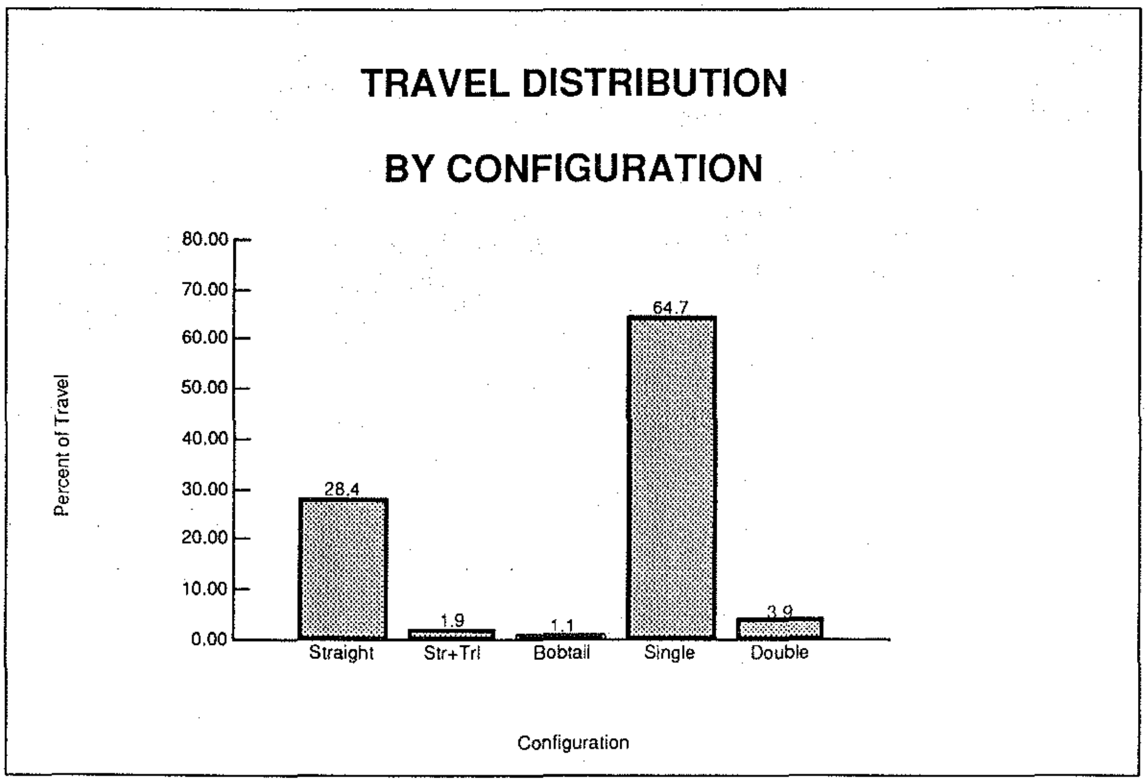
Figure 19



The normalized rate is highest at 2.27 for the bobtail tractors. Tractors pulling a single trailer and straight trucks pulling one or more trailers are also over-involved at 1.06 and 1.27, respectively. Straight trucks with no trailers and doubles (tractors pulling two trailers) are under-involved at 0.81 and 0.90, respectively. Figure 20 shows the travel distribution across the five configurations. Singles accumulated nearly 65 percent of the total travel.

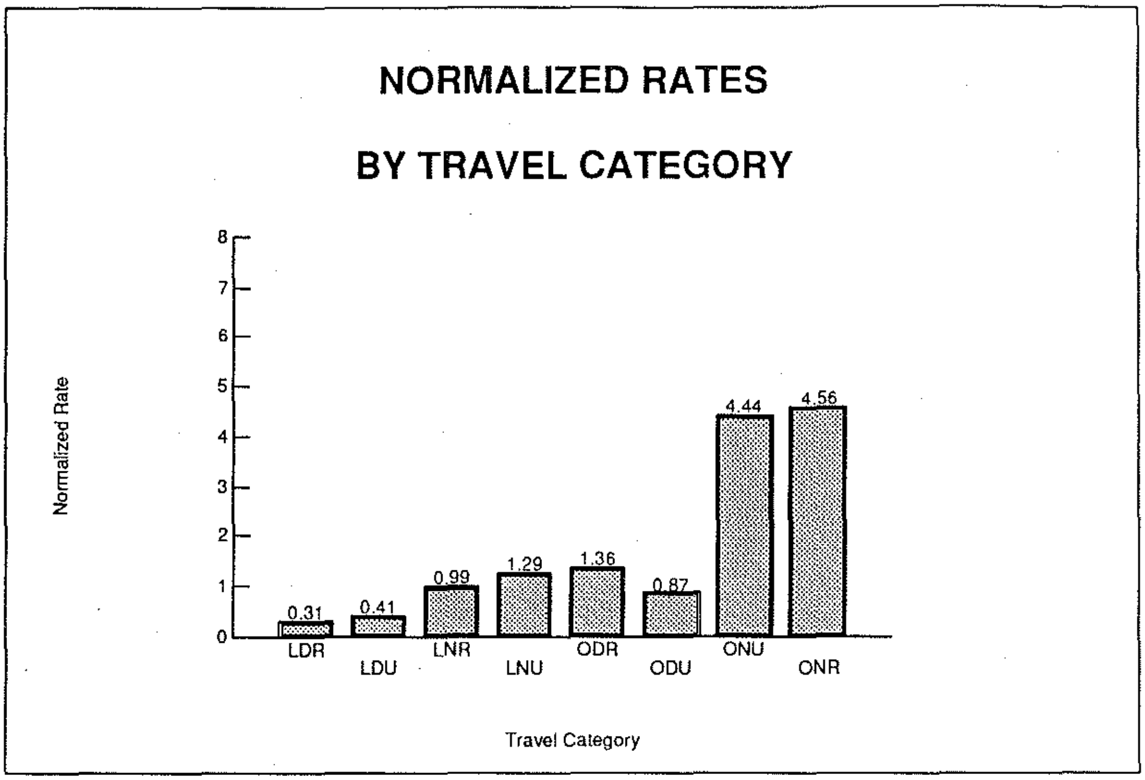
Straight trucks without trailers accounted for 28 percent, leaving only 7 percent for the straight trucks pulling trailers, bobtails, and doubles.

Figure 20



Travel can be divided into 8 categories that are defined by the combinations of two road types (limited access versus all other roads), rural versus urban areas, and day versus night. In Figures 21-27, the labels indicate combinations of road type, time-of-day, and population type. LDR, for example, stands for Limited Day Rural and ODR stands for Other Day Rural. U indicates Urban. Normalized rates for these 8 travel categories are presented in Figure 21 for the aggregate of all large trucks involved in fatal accidents. The differences in the normalized rates by travel category are substantial. The fatal accident involvement rate for all large trucks on limited access roads is one-half to one-fourth the rate on all other roads. The rate at night is approximately three times the daytime rate.

Figure 21



It should be noted that for these categories, "night" has been arbitrarily defined as 9:00 PM to 6:00 AM, while the other 15 hours of the day are designated "daytime." For the NTTIS respondents, it did not seem feasible to ascertain the actual point on their trip where dawn or dusk came. Instead, travel was simply categorized by the times specified above. Thus, nearly all of the travel classified as "night" was driven during darkness, but some of the travel classified as "day" was actually driven in the dark. For the TIFA file, the exact same classification of day and night based on the 9:00 PM to 6:00 AM definition was used, even though the actual light condition is coded for almost all cases. A comparison of the light condition with the time of day coded in the TIFA file shows that only 1.5 percent of the accidents occurring from 9:00 PM to 6:00 AM have the light condition coded "day," while 13.1 percent of the accidents occurring from 6:00 AM to 9:00 PM have the light condition coded as "night." Although the definition of day and night does not precisely correspond to the actual light condition, it *is* exactly comparable in the accident and exposure files.

The reader should also be aware of some small problems in the comparability of the road class definitions in the accident and exposure files. For the NTTIS data, the state maps and urban insets of the 1985 Rand McNally road atlas were used to classify the roads travelled on the reported trips into three categories. These were: limited access roads (blue in the atlas), other divided and principal highways (yellow and red in the atlas), and all remaining roads (grey in the atlas).

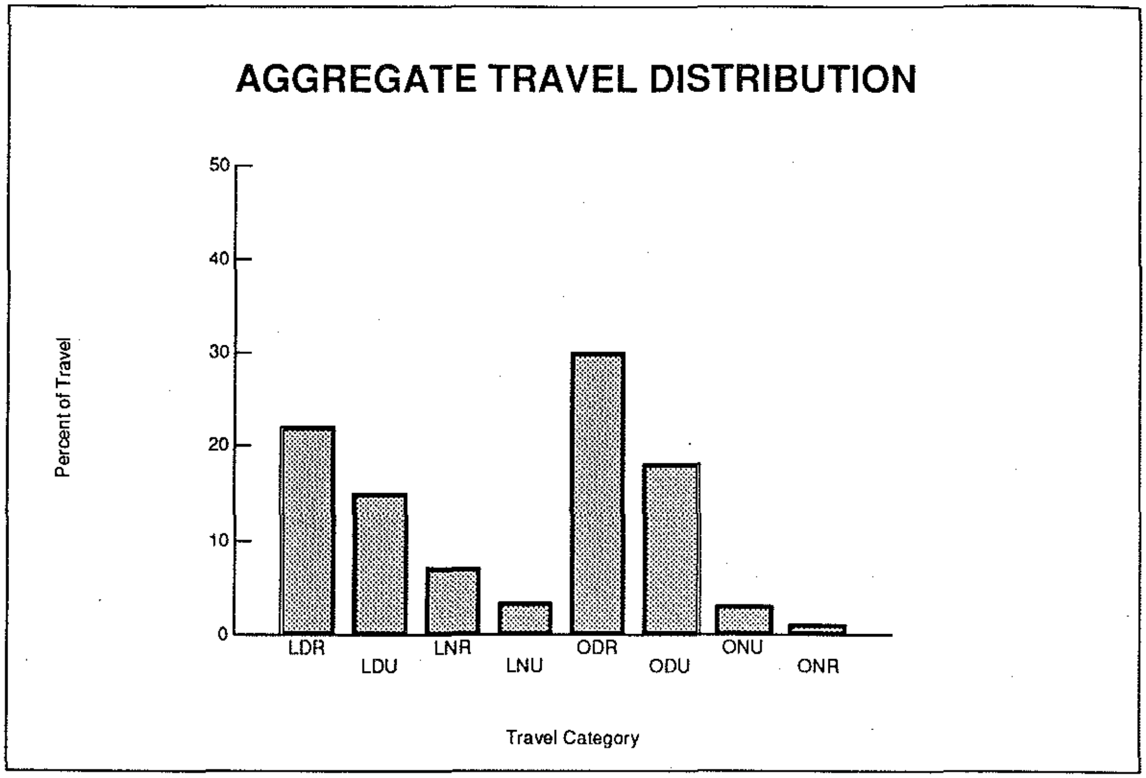
For the TIFA data, the road class at the accident location provided by FARS was used. Unfortunately, these do not match the NTTIS categories exactly. FARS does not have a "limited access" category as such. It has a category for interstate, and all roads in this category should be limited access. In 1980, FARS has a category called "other limited access" (that seems under-represented in the actual data), and in 1981-1984 there is a category with the rather ambiguous label "other urban freeways and expressways." Approximately three-fourths of the cases in this category were also coded as a divided highway in a separate variable. These case were combined with those coded interstate to comprise the limited access category. But this category is somewhat deficient in not including rural non-interstate limited access roads.

The TIFA distinction between major routes and other roads is also problematic. FARS does provide a distinction between "primary and arterial" roads and "secondary, collector, and other local" roads for all five years, but these do not seem to match exactly with the Rand McNally color groups. A closer match is found in another FARS variable distinguishing U.S. and state highways from other roads. This classification seems to better match the Rand McNally yellow-red and grey color groups respectively. In rural areas, almost all of the yellow and red roads are U.S. or state highways, and only a few minor state routes are shown in grey. In urban areas, all U.S. and state routes are shown in yellow or red, but in the larger urban areas there are also some roads shown in yellow or red that are not U.S. or state highways.

These problems prevent the match between the Rand McNally road classification used in the NTTIS file and the FARS road type categories in the TIFA file from being exact. However, the exceptions seem to be very few, it is unlikely that these problems are sufficient to influence any of the comparisons by travel category that are presented in this report. Unfortunately, the 1981 FARS file did not include the variable identifying U.S. and state routes. Consequently, analyses using all three road types were restricted to the 1982-1984 TIFA data. In order to use all five years of TIFA data, 1980-1984, road class is collapsed to the two categories, limited access, and all other roads.

Since the risk of accident varies substantially across the different travel categories, one would like to know the distribution of travel for each of the five configurations. If the travel distributions are different, then the aggregate rates will be influenced by the amount of travel in the various categories. Figure 22 shows the distribution of all large-truck travel across the 8 travel categories for comparison.

Figure 22



Travel distributions across the 8 travel categories are shown for each of the five configurations in Figures 23 through 27. Comparison of Figures 23 through 27, and Figure 22, the aggregate travel distribution, reveals substantial differences in the travel distributions of the five configurations. The straight trucks accumulate much more travel on the other roads (as compared to limited access roads). Both straight truck configurations and the bobtails put on very little nighttime mileage. The singles, on the other hand, accumulate substantial travel on limited access roads, and travel more at night. Perhaps the most striking travel distribution is that for doubles. The doubles travel distribution is not similar to any of the others. Because this configuration is primarily restricted to limited access roads in most states, doubles travel less on non-limited access roads.

Figure 23

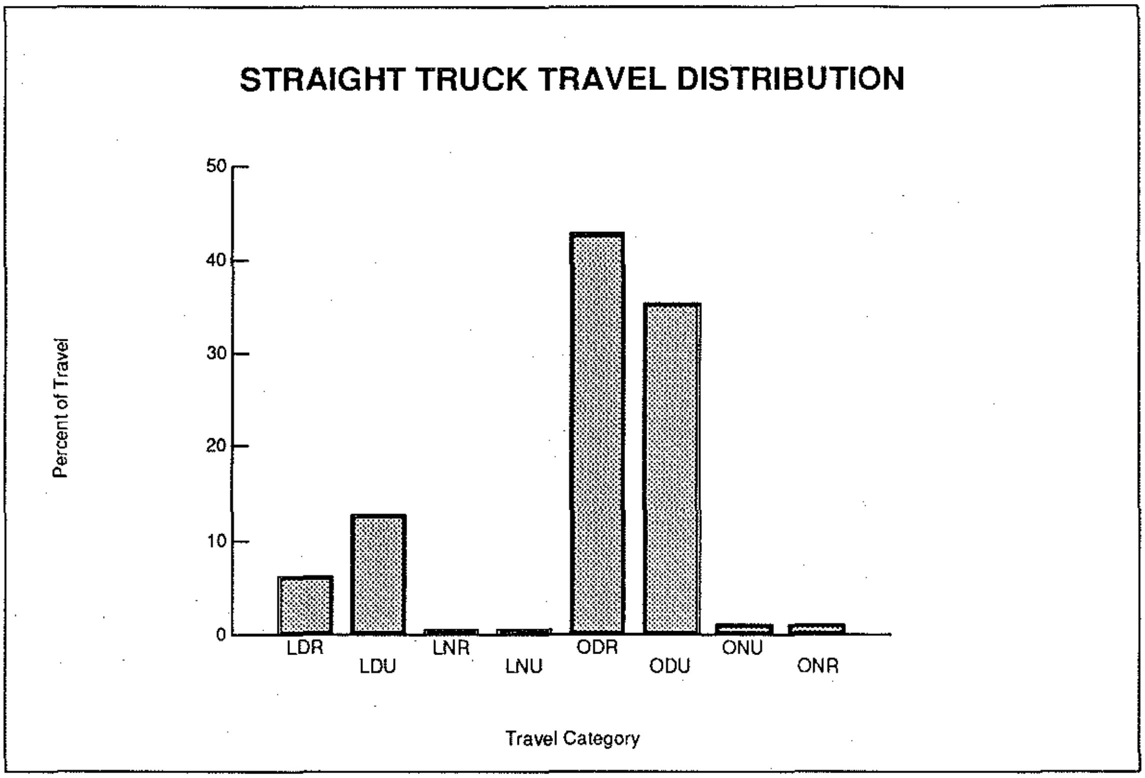


Figure 24

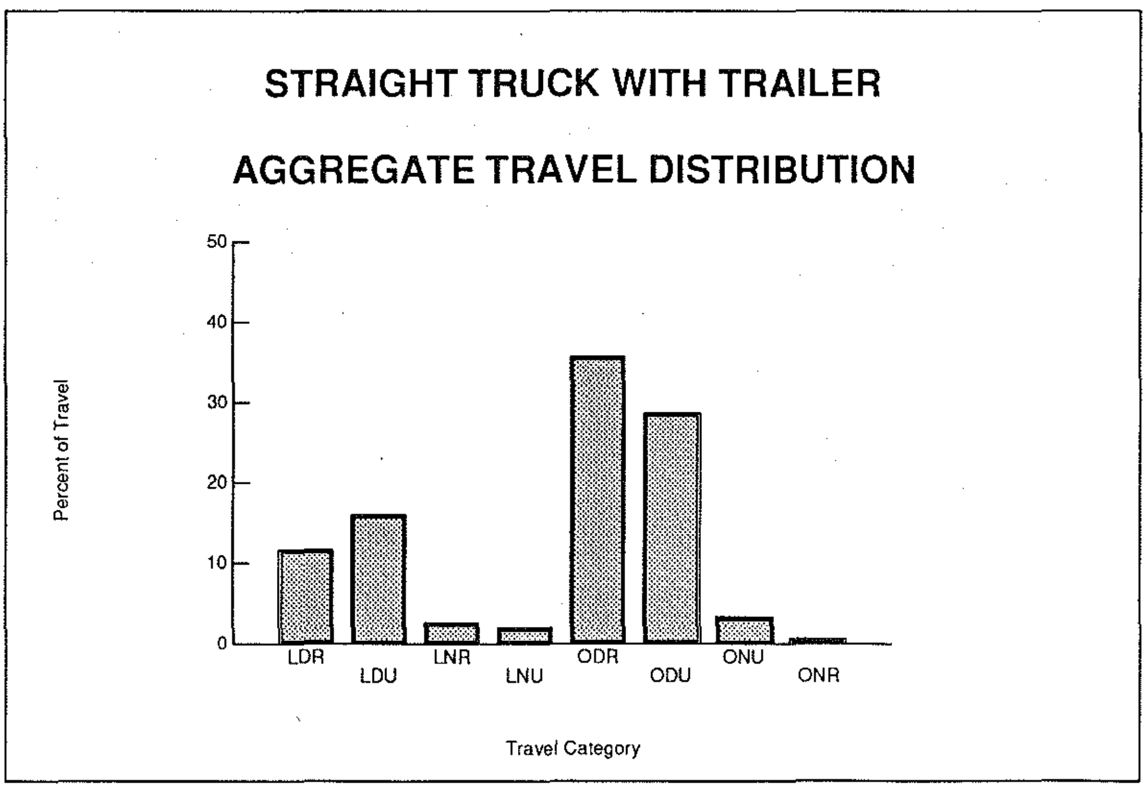


Figure 25

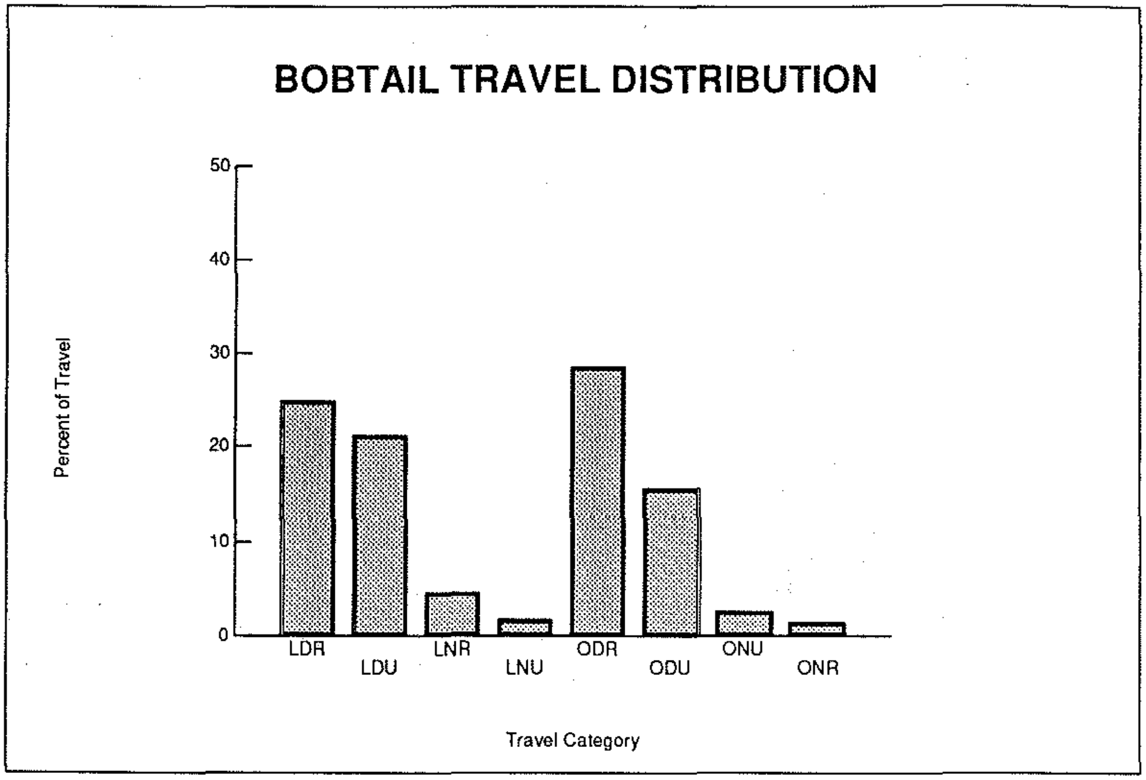


Figure 26

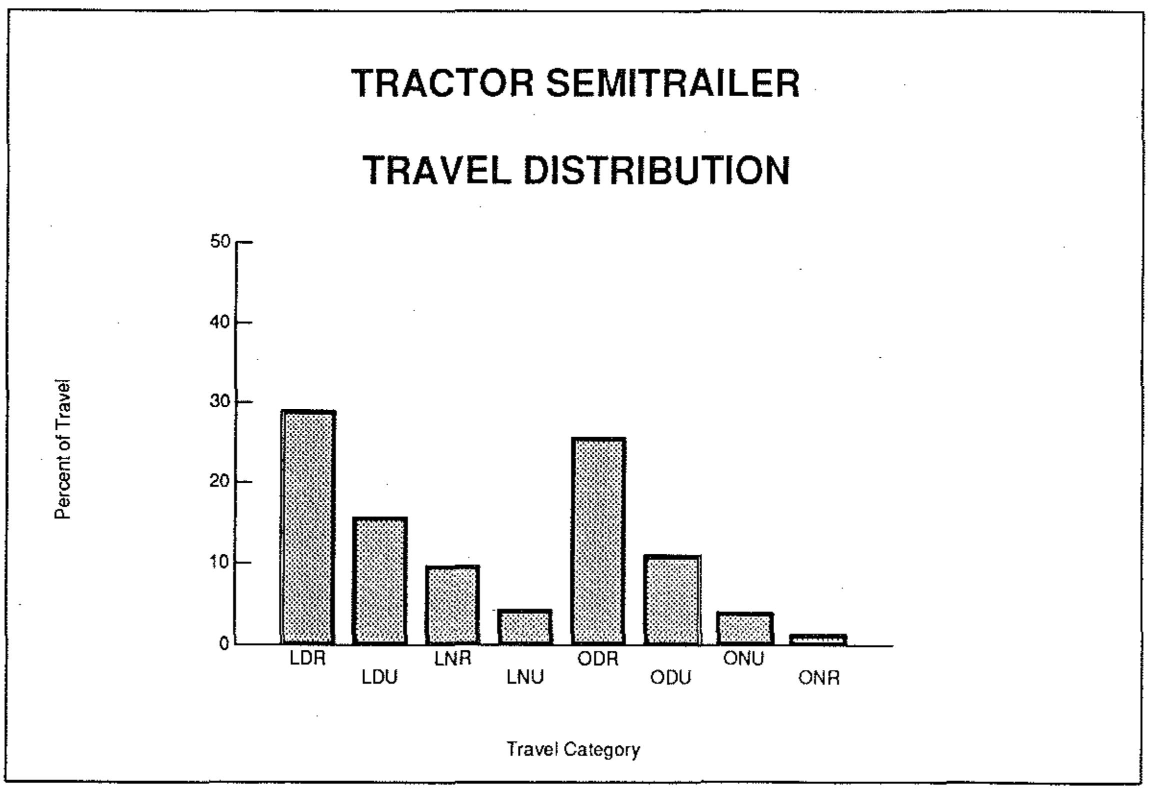
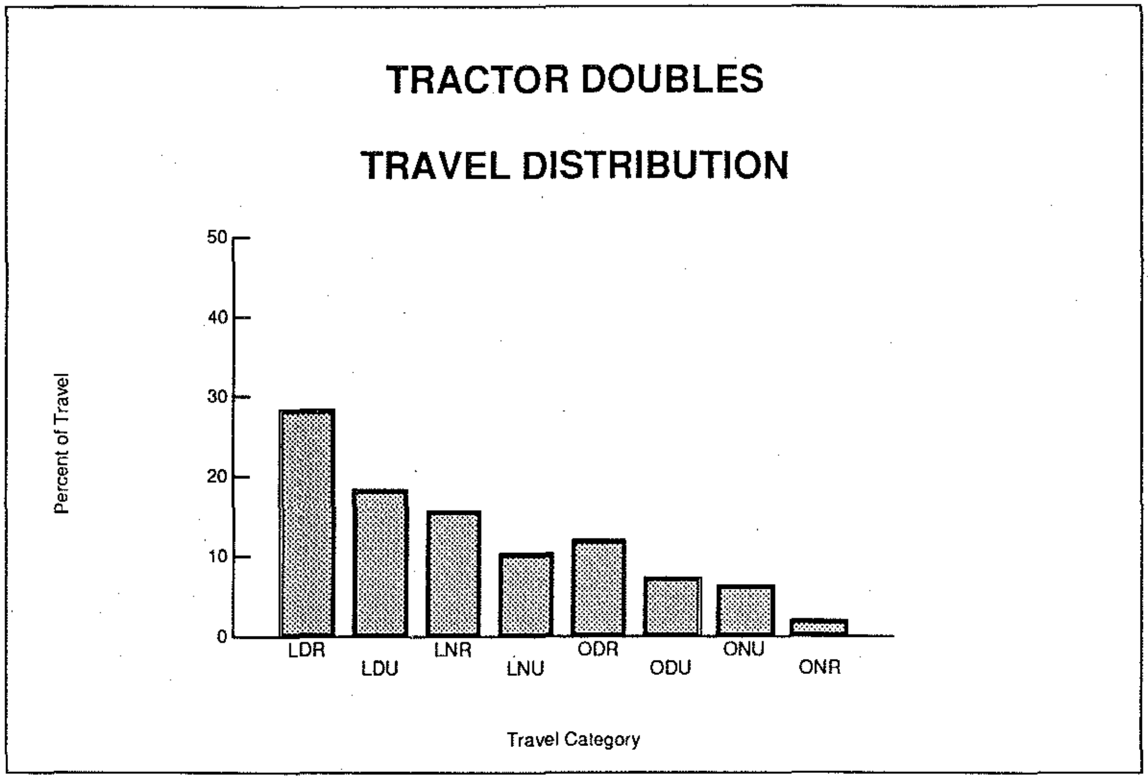


Figure 27



The differences in the risk of accident for the 8 travel categories and the differences in the distributions of travel across these categories for the five configurations raises the possibility that the travel differences are responsible for variation in the normalized rates shown for the five configurations in Figure 19 at the beginning of this section. In other words, the straight trucks pulling trailers may be over-involved because they travel more on non-limited access roads having a higher risk of accident, or the doubles may be under-involved because they travel more on the relatively safe limited access roads. Given these findings, how can comparisons between configurations be made that are not confounded by the travel distributions?

A direct approach is to confine the comparison of the configurations to the individual travel categories, that is, to make 8 separate comparisons of the configurations, one in each of the 8 travel categories. This approach produces a large volume of information and taxes the available sample size, particularly for the small subsets. However, Figures 28 through 35 repeat the comparison of the five configurations for each of the 8 travel categories.

Figure 28

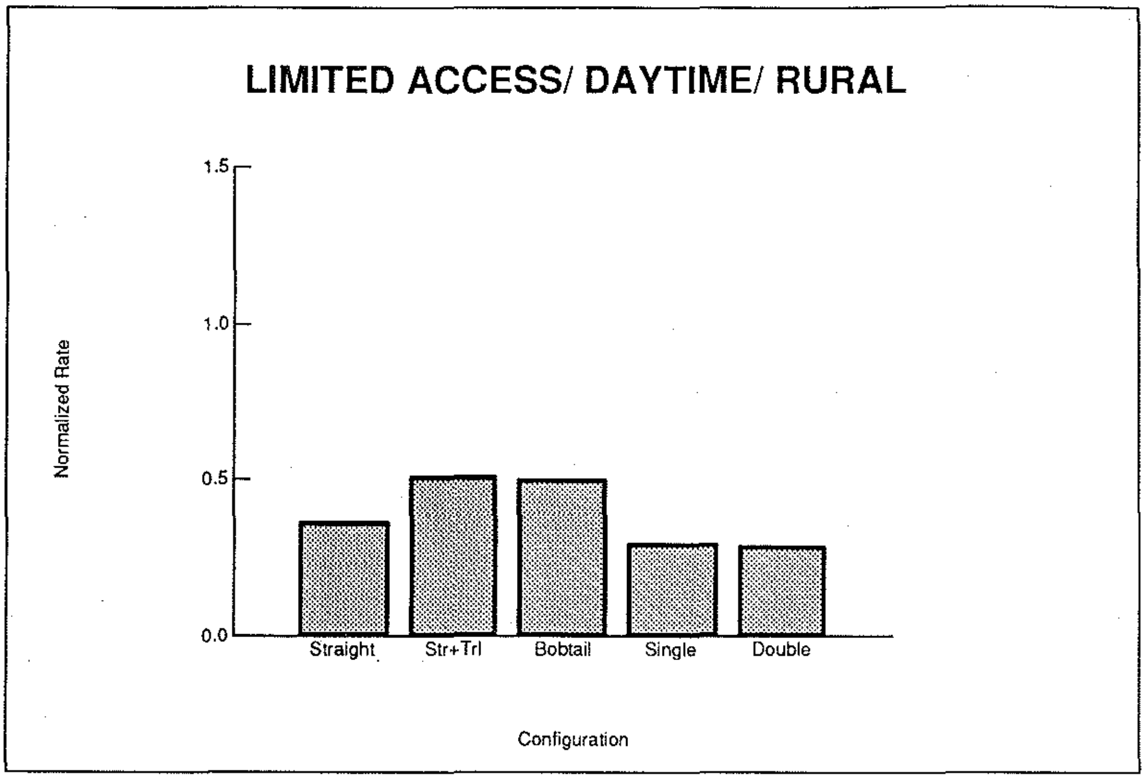


Figure 29

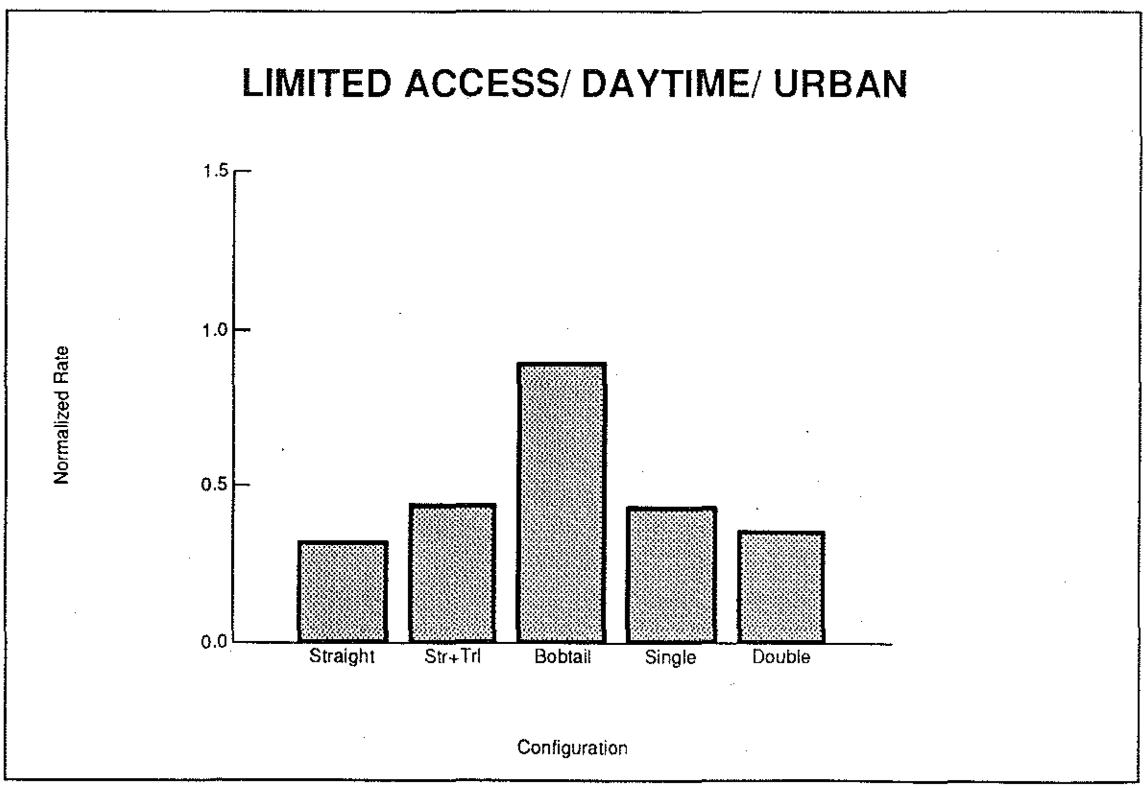


Figure 30

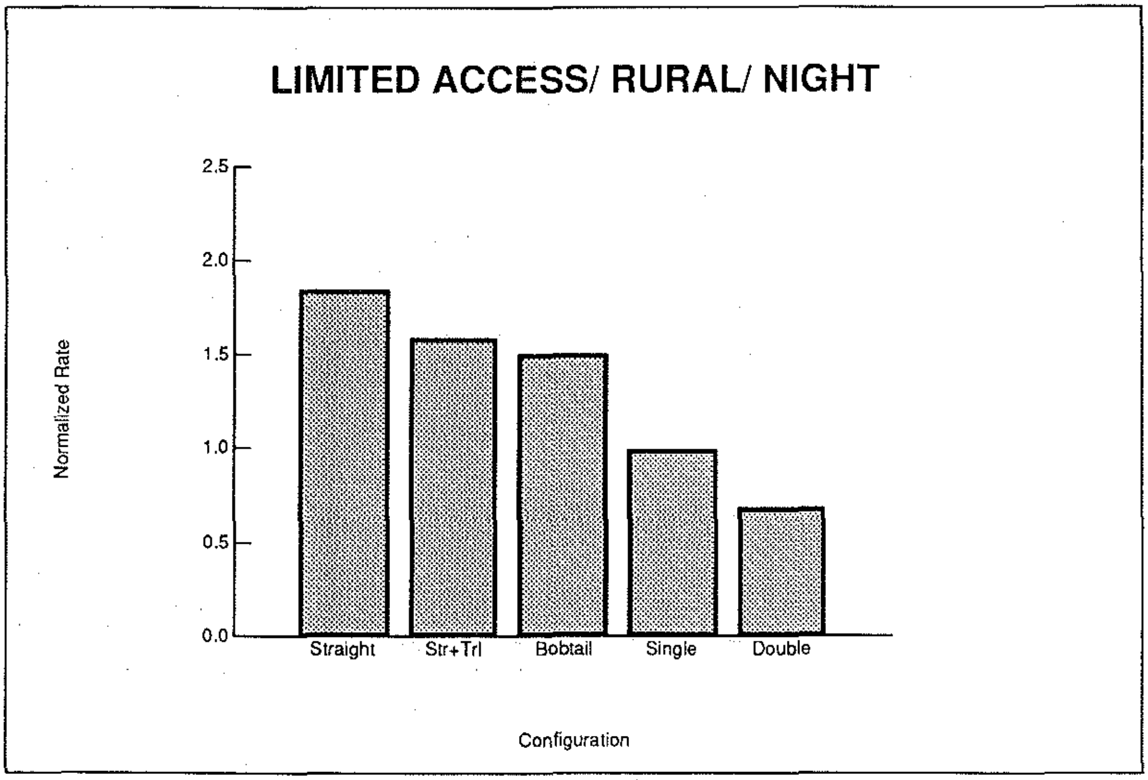


Figure 31

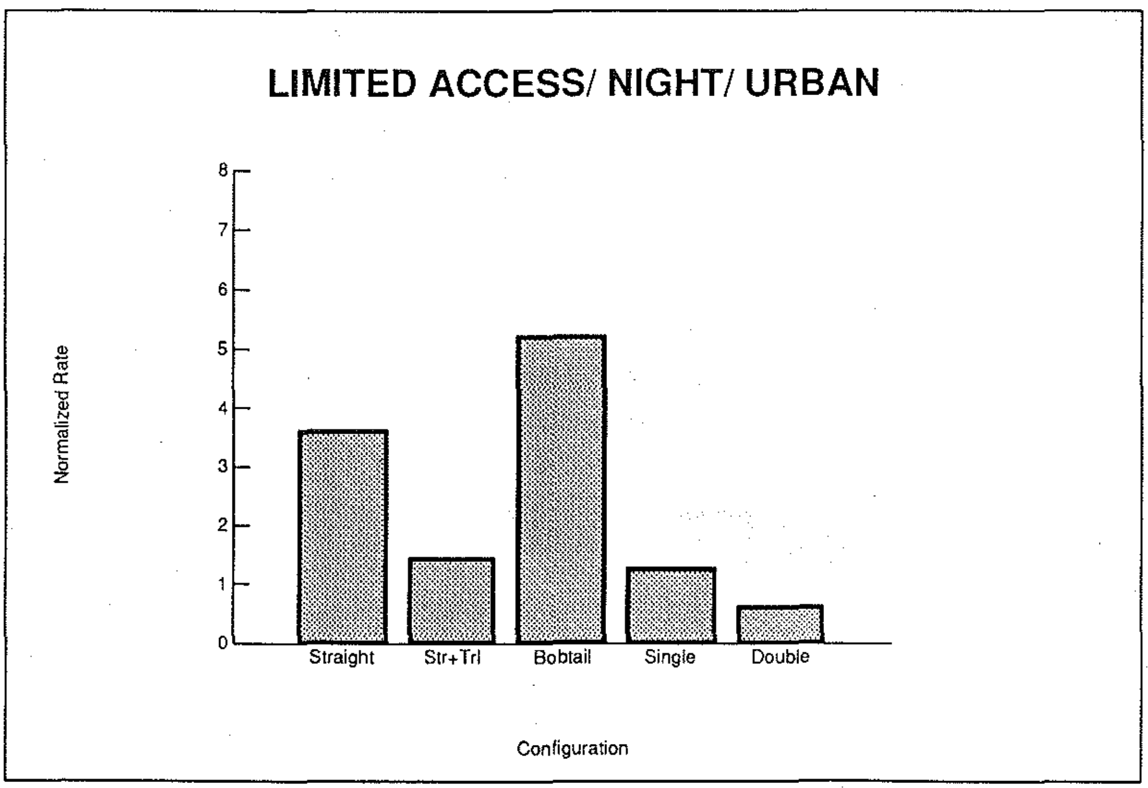


Figure 32

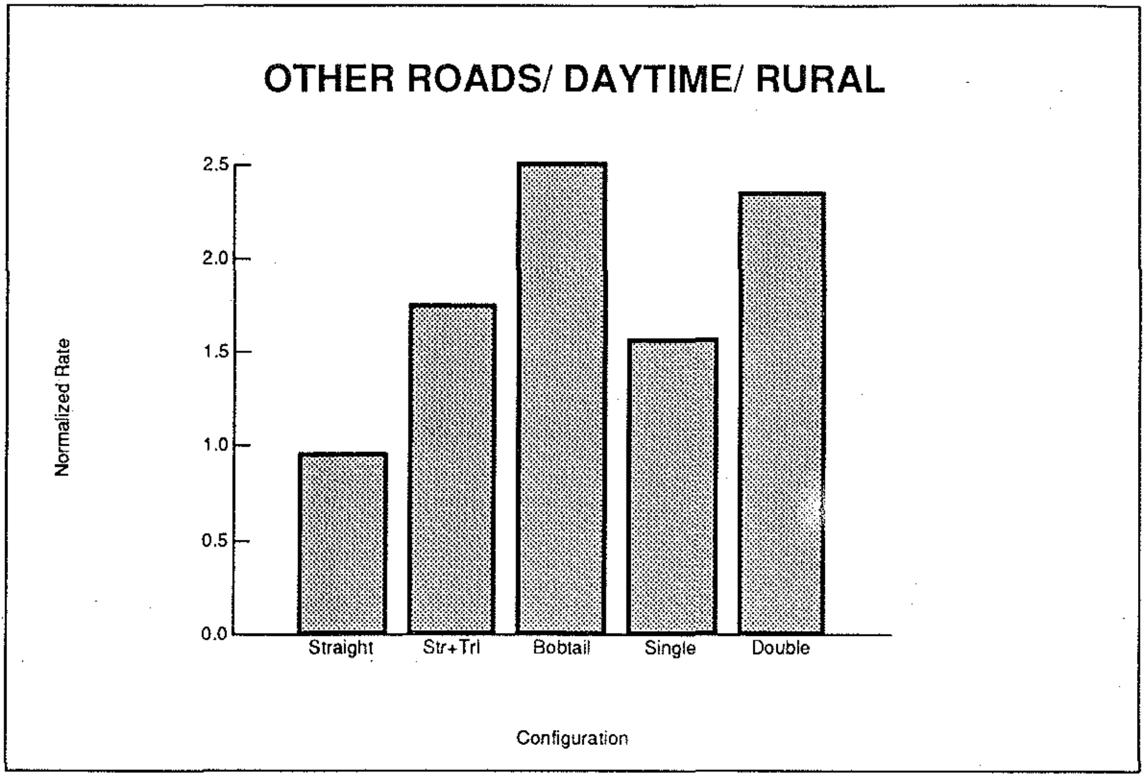


Figure 33

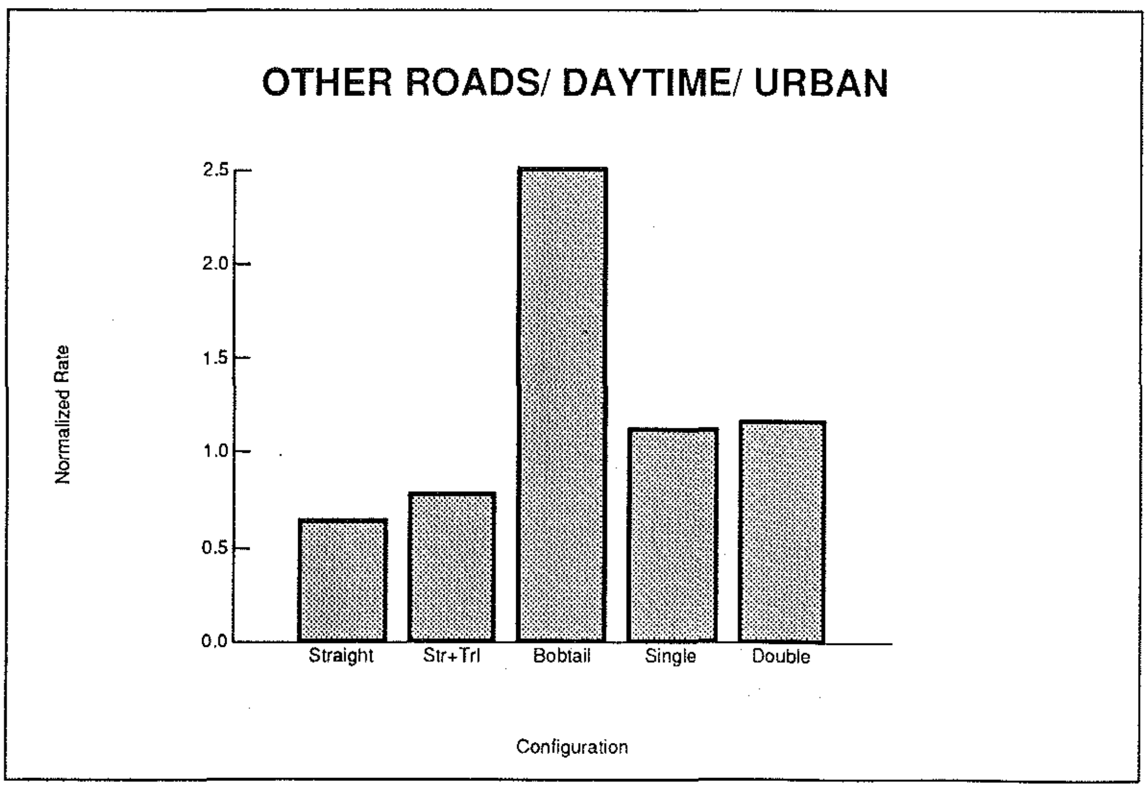


Figure 34

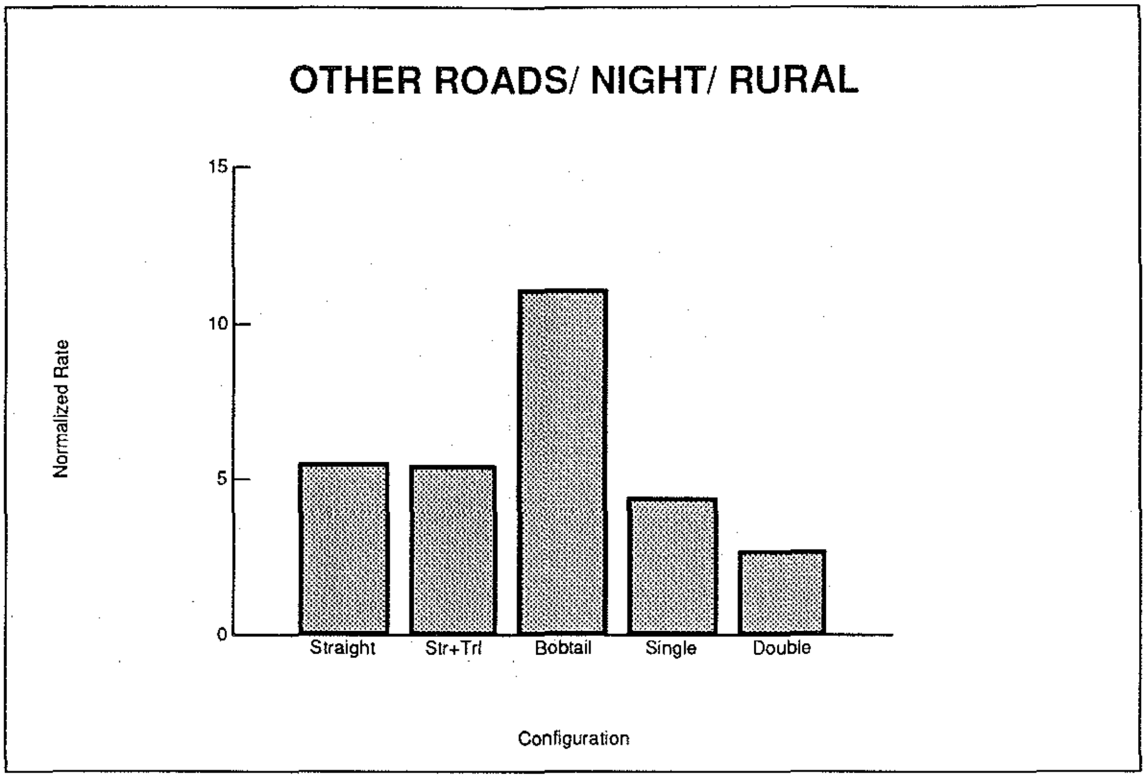
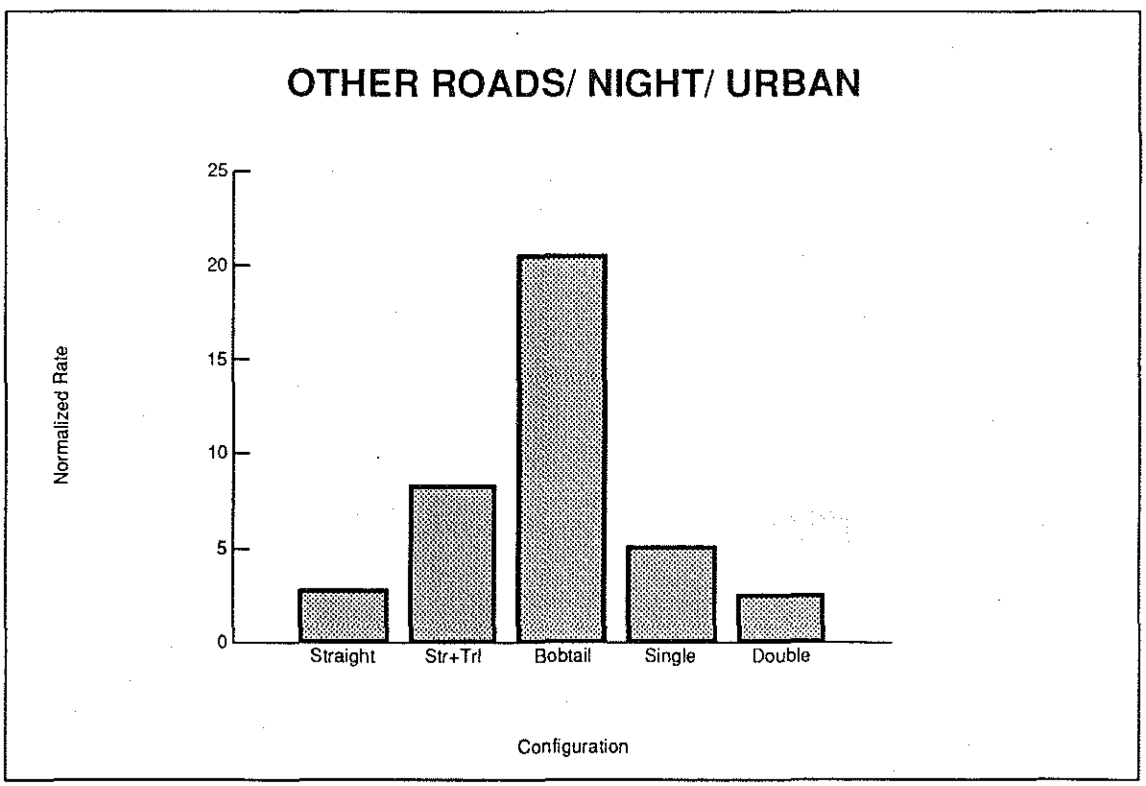


Figure 35



Despite (or perhaps because of) the large volume of information, Figures 28 to 35 do not resolve the question of comparisons between the configurations. The 8 figures show that the bobtails are over-involved in each travel category. For the other configurations, the results are not so consistent. Looking at Figure 30, for example, the straight trucks without trailers are over-involved, when they were under-involved in the aggregate rate. Although doubles were under-involved in the aggregate, they are over-involved on other rural roads in the day, as shown in Figure 32. These figures indicate that in different travel categories, some configurations have quite different relative risks compared to other configurations.

The adjusted rates method allows the influence of the travel categories to be removed from the comparison between configurations. The aggregate rate may be thought of as a weighted combination of the rates for the individual subsets, or categories, where the weighting factor is the proportion of the total travel for the subset. Similarly, the normalized rate is also a weighted combination of the normalized rates for the individual categories. An adjusted rate can be computed for any arbitrary travel distribution, from the following:

$$r_j = \frac{\Sigma_i t_i r_{ij}}{\Sigma_j t_j \, \Sigma_i t_i r_{ij}}$$

where: r_j is the normalized adjusted rate for the j^{th} configuration

t_i is the proportion of travel of the new travel distribution

r_{ij} is the normalized rate for the individual cells

and t_j is the proportion of travel for the j^{th} configuration

If an adjusted rate is calculated for each of the configurations using the same travel distributions, then the influence of the travel categories is removed from the comparison of the aggregate rates for the configurations. An appropriate travel distribution to adjust to is the aggregate travel distribution for all large trucks, shown in Figure 20. Normalized rates for the five configurations adjusted to the travel distribution in Figure 20 are shown in Figure 36. These are the aggregate rates for each configuration *if* each had the travel distribution shown in Figure 20.

Figure 36

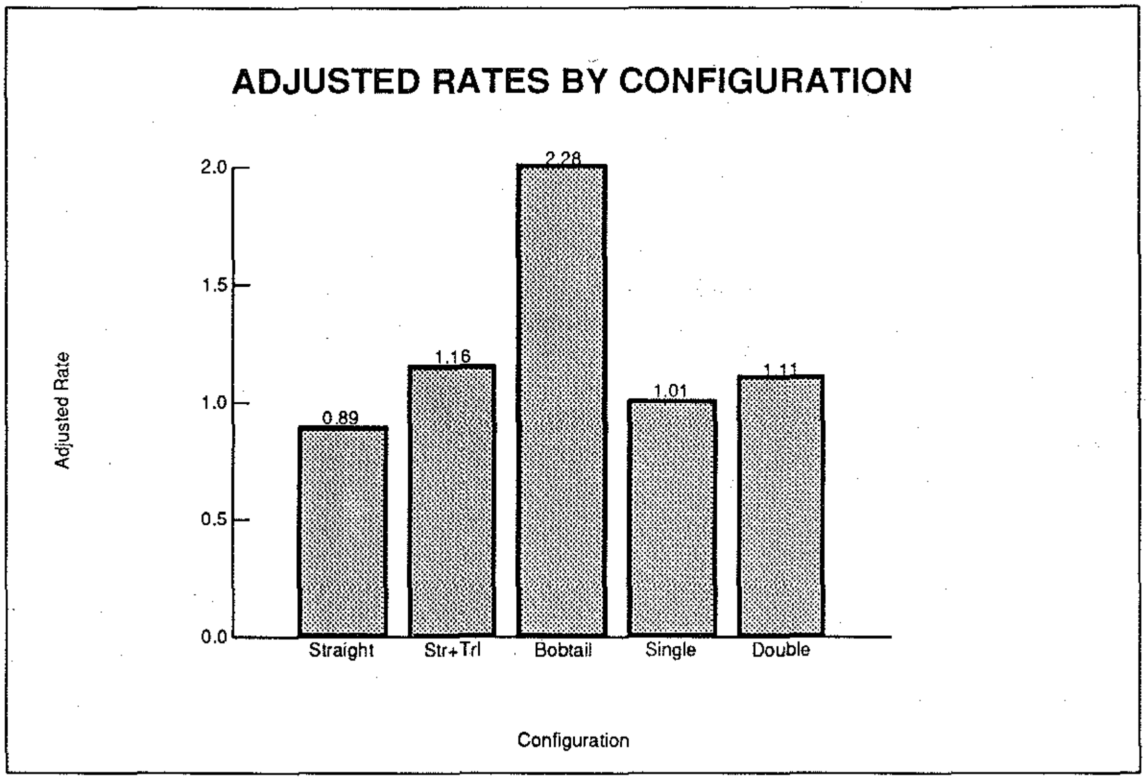


Figure 36 should be compared with Figure 19 to see the effect of the adjustment. The major difference is that doubles are now 11 percent over-involved instead of 10 percent under-involved. This is a consequence of the adjustment putting more doubles travel on the relatively less safe non-limited access roads. Although the actual doubles travel is relatively safe because a large proportion of their travel is on limited access roads, this analysis suggests that doubles would be over-involved if they operated with a travel distribution more similar to that for singles. The adjusted rate still shows bobtails to be over-involved by more than a factor of two. Straight trucks pulling one or more trailers are 16 percent over-involved as compared to 27 percent, and straight trucks alone still have the lowest relative risk, although by a smaller margin. The adjusted rate shows straight trucks to be under-involved by 11 percent as compared to 19 percent based on the aggregate rate.

Although the adjusted rates method provides a means for removing the influence of the travel distribution from comparisons across other factors, there are some aspects of the method to consider. First, of course, it should be remembered that the adjusted rate no longer reflects the actual use of the vehicle. In addition, the choice of a travel distribution to adjust to can influence the result. This can happen when the relative rates for the different configurations are different in the different travel categories. For example, whereas doubles had a better rate than singles on limited access roads at night, they were much worse than the singles off the limited access roads. Since the travel distribution chosen for the adjustment had less limited access travel at night, and more travel off the limited access roads, the adjusted rate for the doubles was higher. If the adjustment had made to a distribution favoring the nighttime operation on limited access roads, the adjusted rate for the doubles may have been lower. Another point to keep in mind is that the adjusted rate is based on the individual cell rates. If these rates are not accurate, perhaps due to small sample sizes, these errors can be magnified if those cells are inflated in the adjustment process.

Rates for Different Collision Types

Cross-classifications of the data could not be pursued too far for all five configurations because the straight trucks pulling trailer(s), bobtails, and doubles groups were each only a few percent of the total. Consequently, the sample sizes were not sufficient. In order to pursue some of the factors further, this section focuses on the two large groups, straight trucks without trailers and tractors pulling a single semitrailer. The increased sample size of these two configurations allows presentation of the full 12 travel categories.

The four additional categories are formed by splitting the non-limited access roads into two categories: primary routes, and all other roads. Due to some problems with the coding of road type in the 1980 and 1981 Fatal Accident Reporting System (FARS) files, only 1982-1984 data are used. (The TIFA file takes the coding for road class from FARS.) After looking at normalized fatal accident involvement rates by 12 travel categories for straight trucks and singles, the analysis in this section then focuses on different collision types. Normalized rates are developed for primary event rollover involvements, pedestrian or bicycle involvements, other single vehicle accidents (primarily collisions with objects), and multiple-vehicle involvements. After presenting the variation in the normalized rates by travel category for each of these collision types, a final comparison is made based on adjusted rates.

Figure 22 presented the distribution of all large-truck travel across 8 travel categories. Figure 37 presents the distribution of all large-truck travel across 12 categories. Normalized fatal accident involvement rates for all large trucks are shown for the 12 travel categories in Figure 38. The normalized rates on primary and other roads at night are especially elevated. But it should be noted that because these roads are travelled so infrequently by large trucks, the sample sizes are very small for these categories.

Figure 37

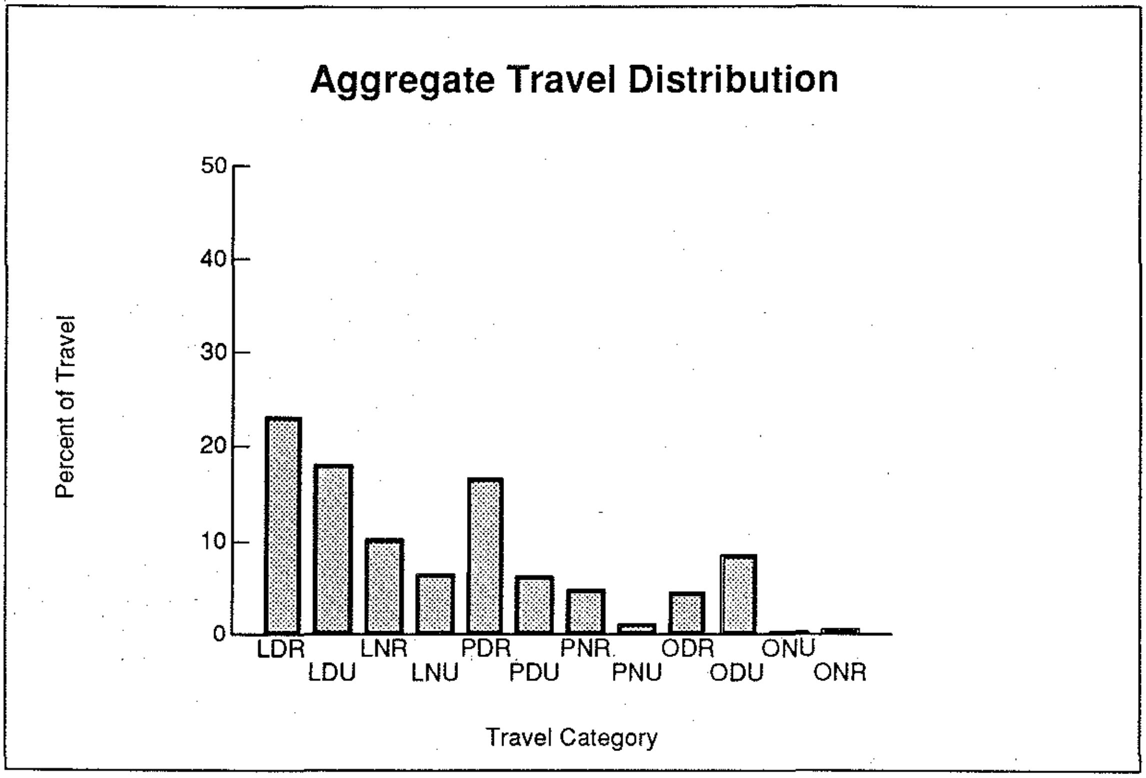
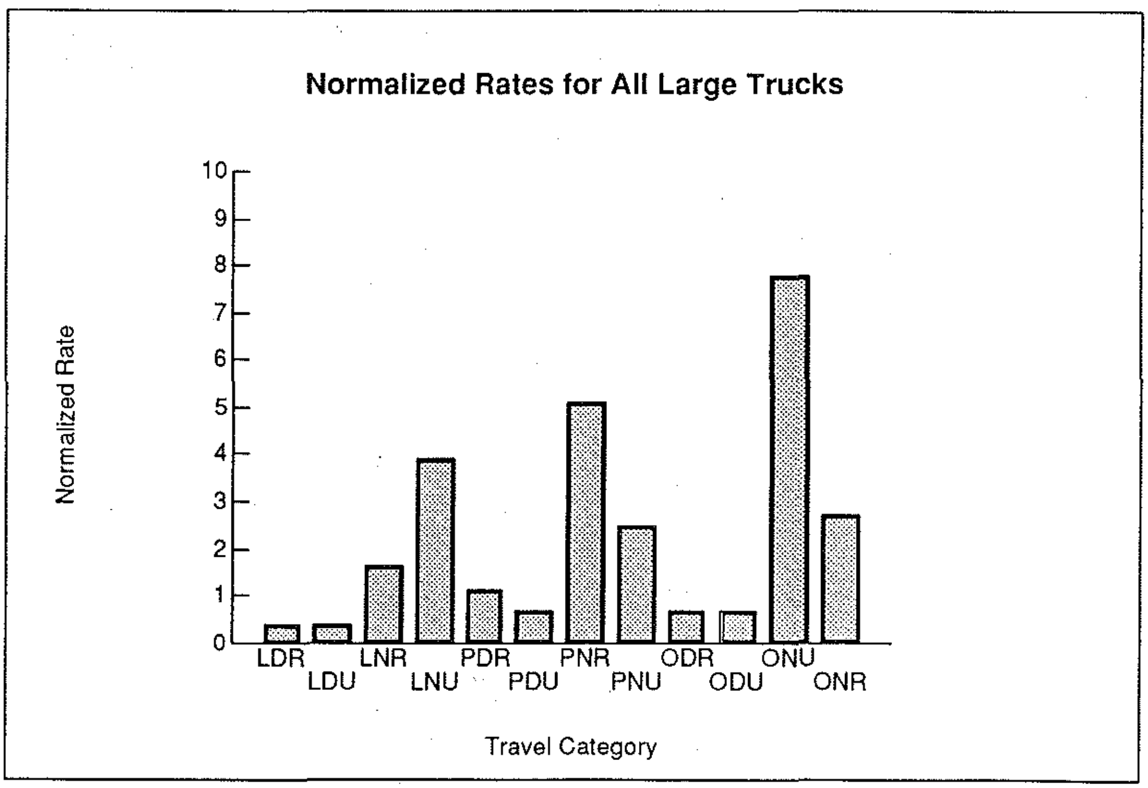


Figure 38



Travel distributions across the 12 categories are presented separately for straight trucks in Figure 39, and for tractors in Figure 40. The 12 category distribution shows that the straight trucks have significant amounts of travel on both the primary and other road types. The tractors with single trailers seldom travel on the other roads in the 12 category distribution. Normalized fatal accident involvement rates are presented separately for straight trucks in Figure 41 and for tractor-semitrailers in Figure 42. The rates for these two configuration are substantially different across the 12 travel categories. The straight trucks have higher rates on the limited access and primary roads at night, while the tractors have higher rates on the primary urban roads.

Figure 39

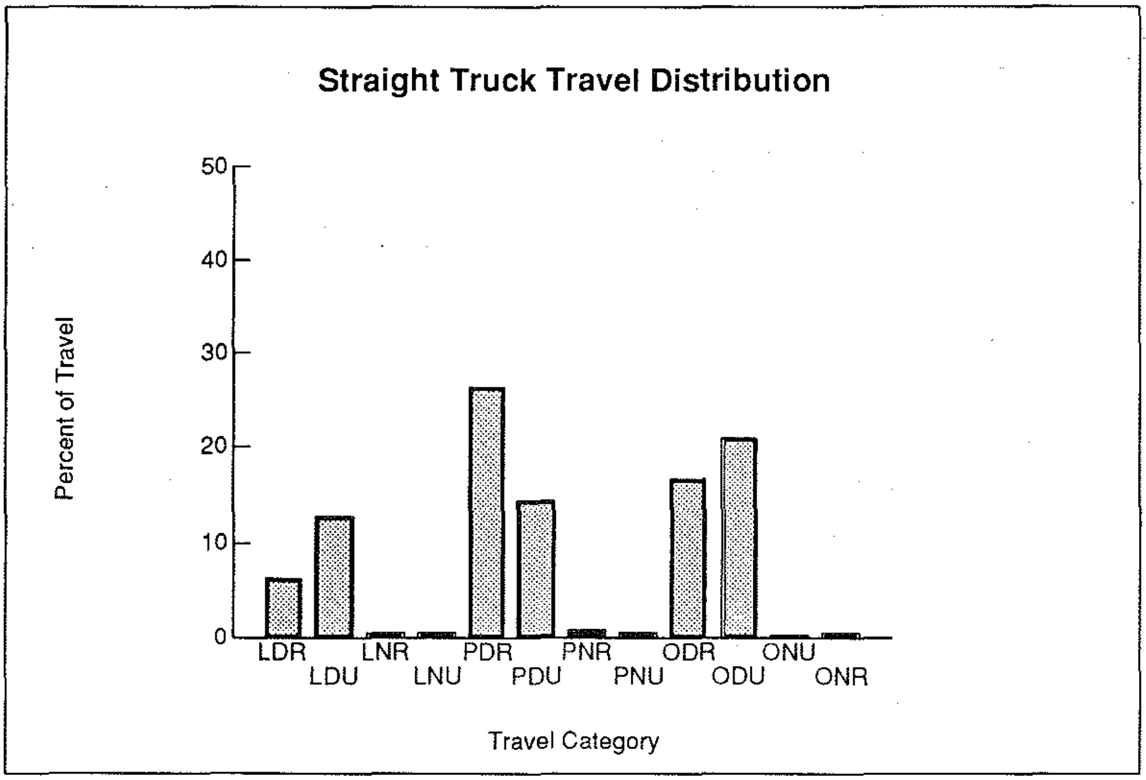


Figure 40

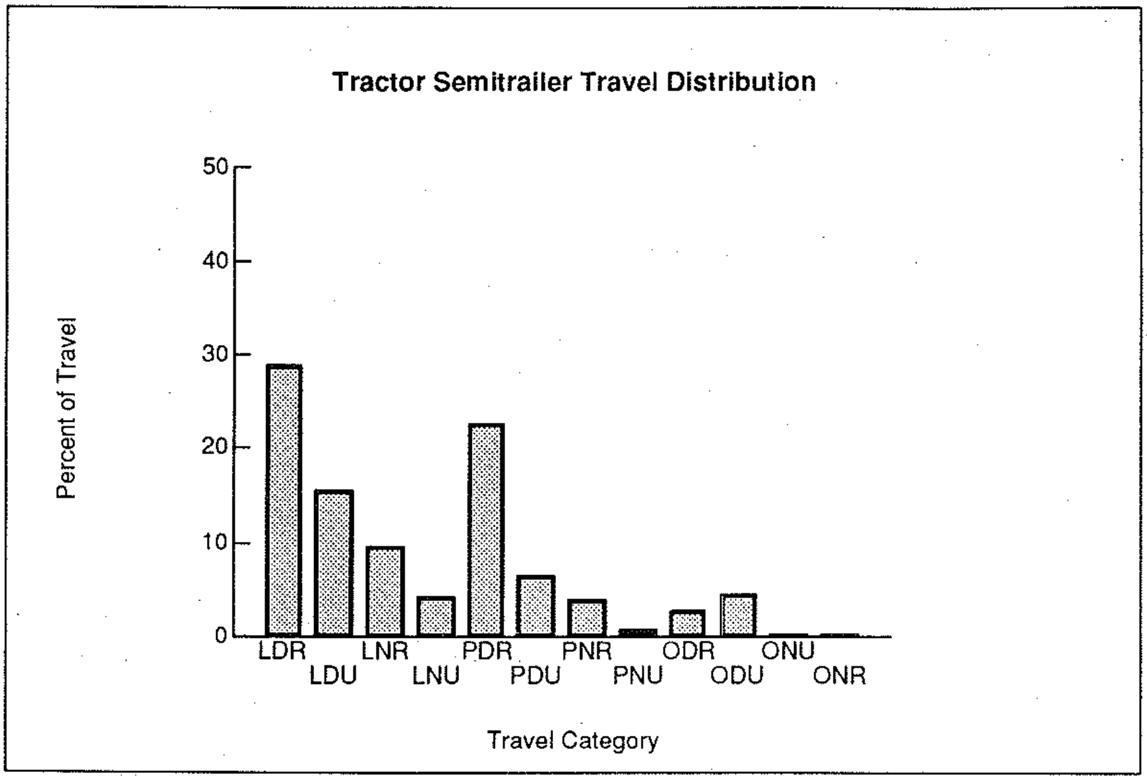


Figure 41

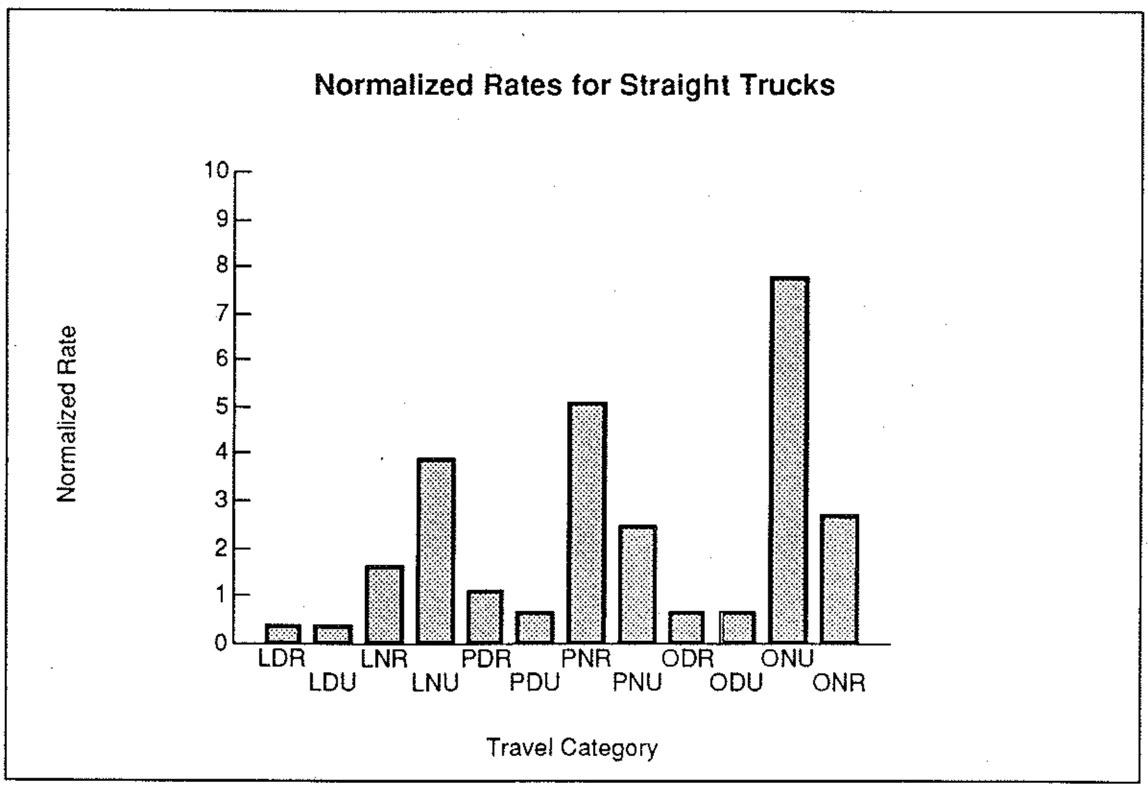
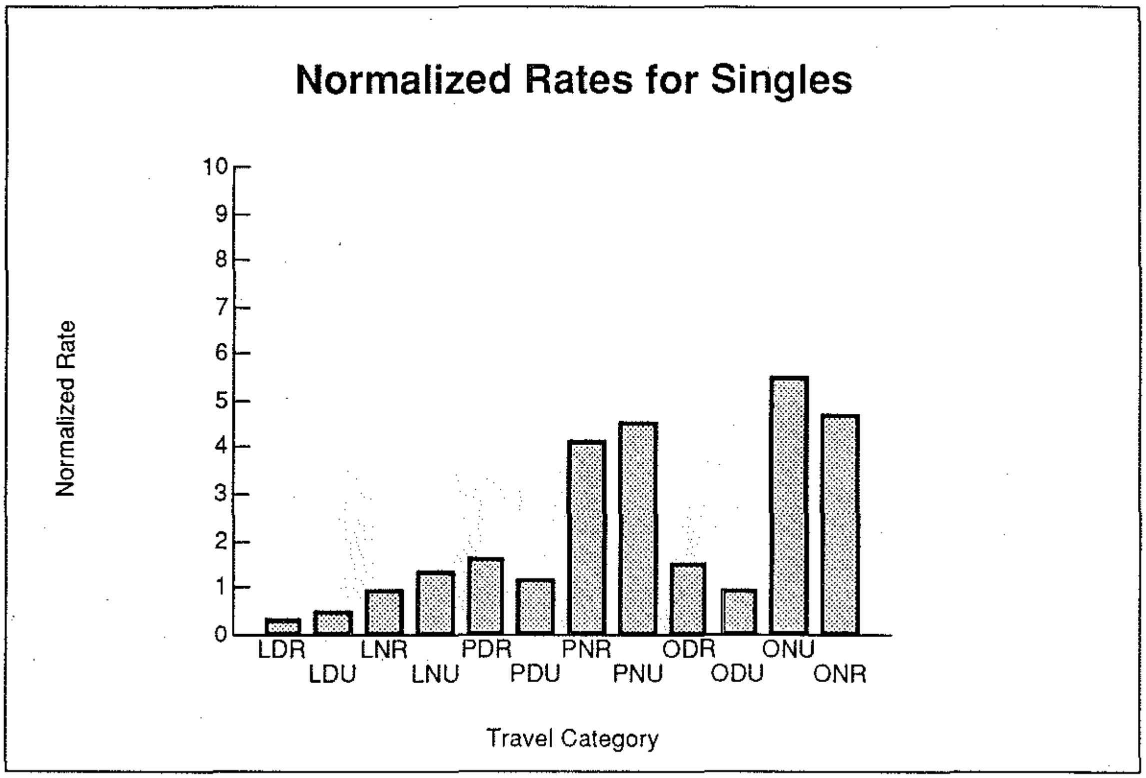
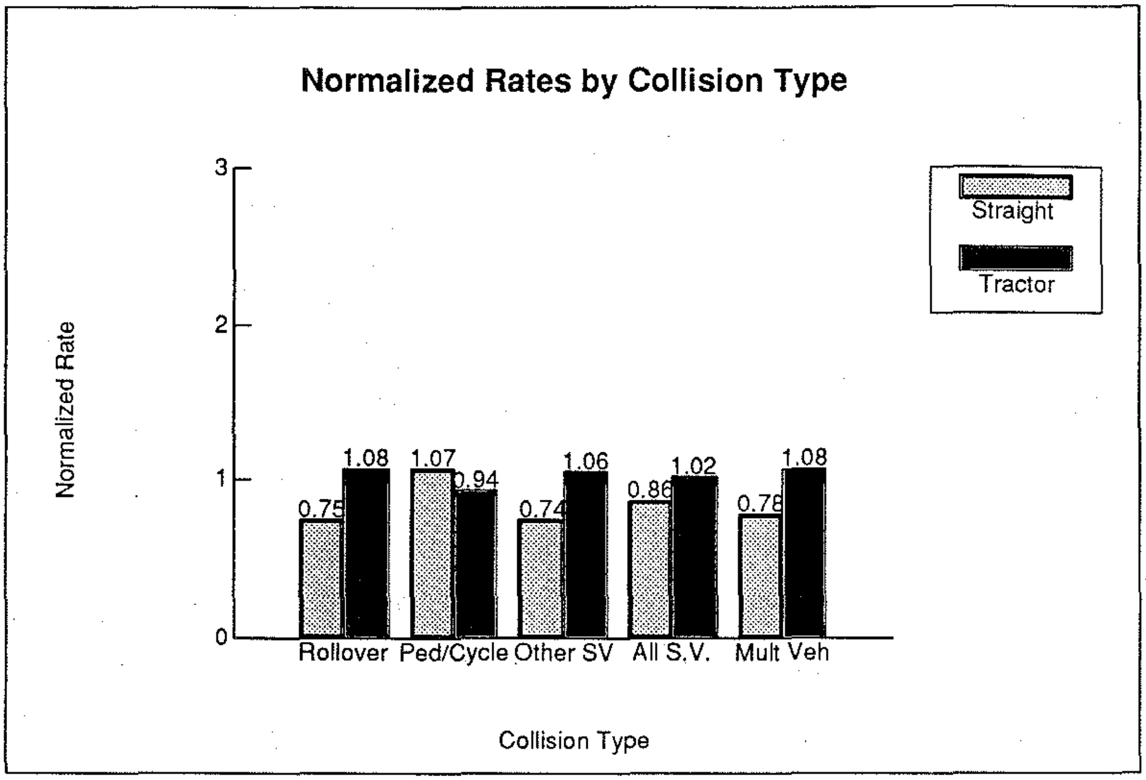


Figure 42



The previous figures have been based on *all* fatal accident involvements. The next series focuses on different collision types. Figure 43 presents data across four collision types. Straight trucks and tractors are shown separately. Single vehicle involvements are divided into three groups, primary event rollover, pedestrian or bicycle, and other single vehicle. The other single vehicle category is mostly collisions with objects. The combination of these three categories is also shown as all single-vehicle involvements. The last collision type shown is all multiple-vehicle involvements. Although the differences between straight trucks and tractor-semitrailers are not large, the straight trucks are under-involved in all collision types except the pedestrian/bicyclist involvements. Each collision type has been normalized separately, so that the absolute rates for these collision types is not evident from this figure in order to facilitate the comparison between the two truck configurations.

Figure 43



The reasons for some of the differences shown in Figure 43 may seem evident. Pedestrian or bicycle involvements are more likely in urban areas. The travel distributions show that straight trucks travel more in these areas. Similarly, rollover seems more likely on rural roads, and the tractor-semitrailers travel more on these roads. Apparently then, one would expect the risk of each of the different collision types to vary by travel category.

Normalized rates by travel category are shown in Figures 44 through 48. All large truck involvements are included in these figures. Indeed, the variation by road type and by collision type is substantial. However, the sample sizes are even smaller now for the other road type at night. The rates for these categories are probably not well-determined. Nonetheless, it is evident that most of the single-vehicle collisions are over-involved at night. Both pedestrian/bicycle and rollover involvements are substantially over-involved on primary roads. Surprisingly, there is a substantial over-involvement of pedestrian collisions on primary rural roads at night and also on limited access urban roads at night.

Figure 44

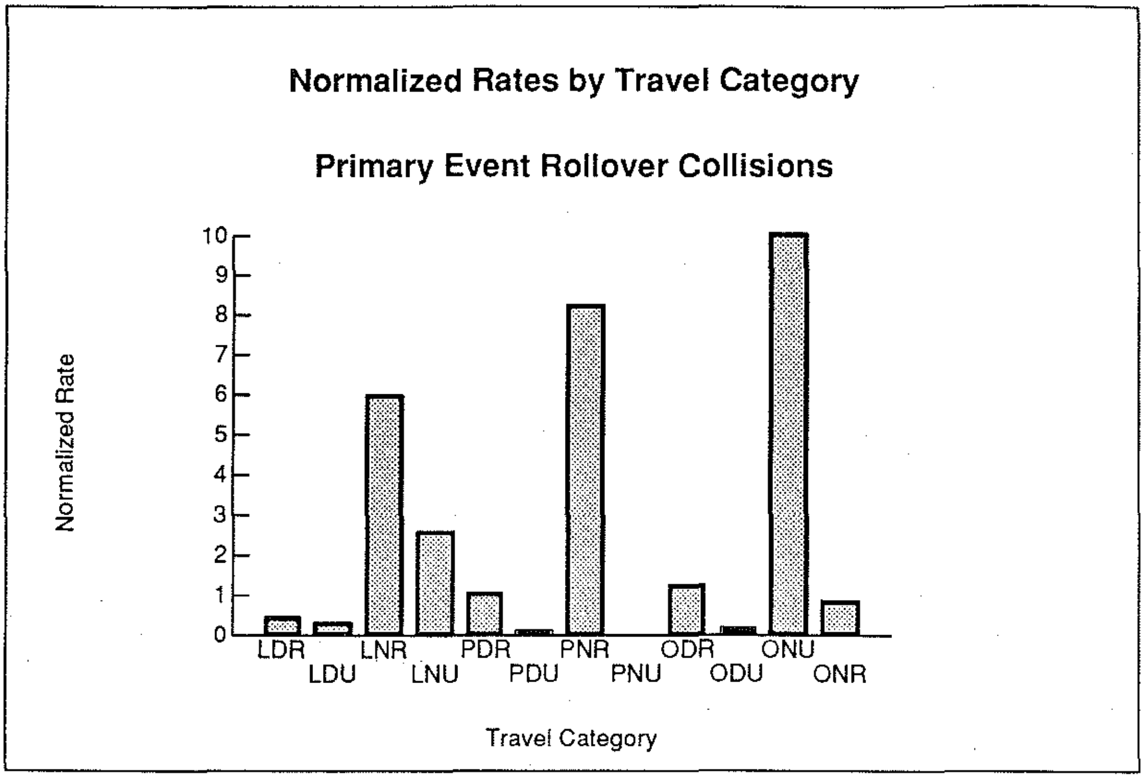


Figure 45

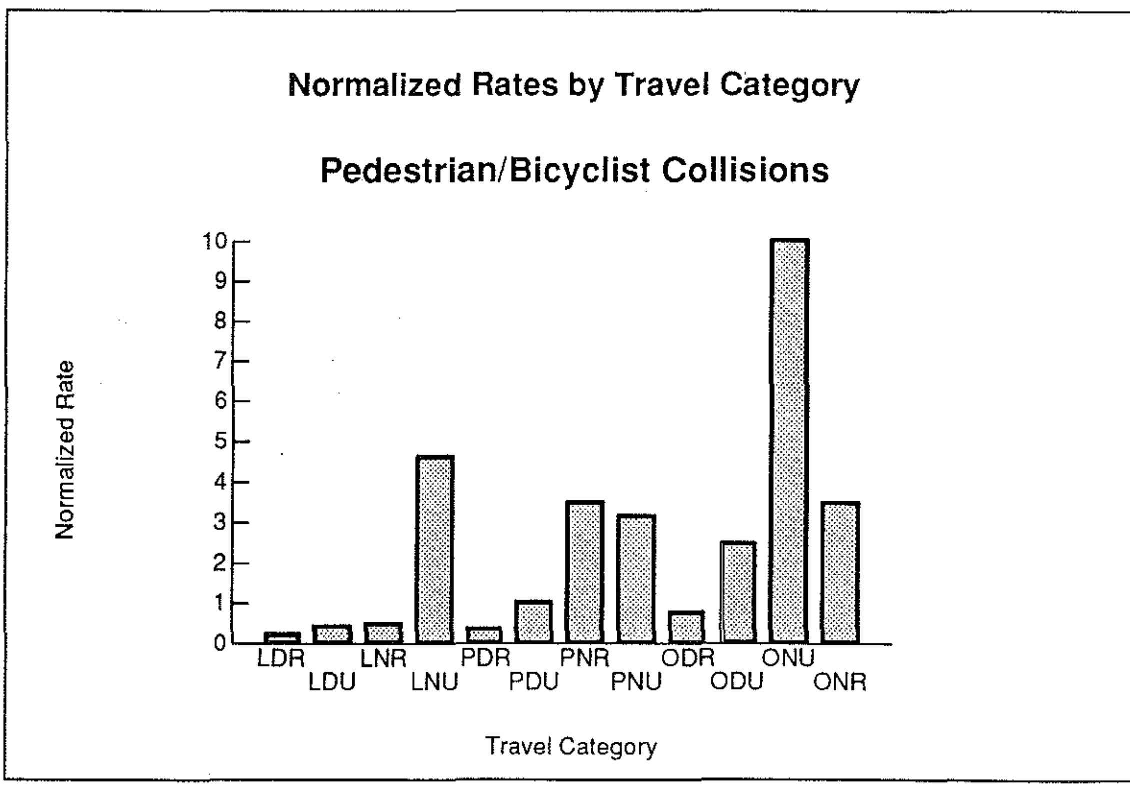


Figure 46

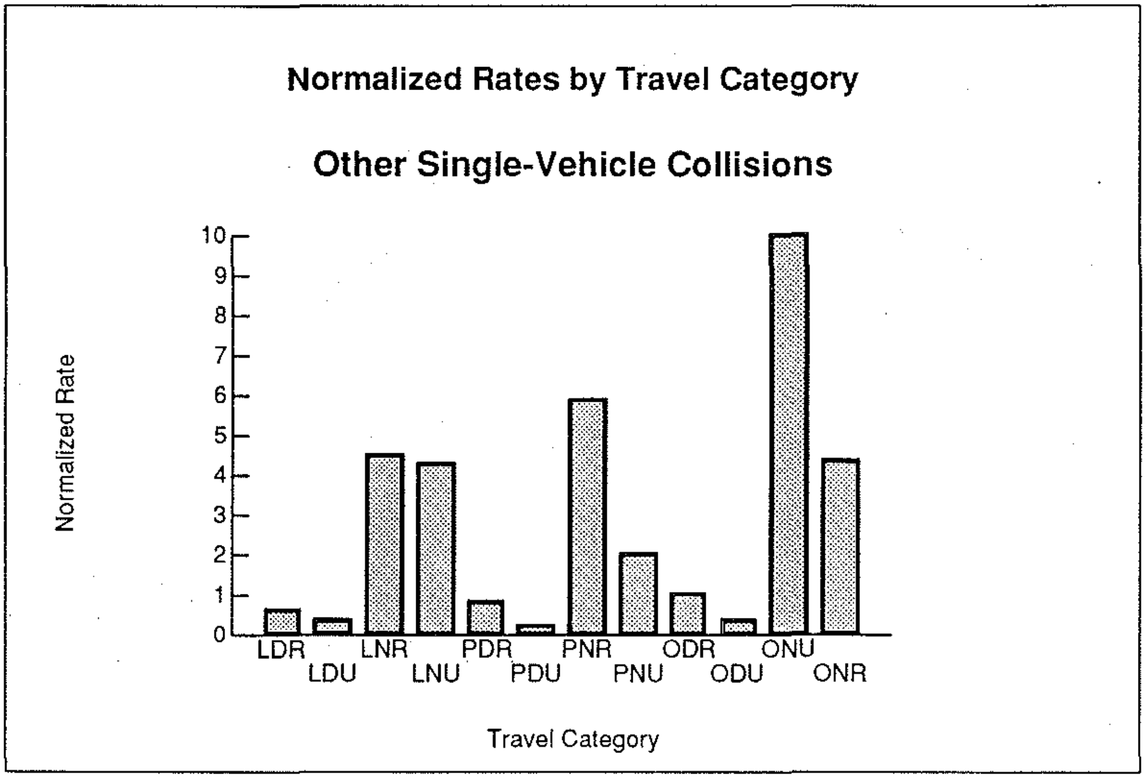


Figure 47

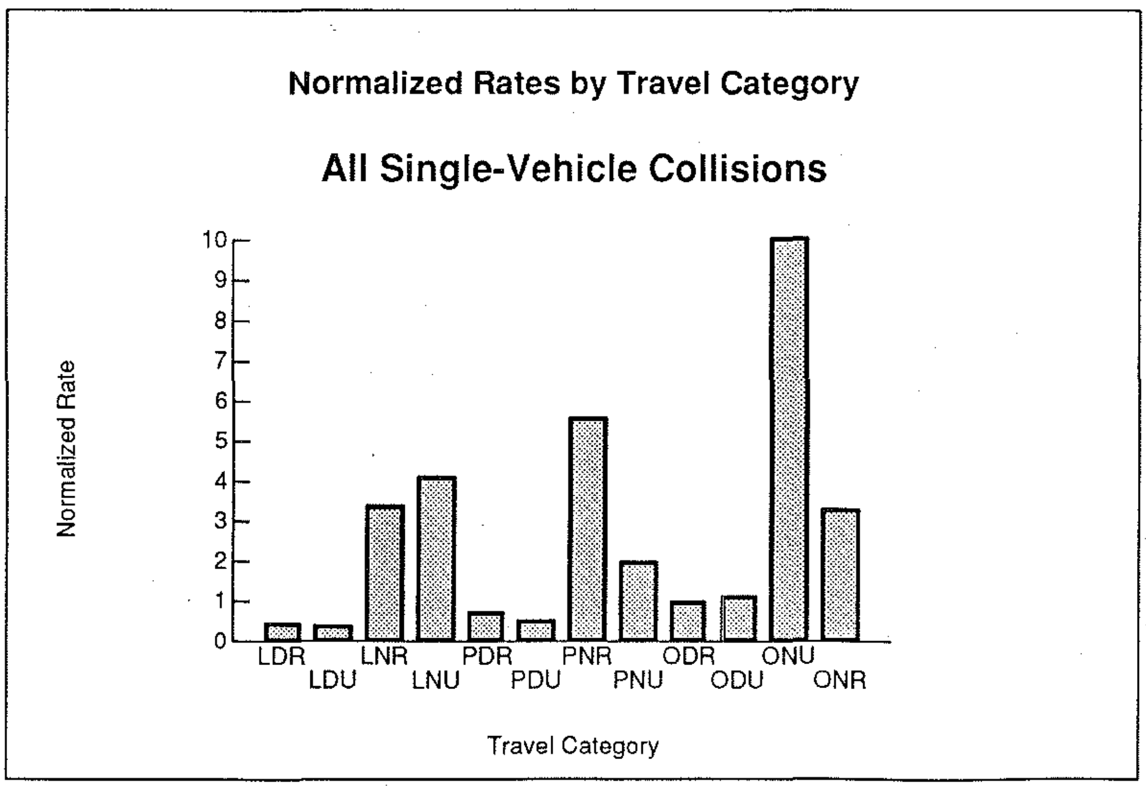
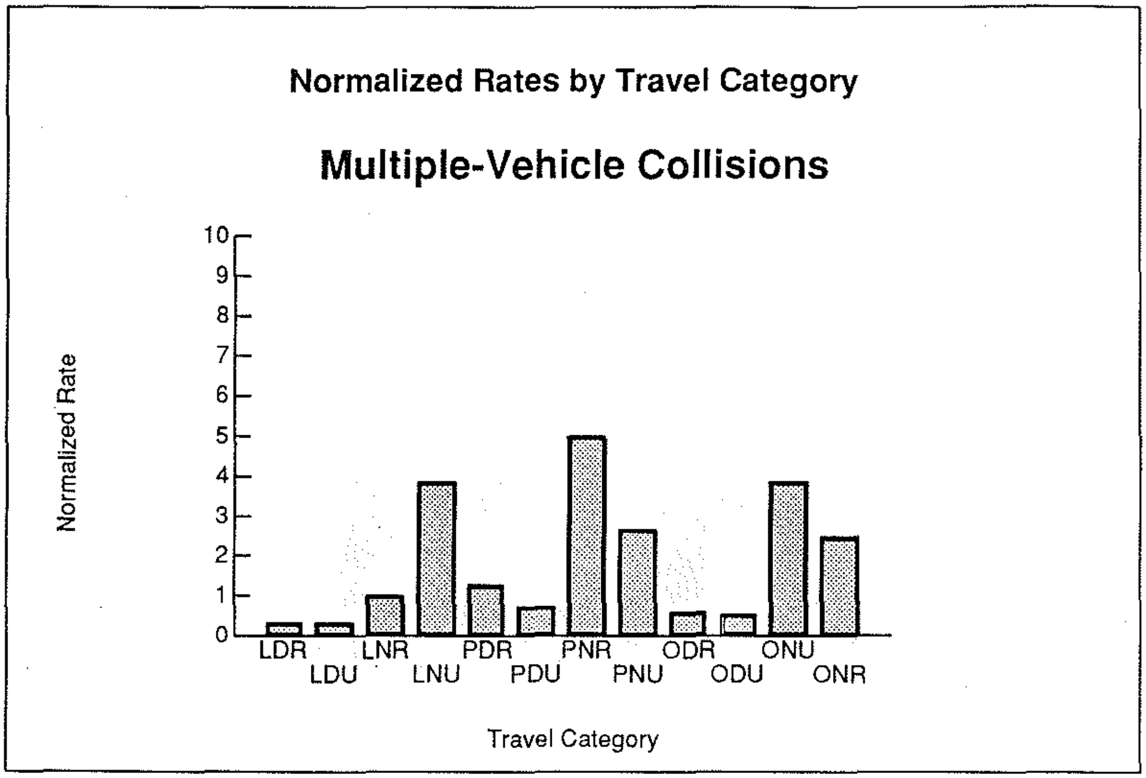
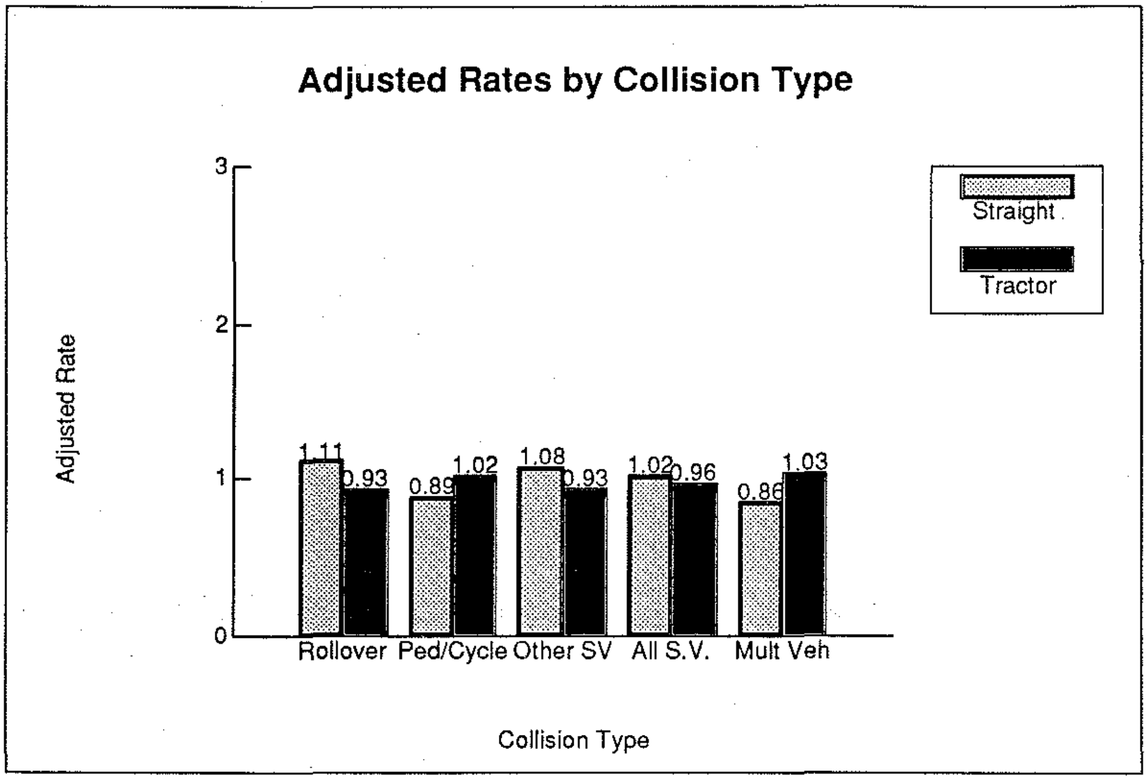


Figure 48



Since the risk of the different collision types varies by travel category, and the two main truck configurations spend substantially different proportions of their travel in the various categories of travel, it is appropriate to question whether the rates for each collision type presented in Figure 43 provide a clear picture of the relative risk for the two truck configurations. The normalized rates essentially aggregated the rates for the individual travel categories in proportion to the travel in each category. However, if the two truck configurations had comparable amounts of travel in each of the travel categories, the comparison might be different. As in the previous section, the adjusted rates method provides just such a comparison. Adjusted rates are presented for each collision type for straight trucks and tractors in Figure 49. This figure should be compared with Figure 43, which presents normalized rates. As before, the average travel distribution for all large trucks, presented in Figure 37, is the basis for the adjustment.

Figure 49



The result is rather surprising in that all of the single-vehicle comparisons between the two truck types are reversed. Now the straight trucks are over-involved in rollovers and collisions with objects (other single-vehicle involvements), and under-involved in pedestrian/bicyclist collisions. Essentially, this result confirms the original hypotheses. Apparently straight trucks do not roll over very much because they travel less on rural roads. The adjusted rate suggests that if their travel on rural roads was comparable to that of tractors they would roll over at least as frequently. The same interpretation may apply to the pedestrian/bicycle collisions. That is, that if straight trucks had the same travel distribution as tractor-semitrailers, they would not be over-involved in pedestrian collisions.

The interrelationships between the various factors is complex. As the data is examined in more detail, it becomes apparent that comparisons across a single factor may be misleading. When the adjusted rates method is used to eliminate the influence of the travel categories, the results in this section and the first have been reversed.

Rates by Gross Combination Weight

This analysis examines fatal accident involvement rates in relation to the gross combination weight (GCW) of tractor-semitrailers. Only tractors pulling a single trailer were used in this analysis. This group has the largest sample size of the five basic configurations, and restricting the analysis to a single configuration reduces the number of factors that must be considered.

The travel distribution for tractor-semitrailers in 5,000 pound increments of GCW is shown in Figure 50. The category labels for this and subsequent figures are for the lower bound of the GCW increment. Figure 51 shows the distribution of fatal accident involvements by GCW, and Figure 52 shows the normalized involvement rate. Normalization has been done on the basis of the aggregate rate for all tractor-semitrailers, rather than for all large trucks as has been done for all of the previous comparisons. Here the focus is on the influence of GCW within the tractor-semitrailer configuration. The distribution of travel and involvements both show two peaks, one at the lower weight range and the other at the upper weight range. The involvement rate tends to follow this pattern.

Figure 50

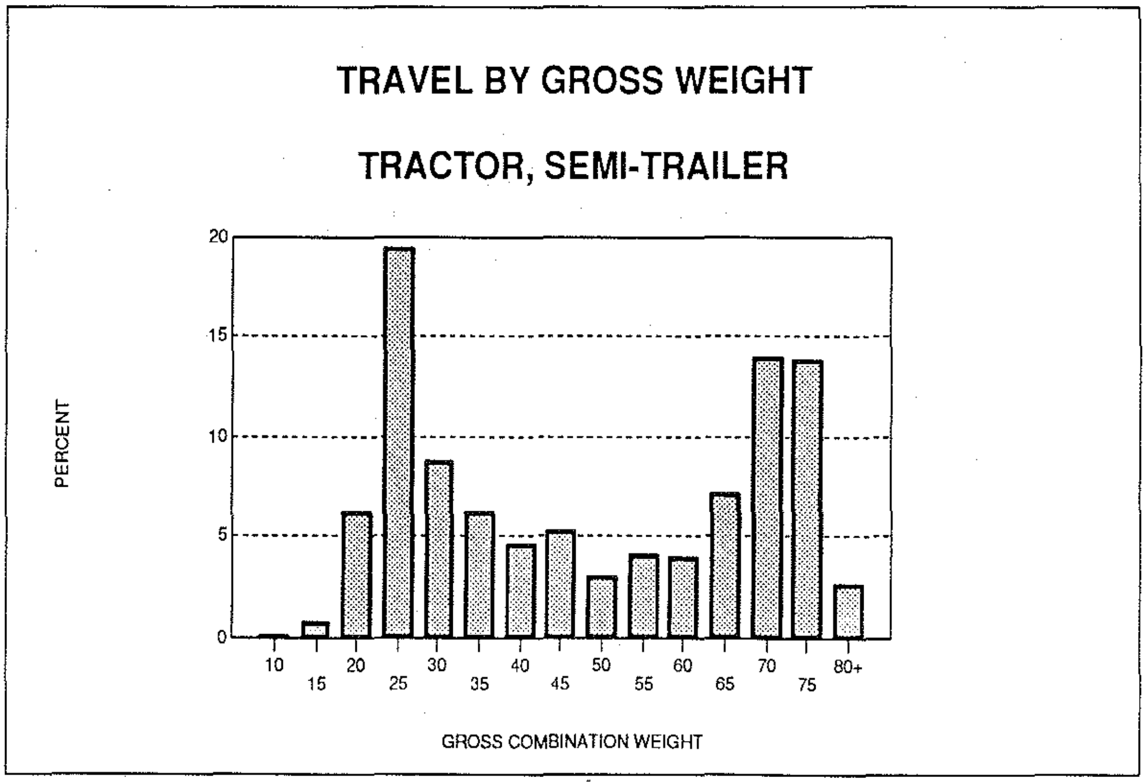


Figure 51

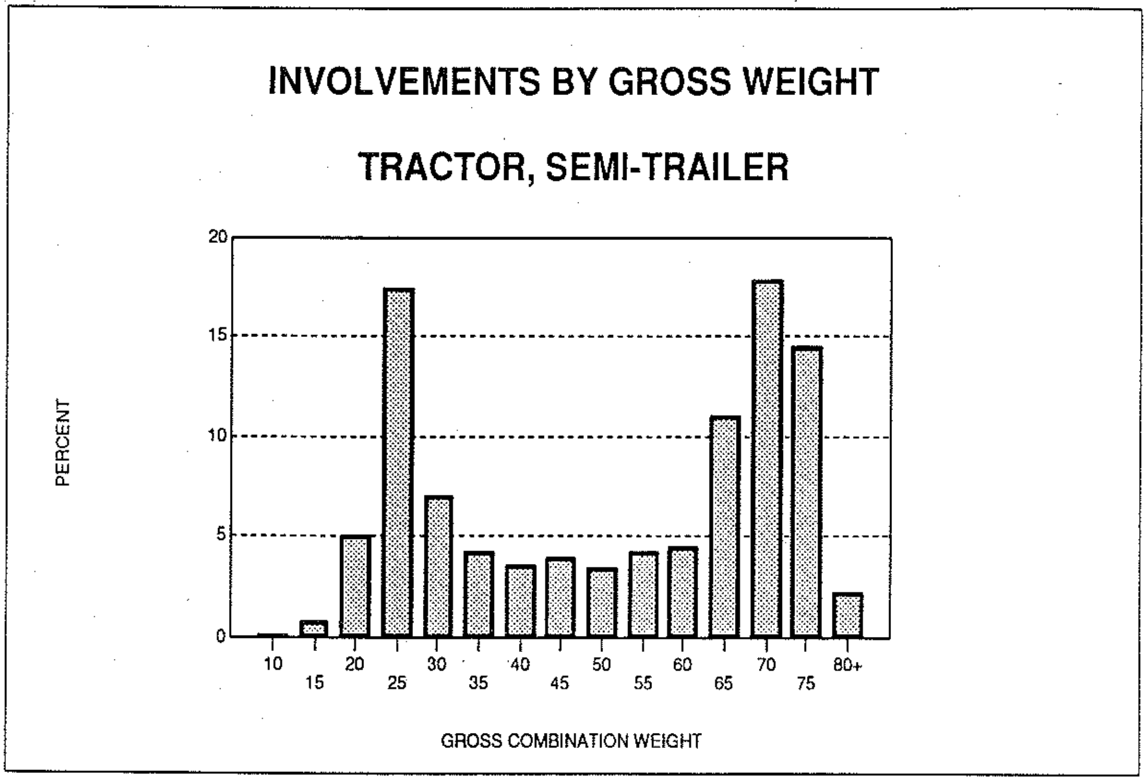
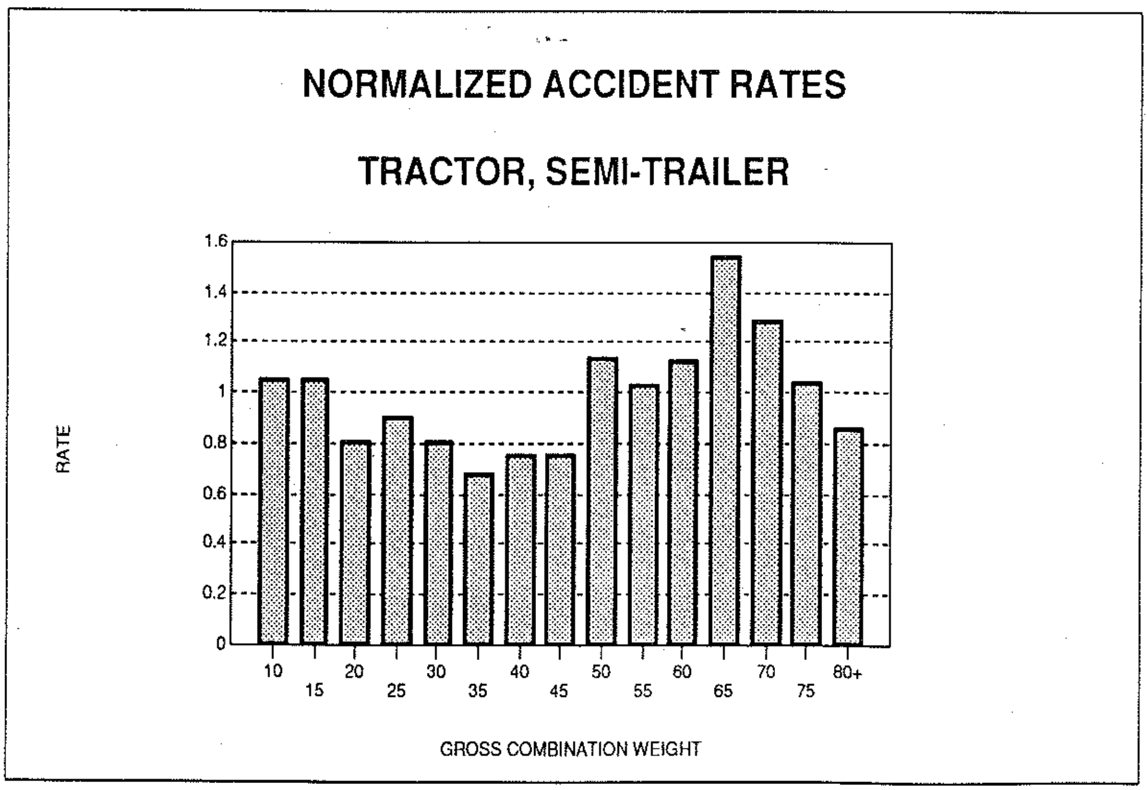


Figure 52



To clarify this distribution, empty tractor-semitrailers were separated from those with cargo (of any amount). The distributions of travel, involvements, and normalized rate are shown in Figures 53-55. Normalization is still based on the aggregate rate for all tractor-semitrailer combinations. The normalized rate does not vary appreciably with the GCW categories. However, all but one of the empty weight categories are under-involved (below 1.0).

Figure 53

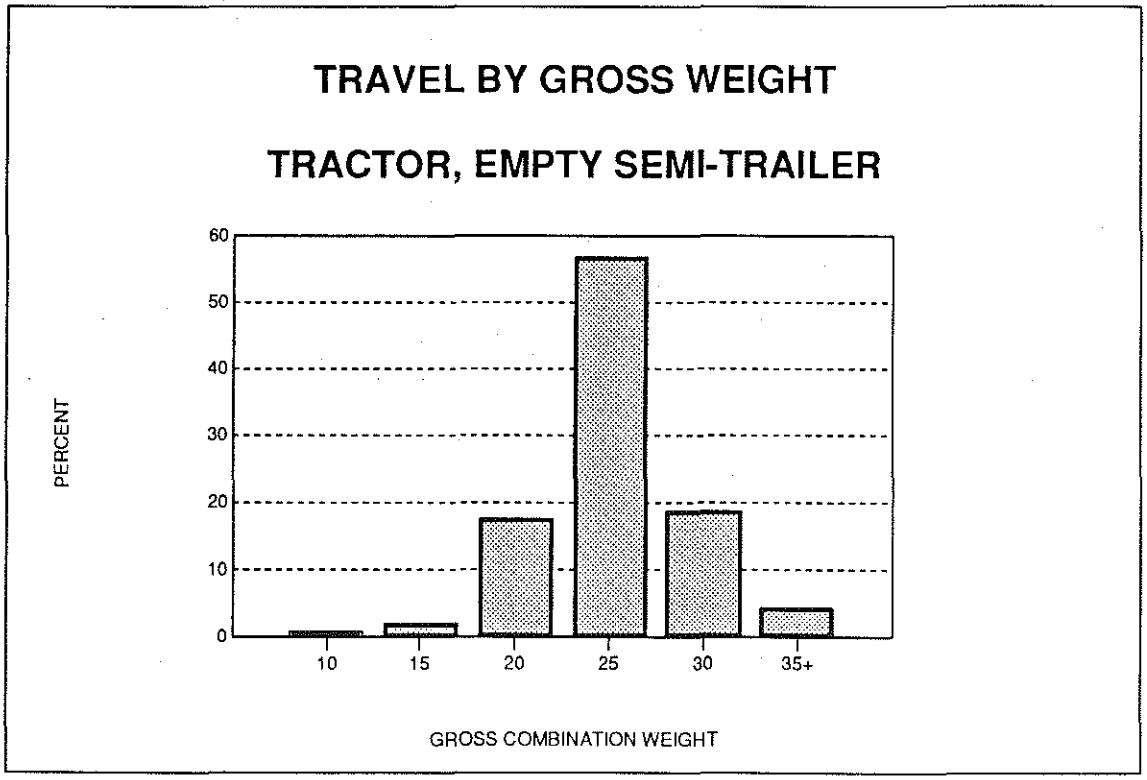


Figure 54

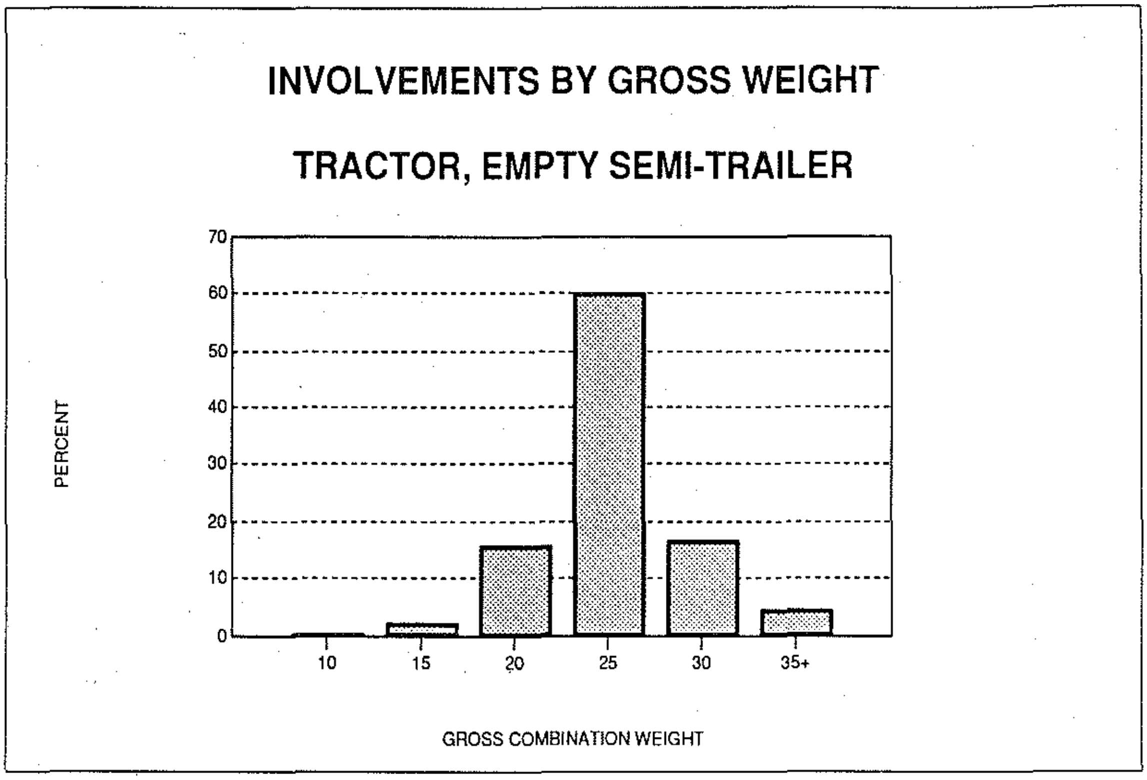
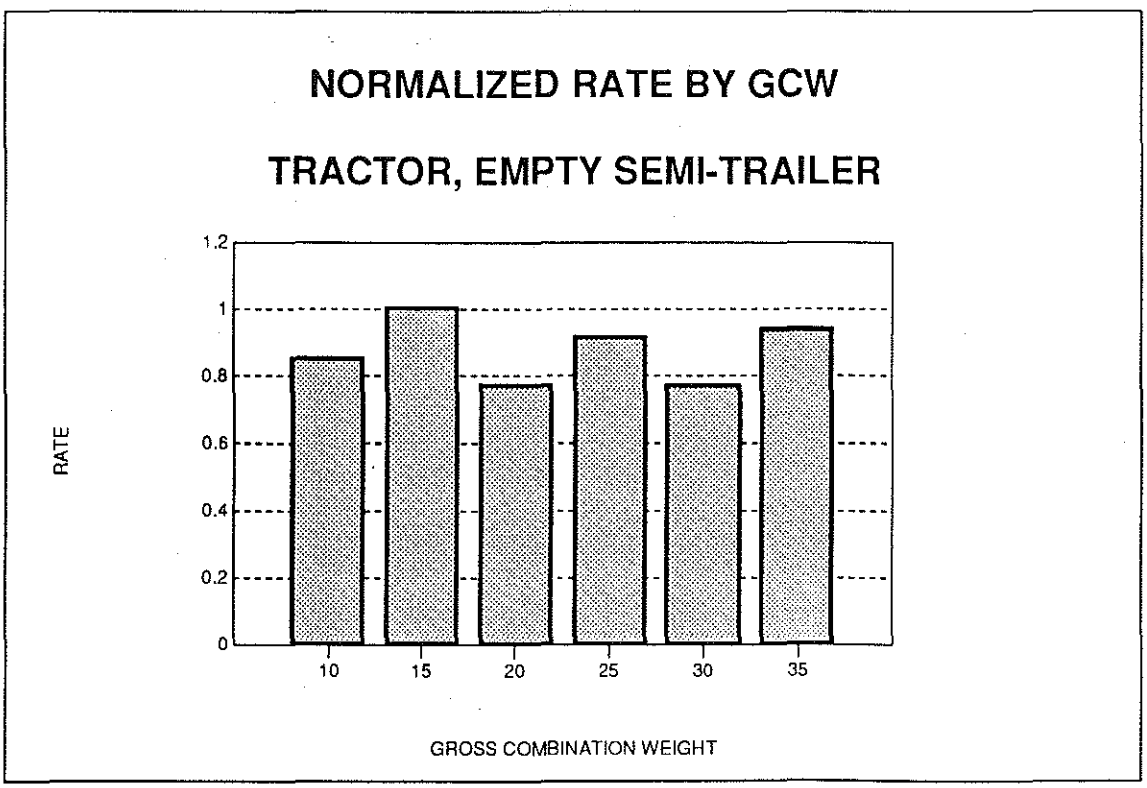


Figure 55



The distributions of travel, involvements, and normalized rates for tractor-semitrailer combinations with cargo are shown in Figures 56 through 58. By comparing the travel distributions from Figures 50, 53, and 56 for all, empty, and not-empty tractor-semitrailers, it is evident that the first peak on the overall distribution is the empty trucks and the second peak is those with cargo. The distribution of normalized involvement rates for tractor-semitrailers with cargo shown in Figure 58 also shows some over-involvement at the lower and upper GCW categories. The middle GCW range, from about 35,000 to 50,000 pounds, is under-involved. The next factor that seemed relevant was the trailer cargo body style. Vans do not typically carry cargo as heavy as tank or flatbed trailers. The vans tend to carry cargo that is limited by the volume of the trailer rather than weight capacity. Thus, the trailers at the lower end of the GCW distribution may be more likely to be vans and those at the higher weights may be more likely to be tank or flatbed trailers. For the next set of figures, an additional split has been added, separating van semitrailer bodies from all other trailer bodies. This additional split divides the tractor-semitrailer combinations into four groups: empty vans, vans with cargo, empty trailers other than vans, and trailers other than vans with cargo.

Figure 59 shows the normalized overall involvement rate for the four truck groups. The non-van (other) semitrailers with cargo are over-involved, and the other three groups are under-involved. In order to pursue this difference, we examined travel distributions for each of the four groups. Figures 60 through 63 show travel distributions for the four groups. Whenever we have divided trucks into different types and compared the travel distributions, there have been substantial differences. This comparison is no exception. Empty trucks travel less on limited access roads and less at night. Vans with cargo travel more on limited access roads and at night. The trailer body styles other than vans with cargo travel less on limited access roads in comparison with the vans with cargo. These differences may explain the difference in the overall rates. A comparison of the normalized rates by travel category for each group will confirm this.

Figure 56

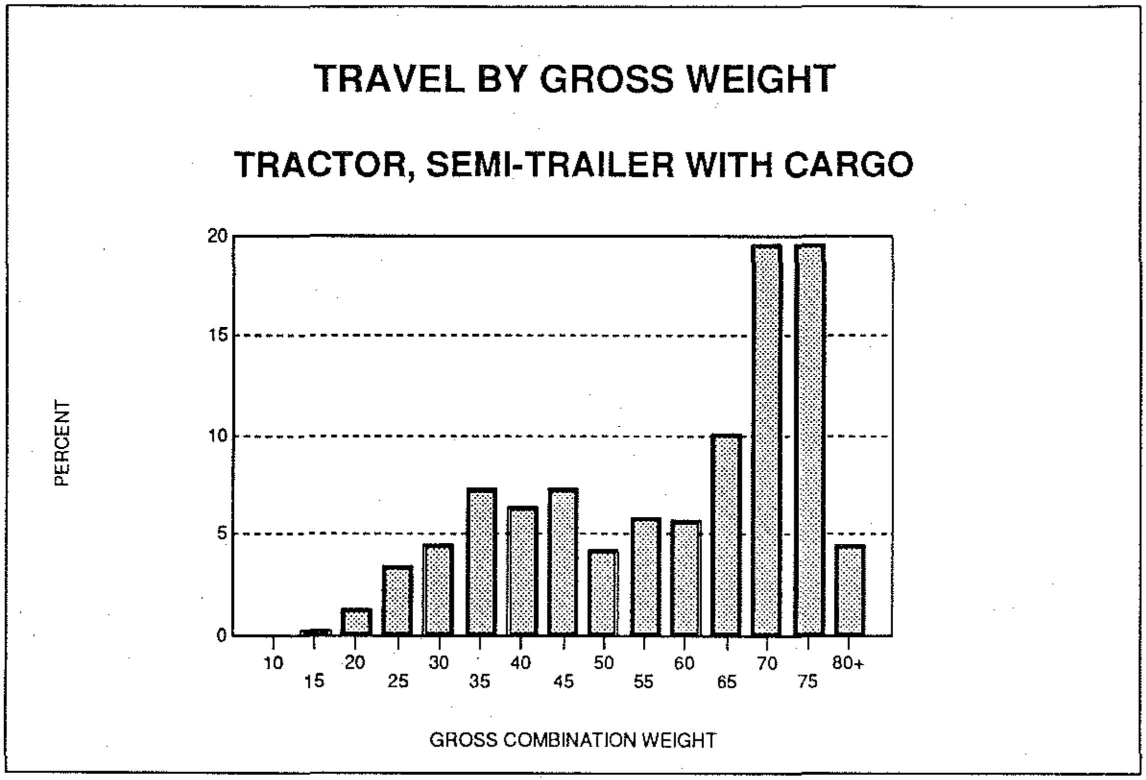


Figure 57

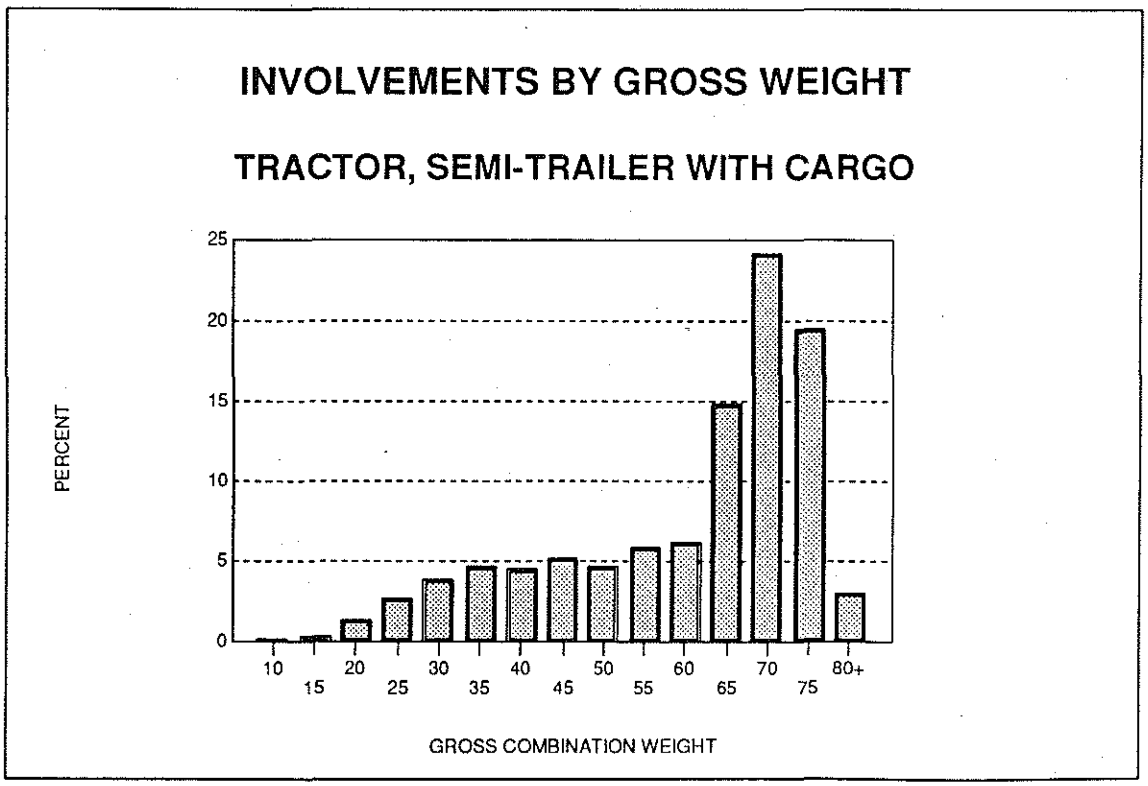


Figure 58

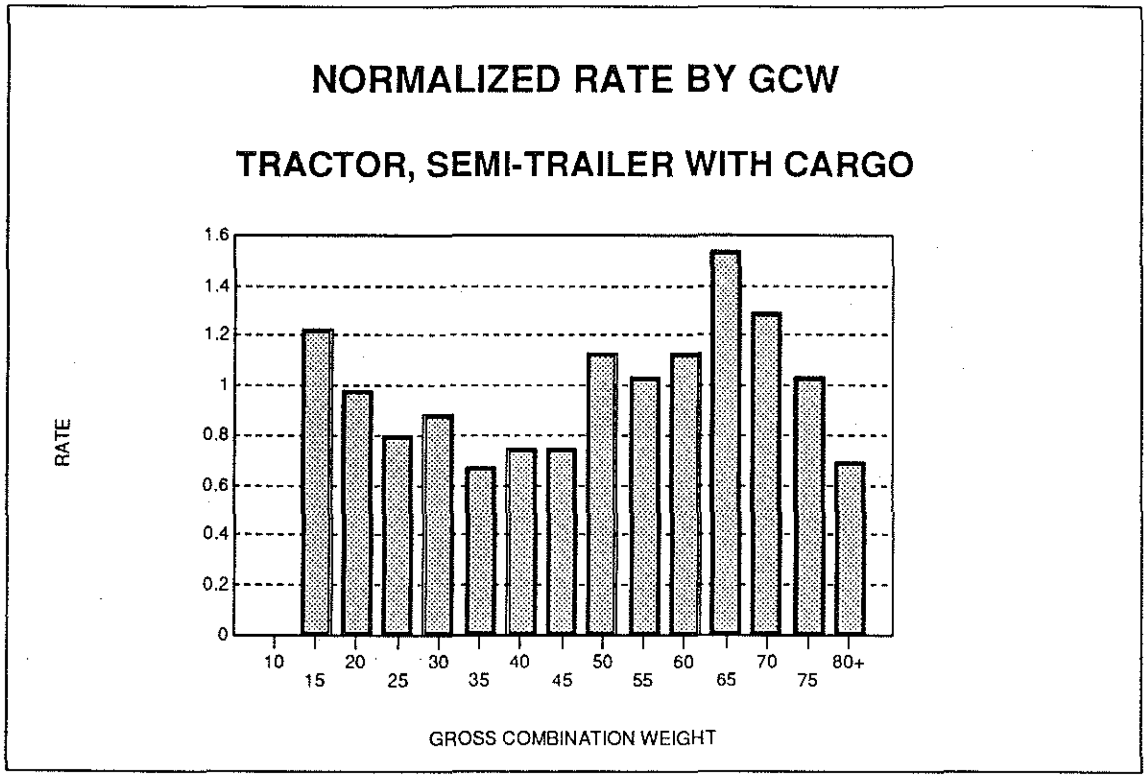


Figure 59

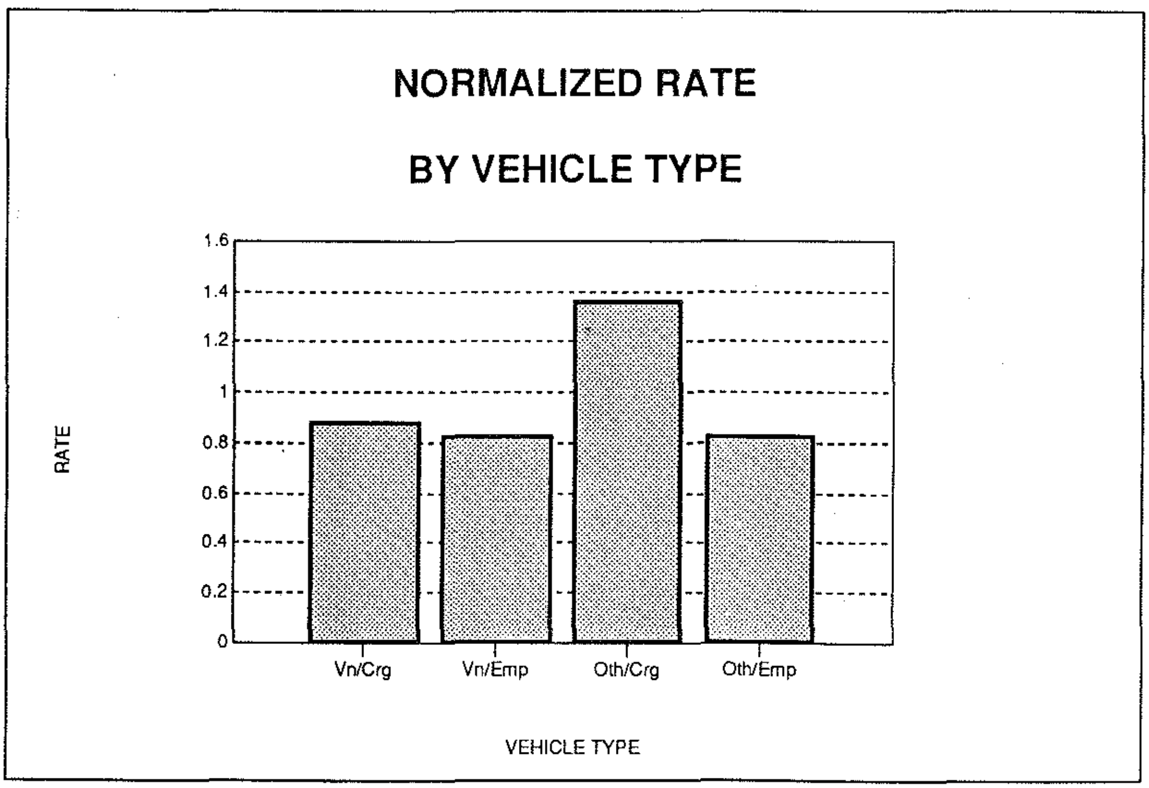


Figure 60

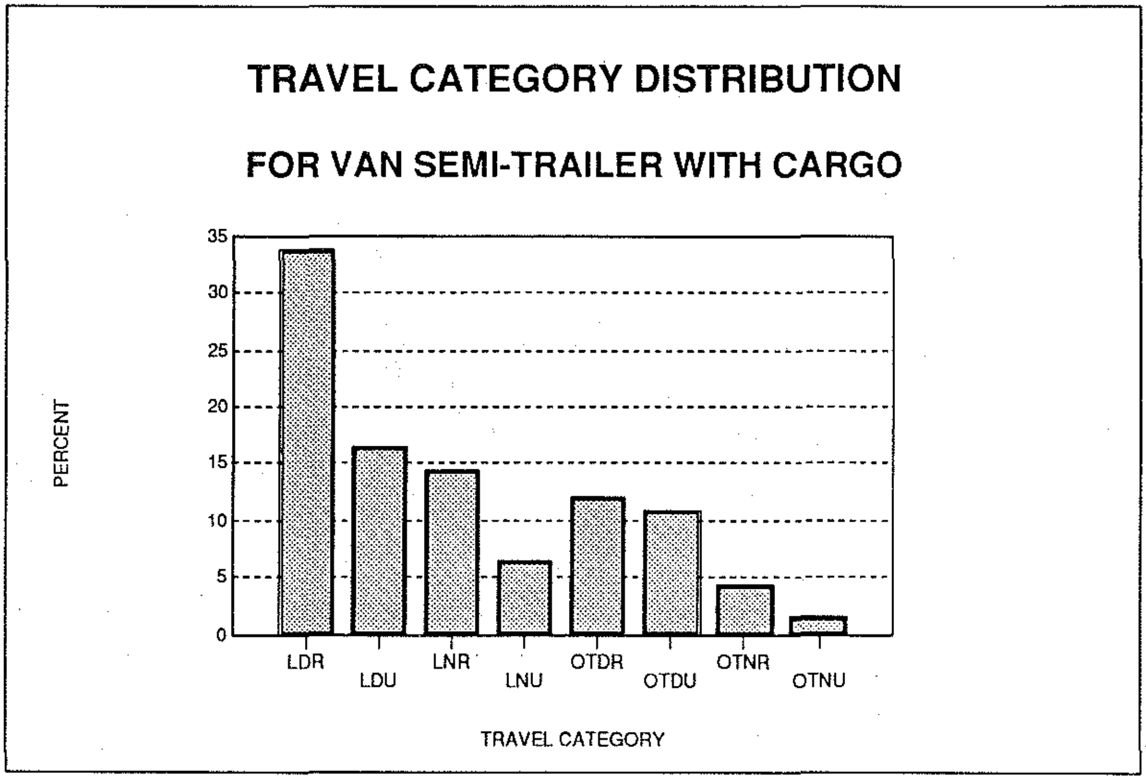


Figure 61

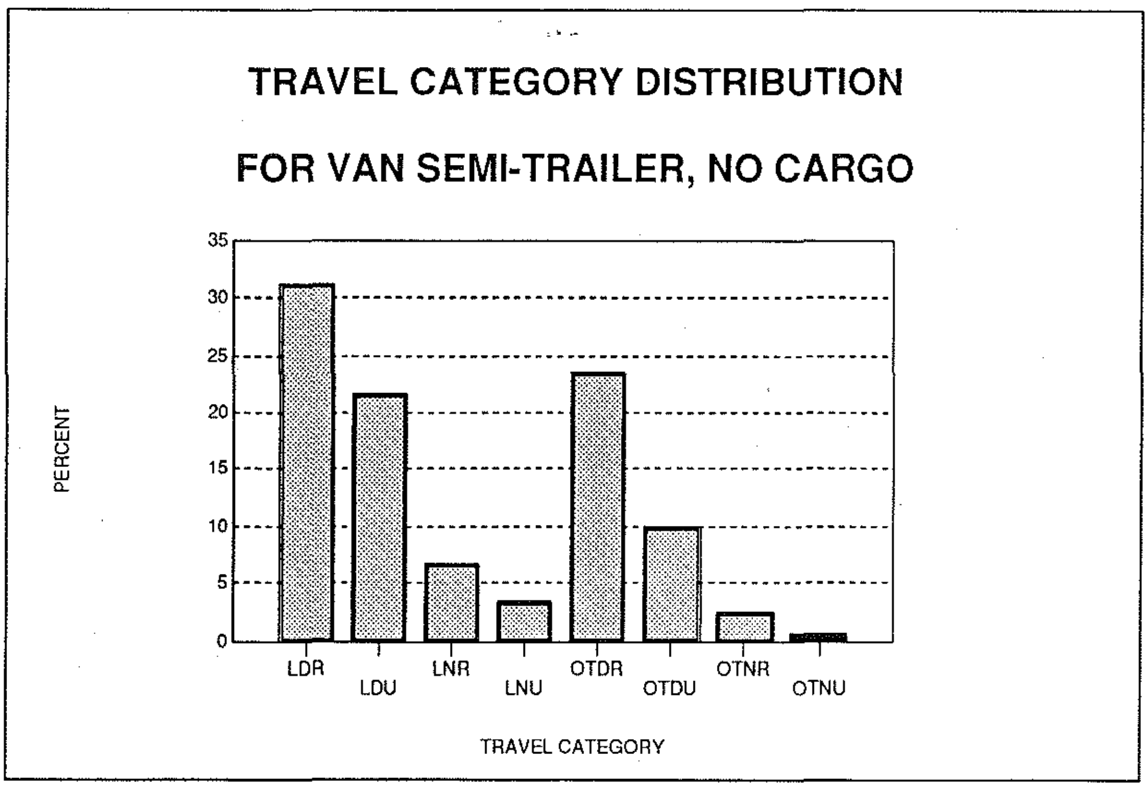


Figure 62

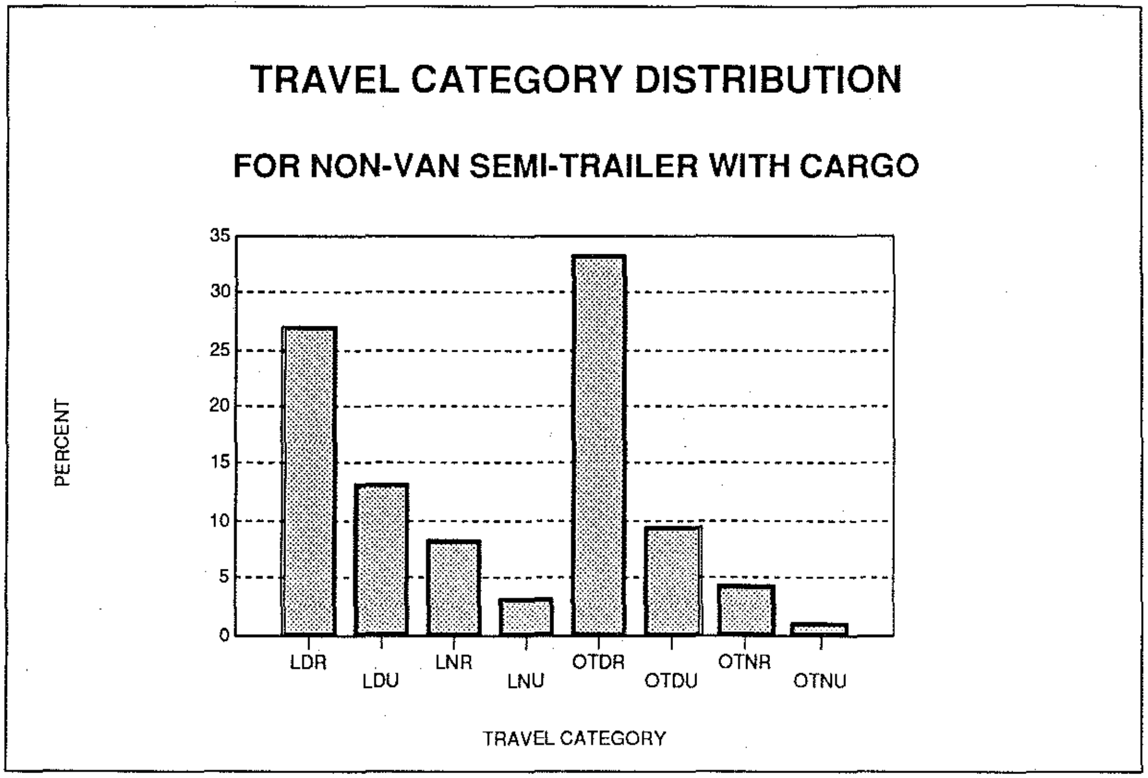
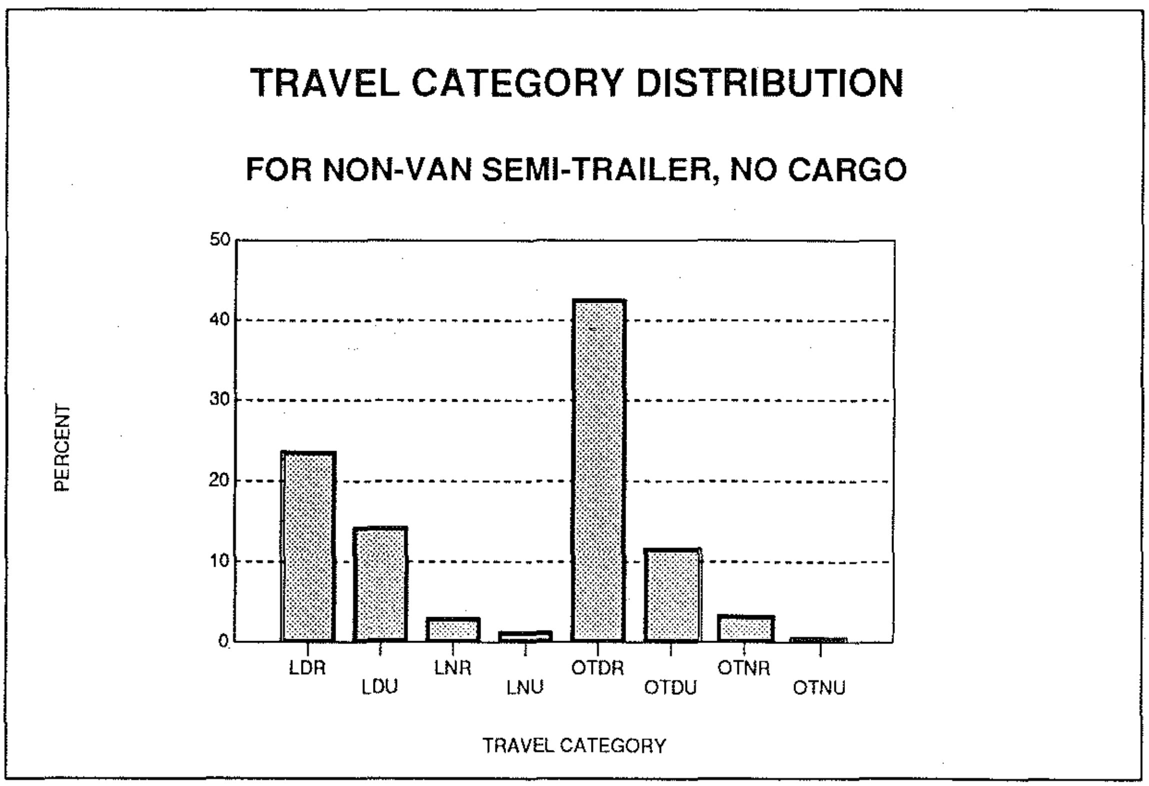
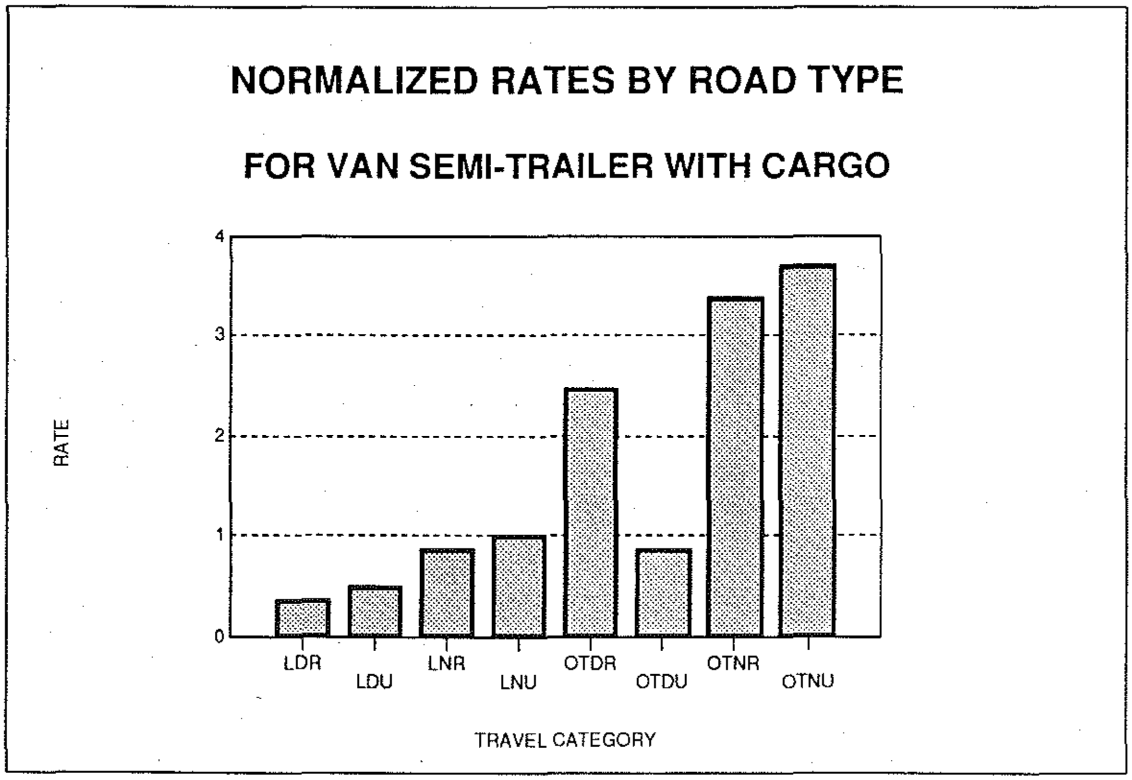


Figure 63



Figures 64 through 67 show the normalized involvement rates by travel category for each of the groups. Each has a similar pattern of normalized involvement rates by travel category. The most striking difference is that van semitrailers with cargo are substantially over-involved on non-limited access rural roads in the day. However, the non-van semitrailers with cargo are not particularly over-involved in any of the travel categories in comparison to the other three groups.

Figure 64



The apparent over-involvement in the overall rate, shown in Figure 59, is probably a consequence of the greater travel on non-limited access roads for this group in comparison to the others. Examination of the normalized involvement rates for the individual travel categories shows the non-van semitrailer combinations with cargo to have comparable involvement rates with the other three groups. The normalized rates for the four groups, aggregated over all travel, appear to be influenced more by the travel differences than by factors associated with the four truck types.

Figure 65

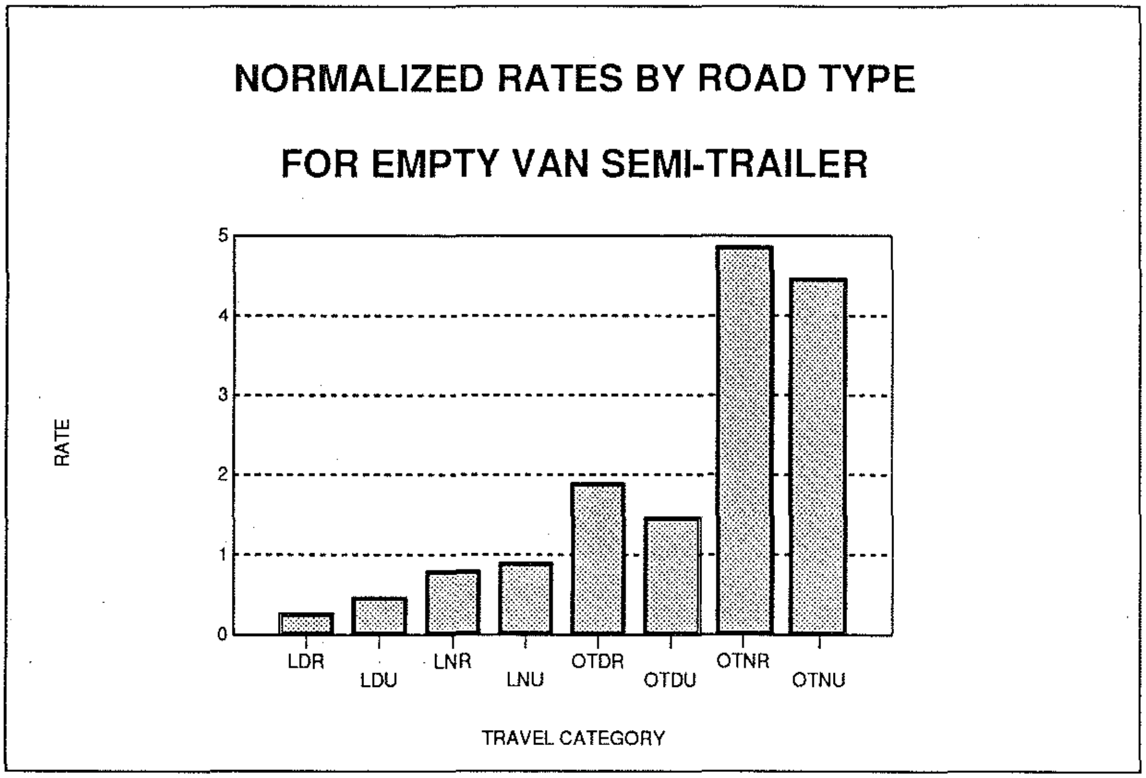


Figure 66

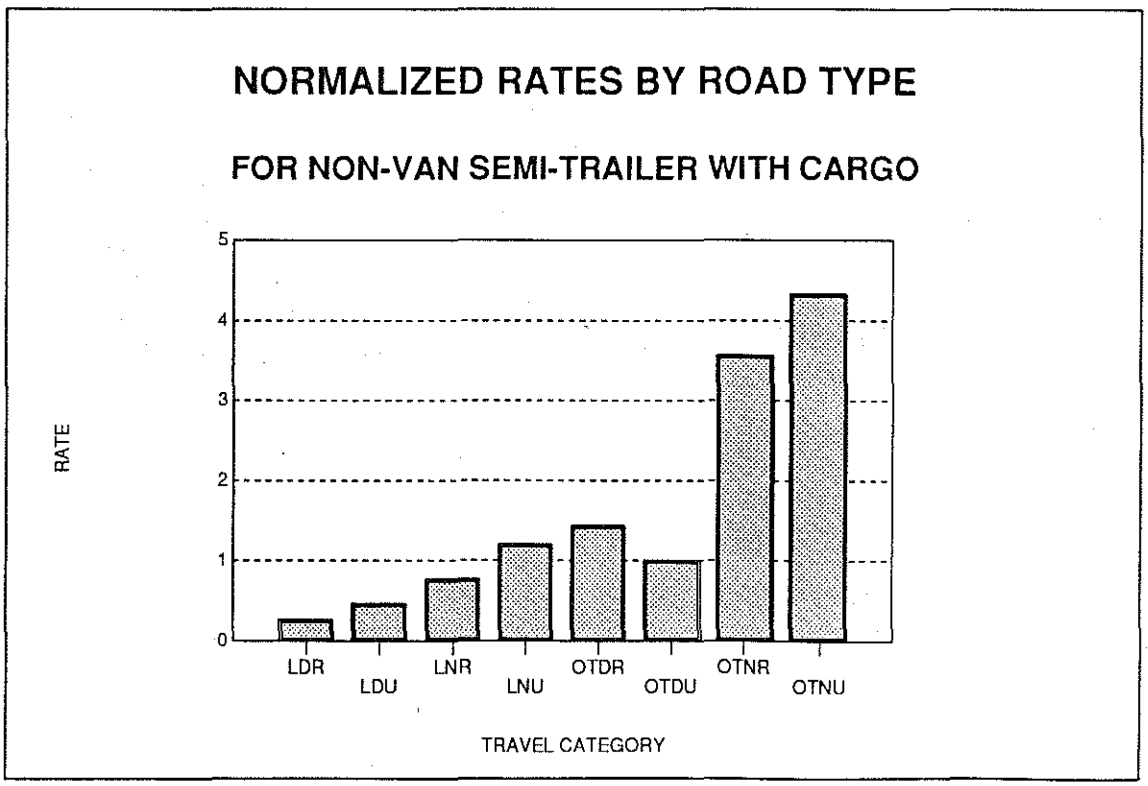
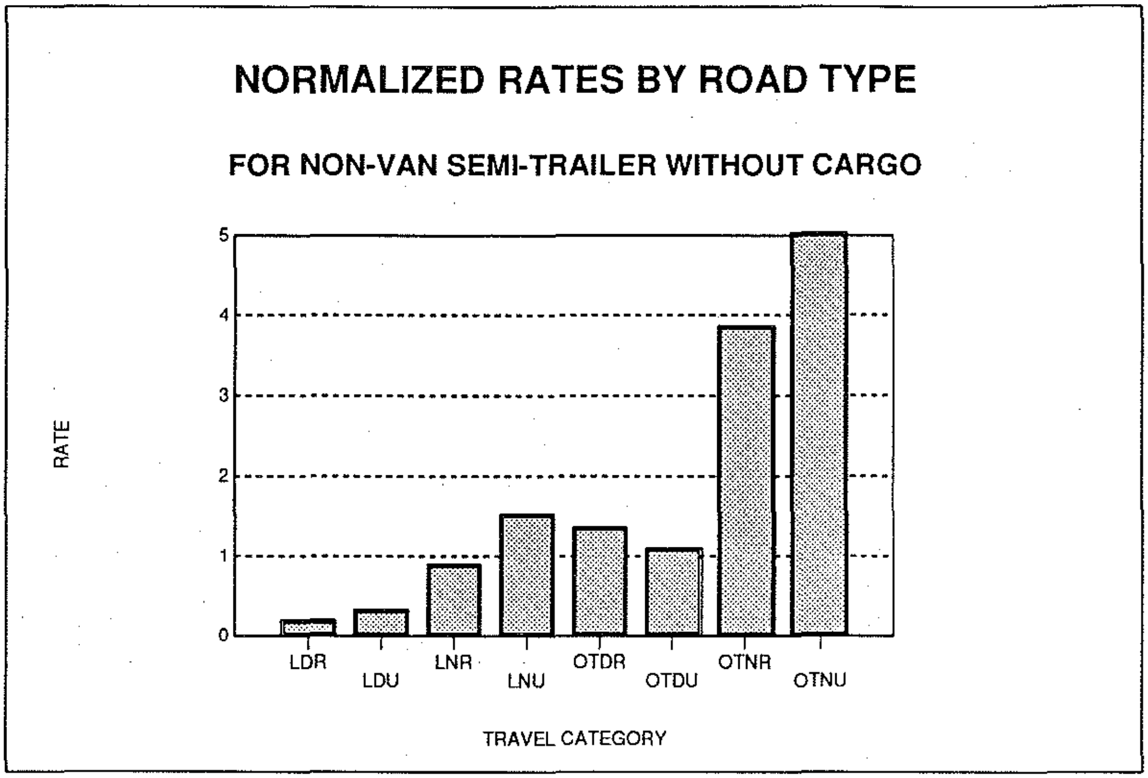


Figure 67



The original objective of this section was to look at the involvement rates in relation to GCW. From the previous material, it appears that the cleanest comparison would be within one of the four groups discussed above. The group with the largest sample size is the van semitrailer combinations with cargo. The rest of this analysis will be limited to that group. It was still desirable to decrease the number of weight categories in order to use the available sample size to look at the travel distributions for van semitrailers with cargo in different weight ranges. An examination of the data indicated that the variation in travel distributions and normalized rates could be adequately described with four weight categories. The four categories of GCW used for the last series of tables are: less than 35,000 pounds, 35,000 to 50,000, 50,000 to 65,000, and greater than 65,000 pounds. Figures 69 through 72 show the distribution of travel for these four weight categories for van semitrailers with cargo. As might have been anticipated, the lightly loaded trucks travel more on urban roads and less on limited access roads and at night. This pattern is consistent with a truck operating in pick-up and delivery service. As the trucks become heavier, there is progressively more travel on the limited access roads, and at night. This pattern is consistent with over-the-road operation.

In order to provide a comparison of involvement rates by GCW category, the influence of the differing travel patterns should be removed. The adjusted rates method described in the first section of the analysis does this. The normalized rates for each of the four weight categories was adjusted to the aggregate travel distribution for all of the van semitrailers with cargo, shown in Figure 59. The resulting adjusted rates for the four weight groups are presented in Figure 72. The effect of the adjustment was to lower the rate for the lowest category, and raise the rate for the highest category. In adjusting to a common travel distribution, the lighter trucks were shifted to a greater proportion of travel on limited access roads. Since the limited access roads have a lower risk of involvement in a fatal accident, the adjusted rate is lower than the aggregate rate. Similarly, the adjustment to a common travel distribution shifted the heavy trucks to a lesser proportion of travel on the limited access roads and a greater proportion off the limited access roads. Consequently, the adjusted rate is higher than the aggregate rate for the heavy trucks. The result of the adjusted rate calculation is that only the highest weight category, GCW greater than 65,000 pounds, is over-involved. The adjusted rate for this category is 1.42. The adjusted rate is also normalized on the overall raw rate for all tractors with a single semitrailer. This means that the van semitrailer combinations carrying cargo and having a gross combination weight greater than 65,000 pounds, *would* have a fatal accident involvement rate 42 percent higher than that of all tractor semitrailer combinations *if* their travel distribution was that shown in Figure 59. Likewise, the van semitrailer combinations with cargo and a GCW between 35,000 and 50,000 pounds would be under-involved by 36 percent.

Figure 68

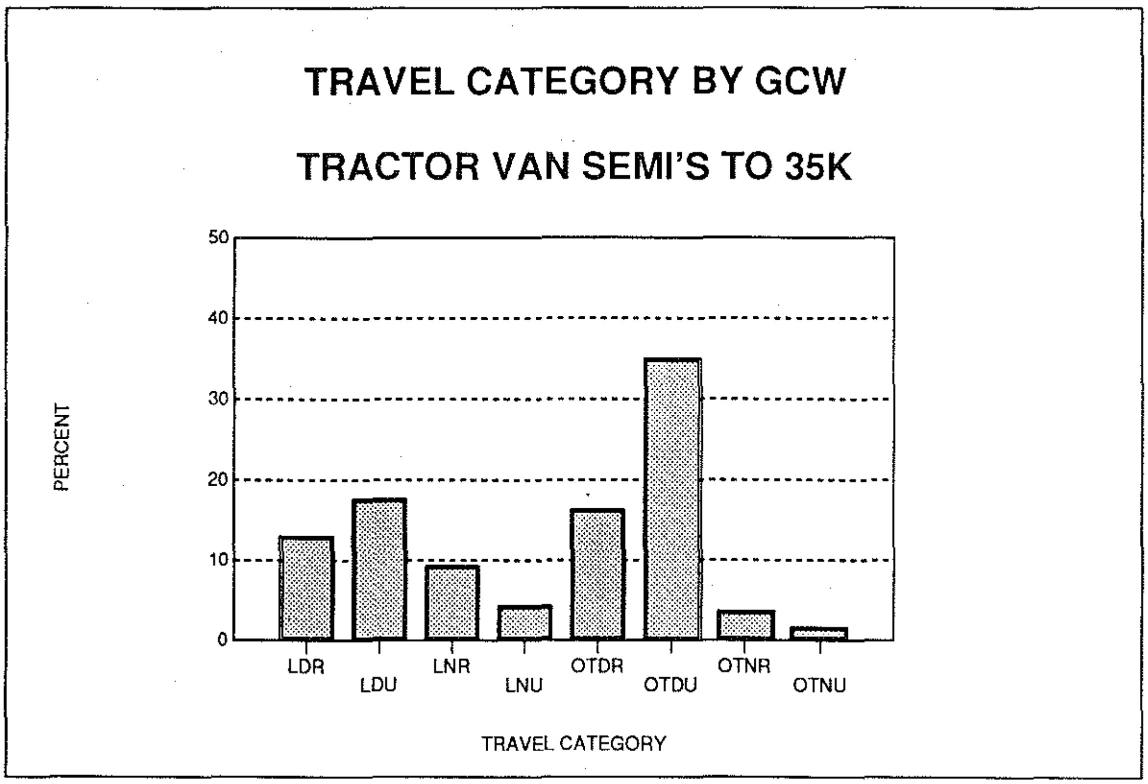


Figure 69

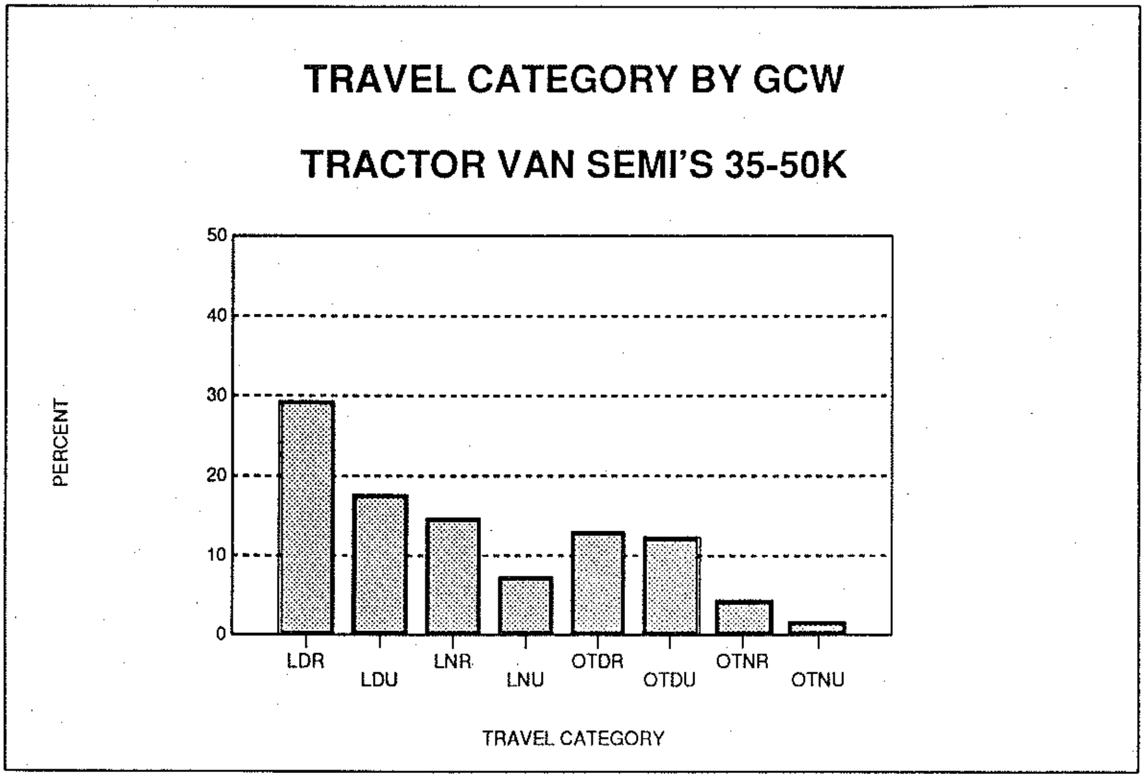


Figure 70

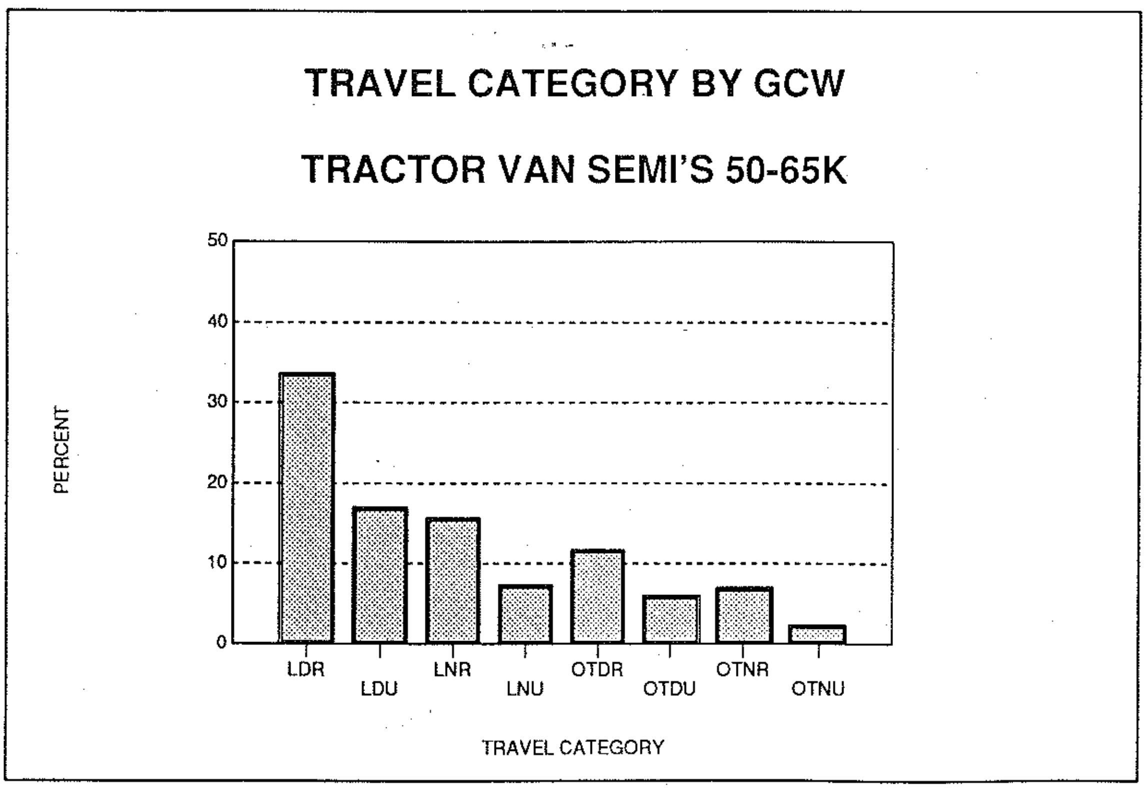


Figure 71

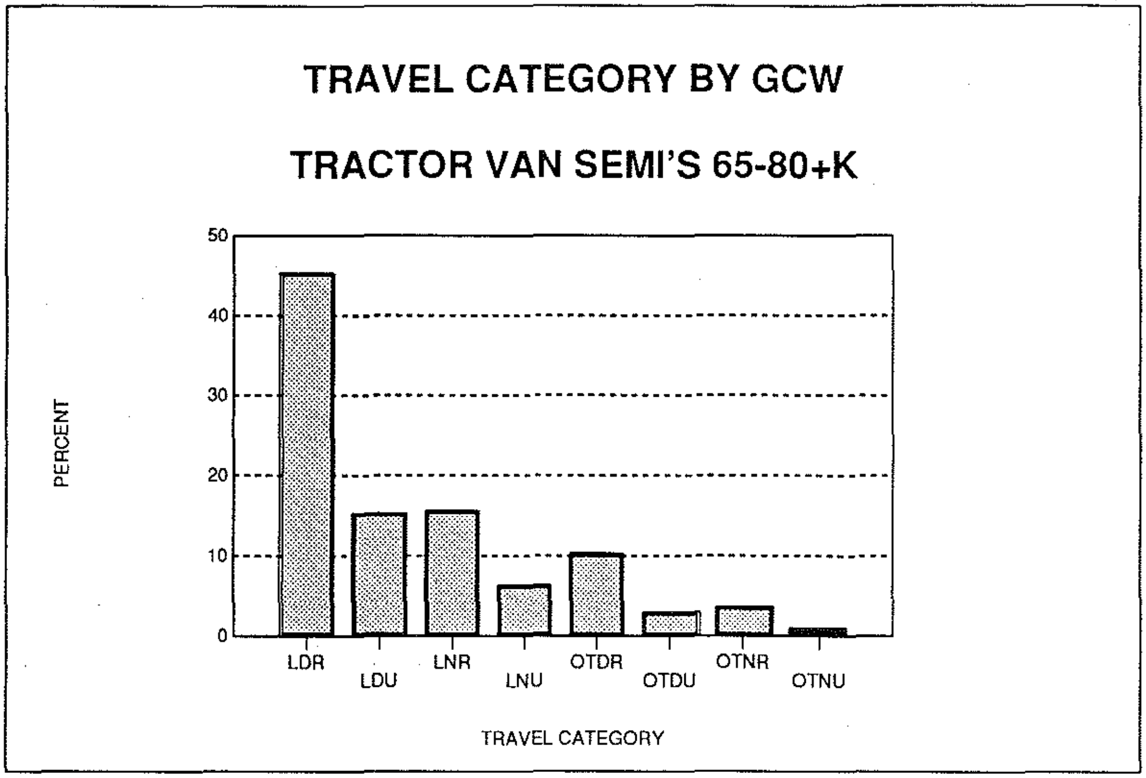
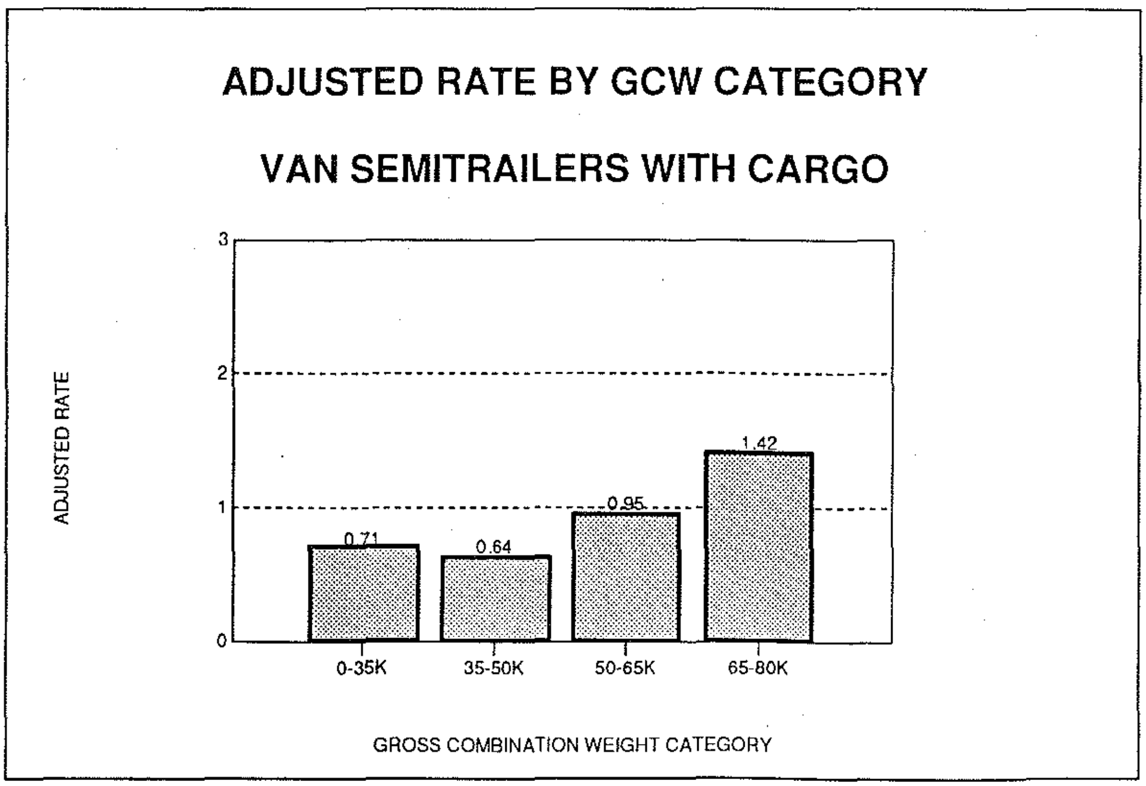


Figure 72



IMPLICATIONS

These findings illustrate several important aspects of the large-truck accident experience. The first is that the differences in fatal accident involvement rates are substantial on different types of roads, and in day versus night. The second is that different types of trucks have substantially different distributions of travel across these categories. Consequently, the combination of different accident rates on different roads and different amounts of travel on each road type has a strong influence on aggregate rates. The method of adjusting rates showed that the differences in the travel distributions had a greater influence on aggregate rates for different truck types than any factors related to the type of truck. In other words, the aggregate rates by truck type reflect the risk of the roads the truck travels on more than the risk of any factors associated with the type of truck. The single exception is the bobtail category. The over-involvement of the bobtail configuration is apparent in all travel categories. Consequently, this result is not sensitive to the distribution of travel across categories.

These findings underscore the importance of the travel data in any analysis that seeks to determine the relative safety of one truck type versus another. To carry out the analysis, it is essential to have both accident data and travel data that can be cross-classified by the factors of interest, especially those categorizing the type of travel. It is not sufficient to simply know the total miles travelled. One must also be able to classify the travel by factors related to the accident risk, such as the type of road and the time of day.

CONTINUED RESEARCH ACTIVITIES

UMTRI's Statistical Research Group has demonstrated significant progress in the effort to develop a national accident and travel database for large trucks. But it is only a beginning, not a concluded project. The United States trucking industry, and the use of large trucks as an essential component in the transportation system of the U.S., will not remain static. Both will continue to change in tandem with demographics, the economy, size and weight legislation, truck equipment and configurations, truck technology, and traffic densities, as well as the nature of the highways on which they must operate with other vehicles. Trucking will indeed be changing, and truck safety as a matter of national concern will continue to be of major importance.

The need for accurate information on the nature of these vehicles' actual highway experience will also be a part of the future of the highway system. There is a continuing need to provide the institutional framework within which the appropriate data collection and analytical activities might continue and evolve to meet changing needs. The research methods pioneered at UMTRI, and demonstrated in the accompanying analyses, have just begun to bear fruit. The results are promising, but it will require time and support to develop improved analytic methods and the larger and more complete sets of information that are needed.

Although the methods employed for the analyses presented were adequate to illustrate the complexity of the data, multivariate models would be more effective. Sample size is exhausted too quickly if it is necessary to subdivide small subsets further in order to control for each successive factor. Multivariate models can estimate the effects of several variables simultaneously, including interactions between the variables.

Similarly, the establishment of ongoing data collection programs would eventually result in the availability of both accident and exposure information for the same period of time. Ongoing programs would also make it possible to track trends over time. There are also improvements that should be made, such as the addition of data on non-fatal accidents, and modifications to the survey method to incorporate important factors such as traffic density into the accident and travel files. Traffic density is, perhaps, the most important data element that it would be desirable to add.

The current files are already becoming outdated, and the time period of the travel data does not match the accidents as well as one would like. The analysis presented is intended to illustrate the potential that these methods have to substantially advance our understanding of the factors associated with accident risk. However, the survey program must be continued in order to realize the potential gains.

The process establishing these survey programs could develop in two separate steps, or stages. Initially, the Center for National Truck Statistics, recently established by the University of Michigan, will continue to serve as the organizing force in data collection and analysis activities. The fatal accident survey, TIFA, will become an ongoing and regular activity, as will the travel/exposure survey, NTTIS. UMTRI has completed the basic period of methodology development, and we are now in a position to establish a program with long-term continuity. These long-term activities are to collect and analyze data on large truck accidents and travel.

There should also be a commitment to maintaining data files so that they can be used by others seeking access to research materials. Public access to a central file storage facility would be permitted over the long-term to allow analyses to be conducted and verified by others interrogating the same files. The Center offers a means of establishing this analytic capability on a continuing basis, organizing and maintaining data files, and providing public access to the data files along with the codebooks to provide users the information necessary to access those data.

The Center would also publish statistics on the accident files, truck population estimates, and travel estimates. In addition, the analytical methods themselves would be published and placed in the public domain where others could critique and suggest modifications and improvements. The same Center staff would conduct their own analyses and contribute findings into the professional arena as an aid to policy making. These publications have potential applications in such an area, for example, as market research for trucking companies, truck component manufacturers, and vehicle manufacturers, as well as in cost-benefit analyses of potential countermeasures.

TIFA will, in these projections, continue to build upon FARS as a national census, adding approximately 5,000 cases per year. It will continue to involve the merging of FARS and OMCS, the follow-up survey in which unmatched cases are pursued, and the extensive editing procedures already in practice. The database will represent the only truly national in-depth set of longitudinal data on the fatal accident experience of large trucks.

NTTIS would be conducted on a biennial basis. At least a year is needed between surveys in order to conduct the planning, select the sample, and contact all the needed respondents for the survey. Approximately 4,000 trucks would be tracked through the year's collection of data, producing on the order of 16,000 survey days of information. These biennial surveys will provide an ongoing study of the actual *use* of heavy trucks on the nation's roadways.

The second stage of the Center's activities could encompass expansion of survey programs to include, for example, a probability-based sample of *all* police-reported accidents involving large trucks. The sample could come from the new NASS General Estimates System. This would be an important addition as it would offer a useful balance to conclusions reached from TIFA-based studies.

Also in the second phase, special studies could be conducted on a host of safety-related and other issues of interest to researchers, planners, manufacturers, and the trucking industry. A project already concluded was prompted by engine manufacturers interested in data on the mileage being covered by different types of power equipment. The study identified each engine being used, the model number, the displacement, and all of the energy-conserving aids employed on each vehicle. These included the aerodynamic spoiler on top of the cab, clutch-operated fan, radial tires, and other measures. Research projects may involve special combinations of existing data, combinations of new and old datasets, or newly developed information in combination with federal and other samples. Ultimately, these second phase data sets could be concerned with analysis to help guide countermeasure development, and, finally, countermeasure evaluation.

TABLES

This section provides tabulations of all the data presented as figures in the report. Tables 26-30 and 41-47 present additional, more detailed tabulations not discussed in the report. As background, a short discussion of cases excluded from the tabulations follows. A more complete documentation of the data files is provided by the codebooks, *Trucks Involved in Fatal Accidents, 1980-84, by Power Unit Type*, UMTRI-87-38, August 1987 and *National Truck Trip Information Survey*, UMTRI-88-11, March 1988.

NTTIS File. The NTTIS file contains at least partial information on 6,305 large trucks sampled from R.L. Polk registration files as of July 1983, and on 13,097 trips taken by these trucks on 5,515 randomly selected days from November 1985 to February 1987. Government-owned trucks are not included in the file because they were generally not available in the R.L. Polk data. Total trip mileage is known for 12,785 (97.6%) of these trips. The trip miles are completely allocated into the 18 travel categories for 12,192 (93.1%) of these trips, and they are partially allocated for another 91 (0.7%) trips (including 25 with unknown total travel). Thus tables using the total mileage variable exclude only 2.4 percent of the trips due to missing data, and tables using mileage in the individual travel categories exclude 6.2 percent of the trips due to missing data. The total travel reported on the survey days was 915,426 miles. Of this, 862,405 miles (94.2%) were allocated to the individual travel categories. Using the final mileage weight (which varies from 1,073 to 1,248,629 for different trips), the estimated total annual travel is 55.9 billion vehicle miles. Using the mileage allocated by travel category, the total annual travel is 51.9 billion vehicle miles.

The power unit was a tractor on 8,131 of the 13,097 trips, and the remaining 4,966 trips were taken by straight trucks. Detailed configuration data are missing for 15 straight truck trips and 24 tractor trips, and there are 20 straight truck trips and 24 tractor trips involving unusual configurations, leaving 13,014 trips. For the five configurations used in the analysis, straight trucks with no trailers (4,504 trips), straight trucks pulling one or two trailers (427 trips), tractors without trailers (234 trips), tractors pulling a single semitrailer (7,335 trips), and tractors pulling two or three trailers (514 trips), the estimated total annual travel is 55.6 billion vehicle miles. Using the variables allocating the mileage to the individual travel categories, the total annual travel for the five configurations is 51.7 billion vehicle miles. Thus, only about 0.5 percent of the mileage is omitted from the analyses using the five configurations.

Overall, the missing data is quite low on the major NTTIS variables. Consequently, no adjustments were made. Of course, when other variables are included in the analysis, such as vehicle weight or axle configuration, additional missing data on these variables will further reduce the total mileage for those tables.

1980-84 TIFA File. This file contains information on 25,278 large trucks involved in fatal accidents in the contiguous United States during the five-year period. These include 6,715 straight trucks, 18,119 tractors, and 444 trucks of unknown power unit type. Since government-owned trucks are excluded from the NTTIS file, 598 government-owned trucks in the TIFA file are excluded, leaving 24,680 trucks. Most of the power units excluded were straight trucks (542). There were 55 government-owned tractors and one government-owned truck of unknown power unit type. Exclusion of these government-owned trucks leaves 6,173 straight trucks, 18,064 tractors, and 443 trucks of unknown power unit type in the five-year TIFA file.

The configuration of the truck at the time of the fatal accident is unknown for an additional 109 (0.4%) trucks (30 straight trucks and 79 tractors). There are also another 114 trucks (47 straight trucks and 67 tractors) with unusual configurations that have been excluded. These exclusions leave 24,014 trucks known to have one of the five configurations used for the analysis in the five-year TIFA file. By configuration, there are 5,511 straight trucks without trailers, 586 straight trucks with trailers, 619 bobtail tractors, 16,468 tractors pulling a single semitrailer, and 830 tractors pulling two or three trailers. Thus 666 trucks not owned by a governmental unit (2.7%) were excluded due to unknown power unit type or unknown/unusual configuration.

Travel category at the time of the accident is determined by variables in the TIFA file that were carried over from the FARS data. These variables are quite complete. Only 316 (1.3%) of the 24,014 trucks of the five configurations were unknown on road type and/or time of day and/or area type (rural/urban). The data are also very complete on collision type, another major variable of interest. Collision type is unknown for only five trucks. For other variables used in the analysis, such as vehicle weight and axle configuration, there is some additional missing data.

The 1982-84 subset that is used in some of the tables contains 14,978 large trucks. Excluding 363 government-owned trucks, 351 trucks of unknown power unit type, 70 trucks with unusual configurations, and 76 trucks with unknown configuration leaves 14,118 trucks in the five main configurations. Only 88 of these trucks have missing data on one or more of the travel category variables (road type, time of day, or rural/urban area), and only 3 are unknown on collision type.

TABLE 1
Straight Trucks in the United States by Gross Vehicle Weight Rating

GVWR	NTTIS		TIUS	
	Sample Size	Population Percent	Sample Size	Population Percent
Class 3–5	436	17.2%	6,365	22.2%
Class 6	1,594	53.8	15,038	50.9
Class 7	649	11.5	5,317	11.0
Class 8	952	17.1	8,464	16.0
Unknown	73	0.4		
Total	3,704	100%	35,184	100%

TABLE 2
Tractors in the United States by Gross Vehicle Weight Rating

GVWR	NTTIS		TIUS	
	Sample Size	Population Percent	Sample Size	Population Percent
Class 3–5	13	0.5%	71	0.6%
Class 6	110	5.4	746	5.4
Class 7	259	9.3	1,840	10.1
Class 8	2,215	84.6	16,581	83.9
Unknown	4	0.1		
Total	2,601	100%	19,238	100%

TABLE 3
Straight Trucks in the United States by Model Year

Model Year	NTTIS		TIUS	
	Sample Size	Population Percent	Sample Size	Population Percent
Pre '73	1,552	48.2%	17,037	50.4%
1973	290	7.5	2,440	6.9
1974	232	5.9	2,304	6.4
1975	233	6.0	2,160	6.2
1976	140	3.7	1,448	4.4
1977	202	4.7	1,735	5.2
1978	227	5.2	1,919	5.4
1979	288	6.9	2,552	6.5
1980	210	4.7	1,736	4.0
1981	166	3.6	1,288	3.1
1982(a)	113	2.4	565	1.5
1983	49	1.1		
1984	2	0.1		
Total	3,704	100%	35,184	100%

[a]1982–1983 in TIUS.

TABLE 4
Tractors in the United States by Model Year

Model Year	NTTIS		TIUS	
	Sample Size	Population Percent	Sample Size	Population Percent
Pre '73	427	19.7%	4,268	22.3%
1973	169	5.8	1,353	7.2
1974	192	7.0	1,433	7.8
1975	126	4.7	1,036	5.6
1976	124	4.5	854	4.4
1977	246	9.3	1,807	9.8
1978	273	10.1	1,992	10.6
1979	347	13.0	2,563	12.9
1980	231	8.1	1,802	9.0
1981	226	8.6	1,392	6.8
1982(a)	140	5.1	738	3.7
1983	94	3.8		
1984	6	0.3		
Total	2,601	100%	19,238	100%

[a]1982–1983 in TIUS.

TABLE 5
Tractors in the United States by Cabstyle

Cab Style	NTTIS		TIUS	
	Sample Size	Population Percent	Sample Size	Population Percent
Cabover	1,172	43.4%	8,836	45.3%
Short Conv.	344	13.6	2,635	14.1
Med. Conv.	714	28.8	4,659	25.2
Long Conv.	370	14.2	2,454	12.1
Other/Unk	1	0.0	654	3.3
Total	2,601	100%	19,238	100%

TABLE 6
Tractors in the United States by Carrier Type

Carrier Type	NTTIS		TIUS	
	Sample Size	Population Percent	Sample Size	Population Percent
Private	1,349	52.8%	9,408	48.7%
ICC Regulated	988	37.2	5,725	29.8
ICC Exempt	66	2.6	319	1.7
ICC Unk	0		1,232	6.2
Intrastate For-Hire	155	5.7	2,068	11.1
Rental	29	1.1	426	2.4
Unknown	14	0.5	60	0.2
Total	2,601	100%	19,238	100%

TABLE 7
Trucks in the United States
Annual Mileage by Power Unit Type

Power Unit Type	NTTIS			TIUS		
	Sample Size	Average Annual Mileage	Total Miles (billions)	Sample Size	Average Annual Mileage	Total Miles (billions)
Straight Trucks	3,621	12,546	26.7	34,455	10,611	26.8
Tractors	2,560	55,149	49.9	19,123	53,128	47.5
Unknown				7	6,508	
Total	6,181	25,260	76.6	53,585	21,741	74.3

TABLE 8
Straight Trucks in the United States
Annual Mileage by Gross Vehicle Weight Rating

GVWR	NTTIS		TIUS	
	Sample Size	Average Annual Mileage	Sample Size	Average Annual Mileage
Class 3–5	409	5,671	6,163	5,690
Class 6	1,563	9,862	14,779	9,117
Class 7	637	19,085	5,249	15,437
Class 8	941	23,330	8,264	18,884
Unknown	71	5,320		
Total	3,621	12,546	34,455	10,611

TABLE 9
Tractors in the United States
Annual Mileage by Gross Vehicle Weight Rating

GVWR	NTTIS		TIUS	
	Sample Size	Average Annual Mileage	Sample Size	Average Annual Mileage
Class 3–5	13	56,822	70	23,155
Class 6	109	17,179	730	14,118
Class 7	256	26,261	1,822	24,608
Class 8	2,178	60,876	16,501	59,203
Unknown	4	5,672		
Total	2,560	55,149	19,123	53,128

TABLE 10
Straight Trucks in the United States
Average Annual Mileage by Model Year

Model Year	NTTIS		TIUS	
	Sample Size	Average Annual Mileage	Sample Size	Average Annual Mileage
Pre '73	1,510	6,247	16,472	5,701
1973	281	12,587	2,402	10,100
1974	227	12,257	2,264	11,095
1975	226	13,193	2,141	11,223
1976	137	17,146	1,431	13,200
1977	196	19,689	1,724	16,500
1978	224	20,103	1,908	17,786
1979	286	22,910	2,542	19,208
1980	206	21,763	1,728	20,870
1981	165	24,424	1,282	22,349
1982(a)	112	25,614	561	26,310
1983	49	27,771		
1984	2	29,817		
Total	3,621	12,546	34,455	10,611

[a] 1982–1983 in TIUS.

TABLE 11
Tractors in the United States
Average Annual Mileage by Model Year

Model Year	NTTIS		TIUS	
	Sample Size	Average Annual Mileage	Sample Size	Average Annual Mileage
Pre '73	415	26,627	4,196	26,002
1973	165	35,125	1,342	36,747
1974	187	41,806	1,421	40,542
1975	125	50,059	1,032	43,496
1976	120	49,651	850	53,296
1977	243	58,886	1,801	57,364
1978	271	58,129	1,991	63,395
1979	342	65,947	2,558	68,540
1980	230	70,768	1,802	76,539
1981	222	70,487	1,392	77,248
1982(a)	140	87,556	738	90,572
1983	94	95,903		
1984	6	117,042		
Total	2,560	55,149	19,123	53,128

[a]1982–1983 in TIUS.

TABLE 12
Tractors in the United States
Annual Miles by Model Year and Cabstyle

Strata	NTTIS		TIUS	
	Sample Size	Average Annual Mileage	Sample Size	Average Annual Mileage
Pre '73	415	26,627	4,196	26,002
'73–'80 Cabover	760	63,038	5,968	67,627
'73–'80 Non-Cabover	923	51,378	6,829	48,732
'81–'84 Cabover	221	94,611	998	98,721
'81–'84 Non-Cabover	241	69,720	1,132	68,494
Total	2,560	55,149	19,123	53,128

TABLE 13
Straight Trucks in the United States Annual Miles by Model Year and Gross Vehicle Weight Rating %

Strata	NTTIS		TIUS	
	Sample Size	Average Annual Mileage	Sample Size	Average Annual Mileage
Pre '73, Class 3-6 & Unk	1,082	5,145	11,813	4,888
Pre '73, Class 7 & 8	428	11,733	4,659	9,366
'73–'78, Class 3-6 & Unk	604	11,526	7,120	10,832
'73–'78, Class 7 & 8	463	22,108	4,750	18,925
Post '78, Class 3-6 & Unk	357	17,381	2,009	16,665
Post '78, Class 7 & 8	687	27,490	4,104	24,709
Total	3,621	12,546	34,455	10,611

TABLE 14
Annual Mileage in NTTIS by Source of Data

Power Unit Type	Self-Reported		Odometer		Mapped	
	Sample Size	Average Annual Mileage	Sample Size	Average Annual Mileage	Sample Size	Average Annual Mileage
Straight	3,621	12,546	1,454	9,088	2,344	5,935
Tractor	2,560	55,149	1,540	43,180	2,440	29,001
Total	6,181	25,260	2,994	19,412	4,784	12,768

TABLE 15
Normalized Fatal Accident Involvement Rates by 8 Travel Categories for 5 Truck Types or Configurations NTTIS and 1980–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
STRAIGHT	**TRUCK**	**ALONE**					
Limited	Day	Rural	897	1.74%	148	0.62%	0.36
Limited	Day	Urban	1851	3.58	273	1.15	0.32
Limited	Night	Rural	79	0.15	67	0.28	1.86
Limited	Night	Urban	52	0.10	86	0.36	3.62
Other	Day	Rural	6311	12.20	2780	11.73	0.96
Other	Day	Urban	5212	10.08	1540	6.50	0.64
Other	Night	Rural	133	0.26	339	1.43	5.55
Other	Night	Urban	145	0.28	187	0.79	2.81
SUBTOTAL			14680	28.39	5420	22.87	0.81
STRAIGHT	**TRUCK**	**& TRAILERS**					
Limited	Day	Rural	116	0.22%	27	0.11%	0.51
Limited	Day	Urban	159	0.31	32	0.14	0.44
Limited	Night	Rural	26	0.05	19	0.08	1.60
Limited	Night	Urban	18	0.04	12	0.05	1.45
Other	Day	Rural	351	0.68	282	1.19	1.75
Other	Day	Urban	282	0.55	103	0.43	0.80
Other	Night	Rural	32	0.06	80	0.34	5.42
Other	Night	Urban	6	0.01	23	0.10	8.10
SUBTOTAL			990	1.91	578	2.44	1.27
TRACTOR	**ALONE**	**(BOBTAIL)**					
Limited	Day	Rural	147	0.28%	34	0.14%	0.51
Limited	Day	Urban	124	0.24	51	0.22	0.90
Limited	Night	Rural	26	0.05	18	0.08	1.49
Limited	Night	Urban	10	0.02	24	0.10	5.29
Other	Day	Rural	168	0.32	222	0.94	2.89
Other	Day	Urban	91	0.18	125	0.53	3.00
Other	Night	Rural	14	0.03	71	0.30	11.47
Other	Night	Urban	7	0.01	66	0.28	21.67
SUBTOTAL			587	1.13	611	2.58	2.27
TRACTOR	**AND 1**	**TRAILER**					
Limited	Day	Rural	9722	18.80%	1335	5.63%	0.30
Limited	Day	Urban	5228	10.11	1032	4.35	0.43
Limited	Night	Rural	3169	6.13	1440	6.08	0.99
Limited	Night	Urban	1374	2.66	797	3.36	1.27
Other	Day	Rural	8548	16.53	6180	26.08	1.58
Other	Day	Urban	3700	7.15	1911	8.06	1.13
Other	Night	Rural	1333	2.58	2685	11.33	4.40
Other	Night	Urban	378	0.73	880	3.71	5.09
SUBTOTAL			33450	64.68	16260	68.61	1.06

TABLE 15 Continued

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
TRACTOR	**AND 2+**	**TRAILERS**					
Limited	Day	Rural	570	1.10%	74	0.31%	0.28
Limited	Day	Urban	364	0.70	59	0.25	0.35
Limited	Night	Rural	316	0.61	98	0.41	0.68
Limited	Night	Urban	205	0.40	58	0.24	0.62
Other	Day	Rural	239	0.46	258	1.09	2.36
Other	Day	Urban	148	0.29	80	0.34	1.18
Other	Night	Rural	127	0.25	157	0.66	2.70
Other	Night	Urban	39	0.08	45	0.19	2.50
SUBTOTAL			2007	3.88	829	3.50	0.90
TOTAL			51714	100.00%	23698	100.00%	1.00

TABLE 16
Normalized Fatal Rollover Accident Involvement Rates by 12 Travel Categories for Straight Trucks Without Trailers NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Limited	Day	Rural	897	6.11%	6	3.68%	0.60
Limited	Day	Urban	1851	12.61	8	4.91	0.39
Limited	Night	Rural	79	0.54	7	4.29	8.00
Limited	Night	Urban	52	0.35	2	1.23	3.47
Primary	Day	Rural	3879	26.42	61	37.42	1.42
Primary	Day	Urban	2131	14.51	3	1.84	0.13
Primary	Night	Rural	115	0.79	14	8.59	10.93
Primary	Night	Urban	64	0.44	0	0.00	—
Other	Day	Rural	2432	16.57	44	26.99	1.63
Other	Day	Urban	3081	20.99	9	5.52	0.26
Other	Night	Rural	18	0.12	8	4.91	39.91
Other	Night	Urban	81	0.55	1	0.61	1.11
TOTAL			14680	100.00	163	100.00	1.00

TABLE 17
Normalized Fatal Pedestrian/Bicylist Accident Involvement Rates by 12 Travel Categories for Straight Trucks Without Trailers NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Limited	Day	Rural	897	6.11%	6	1.54%	0.25
Limited	Day	Urban	1851	12.61	19	4.88	0.39
Limited	Night	Rural	79	0.54	1	0.26	0.48
Limited	Night	Urban	52	0.35	6	1.54	4.37
Primary	Day	Rural	3879	26.42	37	9.51	0.36
Primary	Day	Urban	2131	14.51	56	14.40	0.99
Primary	Night	Rural	115	0.79	10	2.57	3.27
Primary	Night	Urban	64	0.44	5	1.29	2.94
Other	Day	Rural	2432	16.57	47	12.08	0.73
Other	Day	Urban	3081	20.99	189	48.59	2.32
Other	Night	Rural	18	0.12	6	1.54	12.54
Other	Night	Urban	81	0.55	7	1.80	3.27
TOTAL			14680	100.00	389	100.00	1.00

TABLE 18
Normalized Fatal Other Single Vehicle Accident Involvement Rates by 12 Travel Categories for Straight Trucks Without Trailers NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Limited	Day	Rural	897	6.11%	18	5.34%	0.87
Limited	Day	Urban	1851	12.61	23	6.82	0.54
Limited	Night	Rural	79	0.54	11	3.26	6.08
Limited	Night	Urban	52	0.35	7	2.08	5.88
Primary	Day	Rural	3879	26.42	98	29.08	1.10
Primary	Day	Urban	2131	14.51	14	4.15	0.29
Primary	Night	Rural	115	0.79	21	6.23	7.93
Primary	Night	Urban	64	0.44	4	1.19	2.71
Other	Day	Rural	2432	16.57	81	24.04	1.45
Other	Day	Urban	3081	20.99	39	11.57	0.55
Other	Night	Rural	18	0.12	10	2.97	24.13
Other	Night	Urban	81	0.55	11	3.26	5.93
TOTAL			14680	100.00	337	100.00	1.00

TABLE 19
Normalized Fatal Multi-Vehicle Accident Involvement Rates by 12 Travel Categories for Straight Trucks Without Trailers NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Limited	Day	Rural	897	6.11%	56	2.45%	0.40
Limited	Day	Urban	1851	12.61	127	5.56	0.44
Limited	Night	Rural	79	0.54	16	0.70	1.31
Limited	Night	Urban	52	0.35	40	1.75	4.95
Primary	Day	Rural	3879	26.42	958	41.93	1.59
Primary	Day	Urban	2131	14.51	297	13.00	0.90
Primary	Night	Rural	115	0.79	115	5.03	6.41
Primary	Night	Urban	64	0.44	34	1.49	3.40
Other	Day	Rural	2432	16.57	276	12.08	0.73
Other	Day	Urban	3081	20.99	312	13.65	0.65
Other	Night	Rural	18	0.12	14	0.61	4.98
Other	Night	Urban	81	0.55	40	1.75	3.18
TOTAL			14680	100.00	2285	100.00	1.00

TABLE 20
Normalized Fatal Accident Involvement Rates by 12 Travel Categories for Straight Trucks Without Trailers NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Limited	Day	Rural	897	6.11%	86	2.71%	0.44
Limited	Day	Urban	1851	12.61	177	5.58	0.44
Limited	Night	Rural	79	0.54	35	1.10	2.06
Limited	Night	Urban	52	0.35	55	1.73	4.90
Primary	Day	Rural	3879	26.42	1154	36.36	1.38
Primary	Day	Urban	2131	14.51	370	11.66	0.80
Primary	Night	Rural	115	0.79	160	5.04	6.42
Primary	Night	Urban	64	0.44	43	1.35	3.10
Other	Day	Rural	2432	16.57	448	14.11	0.85
Other	Day	Urban	3081	20.99	549	17.30	0.82
Other	Night	Rural	18	0.12	38	1.20	9.74
Other	Night	Urban	81	0.55	59	1.86	3.38
TOTAL			14680	100.00	3174	100.00	1.00

TABLE 21
Normalized Fatal Rollover Accident Involvement Rates by 12 Travel Categories for Tractors With 1 Trailer NTTIS and 1982–84 TIFA Files

Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Limited	Day	Rural	9722	29.06%	65	12.22%	0.42
Limited	Day	Urban	5228	15.63	22	4.14	0.26
Limited	Night	Rural	3169	9.47	49	9.21	0.97
Limited	Night	Urban	1374	4.11	33	6.20	1.51
Primary	Day	Rural	7596	22.71	191	35.90	1.58
Primary	Day	Urban	2204	6.59	8	1.50	0.23
Primary	Night	Rural	1259	3.77	105	19.74	5.24
Primary	Night	Urban	279	0.83	4	0.75	0.90
Other	Day	Rural	951	2.84	41	7.71	2.71
Other	Day	Urban	1496	4.47	4	0.75	0.17
Other	Night	Rural	73	0.22	8	1.50	6.87
Other	Night	Urban	99	0.30	2	0.38	1.27
TOTAL			33450	100.00	532	100.00	1.00

TABLE 22
Normalized Fatal Pedestrian/Bicyclist Accident Involvement Rates by 12 Travel Categories for Tractors With 1 Trailer NTTIS and 1982–84 TIFA Files

Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Limited	Day	Rural	9722	29.06%	63	8.13%	0.28
Limited	Day	Urban	5228	15.63	60	7.74	0.50
Limited	Night	Rural	3169	9.47	78	10.06	1.06
Limited	Night	Urban	1374	4.11	74	9.55	2.33
Primary	Day	Rural	7596	22.71	109	14.06	0.62
Primary	Day	Urban	2204	6.59	72	9.29	1.41
Primary	Night	Rural	1259	3.77	121	15.61	4.15
Primary	Night	Urban	279	0.83	23	2.97	3.56
Other	Day	Rural	951	2.84	25	3.23	1.13
Other	Day	Urban	1496	4.47	129	16.65	3.72
Other	Night	Rural	73	0.22	9	1.16	5.30
Other	Night	Urban	99	0.30	12	1.55	5.24
TOTAL			33450	100.00	775	100.00	1.00

TABLE 23
Normalized Fatal Other Single Vehicle Accident Involvement Rates by 12 Travel Categories for Tractors With 1 Trailer NTTIS and 1982–84 TIFA Files

Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Limited	Day	Rural	9722	29.06%	151	13.75%	0.47
Limited	Day	Urban	5228	15.63	124	11.29	0.72
Limited	Night	Rural	3169	9.47	184	16.76	1.77
Limited	Night	Urban	1374	4.11	84	7.65	1.86
Primary	Day	Rural	7596	22.71	266	24.23	1.07
Primary	Day	Urban	2204	6.59	35	3.19	0.48
Primary	Night	Rural	1259	3.77	138	12.57	3.34
Primary	Night	Urban	279	0.83	16	1.46	1.75
Other	Day	Rural	951	2.84	63	5.74	2.02
Other	Day	Urban	1496	4.47	20	1.82	0.41
Other	Night	Rural	73	0.22	11	1.00	4.57
Other	Night	Urban	99	0.30	6	0.55	1.85
TOTAL			33450	100.00	1098	100.00	1.00

TABLE 24
Normalized Fatal Multi-Vehicle Accident Involvement Rates by 12 Travel Categories for Tractors With 1 Trailer NTTIS and 1982–84 TIFA Files

Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
Limited	Day	Rural	9722	29.06%	511	7.07%	0.24
Limited	Day	Urban	5228	15.63	459	6.35	0.41
Limited	Night	Rural	3169	9.47	519	7.19	0.76
Limited	Night	Urban	1374	4.11	304	4.21	1.02
Primary	Day	Rural	7596	22.71	2801	38.78	1.71
Primary	Day	Urban	2204	6.59	579	8.02	1.22
Primary	Night	Rural	1259	3.77	1052	14.56	3.87
Primary	Night	Urban	279	0.83	302	4.18	5.02
Other	Day	Rural	951	2.84	266	3.68	1.30
Other	Day	Urban	1496	4.47	243	3.36	0.75
Other	Night	Rural	73	0.22	81	1.12	5.12
Other	Night	Urban	99	0.30	106	1.47	4.97
TOTAL			33450	100.00	7223	100.00	1.00

TABLE 25
Normalized Fatal Accident Involvement Rates by 12 Travel Categories for Tractors With 1 Trailer NTTIS and 1982–84 TIFA Files

Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
Limited	Day	Rural	9722	29.06%	790	8.20%	0.28
Limited	Day	Urban	5228	15.63	665	6.91	0.44
Limited	Night	Rural	3169	9.47	830	8.62	0.91
Limited	Night	Urban	1374	4.11	495	5.14	1.25
Primary	Day	Rural	7596	22.71	3368	34.97	1.54
Primary	Day	Urban	2204	6.59	694	7.21	1.09
Primary	Night	Rural	1259	3.77	1417	14.71	3.91
Primary	Night	Urban	279	0.83	345	3.58	4.30
Other	Day	Rural	951	2.84	395	4.10	1.44
Other	Day	Urban	1496	4.47	396	4.11	0.92
Other	Night	Rural	73	0.22	109	1.13	5.17
Other	Night	Urban	99	0.30	126	1.31	4.43
TOTAL			33450	100.00	9630	100.00	1.00

TABLE 26
Normalized Fatal Accident Involvement Rates by 4 Accident Types for 5 Truck Types or Configurations NTTIS and 1980–84 TIFA Files

Truck Type or Configuration/ Accident Type	10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
STRAIGHT TRUCK ALONE					
Multi-Vehicle	16679	30.02%	3921	22.21%	0.74
Rollover	16679	30.02	297	21.37	0.71
Pedestrian/Bicyclist	16679	30.02	678	31.20	1.04
Other Single Vehicle	16679	30.02	613	21.93	0.73
SUBTOTAL	16679	30.02	5509	22.95	0.76
STRAIGHT TRUCK & TRAILERS					
Multi-Vehicle	1226	2.21%	459	2.60%	1.18
Rollover	1226	2.21	32	2.30	1.04
Pedestrian/Bicylist	1226	2.21	44	2.02	0.92
Other Single Vehicle	1226	2.21	50	1.79	0.81
SUBTOTAL	1226	2.21	585	2.44	1.10
TRACTOR ALONE (BOBTAIL)					
Multi-Vehicle	602	1.08%	405	2.29%	2.12
Rollover	602	1.08	45	3.24	2.99
Pedestrian/Bicyclist	602	1.08	57	2.62	2.42
Other Single Vehicle	602	1.08	112	4.01	3.70
SUBTOTAL	602	1.08	619	2.58	2.38
TRACTOR AND 1 TRAILER					
Multi-Vehicle	35009	63.01%	12283	69.59%	1.10
Rollover	35009	63.01	972	69.93	1.11
Pedestrian/Bicyclist	35009	63.01	1304	60.01	0.95
Other Single Vehicle	35009	63.01	1907	68.23	1.08
SUBTOTAL	35009	63.01	16466	68.58	1.09
TRACTOR AND 2–3 TRAILERS					
Multi-Vehicle	2041	3.67%	583	3.30%	0.90
Rollover	2041	3.67	44	3.17	0.86
Pedestrian/Bicyclist	2041	3.67	90	4.14	1.13
Other Single Vehicle	2041	3.67	113	4.04	1.10
SUBTOTAL	2041	3.67	830	3.46	0.94
GRAND TOTAL	55558	100.00%	24009	100.00%	1.00

TABLE 27
Normalized Fatal Multi-Vehicle Accident Involvement Rates by 8 Travel Categories for 5 Truck Types or Configurations NTTIS and 1980–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
STRAIGHT	**TRUCK**	**ALONE**					
Limited	Day	Rural	897	1.74%	94	0.54%	0.31
Limited	Day	Urban	1851	3.58	181	1.04	0.29
Limited	Night	Rural	79	0.15	35	0.20	1.32
Limited	Night	Urban	52	0.10	61	0.35	3.49
Other	Day	Rural	6311	12.20	2124	12.18	1.00
Other	Day	Urban	5212	10.08	1024	5.87	0.58
Other	Night	Rural	133	0.26	222	1.27	4.94
Other	Night	Urban	145	0.28	133	0.76	2.72
SUBTOTAL			14680	28.39	3874	22.22	0.78
STRAIGHT	**TRUCK**	**& TRAILERS**					
Limited	Day	Rural	116	0.22%	18	0.10%	0.46
Limited	Day	Urban	159	0.31	24	0.14	0.45
Limited	Night	Rural	26	0.05	13	0.07	1.49
Limited	Night	Urban	18	0.04	9	0.05	1.47
Other	Day	Rural	351	0.68	231	1.32	1.95
Other	Day	Urban	282	0.55	79	0.45	0.83
Other	Night	Rural	32	0.06	64	0.37	5.89
Other	Night	Urban	6	0.01	16	0.09	7.65
SUBTOTAL			990	1.91	454	2.60	1.36
TRACTOR	**ALONE**	**(BOBTAIL)**					
Limited	Day	Rural	147	0.28%	16	0.09%	0.32
Limited	Day	Urban	124	0.24	22	0.13	0.53
Limited	Night	Rural	26	0.05	7	0.04	0.79
Limited	Night	Urban	10	0.02	15	0.09	4.49
Other	Day	Rural	168	0.32	168	0.96	2.97
Other	Day	Urban	91	0.18	87	0.50	2.83
Other	Night	Rural	14	0.03	38	0.22	8.35
Other	Night	Urban	7	0.01	46	0.26	20.52
SUBTOTAL			587	1.13	399	2.29	2.02
TRACTOR	**AND 1**	**TRAILER**					
Limited	Day	Rural	9722	18.80%	854	4.90%	0.26
Limited	Day	Urban	5228	10.11	678	3.89	0.38
Limited	Night	Rural	3169	6.13	866	4.97	0.81
Limited	Night	Urban	1374	2.66	469	2.69	1.01
Other	Day	Rural	8548	16.53	5006	28.71	1.74
Other	Day	Urban	3700	7.15	1447	8.30	1.16
Other	Night	Rural	1333	2.58	2039	11.69	4.54
Other	Night	Urban	378	0.73	768	4.40	6.03
SUBTOTAL			33450	64.68	12127	69.55	1.08

TABLE 27 Continued

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
TRACTOR	**AND 2+**	**TRAILERS**					
Limited	Day	Rural	570	1.10%	40	0.23%	0.21
Limited	Day	Urban	364	0.70	38	0.22	0.31
Limited	Night	Rural	316	0.61	57	0.33	0.54
Limited	Night	Urban	205	0.40	31	0.18	0.45
Other	Day	Rural	239	0.46	213	1.22	2.64
Other	Day	Urban	148	0.29	53	0.30	1.06
Other	Night	Rural	127	0.25	113	0.65	2.64
Other	Night	Urban	39	0.08	38	0.22	2.87
SUBTOTAL			2007	3.88	583	3.34	0.86
TOTAL			51714	100.00%	17437	100.00%	1.00

TABLE 28
Normalized Fatal Rollover Accident Involvement Rates by 8 Travel Categories for 5 Truck Types or Configurations NTTIS and 1980–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
STRAIGHT	**TRUCK**	**ALONE**					
Limited	Day	Rural	897	1.74%	14	1.02%	0.59
Limited	Day	Urban	1851	3.58	12	0.88	0.24
Limited	Night	Rural	79	0.15	12	0.88	5.75
Limited	Night	Urban	52	0.10	2	0.15	1.45
Other	Day	Rural	6311	12.20	192	14.00	1.15
Other	Day	Urban	5212	10.08	25	1.82	0.18
Other	Night	Rural	133	0.26	35	2.55	9.90
Other	Night	Urban	145	0.28	1	0.07	0.26
SUBTOTAL			14680	28.39	293	21.37	0.75
STRAIGHT	**TRUCK**	**& TRAILERS**					
Limited	Day	Rural	116	0.22%	5	0.36%	1.63
Limited	Day	Urban	159	0.31	2	0.15	0.47
Limited	Night	Rural	26	0.05	0	0.00	–
Limited	Night	Urban	18	0.04	0	0.00	–
Other	Day	Rural	351	0.68	16	1.17	1.72
Other	Day	Urban	282	0.55	3	0.22	0.40
Other	Night	Rural	32	0.06	5	0.36	5.85
Other	Night	Urban	6	0.01	0	0.00	–
SUBTOTAL			990	1.91	31	2.26	1.18
TRACTOR	**ALONE**	**(BOBTAIL)**					
Limited	Day	Rural	147	0.28%	6	0.44%	1.54
Limited	Day	Urban	124	0.24	7	0.51	2.13
Limited	Night	Rural	26	0.05	5	0.36	7.13
Limited	Night	Urban	10	0.02	0	0.00	–
Other	Day	Rural	168	0.32	19	1.39	4.27
Other	Day	Urban	91	0.18	1	0.07	0.41
Other	Night	Rural	14	0.03	6	0.44	16.76
Other	Night	Urban	7	0.01	1	0.07	5.67
SUBTOTAL			587	1.13	45	3.28	2.89
TRACTOR	**AND 1**	**TRAILER**					
Limited	Day	Rural	9722	18.80%	111	8.10%	0.43
Limited	Day	Urban	5228	10.11	45	3.28	0.32
Limited	Night	Rural	3169	6.13	97	7.08	1.15
Limited	Night	Urban	1374	2.66	51	3.72	1.40
Other	Day	Rural	8548	16.53	423	30.85	1.87
Other	Day	Urban	3700	7.15	23	1.68	0.23
Other	Night	Rural	1333	2.58	197	14.37	5.58
Other	Night	Urban	378	0.73	11	0.80	1.10
SUBTOTAL			33450	64.68	958	69.88	1.08

TABLE 28 Continued

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
TRACTOR	**AND 2+**	**TRAILERS**					
Limited	Day	Rural	570	1.10%	4	0.29%	0.26
Limited	Day	Urban	364	0.70	3	0.22	0.31
Limited	Night	Rural	316	0.61	11	0.80	1.31
Limited	Night	Urban	205	0.40	2	0.15	0.37
Other	Day	Rural	239	0.46	10	0.73	1.58
Other	Day	Urban	148	0.29	3	0.22	0.76
Other	Night	Rural	127	0.25	11	0.80	3.27
Other	Night	Urban	39	0.08	0	0.00	—
SUBTOTAL			2007	3.88	44	3.21	0.83
TOTAL			51714	100.00%	1371	100.00%	1.00

TABLE 29
Normalized Fatal Pedestrian/Bicyclist Accident Involvement Rates by 8 Travel Categories for 5 Truck Types or Configurations NTTIS and 1980-84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
STRAIGHT	**TRUCK**	**ALONE**					
Limited	Day	Rural	897	1.74%	9	0.42%	0.24
Limited	Day	Urban	1851	3.58	32	1.50	0.42
Limited	Night	Rural	79	0.15	4	0.19	1.23
Limited	Night	Urban	52	0.10	9	0.42	4.20
Other	Day	Rural	6311	12.20	152	7.11	0.58
Other	Day	Urban	5212	10.08	390	18.25	1.81
Other	Night	Rural	133	0.26	30	1.40	5.44
Other	Night	Urban	145	0.28	31	1.45	5.17
SUBTOTAL			14680	28.39	657	30.74	1.08
STRAIGHT	**TRUCK**	**& TRAILERS**					
Limited	Day	Rural	116	0.22%	1	0.05%	0.21
Limited	Day	Urban	159	0.31	2	0.09	0.30
Limited	Night	Rural	26	0.05	1	0.05	0.94
Limited	Night	Urban	18	0.04	2	0.09	2.67
Other	Day	Rural	351	0.68	15	0.70	1.03
Other	Day	Urban	282	0.55	13	0.61	1.11
Other	Night	Rural	32	0.06	4	0.19	3.00
Other	Night	Urban	6	0.01	5	0.23	19.52
SUBTOTAL			990	1.91	43	2.01	1.05
TRACTOR	**ALONE**	**(BOBTAIL)**					
Limited	Day	Rural	147	0.28%	3	0.14%	0.49
Limited	Day	Urban	124	0.24	3	0.14	0.58
Limited	Night	Rural	26	0.05	1	0.05	0.92
Limited	Night	Urban	10	0.02	4	0.19	9.77
Other	Day	Rural	168	0.32	9	0.42	1.30
Other	Day	Urban	91	0.18	23	1.08	6.11
Other	Night	Rural	14	0.03	6	0.28	10.75
Other	Night	Urban	7	0.01	7	0.33	25.48
SUBTOTAL			587	1.13	56	2.62	2.31
TRACTOR	**AND 1**	**TRAILER**					
Limited	Day	Rural	9722	18.80%	96	4.49%	0.24
Limited	Day	Urban	5228	10.11	97	4.54	0.45
Limited	Night	Rural	3169	6.13	147	6.88	1.12
Limited	Night	Urban	1374	2.66	129	6.04	2.27
Other	Day	Rural	8548	16.53	223	10.44	0.63
Other	Day	Urban	3700	7.15	344	16.10	2.25
Other	Night	Rural	1333	2.58	192	8.98	3.49
Other	Night	Urban	378	0.73	63	2.95	4.04
SUBTOTAL			33450	64.68	1291	60.41	0.93

TABLE 29 Continued

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
TRACTOR	**AND 2+**	**TRAILERS**					
Limited	Day	Rural	570	1.10%	6	0.28%	0.25
Limited	Day	Urban	364	0.70	9	0.42	0.60
Limited	Night	Rural	316	0.61	11	0.51	0.84
Limited	Night	Urban	205	0.40	14	0.66	1.66
Other	Day	Rural	239	0.46	12	0.56	1.21
Other	Day	Urban	148	0.29	19	0.89	3.10
Other	Night	Rural	127	0.25	14	0.66	2.67
Other	Night	Urban	39	0.08	5	0.23	3.09
SUBTOTAL			2007	3.88	90	4.21	1.09
TOTAL			51714	100.00%	2137	100.00%	1.00

TABLE 30
Normalized Fatal Other Single Vehicle Accident Involvement Rates by 8 Travel Categories for 5 Truck Types or Configurations NTTIS and 1980–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
STRAIGHT	**TRUCK**	**ALONE**					
Limited	Day	Rural	897	1.74%	9	0.42%	0.24
Limited	Day	Urban	1851	3.58	32	1.50	0.42
Limited	Night	Rural	79	0.15	4	0.19	1.23
Limited	Night	Urban	52	0.10	9	0.42	4.20
Other	Day	Rural	6311	12.20	152	7.11	0.58
Other	Day	Urban	5212	10.08	390	18.25	1.81
Other	Night	Rural	133	0.26	30	1.40	5.44
Other	Night	Urban	145	0.28	31	1.45	5.17
SUBTOTAL			14680	28.39	657	30.74	1.08
STRAIGHT	**TRUCK**	**& TRAILERS**					
Limited	Day	Rural	116	0.22%	1	0.05%	0.21
Limited	Day	Urban	159	0.31	2	0.09	0.30
Limited	Night	Rural	26	0.05	1	0.05	0.94
Limited	Night	Urban	18	0.04	2	0.09	2.67
Other	Day	Rural	351	0.68	15	0.70	1.03
Other	Day	Urban	282	0.55	13	0.61	1.11
Other	Night	Rural	32	0.06	4	0.19	3.00
Other	Night	Urban	6	0.01	5	0.23	19.52
SUBTOTAL			990	1.91	43	2.01	1.05
TRACTOR	**ALONE**	**(BOBTAIL)**					
Limited	Day	Rural	147	0.28%	3	0.14%	0.49
Limited	Day	Urban	124	0.24	3	0.14	0.58
Limited	Night	Rural	26	0.05	1	0.05	0.92
Limited	Night	Urban	10	0.02	4	0.19	9.77
Other	Day	Rural	168	0.32	9	0.42	1.30
Other	Day	Urban	91	0.18	23	1.08	6.11
Other	Night	Rural	14	0.03	6	0.28	10.75
Other	Night	Urban	7	0.01	7	0.33	25.48
SUBTOTAL			587	1.13	56	2.62	2.31
TRACTOR	**AND 1**	**TRAILER**					
Limited	Day	Rural	9722	18.80%	96	4.49%	0.24
Limited	Day	Urban	5228	10.11	97	4.54	0.45
Limited	Night	Rural	3169	6.13	147	6.88	1.12
Limited	Night	Urban	1374	2.66	129	6.04	2.27
Other	Day	Rural	8548	16.53	223	10.44	0.63
Other	Day	Urban	3700	7.15	344	16.10	2.25
Other	Night	Rural	1333	2.58	192	8.98	3.49
Other	Night	Urban	378	0.73	63	2.95	4.04
SUBTOTAL			33450	64.68	1291	60.41	0.93

TABLE 30 Continued

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
TRACTOR	**AND 2+**	**TRAILERS**					
Limited	Day	Rural	570	1.10%	6	0.28%	0.25
Limited	Day	Urban	364	0.70	9	0.42	0.60
Limited	Night	Rural	316	0.61	11	0.51	0.84
Limited	Night	Urban	205	0.40	14	0.66	1.66
Other	Day	Rural	239	0.46	12	0.56	1.21
Other	Day	Urban	148	0.29	19	0.89	3.10
Other	Night	Rural	127	0.25	14	0.66	2.67
Other	Night	Urban	39	0.08	5	0.23	3.09
SUBTOTAL			2007	3.88	90	4.21	1.09
TOTAL			51714	100.00%	2137	100.00%	1.00

TABLE 31
Normalized Fatal Accident Involvement Rates by Gross Combination Weight All Tractor and Semi-Trailers NTTIS and 80–84 TIFA Files

GCW	Travel		Involvements		Norm. Rate
	10^8 VMT	Column Percent	Involv.	Column Percent	
10K-15K	0.5	0.1%	21	0.2%	1.06
15K-20K	2.3	0.7	107	0.8	1.06
20K-25K	19.4	6.1	692	5.0	0.81
25K-30K	61.0	19.3	2,425	17.4	0.90
30K-35K	27.5	8.7	984	7.1	0.81
35K-40K	19.4	6.1	581	4.2	0.68
40K-45K	14.7	4.6	489	3.5	0.76
45K-50K	16.5	5.2	551	4.0	0.76
50K-55K	9.4	3.0	472	3.4	1.14
55K-60K	13.0	4.1	595	4.3	1.04
60K-65K	12.6	4.0	629	4.5	1.13
65K-70K	22.4	7.1	1,523	11.0	1.55
70K-75K	43.7	13.8	2,483	17.8	1.29
75K-80K	43.7	13.8	2,005	14.4	1.04
80K+	10.3	3.3	379	2.7	0.84
Total	316.3	100.0%	13,936	100.0%	1.00

Excludes Pedestrian/Bicycle Involvements

TABLE 32
Normalized Fatal Accident Involvement Rates by Gross Combination Weight Tractor and Semi-Trailer With No Cargo NTTIS and 80–84 TIFA Files

GCW	Travel		Involvements		Norm. Rate	Rate Norm. to all Trac/Semi
	10^8 VMT	Column Percent	Involv.	Column Percent		
10K-15K	0.5	0.5%	17	0.5%	0.99	0.86
15K-20K	1.8	1.9	79	2.2	1.17	1.01
20K-25K	16.5	17.6	566	15.8	0.90	0.78
25K-30K	53.3	56.8	2,154	60.1	1.06	0.92
30K-35K	17.6	18.7	599	16.7	0.89	0.77
35K+	4.3	4.6	169	4.7	1.04	0.90
Total	93.9	100.0%	3,584	100.0%	1.00	0.87

Excludes Pedestrian/Bicycle Involvements

TABLE 33
Normalized Fatal Accident Involvement Rates by Gross Combination Weight Tractor and Semi-Trailer with Cargo NTTIS and 80–84 TIFA Files

GCW	Travel		Involvements		Norm. Rate	Rate Norm. to all Trac/Semi.
	10^8 VMT	Column Percent	Involv.	Column Percent		
15K-20K	0.5	0.2%	32	0.3%	1.16	1.22
20K-25K	2.9	1.3	126	1.2	0.93	0.99
25K-30K	7.7	3.4	271	2.6	0.76	0.80
30K-35K	9.9	4.5	385	3.7	0.83	0.88
35K-40K	16.2	7.3	481	4.7	0.64	0.67
40K-45K	14.2	6.4	464	4.5	0.70	0.74
45K-50K	16.3	7.3	534	5.2	0.70	0.74
50K-55K	9.4	4.2	467	4.5	1.07	1.13
55K-60K	13.0	5.8	590	5.7	0.98	1.03
60K-65K	12.6	5.7	625	6.0	1.07	1.13
65K-70K	22.4	10.1	1,518	14.7	1.46	1.54
70K-75K	43.6	19.6	2,481	24.0	1.22	1.29
75K-80K	43.7	19.6	2,000	19.3	0.98	1.04
80K+	10.1	4.5	379	3.7	0.80	0.85
Total	222.4	100.0%	10,352	100.0%	1.00	1.06

Excludes Pedestrian/Bicycle Involvements

TABLE 34
Normalized Fatal Accident Involvement Rates by 8 Travel Categories Tractor and Van Semi-Trailer with Cargo NTTIS and 82–84 TIFA Files

Travel Category	Travel		Involvements		Norm. Rate
	10^8 VMT	Column Percent	Involv.	Column Percent	
Limited Day Rural	44.7	33.8%	377	12.7%	0.38
Limited Day Urban	21.9	16.6	247	8.3	0.50
Limited Nite Rural	19.0	14.4	371	12.5	0.87
Limited Nite Urban	8.4	6.4	192	6.5	1.02
Other Day Rural	16.1	12.2	895	30.1	2.5
Other Day Urban	14.3	10.8	283	9.5	0.88
Other Nite Rural	5.9	4.5	448	15.1	3.38
Other Nite Urban	2.0	1.5	163	5.5	3.69
Total	132.4	100.0%	2,976	100.0%	1.00

Excludes Pedestrian/Bicycle Involvements

TABLE 35
Normalized Fatal Accident Involvement Rates by 8 Travel Categories Tractor and Van Semi-Trailer with No Cargo NTTIS and 82–84 TIFA Files

Travel Category	Travel		Involvements		Norm. Rate
	10^8 VMT	Column Percent	Involv.	Column Percent	
Limited Day Rural	10.2	31.3%	59	7.8%	0.25
Limited Day Urban	7.1	21.7	73	9.6	0.44
Limited Nite Rural	2.2	6.8	41	5.4	0.80
Limited Nite Urban	1.1	3.4	23	3.0	0.89
Other Day Rural	7.7	23.6	337	44.3	1.88
Other Day Urban	3.3	10.1	111	14.6	1.45
Other Nite Rural	0.8	2.5	91	12.0	4.85
Other Nite Urban	0.2	0.7	25	3.3	4.46
Total	32.6	100.0%	760	100.0%	1.00

Excludes Pedestrian/Bicycle Involvements

TABLE 36
Normalized Fatal Accident Involvement Rates by 8 Travel Categories Tractor and Non-Van Semi-Trailer with Cargo NTTIS and 82–84 TIFA Files

Travel Category	Travel		Involvements		Norm. Rate
	10^8 VMT	Column Percent	Involv.	Column Percent	
Limited Day Rural	24.4	27.1%	215	6.8%	0.25
Limited Day Urban	12.0	13.3	193	6.1	0.46
Limited Nite Rural	7.4	8.2	199	6.3	0.77
Limited Nite Urban	2.9	3.3	125	4.0	1.21
Other Day Rural	30.0	33.3	1,492	47.3	1.42
Other Day Urban	8.6	9.5	295	9.4	0.98
Other Nite Rural	3.9	4.4	497	15.8	3.60
Other Nite Urban	0.9	1.0	137	4.4	4.39
Total	90.1	100.0%	3,153	100.0%	1.00

Excludes Pedestrian/Bicycle Involvements

TABLE 37
Normalized Fatal Accident Involvement Rates by 8 Travel Categories Tractor and Non-Van Semi-Trailer with No Cargo NTTIS and 82–84 TIFA Files

Travel Category	Travel		Involvements		Norm. Rate
	10^8 VMT	Column Percent	Involv.	Column Percent	
Limited Day Rural	14.4	23.5%	63	4.4%	0.19
Limited Day Urban	8.6	14.1	68	4.7	0.34
Limited Nite Rural	1.8	2.9	38	2.6	0.91
Limited Nite Urban	0.7	1.2	26	1.8	1.54
Other Day Rural	26.2	42.8	827	57.5	1.34
Other Day Urban	7.0	11.5	180	12.5	1.09
Other Nite Rural	2.1	3.4	186	12.9	3.86
Other Nite Urban	0.4	0.7	50	3.5	5.19
Total	61.3	100.0%	1,438	100.0%	1.00

Excludes Pedestrian/Bicycle Involvements

TABLE 38
Normalized Fatal Accident Involvement Rates by Body Style and Cargo for 4 Accident Types All Tractor and Semi-Trailers NTTIS and 80-84 TIFA Files

Body Style/ Cargo or Not	Travel		Involvements		Norm. Rate
	10^8 VMT	Column Percent	Involv.	Column Percent	
Jackknife					
Van with Cargo	132.4	41.8%	305	36.2%	0.86
Van, No Cargo	32.6	10.3	126	15.0	1.45
Non-Van with Cargo	90.1	28.4	225	26.7	0.94
Non-Van, No Cargo	61.3	19.4	187	22.2	1.14
Total	316.3	100.0%	843	100.0%	1.00
Rollover					
Van with Cargo	132.4	41.8%	303	32.1%	0.77
Van, No Cargo	32.6	10.3	14	1.5	0.14
Non-Van with Cargo	90.1	28.4	597	63.2	2.22
Non-Van, No Cargo	61.3	19.4	31	3.3	0.17
Total	316.3	100.0%	945	100.0%	1.00
All Single Vehicle(except Pedestrian/Bicycle)					
Van with Cargo	132.4	41.8%	1,072	38.9%	0.93
Van, No Cargo	32.6	10.3	177	6.4	0.62
Non-Van with Cargo	90.1	28.4	1,281	46.5	1.63
Non-Van, No Cargo	61.3	19.4	225	8.2	0.42
Total	316.3	100.0%	2,755	100.0%	1.00
Multiple Vehicle					
Van with Cargo	132.4	41.8%	4,252	36.6%	0.87
Van, No Cargo	32.6	10.3	1,062	9.1	0.89
Non-Van with Cargo	90.1	28.4	4,210	36.2	1.27
Non-Van, No Cargo	61.3	19.4	2,105	18.1	0.93
Total	316.3	100.0%	11,629	100.0%	1.00

TABLE 39
Normalized Fatal Accident Involvement Rates by Body Style and Cargo—Tractor and Semi-Trailer NTTIS and 80-84 TIFA Files

Body Style/ Cargo or Not	Travel		Involvements		Norm. Rate
	10^8 VMT	Column Percent	Involv.	Column Percent	
Van with Cargo	132.4	41.8%	5,334	37.0%	0.88
Van, No Cargo	32.6	10.3	1,241	8.6	0.84
Non-Van with Cargo	90.1	28.4	5,503	38.2	1.34
Non-Van, No Cargo	61.3	19.4	2,334	16.2	0.84
Total	316.3	100.0%	14,412	100.0%	1.00

Excludes Pedestrian/Bicycle Involvements

TABLE 40
Normalized Fatal Accident Involvement Rates by Travel Category and Gross Combination Weight for Tractors and Van Semi-Trailers with Cargo NTTIS and 80–84 TIFA Files

Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
15,000 – 35,000 pounds GCW							
Limited	Day	Rural	241	1.82%	16	0.57%	0.32
Limited	Day	Urban	326	2.46	25	0.90	0.36
Limited	Nite	Rural	167	1.26	15	0.54	0.42
Limited	Nite	Urban	76	0.57	17	0.61	1.07
Other	Day	Rural	297	2.24	129	4.62	2.06
Other	Day	Urban	646	4.88	73	2.61	0.54
Other	Nite	Rural	63	0.47	38	1.36	2.87
Other	Nite	Urban	30	0.22	16	0.57	2.56
SUBTOTAL			1844	13.93	329	11.78	0.85
35,000 – 50,000 pounds GCW							
Limited	Day	Rural	1166	8.81%	64	2.29%	0.26
Limited	Day	Urban	703	5.31	45	1.61	0.30
Limited	Nite	Rural	573	4.33	73	2.61	0.60
Limited	Nite	Urban	283	2.14	31	1.11	0.52
Other	Day	Rural	519	3.92	194	6.95	1.77
Other	Day	Urban	486	3.67	63	2.26	0.61
Other	Nite	Rural	174	1.32	98	3.51	2.66
Other	Nite	Urban	67	0.51	41	1.47	2.90
SUBTOTAL			3971	30.01	609	21.81	0.73
50,000 – 65,000 pounds GCW							
Limited	Day	Rural	826	6.24%	84	3.01%	0.48
Limited	Day	Urban	416	3.14	55	1.97	0.63
Limited	Nite	Rural	387	2.93	68	2.44	0.83
Limited	Nite	Urban	178	1.35	46	1.65	1.22
Other	Day	Rural	284	2.15	147	5.27	2.45
Other	Day	Urban	149	1.12	39	1.40	1.24
Other	Nite	Rural	174	1.32	83	2.97	2.26
Other	Nite	Urban	54	0.41	32	1.15	2.80
SUBTOTAL			2469	18.65	554	19.84	1.06

TABLE 40 Continued

Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
65,000 pounds and Over GCW							
Limited	Day	Rural	2237	16.90%	194	6.95%	0.41
Limited	Day	Urban	748	5.65	101	3.62	0.64
Limited	Nite	Rural	776	5.86	185	6.63	1.13
Limited	Nite	Urban	304	2.30	90	3.22	1.40
Other	Day	Rural	512	3.87	384	13.75	3.56
Other	Day	Urban	151	1.14	83	2.97	2.61
Other	Nite	Rural	177	1.34	198	7.09	5.29
Other	Nite	Urban	45	0.34	65	2.33	6.78
SUBTOTAL			4950	37.4	1300	46.56	1.24
GRAND TOTAL			13234	100.00%	2792	100.00%	1.00

Excludes Pedestrian/Bicycle Involvements

TABLE 41
Normalized Fatal Accident Involvement Rates by 12 Travel Categories for Single-Unit and Combination Vehicles NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
SINGLE-UNIT	**VEHICLE**						
Limited	Day	Rural	1044	2.02%	103	0.73%	0.36
Limited	Day	Urban	1975	3.82	206	1.47	0.38
Limited	Night	Rural	105	0.20	44	0.31	1.54
Limited	Night	Urban	62	0.12	71	0.51	4.24
Primary	Day	Rural	4030	7.79	1269	9.05	1.16
Primary	Day	Urban	2183	4.22	409	2.92	0.69
Primary	Night	Rural	127	0.24	195	1.39	5.68
Primary	Night	Urban	69	0.13	60	0.43	3.22
Other	Day	Rural	2449	4.74	476	3.39	0.72
Other	Day	Urban	3120	6.03	586	4.18	0.69
Other	Night	Rural	20	0.04	51	0.36	9.23
Other	Night	Urban	83	0.16	73	0.52	3.24
SUBTOTAL			15267	29.52	3543	25.26	0.86
COMBINATION	**VEHICLE**						
Limited	Day	Rural	10407	20.12%	856	6.10%	0.30
Limited	Day	Urban	5751	11.12	721	5.14	0.46
Limited	Night	Rural	3511	6.79	892	6.36	0.94
Limited	Night	Urban	1596	3.09	538	3.84	1.24
Primary	Day	Rural	8048	15.56	3615	25.77	1.66
Primary	Day	Urban	2372	4.59	747	5.33	1.16
Primary	Night	Rural	1415	2.74	1525	10.87	3.97
Primary	Night	Urban	308	0.60	371	2.64	4.44
Other	Day	Rural	1089	2.11	484	3.45	1.64
Other	Day	Urban	1759	3.40	463	3.30	0.97
Other	Night	Rural	77	0.15	128	0.91	6.15
Other	Night	Urban	115	0.22	147	1.05	4.70
SUBTOTAL			36447	70.48	10487	74.76	1.06
GRAND TOTAL			51714	100.00%	14030	100.00%	1.00

TABLE 42
Normalized Fatal Multi-Vehicle Accident Involvement Rates by 12 Travel Categories for Single-Unit and Combination Vehicles NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
SINGLE-UNIT	**VEHICLE**						
Limited	Day	Rural	1044	2.02%	66	0.64%	0.31
Limited	Day	Urban	1975	3.82	141	1.36	0.36
Limited	Night	Rural	105	0.20	20	0.19	0.95
Limited	Night	Urban	62	0.12	51	0.49	4.11
Primary	Day	Rural	4030	7.79	1049	10.10	1.30
Primary	Day	Urban	2183	4.22	331	3.19	0.76
Primary	Night	Rural	127	0.24	136	1.31	5.35
Primary	Night	Urban	69	0.13	46	0.44	3.34
Other	Day	Rural	2449	4.74	292	2.81	0.59
Other	Day	Urban	3120	6.03	333	3.21	0.53
Other	Night	Rural	20	0.04	16	0.15	3.91
Other	Night	Urban	83	0.16	49	0.47	2.94
SUBTOTAL			15267	29.52	2530	24.36	0.83
COMBINATION	**VEHICLE**						
Limited	Day	Rural	10407	20.12%	548	5.28%	0.26
Limited	Day	Urban	5751	11.12	496	4.78	0.43
Limited	Night	Rural	3511	6.79	555	5.34	0.79
Limited	Night	Urban	1596	3.09	331	3.19	1.03
Primary	Day	Rural	8048	15.56	3008	28.96	1.86
Primary	Day	Urban	2372	4.59	619	5.96	1.30
Primary	Night	Rural	1415	2.74	1127	10.85	3.97
Primary	Night	Urban	308	0.60	322	3.10	5.21
Other	Day	Rural	1089	2.11	338	3.25	1.55
Other	Day	Urban	1759	3.40	292	2.81	0.83
Other	Night	Rural	77	0.15	96	0.92	6.23
Other	Night	Urban	115	0.22	123	1.18	5.32
SUBTOTAL			36447	70.48	7855	75.64	1.07
GRAND TOTAL			51714	100.00%	10385	100.00%	1.00

TABLE 43
Normalized Fatal Rollover Accident Involvement Rates by 12 Travel Categories for Single-Unit and Combination Vehicles NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
SINGLE-UNIT	**VEHICLE**						
Limited	Day	Rural	1044	2.02%	7	0.92%	0.45
Limited	Day	Urban	1975	3.82	11	1.44	0.38
Limited	Night	Rural	105	0.20	9	1.18	5.80
Limited	Night	Urban	62	0.12	2	0.26	2.19
Primary	Day	Rural	4030	7.79	69	9.04	1.16
Primary	Day	Urban	2183	4.22	4	0.52	0.12
Primary	Night	Rural	127	0.24	17	2.23	9.11
Primary	Night	Urban	69	0.13	1	0.13	0.99
Other	Day	Rural	2449	4.74	48	6.29	1.33
Other	Day	Urban	3120	6.03	9	1.18	0.20
Other	Night	Rural	20	0.04	10	1.31	33.27
Other	Night	Urban	83	0.16	1	0.13	0.82
SUBTOTAL			15267	29.52	188	24.64	0.83
COMBINATION	**VEHICLE**						
Limited	Day	Rural	10407	20.12%	71	9.31%	0.46
Limited	Day	Urban	5751	11.12	25	3.28	0.29
Limited	Night	Rural	3511	6.79	53	6.95	1.02
Limited	Night	Urban	1596	3.09	34	4.46	1.44
Primary	Day	Rural	8048	15.56	200	26.21	1.68
Primary	Day	Urban	2372	4.59	9	1.18	0.26
Primary	Night	Rural	1415	2.74	117	15.33	5.60
Primary	Night	Urban	308	0.60	4	0.52	0.88
Other	Day	Rural	1089	2.11	46	6.03	2.86
Other	Day	Urban	1759	3.40	6	0.79	0.23
Other	Night	Rural	77	0.15	8	1.05	7.07
Other	Night	Urban	115	0.22	2	0.26	1.18
SUBTOTAL			36447	70.48	575	75.36	1.07
GRAND TOTAL			51714	100.00%	763	100.00%	1.00

TABLE 44
Normalized Fatal Pedestrian/Bicyclist Accident Involvement Rates by 12 Travel Categories for Single-Unit and Combination Vehicles NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
SINGLE-UNIT	**VEHICLE**						
Limited	Day	Rural	1044	2.02%	8	0.63%	0.31
Limited	Day	Urban	1975	3.82	21	1.64	0.43
Limited	Night	Rural	105	0.20	1	0.08	0.38
Limited	Night	Urban	62	0.12	7	0.55	4.59
Primary	Day	Rural	4030	7.79	41	3.21	0.41
Primary	Day	Urban	2183	4.22	60	4.70	1.11
Primary	Night	Rural	127	0.24	12	0.94	3.84
Primary	Night	Urban	69	0.13	7	0.55	4.13
Other	Day	Rural	2449	4.74	50	3.92	0.83
Other	Day	Urban	3120	6.03	198	15.51	2.57
Other	Night	Rural	20	0.04	7	0.55	13.91
Other	Night	Urban	83	0.16	10	0.78	4.87
SUBTOTAL			15267	29.52	422	33.05	1.12
COMBINATION	**VEHICLE**						
Limited	Day	Rural	10407	20.12%	68	5.32%	0.26
Limited	Day	Urban	5751	11.12	66	5.17	0.46
Limited	Night	Rural	3511	6.79	85	6.66	0.98
Limited	Night	Urban	1596	3.09	83	6.50	2.11
Primary	Day	Rural	8048	15.56	116	9.08	0.58
Primary	Day	Urban	2372	4.59	80	6.26	1.37
Primary	Night	Rural	1415	2.74	131	10.26	3.75
Primary	Night	Urban	308	0.60	27	2.11	3.55
Other	Day	Rural	1089	2.11	32	2.51	1.19
Other	Day	Urban	1759	3.40	142	11.12	3.27
Other	Night	Rural	77	0.15	10	0.78	5.28
Other	Night	Urban	115	0.22	15	1.17	5.27
SUBTOTAL			36447	70.48	855	66.95	0.95
GRAND TOTAL			51714	100.00%	1277	100.00%	1.00

TABLE 45
Normalized Fatal Other Single Vehicle Accident Involvement Rates by 12 Travel Categories for Single-Unit and Combination Vehicles NTTIS and 1982–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
SINGLE-UNIT	**VEHICLE**						
Limited	Day	Rural	1044	2.02%	22	1.37%	0.68
Limited	Day	Urban	1975	3.82	33	2.06	0.54
Limited	Night	Rural	105	0.20	14	0.87	4.30
Limited	Night	Urban	62	0.12	11	0.69	5.75
Primary	Day	Rural	4030	7.79	110	6.87	0.88
Primary	Day	Urban	2183	4.22	14	0.87	0.21
Primary	Night	Rural	127	0.24	30	1.87	7.65
Primary	Night	Urban	69	0.13	6	0.37	2.82
Other	Day	Rural	2449	4.74	86	5.37	1.13
Other	Day	Urban	3120	6.03	46	2.87	0.48
Other	Night	Rural	20	0.04	18	1.12	28.52
Other	Night	Urban	83	0.16	13	0.81	5.05
SUBTOTAL			15267	29.52	403	25.16	0.85
COMBINATION	**VEHICLE**						
Limited	Day	Rural	10407	20.12%	169	10.55%	0.52
Limited	Day	Urban	5751	11.12	134	8.36	0.75
Limited	Night	Rural	3511	6.79	199	12.42	1.83
Limited	Night	Urban	1596	3.09	90	5.62	1.82
Primary	Day	Rural	8048	15.56	290	18.10	1.16
Primary	Day	Urban	2372	4.59	38	2.37	0.52
Primary	Night	Rural	1415	2.74	149	9.30	3.40
Primary	Night	Urban	308	0.60	18	1.12	1.89
Other	Day	Rural	1089	2.11	68	4.24	2.02
Other	Day	Urban	1759	3.40	23	1.44	0.42
Other	Night	Rural	77	0.15	14	0.87	5.89
Other	Night	Urban	115	0.22	7	0.44	1.96
SUBTOTAL			36447	70.48	1199	74.84	1.06
GRAND TOTAL			51714	100.00%	1602	100.00%	1.00

TABLE 46
Normalized Fatal Accident Involvement Rates by 8 Travel Categories for Single-Unit and Combination Vehicles in Various Axle Configurations NTTIS and 1980–84 TIFA Files

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
SINGLE-UNIT	**VEHICLE**						
Axles = 2							
Limited	Day	Rural	626	1.22%	104	0.46%	0.38
Limited	Day	Urban	1275	2.48	184	0.81	0.33
Limited	Night	Rural	61	0.12	57	0.25	2.12
Limited	Night	Urban	30	0.06	66	0.29	4.94
Other	Day	Rural	4325	8.40	1606	7.05	0.84
Other	Day	Urban	3481	6.76	949	4.17	0.62
Other	Night	Rural	65	0.13	.228	1.00	7.89
Other	Night	Urban	98	0.19	134	0.59	3.09
SUBTOTAL			9963	19.35	3328	14.61	0.76
Axles = 3							
Limited	Day	Rural	390	0.76%	71	0.31%	0.41
Limited	Day	Urban	647	1.26	125	0.55	0.44
Limited	Night	Rural	44	0.09	25	0.11	1.28
Limited	Night	Urban	27	0.05	38	0.17	3.19
Other	Day	Rural	1844	3.58	1212	5.32	1.49
Other	Day	Urban	1593	3.10	641	2.81	0.91
Other	Night	Rural	68	0.13	155	0.68	5.13
Other	Night	Urban	45	0.09	115	0.50	5.76
SUBTOTAL			4658	9.05	2382	10.46	1.16
Axles = 4							
Limited	Day	Rural	28	0.05%	3	0.01%	0.25
Limited	Day	Urban	53	0.10	11	0.05	0.47
Limited	Night	Rural	0	0.00	2	0.01	24.57
Limited	Night	Urban	5	0.01	0	0.00	–
Other	Day	Rural	310	0.60	158	0.69	1.15
Other	Day	Urban	228	0.44	56	0.25	0.56
Other	Night	Rural	13	0.03	15	0.07	2.56
Other	Night	Urban	9	0.02	0	0.00	–
SUBTOTAL			646	1.25	245	1.08	0.86

TABLE 46 Continued

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
COMBINATION VEHICLE, 1 TRAILER							
Axles = 2,1							
Limited	Day	Rural	253	0.49%	17	0.07%	0.15
Limited	Day	Urban	279	0.54	19	0.08	0.15
Limited	Night	Rural	126	0.24	14	0.06	0.25
Limited	Night	Urban	56	0.11	9	0.04	0.36
Other	Day	Rural	276	0.54	146	0.64	1.20
Other	Day	Urban	597	1.16	91	0.40	0.34
Other	Night	Rural	58	0.11	51	0.22	1.99
Other	Night	Urban	15	0.03	22	0.10	3.23
SUBTOTAL			1660	3.22	369	1.62	0.50
Axles = 2,2							
Limited	Day	Rural	945	1.84%	87	0.38%	0.21
Limited	Day	Urban	798	1.55	117	0.51	0.33
Limited	Night	Rural	365	0.71	74	0.32	0.46
Limited	Night	Urban	197	0.38	61	0.27	0.70
Other	Day	Rural	757	1.47	516	2.27	1.54
Other	Day	Urban	858	1.67	259	1.14	0.68
Other	Night	Rural	143	0.28	205	0.90	3.25
Other	Night	Urban	60	0.12	83	0.36	3.13
SUBTOTAL			4123	8.01	1402	6.16	0.77
Axles = 2,3							
Limited	Day	Rural	44	0.08%	11	0.05%	0.57
Limited	Day	Urban	27	0.05	9	0.04	0.74
Limited	Night	Rural	10	0.02	9	0.04	2.04
Limited	Night	Urban	2	0.00	6	0.03	7.64
Other	Day	Rural	103	0.20	63	0.28	1.38
Other	Day	Urban	31	0.06	28	0.12	2.06
Other	Night	Rural	1	0.00	15	0.07	22.79
Other	Night	Urban	1	0.00	3	0.01	11.86
SUBTOTAL			219	0.42	144	0.63	1.49

TABLE 46 Continued

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
Axles = 3,2							
Limited	Day	Rural	8213	15.95%	1159	5.09%	0.32
Limited	Day	Urban	4087	7.94	830	3.64	0.46
Limited	Night	Rural	2590	5.03	1275	5.60	1.11
Limited	Night	Urban	1092	2.12	687	3.02	1.42
Other	Day	Rural	7114	13.82	5231	22.97	1.66
Other	Day	Urban	2291	4.45	1440	6.32	1.42
Other	Night	Rural	1098	2.13	2297	10.09	4.73
Other	Night	Urban	291	0.57	717	3.15	5.57
SUBTOTAL			26776	52.01	13636	59.88	1.15
Axles = 3 + ,1							
Limited	Day	Rural	69	0.13%	8	0.04%	0.26
Limited	Day	Urban	39	0.08	3	0.01	0.17
Limited	Night	Rural	24	0.05	5	0.02	0.47
Limited	Night	Urban	16	0.03	1	0.00	0.14
Other	Day	Rural	72	0.14	31	0.14	0.97
Other	Day	Urban	24	0.05	15	0.07	1.39
Other	Night	Rural	15	0.03	13	0.06	2.00
Other	Night	Urban	3	0.01	3	0.01	2.29
SUBTOTAL			262	0.51	79	0.35	0.68
Axles = 2,4 +	**or 3,3 +**	**or 4 + ,2 +**					
Limited	Day	Rural	279	0.54%	25	0.11%	0.20
Limited	Day	Urban	148	0.29	21	0.09	0.32
Limited	Night	Rural	61	0.12	14	0.06	0.52
Limited	Night	Urban	19	0.04	11	0.05	1.34
Other	Day	Rural	510	0.99	194	0.85	0.86
Other	Day	Urban	159	0.31	61	0.27	0.87
Other	Night	Rural	35	0.07	51	0.22	3.30
Other	Night	Urban	11	0.02	22	0.10	4.55
SUBTOTAL			1221	2.37	399	1.75	0.74

TABLE 46 Continued

Truck Type or Configuration/ Travel Category			10^6 VMT	Column Percent	Fatal Involve ments	Column Percent	Norm. Rate
COMBINATION VEHICLE, 2 TRAILERS							
Axles = 2,1,2							
Limited	Day	Rural	317	0.62%	51	0.22%	0.36
Limited	Day	Urban	227	0.44	47	0.21	0.47
Limited	Night	Rural	201	0.39	67	0.29	0.75
Limited	Night	Urban	144	0.28	42	0.18	0.66
Other	Day	Rural	116	0.23	170	0.75	3.31
Other	Day	Urban	89	0.17	52	0.23	1.32
Other	Night	Rural	113	0.22	109	0.48	2.18
Other	Night	Urban	34	0.07	30	0.13	1.98
SUBTOTAL			1241	2.41	568	2.49	1.04
Axles = Other							
Limited	Day	Rural	218	0.42%	22	0.10%	0.23
Limited	Day	Urban	120	0.23	11	0.05	0.21
Limited	Night	Rural	114	0.22	26	0.11	0.52
Limited	Night	Urban	60	0.12	12	0.05	0.45
Other	Day	Rural	123	0.24	78	0.34	1.44
Other	Day	Urban	59	0.12	25	0.11	0.95
Other	Night	Rural	13	0.03	37	0.16	6.30
Other	Night	Urban	5	0.01	11	0.05	5.31
SUBTOTAL			712	1.38	222	0.97	0.70
TOTAL			51479	100.00%	22774	100.00%	1.00

NOTE: In the travel data, missing data on the axle information reduces the total travel estimate from 51.7 billion to 51.5 billion. In the accident data, 316 involvements are missing on travel category, and 924 involvements are missing axle information.

TABLE 47
Normalized Fatal Accident Involvement Rates by Various Gross Weight Categories for Single-Unit and Combination Vehicles NTTIS and 1980–84 TIFA Files

Truck Type/Road Type/ Load Condition/ Gross Weight (1000s)	10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
SINGLE-UNIT VEHICLES ON LIMITED ACCESS ROADS					
Empty Under 10K GVW	284	0.58%	40	0.18%	0.32
Empty 10K-15K GVW	377	0.77	97	0.45	0.58
Empty 15K-20K GVW	452	0.92	91	0.42	0.45
Empty 20K-25K GVW	146	0.30	29	0.13	0.45
Empty 25K-30K GVW	125	0.26	14	0.06	0.25
Empty Over 30K GVW	39	0.08	13	0.06	0.75
Empty Subtotal	1422	2.91	284	1.31	0.45
Loaded Under 15K GVW	343	0.70	79	0.36	0.52
Loaded 15K-20K GVW	448	0.92	60	0.28	0.30
Loaded 20K-25K GVW	202	0.41	51	0.24	0.57
Loaded 25K-35K GVW	230	0.47	48	0.22	0.47
Loaded 35K-50K GVW	231	0.47	27	0.12	0.26
Loaded Over 50K GVW	142	0.29	37	0.17	0.59
Loaded Subtotal	1595	3.26	302	1.39	0.43
SUBTOTAL	3018	6.18	586	2.70	0.44
SINGLE-UNIT VEHICLES ON OTHER ROADS					
Empty Under 10K GVW	758	1.55%	343	1.58%	1.02
Empty 10K-15K GVW	1511	3.09	515	2.38	0.77
Empty 15K-20K GVW	810	1.66	515	2.38	1.43
Empty 20K-25K GVW	632	1.29	252	1.16	0.90
Empty 25K-30K GVW	373	0.76	183	0.84	1.11
Empty Over 30K GVW	168	0.34	125	0.58	1.68
Empty Subtotal	3711	7.59	1625	7.50	0.99
Loaded Under 15K GVW	1546	3.16	587	2.71	0.86
Loaded 15K-20K GVW	1427	2.92	478	2.21	0.76
Loaded 20K-25K GVW	1324	2.71	400	1.85	0.68
Loaded 25K-35K GVW	1083	2.22	498	2.30	1.04
Loaded 35K-50K GVW	869	1.78	431	1.99	1.12
Loaded Over 50K GVW	784	1.60	442	2.04	1.27
Loaded Subtotal	7573	15.50	3144	14.51	0.94
SUBTOTAL	11283	23.09	4769	22.01	0.95

TABLE 47 Continued

Truck Type/Road Type/ Load Condition/ Gross Weight (1000s)	10^6 VMT	Column Percent	Fatal Involvements	Column Percent	Norm. Rate
COMBINATION VEHICLES ON LIMITED ACCESS ROADS					
Empty Under 25K GCW	665	1.36%	115	0.53%	0.39
Empty 25K-30K GCW	2736	5.60	442	2.04	0.36
Empty 30K-35K GCW	1270	2.60	204	0.94	0.36
Empty Over 35K GCW	268	0.55	53	0.24	0.45
Empty Subtotal	4939	10.11	814	3.76	0.37
Loaded Under 35K GCW	946	1.94	207	0.96	0.49
Loaded 35K-50K GCW	3311	6.77	546	2.52	0.37
Loaded 50K-60K GCW	1773	3.63	425	1.96	0.54
Loaded 60K-65K GCW	979	2.00	281	1.30	0.65
Loaded 65K-70K GCW	1773	3.63	485	2.24	0.62
Loaded 70K-75K GCW	3145	6.44	949	4.38	0.68
Loaded 75K-80K GCW	2798	5.72	627	2.89	0.51
Loaded Over 80K GCW	746	1.53	226	1.04	0.68
Loaded Subtotal	15471	31.66	3746	17.28	0.55
SUBTOTAL	20410	41.77	4560	21.04	0.50
COMBINATION VEHICLES ON OTHER ROADS					
Empty Under 25K GCW	833	1.70%	478	2.21%	1.29
Empty 25K-30K GCW	2619	5.36	1891	8.73	1.63
Empty 30K-35K GCW	1236	2.53	865	3.99	1.58
Empty Over 35K GCW	416	0.85	220	1.02	1.19
Empty Subtotal	5104	10.45	3454	15.94	1.53
Loaded Under 35K GCW	1421	2.91	809	3.73	1.28
Loaded 35K-50K GCW	1699	3.48	1138	5.25	1.51
Loaded 50K-60K GCW	898	1.84	771	3.56	1.94
Loaded 60K-65K GCW	399	0.82	440	2.03	2.49
Loaded 65K-70K GCW	598	1.22	849	3.92	3.20
Loaded 70K-75K GCW	1261	2.58	1930	8.91	3.45
Loaded 75K-80K GCW	1867	3.82	1551	7.16	1.87
Loaded Over 80K GCW	909	1.86	815	3.76	2.02
Loaded Subtotal	9052	18.52	8303	38.31	2.07
SUBTOTAL	14156	28.97	11757	54.25	1.87
GRAND TOTAL	48867	100.00%	21672	100.00%	1.00

NOTE: In the travel data, additional missing data on GCW reduces the total travel estimate from 51.7 billion to 48.9 billion. In the accident data, 194 involvements are missing on road type and 2,148 are missing on GCW.