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State-Level Accident Rates of Surface Freight Transportation: A Reexamination

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State-Level Accident Rates of Surface Freight Transportation: A Reexamination

by C.L. Saricks and M.M. Tompkins*

The Center for Transportation Research, Energy Systems Division,
Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439

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**Tompkins is affiliated with the Decision and Information Sciences Division.*

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ABSTRACT

State-level accident rates for truck, rail, and barge transportation have been updated for mid-1990s shipping conditions. The updated accident, fatality, and injury rates reflect multiyear data for interstate-registered highway carriers, American Association of Railroads member carriers (i.e., all Class 1 and Class 2 railroads), and coastal and internal waterway barge traffic. Adjustments have been made to account for the share of highway combination-truck traffic actually attributable to interstate-registered carriers and for duplicated or otherwise inaccurate or unusable entries in the public-use accident data files applied. State-to-state variation in rates, reflecting recent developments in freight flows, the possible effect of speed limit changes on highway rates, and the stability of rates over time, are discussed. Carrier-specific information was used to confirm the general accuracy of the computed rates for highway shipments. Study conclusions suggest that these rates may be used for the next several years. However, further investigation is suggested, within two to three years, to verify or reject the emergence of a trend toward higher truck accident rates in states that raised highway speed limits between 1995 and 1996.

1 INTRODUCTION—BACKGROUND AND OBJECTIVES

In 1994, Argonne National Laboratory (ANL) published *Longitudinal Review of State-Level Accident Statistics for Carriers of Interstate Freight* (ANL/ESD/TM-68) (Saricks and Kvitek 1994), an investigation of highway, rail, and waterborne freight safety, on a state-by-state basis, as revealed by mid-1980s transportation statistics. The report documented an analysis completed earlier in the decade that had been performed for the U.S. Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM). The analysis had been conducted to improve the prospects for safe transport of hazardous shipments under the DOE's purview, including spent nuclear fuel and radioactive and mixed wastes from DOE facilities. The safety of such shipments has a high priority, and shipping campaigns for such waste materials will be highly visible. Concern exists about the relative risks of such campaigns, both among transport modes and within a given mode among the states, because they will be conducted over a period of several years and could involve multiple modes and shipment plans, depending on cost and safety.

The potential involvement of multiple-mode shipment campaigns called for a comparative examination applying the latest knowledge about how each mode operates. More particularly, it had not been determined whether two key identified elements of shipping risk in the latter 1980s were mitigated over the intervening years:

1. As recently as 1988, a few states still had uncompleted links in their designated interstate highway system networks, necessitating the relatively unsafe practice of combination trucks having to depart access-controlled, multilane highways for two-lane roads.

2. The structure of the U.S. rail freight system was experiencing considerable turbulence, with consolidation both of the carrier corporations and of the heaviest freight movements onto fewer and fewer lines, accompanied by concomitant elimination of "redundant" capacity.

Adding to these unknowns were several other factors that emerged in the 1990s:

3. An increase in speed limits was enacted in most states, for both access-controlled and at-grade highways, by a factor of up to 36 percent relative to mid-1980s values (with a significant increase occurring in many states between 1995 and 1996) (NSC 1997).

4. The number of domestically controlled Class 1 rail carriers was reduced to seven, with a corresponding reduction in the line haul routing options available in the rail mode (AAR 1997).

5. Increased intermodalism, improved track, and advanced technology for new (and many rebuilt) locomotives combined substantially to improve rail freight flows and speeds on railroads not plagued by traffic congestion difficulties.

This report has four objectives:

1. Update the accident-risk-factor database with such data for 1994–1996 as are available and complete, following procedures as identical as possible to those employed in development of the 1994 report.

2. Identify and document changes in data reporting and formatting requirements that may necessitate modifications to these procedures.

3. Conduct both cross-sectional and longitudinal statistical tests on the resulting state-level data, for the purpose of revealing emergent trends or relationships of which planners of hazardous waste shipping campaigns should be aware.

4. Deliver a consistent set of state-level accident rates in electronic form for subsequent use in transportation risk models, with magnitudes supported by contact with individual interstate-registered specialty carriers as a means of empirical confirmation.

The following section describes changes in accident reporting requirements and procedures that made the effort documented in this report different from that of its predecessor. Section 3 presents the procedures the authors followed in developing the new rates for the 1990s. Section 4 lays out the resulting findings by transportation mode with respect to trends observed and statistical tests performed; this section also discusses the confirmatory examination of highway carrier data. Section 5 discusses the possible implications of the findings and areas of further productive research. Sections 6-8 present statistical data and tables of rates with respect to highways, railroads, and waterways.

2 PRIMARY ACCIDENT REPORTING REQUIREMENTS AND DATA SOURCES—EVOLUTION SINCE THE 1980s

2.1 ACCIDENTS OF TRUCKS OPERATED BY COMMERCIAL MOTOR CARRIERS

Until March 4, 1993, Part 394 of Title 49 of the *Code of Federal Regulations* required motor carriers to submit accident reports to the Federal Highway Administration (FHWA) in the so-called "50-T" reporting format. The master file compiled from entering the data on these reports in FHWA's Office of Motor Carriers (OMC) was the basis of accident, fatality, and injury rates developed for the 1994 Argonne National Laboratory document. By Final Rule of February 2, 1993 [58 **FR** 6726], the reporting requirement was removed; instead of submitting reports, carriers were now required to maintain a register of accidents meeting the definition of an accident (see below) for a period of one year after such an accident occurred. Carriers were to make the contents of these registers available to FHWA agents investigating specific accidents. They were also required to give "all reasonable assistance in the investigation of any accident including providing a full, true, and correct answer to any question or inquiry," to reveal whether hazardous materials other than spilled fuel from the fuel tanks were released, and to furnish copies of all state-required accident reports [49 **CFR** 390.15]. The reason for this change in rule was the emergence of an automated state accident reporting system compiled from law enforcement accident reports that, pursuant to provisions of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 [PL 102-240, 105 STAT. 1914], was being established under the Motor Carrier Safety Assistance Program (MCSAP). Under Section 408 of Title IV of the Motor Carrier Act of 1991, a component of ISTEA, the Secretary of Transportation is authorized to make grants to states in order to help them achieve uniform implementation of the police accident reporting system for truck and bus accidents recommended by the National Governors' Association. Under this system, called SAFETYNET, accident data records generated by each state follow identical formatting and content instructions; the records are entered on approximately a weekly basis into a federally maintained database. This database is in turn compiled and managed by a DOT contractor as part of the Motor Carrier Management Information System (MCMIS).

Motor carrier reporting rules in 49 **CFR** 390.5 define an accident as an occurrence involving a commercial motor vehicle *operating on a public road* that results in (1) a fatality and/or (2) bodily injury to a person that requires medical treatment away from the accident scene; and/or (3) one or more involved motor vehicles incurring disabling damage as a result of the accident such that the vehicle must be towed from the scene. Specifically excluded from this definition of "accident" are occurrences involving only boarding and alighting from a stationary vehicle, involving only the loading or unloading of cargo, or involving a passenger car or other multipurpose passenger vehicle owned by the carrier that is transporting neither passengers for hire nor placard-quantity hazardous materials. The latter exclusions represent a key difference between this definition and the *immediate* reporting requirements for hazardous materials incidents under 49 **CFR** 171.15, which stipulate the following criteria:

- Fatality

- Injury requiring hospitalization

- Total property damage in excess of $50,000 (tow-aways may not meet this threshold, but total damage *could* meet this criterion without a tow-away)

- An evacuation of the general public lasting at least one hour

- Closure of one or more major transportation arteries or facilities for at least one hour

- Alteration of an aircraftṡ routine flight plan (not relevant to surface modes)

  Fire, breakage, spillage, or suspected radioactive contamination during shipment of *radioactive* material

- Fire, breakage, spillage, or suspected contamination during shipment of *etiologic* agents

- Release of a marine pollutant in quantity exceeding 450 liters (119 gal) for liquids or 400 kg (882 lb) for solids

- A decision *by the carrier* that a reportable situation (e.g., continuing danger to life at the scene) exists.

Thus, reportable accidents under MCSAP are far more exclusionary than for reportable hazardous materials situations, which include not only release of cargo wherever it may occur but also impacts on uninvolved parties (i.e., the general public) and also give reporting discretion to carriers not authorized under law-enforcement-based incident accounting systems.

2.2 RAIL CARRIER ACCIDENTS AND INCIDENTS

Under 49 **USC** 20901, rail carriers must file a report with the Secretary of Transportation, not later than 30 days after the end of each month in which an accident or incident occurs, that states the nature, cause, and circumstances of the reported accident or incident. The format for such reports is provided by the Federal Railroad Administration (FRA) under 49 **CFR** 225.11. The criteria for a reportable accident or incident currently encoded in 49 **CFR** Part 225 are as follows:

- An impact occurs between railroad on-track equipment and (a) a motorized or non-motorized highway or farm vehicle, (b) a pedestrian, or (c) other highway user at a highway-rail crossing.

- A collision, derailment, fire, explosion, act of God, or other event involving the operation of standing or moving railroad on-track equipment results in aggregate damage (to on-track equipment, signals, track and/or other track structures, and/or roadbed) of more than $6,300 (as of 1996).

- An event arising from railroad operation that results in (a) the death of one or more persons; (b) injury to one or more persons, other than railroad employees, that requires medical treatment; (c) injury to one or more employees that requires medical treatment or results in restriction of work or motion for one or more days, one or more lost work days, transfer to another job, termination of employment, or loss of consciousness; and/or (d) any occupational illness of a railroad employee diagnosed by a physician.

Certain types of railroad carriers are exempted from these requirements, specifically (1) those owning or operating on track entirely within a facility not part of the general freight railroad system; (2) rail urban mass transit operations not connected to the general railroad transportation system; and (3) those owning or operating an exclusively passenger-hauling railroad entirely within an installation isolated from the general freight railroad system. (The definition of isolation, or insularity, of operations in this last category excludes any situations involving one or more at-grade crossings of (active) public roads or other railroads, bridges over public roads or commercially navigated waterways, or operations conducted within 30 feet of any other (active) railroad.) Partial relief from requirements is also available for rail carriers with 15 or fewer employees covered by the hours of service law of 49 **USC** 21101-21107, or that own or operate track exclusively off the general system. For purposes of this analysis, the entities subject to full reporting requirements are sufficiently comprehensive.

Carriers covered by these requirements must fulfill several bookkeeping tasks. FRA requires submittal of a monthly status report, even if there were no reportable events during the period. Accidents and incidents must be reported on the FRA standardized form, but certain types of incidents require immediate telephone notification. Logs of both reportable injuries and on-track incidents must be maintained by each railroad on which they occur, and a listing of such events must be posted and made available to employees and to the FRA, along with required records and reports, upon request for them. The consolidated data entries extracted from the FRA reporting forms are consolidated into an accident/incident database that separates reportable *accidents* from grade-crossing *incidents*. These are annually processed into event, fatality, and injury count tables as part of the *Accident/Incident Bulletin* (FRA 1994-1996) published on the Internet by the Office of Safety at gopher://gopher.dot.gov:70/11/fra/safety/rrsafety/binary/ftpai.

2.3 ACCIDENTS AND INCIDENTS INVOLVING COMMERCIAL SHIPPING VESSELS ON DOMESTIC WATERWAYS

Under 46 **USC** 6101-6103, criteria have been established for the required reporting (by vessel operators and owners) of marine casualties and incidents involving all United States flag vessels occurring anywhere in the world and any foreign flag vessel operating on waters subject to the jurisdiction of the United States. An incident must be reported within five days if it results in

- The death of an individual,
- Serious injury to an individual,
- “Material” loss of property (threshold not specified; previously was $25,000),

  Material damage affecting the seaworthiness or efficiency of the vessel, or
- Significant harm to the environment.

The last criterion should be directly comparable to vessel spillage reporting requirements under 49 **CFR** 171.15, discussed above. If alcohol abuse was determined to be a contributing factor, this must also be reported. Individual states also collect casualty data for incidents occurring in navigable waterways within their state borders, and a uniform state marine casualty reporting system has been created for transmitting these reports to federal jurisdiction (i.e., the U.S. Coast Guard); however, the ability of federal authority to use the information is restricted within the same limits as those applicable to the state providing the report. Failure to meet reporting obligations can result in a civil penalty, not to exceed $25,000, imposed on the vessel owner, charterer, managing operator, agent, master, or “individual in charge.”

U.S. Coast Guard Headquarters receives quarterly extracts of the Marine Safety Information System (MSIS) developed from these sources. MSIS is a network database residing in Martinsburg, West Virginia. Investigation cases are entered at each marine safety unit by Coast Guard investigators. Analysis of data is conducted at Headquarters using a Relational Database Management System. The Headquarters Office of Investigations and Analysis compiles and processes the casualty reports into several formats and partitioned data sets that make up the MSIS database. It covers maritime accidents, fatalities, injuries, and pollution spills as far back as 1941 (although the file is complete only for about 1991 onward) and is available from the National Technical Information Service (NTIS) on CD-ROM.

2.4 DATABASE SOURCES

Until the early 1990s, large data sets archiving the information for which the various agencies of the U.S. Department of Transportation (DOT) were responsible could be obtained, generally on open-reel tapes or floppy disks, directly from an office within each agency. Recently, the processing and distribution of such databases has largely been out-sourced. Thus, for example, the FHWA Office of Motor Carriers (OMC) now makes its (state law-enforcement-generated) commercial truck and bus accident database available on CD-ROM through an external vendor. Railroad data (both state-level accidents and carloads handled) are still available at no charge on, respectively, the FRA and Association of American Railroads (AAR) Web sites. Highway flow data (from FHWA's *Highway Statistics*) can be downloaded from the DOT Bureau of Transportation Statistics page on the Internet (DOT/FHWA 1995-1997). Incidentally, utilizing data available on the Internet is probably the single most dramatic change experienced in compiling statistics since undertaking the earlier analysis. Unfortunately, DOT's Office of Highway Information Management (which develops *Highway Statistics*), due to suspected problems in data accuracy, no longer offers a spreadsheet version of state-level data enabling highway miles by heavy combination trucks to be extracted *directly*. These changes collectively have necessitated some revision of the earlier procedures used to develop incident numerators and to estimate transport activity denominators.

Two other developments of interest should be noted. With the restructuring of its data distribution channels, DOT has enabled additional file preparation and management techniques, such as prestructuring to facilitate data queries, to go forward. The MSIS casualty files in particular have been preprocessed to create numerous auxiliary spreadsheet-compatible files with limited record sizes that target specific areas of data need (e.g., ship's registry, incident type, fatality causes). To a significant extent, this has facilitated use of these data. On the other hand, new obstacles to data extraction have emerged for some categories. While it was formerly possible to identify specific rail freight flow volumes by state from the old Interstate Commerce Commission (ICC) 2% Waybill Sample, railroad corporate consolidation has resulted in many states being served by only one reporting railroad. Beginning in the late 1980s, confidentiality rules established for collection of the sample thus precluded identification of states of origin and destination for shipments because it would result in automatic identification of the carrier. The lowest reporting level became the Bureau of Economic Analysis (BEA) region, some of which spanned multiple states. The 2% Waybill Sample is still collected and maintained, but by the DOT Surface Transportation Board, nominal successor to the ICC. Currently, the most reliable state-level rail freight flow data are available from AAR sources.

3 PROCEDURES FOR OBTAINING, COMPILING, AND PROCESSING DATA

3.1 HIGHWAY ACCIDENTS AND RATES

Heavy combination-truck accident counts were extracted from the Motor Carrier Management Information System (MCMIS) accident files maintained by the Office of Motor Carriers of the Federal Highway Administration (FHWA). Since 1992, this file has been built from accident reports submitted by law enforcement organizations, rather than from reports filed by the carriers themselves under the “50-T” accident reporting system that was used in the prior analysis. The first year of database development under the new system (1993) witnessed considerable inconsistency in data quality from state to state; many state-level records were found not to be useable because of missing and incomplete data fields. Overall data quality improved steadily from 1994 through 1996, but some problems remain. Several states either do not furnish location-specific information (rendering assignment to a highway type impossible) or provide it in a coded manner unintelligible to the general user. This problem could be resolved for Texas, thanks to cooperation from state-level personnel there. However, Georgia, Louisiana, New York, Oregon, and South Carolina lack rates by road type. Also, a handful of other states, including Florida, Maine, Maryland, North Dakota, Ohio, and Tennessee, are missing data from portions of one or more years, requiring us to rely on only the complete year(s) of data from these states for the purpose of developing rates.

Only accidents involving heavy combination trucks (bobtail to turnpike triple) of interstate-registered carriers are included in numerator totals; no single-unit trucks are included. The MCMIS categories are shown below, with those included indicated in bold.

Vehicle Configuration Code	**Truck Type**
1	Bus (> 15 psgr. + driver)
2	2-axle, 6-tire truck
3	Single-unit truck, ≥ 3 axles
4	**Truck/Trailer**
5	**Bobtail (tractor only)**
6	**Tractor/Semitrailer**
7	**Tractor/Double**
8	**Tractor/Triple**
9	Unknown; unclassifiable

A binary (Y/N) field in the MCMIS file identifies whether the operator of an involved truck is registered for interstate haulage, and all records with “N” in that field were excluded. Excluding non-interstate-registered carriers reduced the combination-truck accident count by 15 to 20 percent in most states. Every accident involving two or more such vehicles—and there is a record for each vehicle in the MCMIS file—was counted as the number of (qualifying) trucks involved. However, a second pass through the data was required to ensure that fatalities and injuries sustained in multi-truck accidents were not double-counted. This operation yielded nine (9) sets of state-level numerators in each year for each state for which allocation by road type was possible; that is, three highway classifications for, respectively, accident involvements, fatalities, and injuries. Partial to almost-complete development of numerators was possible by using the MCMIS data for 1994, 1995, and 1996. These numerators are shown in Tables 1a and 1b (Section 6).

Three state-level denominators for highway combination-truck kilometers were needed for each analysis year to complete the accident rates by using the above data. Estimates of combination truck travel on (1) interstates, (2) other principal highways (generally, other components of the National Highway System), and (3) other roads (i.e., county highways, farm-to-market roads, local streets) for 1994, 1995, and 1996 were developed from the FHWA's annual publication *Highway Statistics*, Tables VM-1 through VM-4 for 1995 and 1996 (from the Bureau of Transportation Statistics Web page).

Table VM-2a of *Highway Statistics* provides (updated) annual state-level VMT by functional system for the prior year. U.S. VMT totals by highway category (interstate/other arterial/other) and vehicle type are found in Table VM-1. The share of state-level VMT (distance traveled) accounted for by combination trucks (single and multiple trailer) was obtained from information in Table VM-4, which consists of a series of tables that provide the distribution of annual VMT by vehicle and road classification. In general, the road classification categories found in Table VM-4 correspond to those in Table VM-2a, although some aggregation of the latter tables' totals is required. Table VM-2a totals for rural minor arterial, major collector, minor collector, and local roads were combined into the category "rural other," and the truck share from "rural minor arterial" found in Table VM-4 was applied. Similarly, the sum of urban "minor arterial," "collector," and "local" shares from Table VM-2a was consolidated as Table VM-4's "urban minor arterial;" this was used to estimate the "other urban" truck VMT, as in Table VM-1. (Urban VMT totals could only be calibrated to "interstate" and "other," the aggregation level of Table VM-1.) At the end of this process, there were three sets of state-level VMT totals, corresponding to the respective combination-truck fraction of national VMT for each highway type in Table VM-1.

This distribution of truck VMT by state was compared with (1) state data on highway diesel ("special fuels") sales (*Highway Statistics*, Table MF-21), and (2) results of an analysis of 1993 truck flows in the Commodity Transportation Study performed by Oak Ridge National Laboratory (ORNL 1998). Adjustments were made on the basis of this cross check. In general, the state shares for diesel sales from Table MF-21 and (adjusted) truck miles traveled were comparable. In addition, the mean and variance of the respective distributions of state-level combination-truck VMT shares and special fuels sales shares were not significantly different statistically. Final state totals for each of the three years are shown in Table 2, with the corresponding rates in Tables 3a-c (Section 6).

Miles for the denominator of each state's rate were converted to kilometers and reduced by 25 percent to parallel the exclusion of accidents of non-interstate (local and regional) carriers from the numerator. This adjustment is supported by data from the 1992 *Truck Inventory and Use Survey* (TIUS 1992). Tabulated information from TIUS indicates that of the 41.9 billion miles (67.4 billion km) of nationwide combination truck movement in 1992 that could be directly assigned to interstate, intrastate, or locally registered carriers, 34.1 billion (54.9 billion km, or about 81%) was by carriers of interstate registry. This might argue that the 25 percent discount is too conservative and should be set closer to 20 percent. However, some 29.6 billion combination truck miles in the TIUS could not be so assigned due to missing data entries on the survey data form. We assumed a slightly greater propensity on the part of non-interstate carriers to leave the needed entries blank, and thus allocated to these carriers a higher proportion of the unattributable kilometers (35%) than their share of the recorded attributable kilometers (19%). This produced the final 75/25 split assigned to each of the three study years.

The final rates are presented in Table 4 (Section 6). In general, our current recommendation is to apply the 1996 rate for interstate highways rather than the three-year average, where possible, in any state that raised its interstate highway speed limit between 1995 and 1996 and for which interstate-specific rates are available for both 1995 and 1996.

As in the prior analysis, empirical verification of the rates shown in Table 4 was sought by examining accident statistics released by carriers and by contacting the carriers' corporate safety directors personally by telephone. Data were obtained for the following carriers, all of which conduct business with one or more national laboratories:[1]

- Consolidated Freightways (California)
- Roadway Express (Ohio)
- Tri-State Motor Carriers, a division of Trism Secured (Missouri)
- Yellow Freight (Kansas)

Consolidated Freightways, a contract carrier for the full spectrum of motor freight, reports on its Web site (CF 1997) that its overall preventable accident rate is less than one per million miles, and that about 10 percent of its drivers have passed the two-million-mile mark without experiencing an accident. Roadway Express, which handles both truckload and less-than-truckload freight of all kinds, has published on its Web site (RE 1997) statistics indicating that, over the past two years, its drivers have collectively experienced about 750,000 miles between accidents, while about 350 of these drivers have accomplished over two million miles without an accident. Presumably, these carriers assign their best drivers to their most sensitive shipments, which enables an accident experience of one accident in no fewer that two million miles of over-the-road service to be appropriate for and representative of conditions for shipping consignments of hazardous and

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[1] Information courtesy of Ronald Richardson, Facilities Planning and Engineering, Argonne National Laboratory.

radioactive waste. This statistic translates to an accident rate of 3.11×10^{-7} accidents per truck kilometer, a value just under the median of the interstate highway range across all states (Table 4).

The officials of the carriers directly contacted by telephone were asked, as before, if a reportable accident involvement rate in the range of one to five per ten million (10^7) total truck miles (i.e., 0.62 to 3.11 accidents per ten million kilometers) was consistent with, higher than, or lower than the firm's experience in recent years. One agreed that this range was consistent with their experience, while the other specifically cited a three-year (1996-1998) average rate of just over 0.7 accidents per million (laden + empty) truck miles, or 4.4×10^{-7} accidents per kilometer—well within the interstate and primary highway range shown in Table 4 (Cooney 1998; Goetz 1998). These discussions reinforce the premise that the Table 4 rates are in the correct range and may tend toward the conservative when applied to specialized carriers.

3.2 RAILROAD RATES

Rates for railroad operations (accidents/incidents/fatalities by railcar-kilometer) are based on more straightforward data. The numerators were derived from the 1994, 1995, and 1996 counts of train accidents (collisions, derailments, highway crossings, and other accidents), grade crossing incidents, fatalities, and injuries reported annually by state in the FRA's *Accident/Incident Bulletin* (FRA 1994-1996). These data tables are also available on the Internet. In response to comments that the prior analysis had improperly excluded fatalities and injuries involving person/vehicle interactions that would not occur in truck transport operations but *were* subject to legitimate accounting in railroad activities, all *trespasser and non-trespasser* fatalities and injuries have now been included. That is, casualty totals are no longer restricted to counts of railroad employees and victims of grade-crossing *accidents* (i.e., most grade-crossing events are classified as *incidents*, which are tabulated for both public and private highway-rail crossings). Counts and estimated car-kilometers by state for each of the three years are shown in Tables 5a-5c (Section 7). Note that, as reported in the FRA *Accident/Incident Bulletin* for 1996, approximately 3.3% (141) of the 4,257 highway-rail accidents reported in 1996 exceeded the damage threshold required for train accidents. In most years, this total is well under 5%.

The car-kilometer of movement, which is the counterpart to the shipment-mile of trucking and water freight transport, was selected as the basis of railroad unit risk estimation in the currently applied DOE radioactive and mixed waste shipping models. If, for example, spent reactor fuel shipments were to be moved uniformly in dedicated (unit) trains of 10-20 car lengths, it would be appropriate to modify this unit risk measurement base to the *train*-kilometer. However, this is not currently advisable, for two reasons.

1. Fuel assembly cask-on-railcar consignments—for that matter, any large radioactive or mixed waste shipment—may still move in blocks of cars (or even as individual cars) in variable-consist trains. Until actual shipment contracts with rail carriers are in place, such a possibility cannot be dismissed.

2. Conversion of a unit train rate to a unit railcar rate, or the converse, requires application of statistical information available only for trains of an "average" length of (currently) about 68 cars. As described above, this count of cars would not be consistent with an accurate profile of unit cask-shipping trains. Also, multiplying a train-kilometer-based rate derived from current statistics by a factor of four as a surrogate for unit cask trains (presumably to account for the need for four times the number of trains) is not statistically defensible.

Rate denominators (car-kilometers) come directly from AAR's state-level data on carloads handled by year. The statistics for 1995 and 1996 have been posted on the Web for easier access (AAR 1998). The average distance traveled (in kilometers) by railcar shipments in each state is based on the distance from the rail "centroid" of each state to the nearest border, except for corridor states clearly dominated by through—as opposed to originating and terminating—hauls. For such states, average haul length was increased by 25 percent. Examples include Kansas, Mississippi, Montana, New Mexico, and North Dakota. The product of the AAR number times the resulting distance was then multiplied by the ratio of *total* car-miles to *loaded* car-miles shown in the "Freight Car Miles" figure of AAR's annual publication *Railroad Facts*. In recent years, this ratio has fluctuated closely around 1.68. Finally, the state level totals of car-kilometers thus derived are summed for comparison to the control total for railcar miles (kilometers) in AAR's annual publication *Railroad Facts*. The control total for each year is the (metric-converted) value for total U.S. freight car miles in the "Freight Car Miles" table (e.g., AAR 1997, p. 34). Any discrepancy with respect to this control total is corrected by uniformly adjusting the average haul length for all states. The resulting composite (1994-1996) rates are shown in Table 6 (Section 7). Although capital improvements on Class 1 railroads continued apace during the 1994-1996 period, no railroad formally raised its mainline speed limit across the board; hence, unlike the case of interstate highway rate estimation, full compositing is not inappropriate. Again, zeroes are replaced by the national mean for the category.

3.3 WATERWAY RATES

Rates for waterway operations (accidents/incidents/fatalities by 500-short-ton-shipment-kilometer by waterway type, and by 500-short-ton shipment for states located on waterways) have been developed by combining flat file data from the Coast Guard's Marine Casualty and Pollution Database (DOT/USCG 1998) and summary information from Tables 1-4 and 4-1 of the U.S. Army Corps of Engineers' annual publication W*aterborne Commerce of the United States* for 1995 and 1996 (USA/CE 1997-1998). The latter publication reports tonnage by state and ton-miles by waterway type (coastwise, lakewise, internal, and intraport—the last of which has been combined with coastwise). The 500-short-ton reference value is the same as that applied in the previous study (Tobin, Meshkov, and Jones 1985). As in the prior work, ton-mile estimates were divided by the 500-ton shipment weight, then converted to shipment ton-kilometers.

All identifiable instances in U.S. internal, lakewise, or coastwise domestic waterways of an accident involvement of a commercial vessel, whether of domestic or foreign registry, but *excluding* ferry boat operations (often the largest single source of accident-related injuries) and events in Alaskan and Hawaiian waters were included in the numerators. Although all individual *powered* vessel involvements were counted, the number of (dumb) barges involved in breakaways was not separately tabulated, in the interest of maintaining a procedure consistent with that used for rail accidents (where no individual car counts per accident were obtainable from the FRA summary data). Accident types included allisions (striking of/scraping against stationary structures), collisions (between vessels or involving a vessel and another moving vehicle), barge breakaways, fires, explosions, groundings, structural failures, flooding, capsizing, and sinking that occurred in U.S. inland waters or (identifiably) within 100 miles of the coastline. Incidental person casualties not directly resulting from an event involving the vessel itself were counted separately. Data used in developing the 1995 and 1996 rates are shown in Table 7, with composite rates for vessel casualties (some with fatalities and/or injuries) and person casualties (only) given in Tables 8a-b and 9, respectively (Section 8).

With respect to its spent reactor fuel shipping options, DOE has identified 14 commercial nuclear power plant sites at which proximity to navigable waters would permit cask pickup by barge, followed by transshipment to rail at the nearest terminal capable of accommodating such a transfer.[2] The list below identifies each of these sites, its state of location, and the waterway type to which it is adjacent and over which, for purposes of applying Tables 8a and 9 rates per shipment or Table 8b rates per shipment-kilometer, its barge link to the railhead would be traveled.

Nuclear Facility	**State**	**Waterway/Type**
Browns Ferry	Alabama	Tennessee R./Internal
Calvert Cliffs	Maryland	Chesapeake Bay/Internal
Cooper	Nebraska	Missouri R./Internal
Diablo Canyon	California	Pacific Ocean/Coastwise
Grand Gulf	Mississippi	Mississippi R./Internal
Hope Creek	Delaware	Delaware R./Internal
Kewaunee	Wisconsin	Lake Michigan/Lakewise
Oyster Creek	New Jersey	Atlantic Ocean/Coastwise
Palisades	Michigan	Lake Michigan/Lakewise
Point Beach	Wisconsin	Lake Michigan/Lakewise
St. Lucie	Florida	Intracoastal W./Internal
Salem	Delaware	Delaware R./Internal
Surry	Virginia	James R./Internal
Turkey Point	Florida	Intracoastal W./Internal

[2] TRW Environmental Safety Systems, Inc., *National Transportation Environmental Baseline File*, Las Vegas, Nev., 1999.

4 RESULTS

Basic descriptive statistics were generated for the rates pertaining to accidents of interstate-registered combination trucks in 1994, 1995, and 1996. The total accident rate over all road types for 1994 was 2.98 (10^{-7} accidents/truck-km); for 1995, 2.97 (10^{-7} accidents/truck-km); and for 1996, 3.46 (10^{-7} accidents/truck-km). Their composite rate is 3.21. The differences overall are not statistically significant (see Appendix A). However, the analysis sought to uncover possible explanations for the observed increase in the interstate highway accident rate in 1996. Approximately 25 states raised the maximum speed limit in the 1995-1996 time frame. The mean accident rate on interstate highways for the group of states that raised the speed limit between 1995 and 1996 was significantly higher in 1996 than for 1995 [3.69 vs. 2.70 (10^{-7} accidents/truck-km)]. The mean accident rate on interstate highways for states that did not change the maximum speed limit was *not* significantly higher in 1996 [3.15 vs. 3.22 (10^{-7} accidents/truck-km)]. This issue is discussed in more detail in Appendix A.

These 1994-1996 results are not directly comparable with their 1986-1988 predecessors from Saricks and Kvitek (1994) because of the differences in source and method by which the accident data were collected and reported, as described in Sections 2.1 and 3.1. It is regrettable both that consistent data are not available to determine whether a general downward trend in rates existed *prior to* the increase in interstate speed limits after 1995, and that it is too early, with respect to database availability, to discover whether the 1996 results represent a transient or the beginning of a multiyear upward trend. The data do appear to show that, although the likelihood of *injury* in accidents involving heavy combination trucks is higher for most states, the likelihood of being killed is almost uniformly *lower*. This may be due primarily to an increase in seat belt use and safer vehicle designs, including airbags and other active restraints, rather than to generally safer roadway conditions, but the root cause remains unknown. If, thanks at least in part to the new restraint systems, what would formerly have been fatalities are now injuries instead, then the observed increase in injury rate should be expected.

The results of the rail computations (Tables 5 and 6, Section 7) show that domestic rail freight accidents, fatalities, and injuries on Class 1 and 2 railroads have apparently stabilized or declined slightly since the late 1980s. Reductions in fatalities and injuries, due in part to increased grade-crossing safety and AAR's "Operation Lifesaver" program, are especially noteworthy. However, this conclusion is based on applying denominators that do *not* include train and car kilometers accounted for by intermodal shipments (containers and trailers-on-flatcar) not loaded by the carriers themselves. Thus, the actual denominators are probably higher, and the rates consequently lower. Nevertheless, the current estimates are appropriately conservative in that including all intermodal car shipments (for which state-level data are not uniformly available) would probably increase the rate denominators by about 20 percent, thus decreasing the rates themselves by a like amount.

Waterway results (Tables 8a-b and 9, Section 8) also show a general improvement over mid-1980s rates, thanks possibly to better overall navigation technology and the elimination of marginal carriers. However, there is one exception to this observation. Coastwise casualty involvement rates appear to have risen sharply compared to what was recorded ten or so years ago. Raw data indicate that much of this is accounted for by high vessel casualty counts in Gulf of Mexico waters, especially those abutting Texas (two-year total of 236 involvements) and Louisiana (two-year total of 153 involvements). The previous report (Saricks and Kvitek 1994) had advised that the rate of casualty involvements recorded in Gulf Coast waters be monitored for possible upturn in succeeding years, and mid-1990s data appear to have validated that recommendation.

In earlier analyses that applied extensive statistical testing to all rail accident and incident records in the FRA database for 1984 through 1988, strong and consistent positive correlation was discovered between temperature extremes and accident frequencies (Lee and Saricks 1991; Saricks and Janssen 1991). An initial analysis was performed to determine if this phenomenon also occurred for truck accidents. States were partitioned into three primary east-west highway corridors representing different seasonal temperature regimes. Along each corridor, three years of MCMIS truck accident counts were partitioned into three-month groupings approximately representing the four seasons. There was special interest in the respective outcomes for the northern and southern corridors in summer (June-August) and winter (December-February), and in any differences that might be detected between them. Appendix B presents the results of these (limited) statistical tests on the basis of the MCMIS count data.

5 IMPLICATIONS OF FINDINGS AND RECOMMENDED FUTURE ACTIVITY

Earlier in the report, five relatively recent developments were identified as possible modifying influences on state-level accident involvement rates of surface freight transportation, relative to their mid-1980s counterparts. The first of these, completion of the Interstate Highway System, appears to have contributed positively to continuing mitigation of these rates. For example, West Virginia was one of the last states to see completion of its designated interstate highway network. There, the accident involvement rate for interstate-registered heavy combination trucks on the primary (non-interstate) highway system—some of which in the mid-1980s was carrying truck traffic diverted from interstate highways under construction—declined by at least 65 percent. The fatality rate dropped by over 60 percent and injury rate by over 70 percent. Even though, for reasons cited earlier, the 1984-1988 rates are not directly comparable with those reported in this study, a reduction of this general magnitude cannot be disregarded (although its absolute value is unknown). Interstate highways are comparatively safe operating environments for large trucks, and a network that permits their unbroken utilization for any long-distance haul should experience fewer accidents per unit of travel.

The second development, continued consolidation and rationalization of the railroad freight system, also appears positive in that such consolidation has, to date, resulted in a network capable of safer, more efficient operations. Changes in economic conditions have combined with elimination of "excess" track miles to bring about shifts in state shares of total freight flows; for example, major increases are evident on the (consolidated) trunk lines in several central, northern, and western states. A continuing shift of shorter hauls to trucks is reducing total railcar flow in New England and in some of the Middle Atlantic States. This latter phenomenon causes incremental accidents to have an exaggerated effect on state-level rates in the affected areas. Although this analysis could not positively identify a consistent mid-1990s reduction in accident rates relative to mid-1980s conditions (in fact, the national rate is statistically unchanged), it did note a downturn in most fatality and injury rates. This, again, may be the result of increased awareness of good safety practice both on the railways and among the general public at railroad crossings, due to such outreach efforts as Operation Lifesaver.

There is limited evidence that the third development, increased highway speed limits, especially on the interstate system, poses a valid concern, as documented above and in Appendix A to this report. Additional analysis is warranted whenever a longer time series of data that includes at least three years before and three after 1996 becomes available. Such an interval will be necessary to reveal whether higher 1996 rates for states that raised the speed limit represent an anomalous "blip" in the time series, or the beginning of a sustained reversal of long-term downward accident trends for heavy combination trucks.

The final two developments cited in the first section of this report might no longer be relevant to an intensive shipping campaign for large consignments of radioactive and hazardous materials. Routing options are now generally constrained by published guidance, but options that remain for routing via the railroads can be worked out directly with carriers during contract negotiations and, in any case, do not appear from recent data to possess (other factors being equal) a clearly "safer" routing choice in the current selection set. With respect to the final development (intermodalism and technological advance), current plans for the spent reactor fuel shipping campaign generally exclude all but necessary near-site transshipment (as in the barge-to-rail cases cited earlier), with casks moving by either railroad or highway (exclusively) from plant site to repository. If additional transshipment options were actively under consideration, the effect and relative safety of intermodal haulage would merit further discussion, but such analysis is now premature. Also, statistics appear to indicate that the adoption of higher operating speeds over improved track in advanced-technology locomotives does not compromise safe railroad operation.

There has been conjecture that the occurrence of a fatality in the course of an accident could be a reliable surrogate for the accident's severity. This conjecture is not statistically testable for this analysis because the database applied for it does not contain information on the severity (crush forces, punctures, fire temperature) of the accident and thus fails to provide a way to examine the existence of such a relationship. The proportion of interstate-registered combination truck accidents for which a fatality was recorded is approximately 3.5% of the total count of such accidents in each of the three study years. It is our judgement that, in the absence of more complete data (e.g., a National Transportation Safety Board report) about each of these 3.5% of accidents and why they were fatal, the existence of a fatality should not be used as a surrogate for accident severity.

Given the limitations on, but also the general consistency of, the rates calculated for this report, recommendations for their further application are offered below.

Highway Transport

- Replace facility-specific rates in current risk model(s) with those in Table 4 for the next two to three years and, until facility-specific values become available for the five states lacking usable location data in their MCMIS records, apply the statewide average for those states across all road types within them.

- Continue to investigate and evaluate procedures to improve estimation of annual combination-truck highway mileage by state.

- Undertake efforts before the end of year 2000 to identify whether the apparent upturn in accident rates from 1995 to 1996 in those states that raised the maximum speed limit on the Interstate Highway System (and possibly other major roads) represents (a) a short-term anomaly, (b) under-reporting of accidents in 1995 and/or 1994, or (c) the actual beginning of a longer-term trend.

- Expand the analysis of seasonal effects by using more detailed accident cause data to estimate whether there is sufficient justification for dispatching shipments over longer-distance, more southerly routes during winter months in order to avoid use of the northern transport corridor.

Railroad Transport

- The three-year average rates shown in Table 6 are believed to reflect a longer-term stability in railroad operations than their predecessors in the Saricks and Kvitek (1994) report, and should therefore replace those rates in risk models for an indefinite period. Total (average) state rates are appropriate because shipments could move in either non-stop dedicated blocks or normal rail freight service with possible reclassification *en route*.

- The hypothesis of operational stability in the current railroad environment should be tested again before the end of year 2000 by examining at least five years of mid- to late-1990s data in three-year moving averages.

- Consider continuing to apply national average or contiguous-state rates in the states (and the District of Columbia) where low rail-traffic volumes produce extreme (and non-representative) annual values for state-level rates.

Waterway Transport

- Barge movements will apparently play only a very limited role in the transport of spent fuel to a repository, and further intense consideration of accident risks for such movements is probably unwarranted. Rates shown in Table 9 should prove adequate for application throughout the campaign, but if greater detail (by actual waterway system) were required, reversion to the earlier rates would be acceptable and conservative.

- An exception to this recommendation would arise in the event that a revision in planning called for more barge transportation of casks within and along the coastal areas of the Gulf of Mexico. Current (and projected) volumes of both coastwise and internal waterway shipping in that corridor appear to have increased the risk of minor to significant freight vessel accidents, relative to findings of the previous analysis.

6 STATISTICAL DATA AND TABLES OF RATES—HIGHWAYS

TABLE 1a Reportable Accident, Fatality, and Injury Counts for States with Facility-Specific Location Data in 1994, 1995, and 1996 for Interstate-Registered Heavy Combination Trucks[a,b]

State	94A/I	94A/P	94A/O	94F/I	94F/P	94F/O	94J/I	94J/P	94J/O	95A/I	95A/P	95A/O	95F/I	95F/P	95F/O	95J/I	95J/P	95J/O	96A/I	96A/P	96A/O	96F/I	96F/P	96F/O	96J/I	96J/P	96J/O
AL	328	536	116	15	50	3	187	311	58	376	642	129	11	51	8	220	408	67	603	911	222	14	65	8	280	549	104
AZ	186	68	1	7	15	0	189	62	0	243	97	0	26	7	0	256	89	0	289	107	1	18	14	0	191	61	0
AR	259	403	18	7	151	0	176	358	15	212	403	28	14	43	0	185	382	34	74	110	5	4	8	0	39	79	3
CA	608	383	110	33	24	7	649	441	111	367	281	75	9	12	1	280	176	50	621	461	131	27	18	2	304	236	93
CO	340	273	132	13	17	3	248	198	94	369	266	134	8	7	13	246	175	90	346	258	139	6	19	5	251	182	92
CT	270	26	22	11	4	4	185	28	11	495	76	173	9	4	6	316	46	147	602	82	152	2	1	0	427	66	100
DE	63	136	27	0	5	1	38	98	16	51	101	30	1	4	0	42	78	19	71	145	25	1	9	0	42	107	17
FL	47	43	13	6	16	2	36	36	13	162	188	88	21	31	11	137	162	94	142	179	115	13	21	8	106	130	71
ID	83	87	43	0	12	2	121	90	52	104	140	58	2	13	8	100	124	67	205	190	56	3	20	1	187	172	51
IL	693	317	282	31	26	16	704	301	265	1240	317	395	46	15	16	757	140	152	1345	621	861	45	17	13	760	154	135
IN	581	213	22	13	19	4	364	165	20	613	227	27	23	26	0	419	179	26	783	317	59	23	33	4	447	265	41
IA	106	89	50	12	14	4	48	39	18	99	88	54	5	15	0	65	71	44	236	249	97	20	24	3	225	222	84
KS	232	418	169	4	27	4	142	261	66	154	299	80	5	36	4	165	350	95	214	386	93	2	37	3	229	416	115
KY	391	547	111	22	32	1	264	373	67	463	672	159	15	35	3	330	474	101	522	612	125	20	27	4	389	447	67
ME	25	31	12	0	0	0	16	22	7	97	22	91	2	0	4	71	21	76	97	47	68	2	0	0	67	41	65
MD	535	359	193	5	21	7	466	321	140	548	286	280	8	14	4	455	224	194	397	218	150	5	8	4	341	194	117
MA	35	50	66	0	3	3	17	35	52	66	57	47	0	2	2	36	36	38	102	71	41	2	1	0	67	54	23
MI	*	*	*	*	*	*	*	*	*	570	339	515	26	20	38	517	377	558	698	464	583	22	34	18	653	493	632
MN	95	140	14	0	13	0	37	101	9	113	172	35	4	15	1	59	132	29	140	190	36	2	29	0	75	165	35
MS	64	110	20	5	6	1	48	94	12	30	62	22	1	3	0	31	77	14	39	116	20	1	9	0	29	120	14
MO	793	697	280	22	58	5	622	495	176	928	728	304	16	22	2	587	520	198	1078	906	411	37	57	6	688	654	236
MT	188	121	29	6	6	0	100	68	5	172	124	27	2	8	6	79	78	11	276	175	34	6	6	0	84	71	14
NE	193	259	74	8	13	2	116	144	36	158	181	42	1	5	2	97	114	19	276	346	100	18	19	2	174	218	54
NV	135	102	3	1	4	0	86	78	0	119	77	1	6	4	0	83	55	0	187	116	5	6	5	1	120	63	8
NH	34	67	22	0	4	1	36	33	10	31	61	29	0	1	0	6	35	17	14	41	25	0	4	0	7	37	18
NJ	410	262	149	18	3	0	215	204	101	383	275	237	4	0	3	251	245	155	649	547	498	9	3	9	532	514	403
NM	98	64	22	6	3	1	97	48	23	94	42	27	8	10	1	87	41	32	111	52	20	17	5	3	123	57	19
NC	452	588	271	18	44	8	399	612	226	566	768	358	33	42	17	548	762	289	787	1074	412	27	52	14	708	1119	329
ND	56	46	2	1	1	0	36	29	1	67	30	16	2	8	0	51	14	16	62	148	26	3	6	0	38	115	32
OH	431	78	78	23	6	3	427	81	99	708	89	92	17	6	7	607	93	119	109	16	15	2	0	0	80	9	19
OK	301	285	92	13	12	1	314	266	86	241	262	186	14	20	8	238	269	186	286	244	114	14	21	4	340	260	121
PA	1459	950	466	33	72	21	1211	872	434	1382	918	630	36	49	13	906	669	538	1673	1271	738	50	56	9	1251	1011	551

TABLE 1a (Cont.)

State	94A/I	94A/P	94A/O	94F/I	94F/P	94F/O	94J/I	94J/P	94J/O	95A/I	95A/P	95A/O	95F/I	95F/P	95F/O	95J/I	95J/P	95J/O	96A/I	96A/P	96A/O	96F/I	96F/P	96F/O	96J/I	96J/P	96J/O
RI	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
SD	*	*	*	*	*	*	*	*	*	14	9	2	0	1	0	11	4	3	101	89	19	3	5	4	74	60	11
TN	69	56	11	3	5	3	48	67	13	333	227	40	27	21	1	248	196	35	399	233	47	31	32	4	310	210	31
TX	*	*	*	*	*	*	*	*	*	2758	3540	740	55	118	21	1946	2475	530	2314	2895	631	55	146	134	2676	2380	487
UT	153	108	75	4	8	3	124	100	54	169	86	76	7	4	2	153	64	54	333	110	88	16	4	1	295	85	71
VT	23	59	5	0	4	0	12	36	2	32	52	8	0	2	0	27	36	1	23	39	5	0	2	0	24	36	7
VA	681	407	9	23	17	0	538	340	3	765	398	8	44	20	0	639	358	10	1003	571	5	33	32	0	752	503	3
WA	161	129	20	0	7	1	141	91	20	147	105	18	2	12	0	98	72	13	288	254	36	2	2	4	164	166	25
WV	170	152	31	26	48	3	88	110	6	140	105	30	7	8	2	93	63	17	111	98	21	8	9	0	94	75	15
WI	468	496	474	11	40	7	372	389	349	461	487	505	8	39	15	312	348	350	553	646	521	11	53	2	414	552	349
WY	382	70	19	9	3	0	203	32	18	391	93	30	8	2	0	226	40	17	664	174	41	6	6	0	260	80	11
Total	11598	9225	3553	409	813	121	9120	7429	2688	16431	13392	5826	534	755	220	11980	10273	4505	18823	15779	6791	586	919	270	14317	12428	4673

[a] Compiled by U.S. Department of Transportation Motor Carrier Management Information System (MCMIS).

[b] KEY: A—Reportable Accidents and/or Tow-Aways I—Interstate Highway System
F-Accident-related Fatalities P—Primary (non-Interstate) System (NHS and Other Principal Arterials)
J—Accident-related Injuries O—Other Roads and Highways

* Indicates states missing partial- or full-year data, or with no qualifying accidents in the MCMIS file (e.g., Rhode Island).

TABLE 1b Reportable Accident, Fatality, and Injury Counts for States Missing Location Data in 1994, 1995, and 1996 for Interstate-Registered Heavy Combination Trucks[a]

	1994			1995			1996		
State	Accidents	Fatalities	Injuries	Accidents	Fatalities	Injuries	Accidents	Fatalities	Injuries
Georgia	2761	107	2632	2580	40	1603	3783	119	2026
Louisiana	396	15	435	451	34	435	1158	34	802
New York	1325	52	830	1612	44	771	1166	52	603
Oregon	298	40	179	211	27	126	773	54	506
South Carolina	1048	67	1001	823	42	492	1104	56	598

[a] Rhode Island provides usable location data but no qualifying accidents in the MCMIS file.

TABLE 2 Estimated Flows in 1994, 1995, and 1996 for Interstate-Registered Heavy Combination Trucks by Road Classification (10^6 km)

	1994				1995				1996			
State	Interstate	Primary	Other	All Roads	Interstate	Primary	Other	All Roads	Interstate	Primary	Other	All Roads
Alabama	1785	1304	395	3484	1326	1457	778	3561	1524	1242	446	3212
Arizona	1617	1167	158	2942	1840	1147	161	3149	1994	1047	126	3168
Arkansas	1378	1388	787	3552	1359	1115	617	3091	1325	1430	816	3571
California	3278	8788	612	12679	3370	8655	611	12636	3324	7564	542	11430
Colorado	724	685	210	1619	855	685	257	1796	785	723	275	1783
Connecticut	534	133	23	689	506	204	29	739	473	194	57	723
Delaware	105	91	10	206	125	259	32	416	127	125	20	272
Florida	2081	2022	268	4371	2230	2643	283	5156	2170	2260	259	4690
Georgia	2510	1138	417	4065	2835	1382	471	4689	2889	1453	537	4878
Idaho	405	228	89	722	451	276	106	833	475	310	108	892
Illinois	4599	1475	264	6338	4862	1857	504	7224	5334	1249	344	6927
Indiana	2738	1756	756	5249	3135	1972	853	5961	2921	1772	913	5606
Iowa	1297	900	321	2517	1340	876	324	2540	1291	699	168	2158
Kansas	612	644	375	1630	752	818	435	2005	749	673	281	1702
Kentucky	1380	560	251	2191	1469	608	263	2340	1592	604	227	2422
Louisiana	1371	1072	629	3072	1376	1042	693	3111	1267	970	647	2884
Maine	224	119	60	403	230	158	95	483	212	209	120	540
Maryland	1004	439	97	1539	1002	352	75	1429	1035	319	96	1451
Massachusetts	878	279	15	1171	710	381	37	1128	769	322	68	1160
Michigan	1733	2054	307	4094	1840	2063	333	4236	2639	6387	1448	10474
Minnesota	641	901	214	1756	689	899	222	1810	700	837	211	1748
Mississippi	872	1043	498	2414	902	1121	548	2572	1022	1158	551	2731
Missouri	1955	1435	410	3801	2020	1501	331	3852	2059	1394	330	3783
Montana	318	203	73	594	349	253	89	691	359	234	96	689
Nebraska	619	432	144	1196	667	461	145	1273	681	458	145	1283
Nevada	601	221	95	918	660	266	100	1026	697	290	112	1098
New Hampshire	82	153	37	272	82	154	37	273	137	131	37	305
New Jersey	770	1316	97	2183	773	1649	122	2544	1011	1094	87	2193
New Mexico	933	506	215	1655	861	561	231	1653	881	485	223	1589
New York	1541	2311	330	4182	1604	2301	326	4231	1613	1576	297	3486
North Carolina	1642	3245	1269	6157	1752	3363	1240	6355	1826	1135	313	3274
North Dakota	173	176	98	448	204	186	99	489	217	223	105	545
Ohio	3853	2560	993	7406	4329	2327	1014	7670	3372	2826	967	7164
Oklahoma	863	769	584	2216	1128	955	675	2758	1101	778	439	2317
Oregon	795	540	183	1518	1099	806	286	2191	1176	789	270	2236
Pennsylvania	2650	1474	274	4398	2900	1457	290	4647	3235	1394	290	4919
Rhode Island	88	78	3	168	127	17	1	145	76	32	0	109
South Carolina	836	524	144	1504	1515	760	271	2546	1562	574	158	2293
South Dakota	189	163	73	425	217	155	45	417	278	238	91	606
Tennessee	2578	802	255	3635	2710	808	259	3777	2783	1206	260	4250
Texas	4430	5327	1222	10979	4181	5035	943	10159	4269	4211	919	9399
Utah	702	333	82	1118	763	332	90	1186	794	332	92	1219
Vermont	127	97	41	264	144	100	45	289	144	88	40	271
Virginia	1705	1122	164	2992	1793	1150	167	3110	2725	4672	1032	8430
Washington	746	1020	189	1955	814	1008	201	2023	685	767	209	1661
West Virginia	971	272	226	1468	785	296	174	1255	692	388	194	1274
Wisconsin	901	1389	334	2625	1132	1372	325	2828	1267	1353	297	2918
Wyoming	554	139	51	744	698	149	57	904	880	166	54	1100
Total	62385	54794	14344	131523	66513	57393	15291	139197	69136	58379	15317	142832

TABLE 3a Accident Rates (10^{-7} accidents/truck-km), Fatality Rates (10^{-8} fatalities/truck-km), and Injury Rates (10^{-7} injuries/truck-km) for Interstate-Registered Heavy Combination Trucks in 1994[a]

	Accidents				Fatalities				Injuries			
State/Parameter	94A/I	94A/P	94A/O	94A/T	94F/I	94F/P	94F/O	94F/T	94J/I	94J/P	94J/O	94I/T
Alabama	1.837	4.110	2.940	2.813	0.840	3.834	0.760	1.952	1.047	2.385	1.470	1.596
Arizona	1.150	0.583	0.063	0.867	0.433	1.285	0.000	0.748	1.169	0.531	0.000	0.853
Arkansas	1.880	2.904	0.229	1.914	0.508	10.881	0.000	4.448	1.278	2.580	0.191	1.545
California	1.855	0.436	1.797	0.868	1.007	0.273	1.143	0.505	1.980	0.502	1.813	0.947
Colorado	4.697	3.985	6.293	4.603	1.796	2.482	1.430	2.039	3.426	2.890	4.481	3.336
Connecticut	5.057	1.960	9.571	4.612	2.060	3.016	17.401	2.756	3.465	2.111	4.785	3.249
Delaware	5.994	14.921	26.447	10.947	0.000	5.486	9.795	2.906	3.616	10.752	15.672	7.362
Florida	0.226	0.213	0.486	0.236	0.288	0.791	0.747	0.549	0.173	0.178	0.486	0.194
Georgia	*	*	*	6.792	*	*	*	2.632	*	*	*	6.475
Idaho	2.052	3.808	4.840	2.951	0.000	5.252	2.251	1.939	2.991	3.939	5.853	3.643
Illinois	1.507	2.149	10.682	2.039	0.674	1.763	6.061	1.152	1.531	2.041	10.038	2.004
Indiana	2.122	1.213	0.291	1.554	0.475	1.082	0.529	0.686	1.330	0.940	0.265	1.046
Iowa	0.817	0.989	1.557	0.973	0.925	1.556	1.246	1.192	0.370	0.433	0.561	0.417
Kansas	3.791	6.495	4.511	5.024	0.654	4.195	1.068	2.147	2.320	4.055	1.762	2.877
Kentucky	2.834	9.761	4.416	4.787	1.595	5.710	0.398	2.510	1.914	6.656	2.665	3.213
Louisiana	*	*	*	1.289	*	*	*	0.488	*	*	*	1.416
Maine	1.118	2.595	1.995	1.686	0.000	0.000	0.000	0.000	0.716	1.841	1.164	1.116
Maryland	5.331	8.179	19.933	7.062	0.498	4.785	7.230	2.144	4.644	7.314	14.459	6.022
Massachusetts	0.399	1.794	44.822	1.290	0.000	1.077	20.374	0.512	0.194	1.256	35.314	0.888
Michigan	*	*	*	3.610	*	*	*	1.490	*	*	*	3.700
Minnesota	1.483	1.553	0.654	1.418	0.000	1.442	0.000	0.740	0.578	1.121	0.421	0.837
Mississippi	0.734	1.054	0.401	0.804	0.573	0.575	0.201	0.497	0.550	0.901	0.241	0.638
Missouri	4.056	4.857	6.825	4.657	1.125	4.042	1.219	2.237	3.181	3.449	4.290	3.402
Montana	5.915	5.946	3.983	5.689	1.888	2.948	0.000	2.020	3.146	3.342	0.687	2.912
Nebraska	3.118	5.994	5.126	4.400	1.292	3.008	1.385	1.924	1.874	3.332	2.494	2.476
Nevada	2.245	4.614	0.315	2.616	0.166	1.809	0.000	0.545	1.430	3.528	0.000	1.787
New Hampshire	4.162	4.373	5.902	4.519	0.000	2.611	2.683	1.837	4.407	2.154	2.683	2.903
New Jersey	5.324	1.991	15.305	3.761	2.337	0.228	0.000	0.962	2.792	1.550	10.374	2.382
New Mexico	1.050	1.265	1.022	1.112	0.643	0.593	0.465	0.604	1.039	0.949	1.068	1.015
New York	*	*	*	3.168	*	*	*	1.243	*	*	*	1.985
North Carolina	2.752	1.812	2.135	2.129	1.096	1.356	0.630	1.137	2.429	1.886	1.781	2.009
North Dakota	3.234	2.613	0.203	2.324	0.577	0.568	0.000	0.447	2.079	1.648	0.102	1.475
Ohio	1.119	0.305	0.785	0.793	0.597	0.234	0.302	0.432	1.108	0.316	0.997	0.820
Oklahoma	3.489	3.705	1.576	3.060	1.507	1.560	0.171	1.173	3.639	3.458	1.473	3.006
Oregon	*	*	*	1.963	*	*	*	2.635	*	*	*	1.179
Pennsylvania	5.505	6.447	17.003	6.537	1.245	4.886	7.662	2.865	4.570	5.918	15.835	5.723
Rhode Island	*	*	*	*	*	*	*	*	*	*	*	*
South Carolina	*	*	*	6.968	*	*	*	4.455	*	*	*	6.656
South Dakota	*	*	*	*	*	*	*	*	*	*	*	*
Tennessee	0.268	0.698	0.431	0.374	0.116	0.623	1.176	0.303	0.186	0.835	0.509	0.352
Texas	*	*	*	6.871	*	*	*	1.758	*	*	*	3.915
Utah	2.179	3.239	9.133	3.006	0.570	2.399	3.653	1.342	1.766	2.999	6.576	2.487
Vermont	1.817	6.110	1.221	3.294	0.000	4.142	0.000	1.514	0.948	3.728	0.488	1.893
Virginia	3.993	3.626	0.547	3.666	1.349	1.515	0.000	1.337	3.155	3.029	0.182	2.944
Washington	2.159	1.265	1.056	1.586	0.000	0.686	0.528	0.409	1.890	0.892	1.056	1.289
West Virginia	1.751	5.591	1.373	2.404	2.679	17.657	1.329	5.244	0.907	4.046	0.266	1.389
Wisconsin	5.195	3.570	14.172	5.479	1.221	2.879	2.093	2.210	4.129	2.800	10.434	4.229
Wyoming	6.900	5.018	3.747	6.332	1.626	2.151	0.000	1.613	3.667	2.294	3.549	3.401

TABLE 3a (Cont.)

	Accidents				Fatalities				Injuries			
State/Parameter	94A/I	94A/P	94A/O	94A/T	94F/I	94F/P	94F/O	94F/T	94J/I	94J/P	94J/O	94I/T
Total Rate	1.859	1.681	2.475	2.980	0.655	1.482	0.843	1.020	1.462	1.354	1.873	1.462
Mean Rate	2.849	3.634	5.995	3.366	0.830	2.856	2.408	1.615	2.093	2.682	4.269	2.500
Standard Deviation	1.824	2.952	8.872	2.293	0.717	3.234	4.532	1.149	1.331	2.139	6.789	1.757
5th Percentile	0.386	0.423	0.226	0.795	0.000	0.234	0.000	0.415	0.193	0.422	0.091	0.472
Median	2.179	3.239	2.135	2.978	0.643	1.809	0.747	1.416	1.890	2.294	1.473	2.007
95th Percentile	5.923	8.337	20.585	6.944	2.088	6.227	10.556	4.062	4.424	6.722	15.688	6.362

[a] Asterisk indicates missing data (no records for state or blank accident location field). Rhode Island had no qualifying accidents, so national mean rates should be used.

TABLE 3b Accident Rates (10^{-7} accidents/truck-km), Fatality Rates (10^{-8} fatalities/ truck-km), and Injury Rates (10^{-7} injuries/truck-km) for Interstate-Registered Heavy Combination Trucks in 1995[a]

	Accidents				Fatalities				Injuries			
State/Parameter	95A/I	95A/P	95A/O	95A/T	95F/I	95F/P	95F/O	95F/T	95J/I	95J/P	95J/O	95I/T
Alabama	2.835	4.407	1.659	3.221	0.829	3.501	1.029	1.966	1.659	2.801	0.861	1.952
Arizona	1.320	0.845	0.000	1.080	1.413	0.610	0.000	1.048	1.391	0.776	0.000	1.096
Arkansas	1.560	3.614	0.454	2.080	1.030	3.856	0.000	1.844	1.361	3.425	0.551	1.944
California	1.089	0.325	1.228	0.572	0.281	0.141	0.221	0.182	0.832	0.204	0.824	0.401
Colorado	4.317	3.883	5.221	4.281	0.936	1.022	5.065	1.559	2.878	2.554	3.506	2.844
Connecticut	9.779	3.720	60.049	10.063	1.778	1.958	20.826	2.570	6.243	2.251	51.024	6.885
Delaware	4.074	3.901	9.385	4.375	0.799	1.545	0.000	1.202	3.355	3.013	5.944	3.341
Florida	0.726	0.711	3.115	0.850	0.942	1.173	3.894	1.222	0.615	0.614	3.314	0.762
Georgia	*	*	*	5.503	*	*	*	0.853	*	*	*	3.419
Idaho	2.306	5.064	5.484	3.624	0.443	4.703	7.564	2.760	2.217	4.485	6.335	3.492
Illinois	2.550	1.707	7.831	2.702	0.950	0.829	3.256	1.080	1.556	0.753	3.022	1.452
Indiana	1.956	1.151	0.316	1.455	0.734	1.318	0.000	0.822	1.337	0.908	0.305	1.047
Iowa	0.739	1.005	1.668	0.949	0.373	1.713	0.000	0.787	0.485	0.811	1.359	0.709
Kansas	2.049	3.656	1.837	2.658	0.665	4.401	0.919	2.244	2.195	4.279	2.182	3.042
Kentucky	3.152	11.055	6.046	5.531	1.021	5.758	1.141	2.265	2.247	7.798	3.840	3.868
Louisiana	*	*	*	1.450	*	*	*	1.093	*	*	*	1.398
Maine	4.225	1.389	9.551	4.345	0.871	0.000	4.198	1.241	3.078	1.346	7.977	3.476
Maryland	5.468	8.131	37.129	7.794	0.798	3.980	5.304	1.819	4.540	6.369	25.725	6.108
Massachusetts	0.930	1.496	12.810	1.508	0.000	0.525	5.451	0.355	0.507	0.945	10.357	0.976
Michigan	3.097	1.643	15.488	3.362	1.413	0.969	11.428	1.983	2.809	1.827	16.781	3.428
Minnesota	1.639	1.914	1.575	1.768	0.580	1.669	0.450	1.105	0.856	1.469	1.305	1.215
Mississippi	0.333	0.553	0.401	0.443	0.111	0.268	0.000	0.156	0.344	0.687	0.255	0.474
Missouri	4.594	4.850	9.182	5.088	0.792	1.466	0.604	1.038	2.906	3.464	5.981	3.388
Montana	4.929	4.895	3.045	4.675	0.573	3.158	6.766	2.316	2.264	3.079	1.240	2.431
Nebraska	2.368	3.928	2.888	2.992	0.150	1.085	1.375	0.628	1.454	2.474	1.307	1.806
Nevada	1.803	2.896	0.100	1.920	0.909	1.504	0.000	0.974	1.257	2.069	0.000	1.345
New Hampshire	3.784	3.973	7.793	4.437	0.000	0.651	0.000	0.367	0.732	2.280	4.568	2.127
New Jersey	4.954	1.668	19.413	3.518	0.517	0.000	2.457	0.275	3.247	1.486	12.696	2.559
New Mexico	1.092	0.748	1.169	0.986	0.981	1.693	0.457	1.150	1.015	0.732	1.368	0.968
New York	*	*	*	3.810	*	*	*	1.040	*	*	*	1.822
North Carolina	3.231	2.284	2.886	2.663	1.884	1.249	1.371	1.448	3.128	2.266	2.330	2.516
North Dakota	3.283	1.609	1.620	2.309	0.980	4.290	0.000	2.044	2.499	0.751	1.620	1.655
Ohio	1.636	0.382	0.907	1.159	0.393	0.258	0.690	0.391	1.402	0.400	1.173	1.068
Oklahoma	2.137	2.745	2.755	2.498	1.241	2.095	1.185	1.523	2.110	2.818	2.755	2.513
Oregon	*	*	*	0.963	*	*	*	1.232	*	*	*	0.575
Pennsylvania	4.765	6.301	21.701	6.305	1.241	3.363	4.478	2.109	3.124	4.592	18.532	4.547
Rhode Island	*	*	*	*	*	*	*	*	*	*	*	*
South Carolina	*	*	*	3.233	*	*	*	1.650	*	*	*	1.933
South Dakota	0.646	0.579	0.442	0.599	0.000	0.643	0.000	0.240	0.507	0.257	0.663	0.431
Tennessee	1.229	2.810	1.547	1.589	0.996	2.600	0.387	1.297	0.915	2.426	1.354	1.268
Texas	6.597	7.031	7.843	6.928	1.316	2.344	2.226	1.910	4.655	4.916	5.618	4.873
Utah	2.215	2.587	8.424	2.792	0.917	1.203	2.217	1.096	2.005	1.925	5.986	2.286
Vermont	2.225	5.176	1.773	3.179	0.000	1.991	0.000	0.691	1.878	3.584	0.222	2.212
Virginia	4.266	3.461	0.479	3.765	2.454	1.739	0.000	2.058	3.564	3.113	0.598	3.238
Washington	1.806	1.042	0.895	1.335	0.246	1.191	0.000	0.692	1.204	0.715	0.647	0.905
West Virginia	1.783	3.545	1.728	2.191	0.892	2.701	1.152	1.355	1.185	2.127	0.979	1.379
Wisconsin	4.074	3.551	15.536	5.137	0.707	2.843	4.615	2.192	2.757	2.537	10.767	3.571
Wyoming	5.603	6.222	5.282	5.685	1.146	1.338	0.000	1.106	3.238	2.676	2.993	3.130

TABLE 3b (Cont.)

	Accidents				Fatalities				Injuries			
State/Parameter	95A/I	95A/P	95A/O	95A/T	95F/I	95F/P	95F/O	95F/T	95J/I	95J/P	95J/O	95I/T
Total Rate	2.835	2.621	4.399	2.972	0.922	1.478	1.660	1.085	2.067	2.011	3.402	1.924
Mean Rate	2.932	3.154	7.111	3.178	0.817	1.889	2.398	1.297	2.085	2.333	5.449	2.295
Standard Deviation	1.902	2.303	11.115	2.076	0.527	1.401	3.892	0.677	1.283	1.659	9.084	1.449
5th Percentile	0.727	0.554	0.321	0.674	0.000	0.147	0.000	0.250	0.507	0.410	0.223	0.505
Median	2.337	2.853	2.887	2.792	0.850	1.525	0.974	1.202	1.941	2.259	2.256	1.952
95th Percentile	5.596	6.994	21.587	6.741	1.760	4.396	7.524	2.301	4.491	4.899	18.444	4.775

[a] Asterisk indicates missing data (no records for state or blank accident location field). Rhode Island had no qualifying accidents, so national mean rates should be used.

TABLE 3c Accident Rates (10^{-7} accidents/truck-km), Fatality Rates (10^{-8} fatalities/ truck-km), and Injury Rates (10^{-7} injuries/truck-km) for Interstate-Registered Heavy Combination Trucks in 1996[a]

	Accidents				Fatalities				Injuries			
State/Parameter	9A/I	96A/P	96A/O	96A/T	96F/I	96F/P	96F/O	96F/T	96J/I	96J/P	96J/O	96/T
Alabama	3.958	7.338	4.973	5.405	0.919	5.235	1.792	2.709	1.838	4.422	2.330	2.905
Arizona	1.449	1.022	0.079	1.253	0.903	1.337	0.000	1.010	0.958	0.582	0.000	0.796
Arkansas	0.558	0.769	0.061	0.529	0.302	0.560	0.000	0.336	0.294	0.553	0.037	0.339
California	1.868	0.609	2.417	1.061	0.812	0.238	0.369	0.411	0.915	0.312	1.716	0.554
Colorado	4.410	3.566	5.055	4.167	0.765	2.626	1.818	1.682	3.199	2.516	3.345	2.944
Connecticut	12.737	4.233	26.728	11.560	0.423	0.516	0.000	0.415	9.035	3.407	17.584	8.200
Delaware	5.607	11.568	12.269	8.849	0.790	7.180	0.000	3.672	3.317	8.537	8.343	6.095
Florida	0.654	0.792	4.433	0.930	0.599	0.929	3.084	0.896	0.489	0.575	2.737	0.655
Georgia	*	*	*	7.755	*	*	*	2.439	*	*	*	4.153
Idaho	4.318	6.138	5.201	5.056	0.632	6.461	0.929	2.691	3.939	5.556	4.737	4.596
Illinois	2.521	4.972	25.022	4.081	0.844	1.361	3.778	1.083	1.425	1.233	3.923	1.514
Indiana	2.681	1.788	0.647	2.067	0.787	1.862	0.438	1.070	1.530	1.495	0.449	1.343
Iowa	1.828	3.562	5.787	2.698	1.549	3.433	1.790	2.178	1.743	3.175	5.012	2.461
Kansas	2.859	5.735	3.315	4.071	0.267	5.497	1.069	2.467	3.059	6.181	4.099	4.465
Kentucky	3.280	10.136	5.513	5.198	1.257	4.472	1.764	2.106	2.444	7.403	2.955	3.728
Louisiana	*	*	*	4.016	*	*	*	1.179	*	*	*	2.781
Maine	4.573	2.254	5.673	3.922	0.943	0.000	0.000	0.370	3.158	1.966	5.423	3.201
Maryland	3.834	6.827	15.630	5.273	0.483	2.505	4.168	1.172	3.293	6.075	12.192	4.494
Massachusetts	1.326	2.203	6.028	1.845	0.260	0.310	0.000	0.259	0.871	1.675	3.381	1.242
Michigan	2.645	0.727	4.025	1.666	0.834	0.532	1.243	0.707	2.475	0.772	4.364	1.698
Minnesota	2.001	2.269	1.706	2.094	0.286	3.464	0.000	1.774	1.072	1.971	1.659	1.573
Mississippi	0.381	1.002	0.363	0.641	0.098	0.777	0.000	0.366	0.284	1.037	0.254	0.597
Missouri	5.236	6.497	12.456	6.330	1.797	4.088	1.818	2.643	3.341	4.690	7.152	4.171
Montana	7.687	7.481	3.558	7.044	1.671	2.565	0.000	1.743	2.339	3.035	1.465	2.454
Nebraska	4.056	7.559	6.898	5.626	2.645	4.151	1.380	3.039	2.557	4.763	3.725	3.476
Nevada	2.685	4.003	0.447	2.805	0.861	1.725	0.893	1.093	1.723	2.174	0.715	1.739
New Hampshire	1.023	3.139	6.675	2.624	0.000	3.063	0.000	1.312	0.512	2.833	4.806	2.034
New Jersey	6.419	4.999	57.086	7.726	0.890	0.274	10.317	0.958	5.262	4.697	46.196	6.609
New Mexico	1.260	1.072	0.898	1.152	1.930	1.031	1.347	1.574	1.396	1.175	0.853	1.253
New York	*	*	*	3.345	*	*	*	1.492	*	*	*	1.730
North Carolina	4.311	9.462	13.161	6.943	1.479	4.581	4.472	2.841	3.878	9.859	10.510	6.586
North Dakota	2.851	6.651	2.465	4.327	1.380	2.696	0.000	1.650	1.748	5.168	3.034	3.392
Ohio	0.323	0.057	0.155	0.195	0.059	0.000	0.000	0.028	0.237	0.032	0.197	0.151
Oklahoma	2.599	3.137	2.599	2.779	1.272	2.700	0.912	1.683	3.089	3.343	2.758	3.112
Oregon	*	*	*	3.458	*	*	*	2.415	*	*	*	2.263
Pennsylvania	5.171	9.117	25.471	7.485	1.545	4.017	3.106	2.338	3.867	7.252	19.017	5.718
Rhode Island	*	*	*	*	*	*	*	*	*	*	*	*
South Carolina	*	*	*	4.814	*	*	*	2.442	*	*	*	2.608
South Dakota	3.637	3.746	2.086	3.447	1.080	2.105	4.391	1.979	2.665	2.526	1.208	2.391
Tennessee	1.434	1.931	1.806	1.598	1.114	2.652	1.537	1.577	1.114	1.741	1.191	1.297
Texas	5.420	6.875	6.863	6.213	1.288	3.467	14.575	3.564	6.268	5.652	5.297	5.897
Utah	4.192	3.309	9.556	4.356	2.014	1.203	1.086	1.723	3.713	2.557	7.710	3.700
Vermont	1.599	4.454	1.264	2.473	0.000	2.284	0.000	0.738	1.668	4.112	1.769	2.473
Virginia	3.680	1.222	0.048	1.873	1.211	0.685	0.000	0.771	2.759	1.077	0.029	1.492
Washington	4.204	3.312	1.724	3.480	0.292	0.261	1.916	0.482	2.394	2.164	1.197	2.138
West Virginia	1.604	2.527	1.083	1.806	1.156	2.321	0.000	1.335	1.359	1.934	0.774	1.445
Wisconsin	4.363	4.774	17.528	5.895	0.868	3.916	0.673	2.262	3.267	4.079	11.742	4.507
Wyoming	7.541	10.507	7.559	7.989	0.681	3.623	0.000	1.091	2.953	4.831	2.028	3.190

TABLE 3c (Cont.)

	Accidents				Fatalities				Injuries			
State/Parameter	9A/I	96A/P	96A/O	96A/T	96F/I	96F/P	96F/O	96F/T	96J/I	96J/P	96J/O	96/T
Total Rate	3.109	2.978	5.065	3.460	0.968	1.734	2.014	1.464	2.364	2.346	3.485	2.519
Mean Rate	3.447	4.365	7.531	4.041	0.928	2.445	1.683	1.569	2.463	3.313	5.188	2.897
Standard Deviation	2.357	3.043	10.464	2.521	0.591	1.825	2.807	0.908	1.698	2.366	7.851	1.852
5th Percentile	0.563	0.729	0.083	0.727	0.061	0.239	0.000	0.345	0.304	0.554	0.045	0.567
Median	3.069	3.656	4.703	3.922	0.865	2.413	0.920	1.574	2.419	2.695	2.994	2.473
95th Percentile	7.485	10.102	25.448	7.919	1.923	5.484	4.468	2.980	5.196	7.396	17.314	6.439

[a] Asterisk indicates missing data (no records for state or blank accident location field). Rhode Island had no qualifying accidents, so national mean rates should be used.

TABLE 4 Composite 1994-1996 Accident, Fatality, and Injury Rates for Interstate-Registered Heavy Combination Trucks[a]

	Composite Accident Rate (10^{-7} Accidents/trk-km)				Composite Fatality Rate (10^{-8} Fatalities/trk-km)				Composite Injury Rate (10^{-7} Injuries/trk-km)			
State/Parameter	Interstate	Primary	Other	Total	Interstate	Primary	Other	Total	Interstate	Primary	Other	Total
Alabama	2.82	5.22	2.88	3.77	0.86	4.15	1.17	2.19	1.48	3.17	1.41	2.13
Arizona	1.32	0.81	0.04	1.07	0.94	1.07	0.00	0.94	1.17	0.63	0.00	0.92
Arkansas	1.34	2.33	0.23	1.48	0.62	5.14	0.00	2.22	0.98	2.08	0.23	1.24
California	1.60	0.45	1.79	0.83	0.70	0.22	0.59	0.36	1.24	0.34	1.44	0.64
Colorado	4.46	3.81	5.46	4.34	1.14	2.05	2.83	1.75	3.15	2.65	3.72	3.03
Connecticut	*9.04*	3.47	*31.93*	*8.82*	1.45	1.70	*9.20*	1.91	*6.13*	2.64	*23.74*	*6.16*
Delaware	5.18	8.04	13.11	7.25	0.56	3.79	1.60	2.35	3.42	5.95	8.31	5.11
Florida	0.69	0.75	3.75	0.89	0.77	1.06	3.51	1.07	0.55	0.60	3.04	0.71
Georgia	*	*	*	6.69	*	*	*	1.95	*	*	*	4.59
Idaho	2.95	5.12	5.19	3.95	0.38	5.52	3.64	2.49	3.07	4.74	5.62	3.94
Illinois	2.22	2.74	13.82	2.96	0.83	1.27	4.08	1.10	1.50	1.30	4.97	1.64
Indiana	2.25	1.38	0.43	1.69	0.67	1.42	0.32	0.86	1.40	1.11	0.34	1.15
Iowa	1.12	1.72	2.47	1.48	0.94	2.14	0.86	1.34	0.86	1.34	1.80	1.13
Kansas	2.84	5.17	3.14	3.83	0.52	4.68	1.01	2.29	2.54	4.81	2.53	3.45
Kentucky	3.10	*10.33*	5.33	5.18	1.28	5.30	1.08	2.29	2.21	*7.30*	3.17	3.61
Louisiana	*	*	*	2.21	*	*	*	0.92	*	*	*	1.84
Maine	4.39	1.88	7.39	4.12	0.91	0.00	1.86	0.78	3.12	1.70	6.55	3.33
Maryland	5.40	8.16	*27.46*	7.41	0.65	4.43	*6.39*	1.99	4.59	*6.89*	*19.39*	*6.06*
Massachusetts	0.86	1.81	12.89	1.55	0.08	0.61	4.19	0.38	0.51	1.27	9.46	1.04
Michigan	2.83	0.95	6.17	2.15	1.07	0.64	3.14	1.07	2.61	1.03	6.68	2.20
Minnesota	1.71	1.90	1.31	1.76	0.30	2.16	0.15	1.20	0.84	1.51	1.13	1.21
Mississippi	0.48	0.87	0.39	0.63	0.25	0.54	0.06	0.34	0.39	0.88	0.25	0.57
Missouri	4.64	5.38	9.29	5.36	1.24	3.16	1.21	1.97	3.14	3.85	5.69	3.65
Montana	6.20	6.08	3.50	5.81	1.36	2.90	2.33	2.03	2.56	3.14	1.17	2.58
Nebraska	3.19	5.82	4.97	4.34	1.37	2.74	1.38	1.87	1.97	3.52	2.51	2.59
Nevada	2.25	3.80	0.29	2.45	0.66	1.67	0.33	0.89	1.48	2.52	0.26	1.62
New Hampshire	2.63	3.86	6.79	3.81	0.00	2.06	0.89	1.18	1.63	2.40	4.02	2.34
New Jersey	5.65	2.67	*28.83*	4.93	1.21	0.15	3.91	0.71	3.91	2.37	*21.49*	3.79
New Mexico	1.13	1.02	1.03	1.08	1.18	1.13	0.76	1.10	1.15	0.94	1.10	1.08
New York	*	*	*	3.45	*	*	*	1.24	*	*	*	1.85
North Carolina	3.46	3.14	3.69	3.34	1.49	1.78	1.38	1.62	3.17	3.22	2.99	3.16
North Dakota	3.02	4.87	1.37	3.42	1.02	1.76	0.00	1.11	1.89	3.61	1.62	2.53
Ohio	1.64	0.38	0.91	1.16	0.39	0.26	0.69	0.39	1.40	0.40	1.17	1.07
Oklahoma	2.68	3.16	2.31	2.76	1.33	2.12	0.77	1.47	2.89	3.18	2.31	2.85
Oregon	*	*	*	2.16	*	*	*	2.04	*	*	*	1.36
Pennsylvania	5.14	7.26	21.47	6.79	1.35	4.09	5.03	2.43	3.83	5.90	*17.83*	5.33
Rhode Island	*	*	*	*	*	*	*	*	*	*	*	*
South Carolina	*	*	*	4.69	*	*	*	2.60	*	*	*	3.30
South Dakota	2.33	2.49	1.54	2.29	0.61	1.53	2.93	1.27	1.72	1.63	1.03	1.59
Tennessee	1.23	2.81	1.55	1.59	1.00	2.60	0.39	1.30	0.92	2.43	1.35	1.27
Texas	6.00	6.96	7.36	6.58	1.30	2.86	*8.32*	2.70	*5.47*	5.25	5.46	5.37
Utah	2.90	3.05	9.04	3.40	1.19	1.60	2.27	1.39	2.53	2.49	6.77	2.84
Vermont	1.88	5.27	1.43	2.98	0.00	2.81	0.00	0.97	1.52	3.80	0.80	2.20
Virginia	3.93	1.98	0.16	2.65	1.61	0.99	0.00	1.16	3.10	1.73	0.12	2.16
Washington	2.65	1.75	1.23	2.05	0.18	0.75	0.83	0.53	1.80	1.18	0.97	1.40
West Virginia	1.72	3.71	1.38	2.15	1.68	*6.80*	0.84	2.78	1.12	2.59	0.64	1.40
Wisconsin	4.49	3.96	15.68	5.51	0.91	3.21	2.51	2.22	3.33	3.13	10.95	4.10
Wyoming	6.74	7.41	5.56	6.78	1.08	2.42	0.00	1.24	3.23	3.34	2.84	3.23

TABLE 4 (Cont.)

	Composite Accident Rate (10^{-7} Accidents/trk-km)				Composite Fatality Rate (10^{-8} Fatalities/trk-km)				Composite Injury Rate (10^{-7} Injuries/trk-km)			
State/Parameter	Interstate	Primary	Other	Total	Interstate	Primary	Other	Total	Interstate	Primary	Other	Total
Total Rate	3.00	2.78	4.56	3.21	0.96	1.78	1.71	1.42	2.25	2.17	3.33	2.39
Mean Rate	3.15	3.66	6.54	3.52	0.88	2.32	1.96	1.49	2.27	2.73	4.69	2.56
Std. Deviation	1.87	2.41	8.02	2.06	0.45	1.64	2.19	0.68	1.32	1.75	5.91	1.48
5th Percentile	0.87	0.75	0.23	0.94	0.09	0.22	0.00	0.38	0.57	0.60	0.24	0.77
Median	2.83	3.15	3.59	3.34	0.92	2.06	1.13	1.30	1.93	2.51	2.52	2.20
95th Percentile	6.19	8.00	27.16	7.12	1.49	5.30	6.32	2.57	4.56	5.95	19.31	5.35

[a] Asterisk indicates missing data (no records for state or blank accident location field). Rhode Island had no qualifying accidents, so national mean rates should be used. Values in italics are equal to or greater than two standard deviations above the national mean rate for the column category.

7 STATISTICAL DATA AND TABLES OF RATES— RAILROADS

TABLE 5a Rail Freight Accidents, Incidents, Fatalities, and Injuries of Trespassers and Nontrespassers, plus Estimated Car-Kilometers, by State and Total, 1994

State	Accidents	Grade-Crossing Incidents	Nontrespasser Fatalities	Trespasser *Fatalities*	Total Fatalities	Nontrespasser Injuries	*Trespasser Injuries*	Total Injuries	Estimated Car-km (loaded + unloaded)
AL	27	179	12	*5*	17	77	*4*	81	930,794,795
AZ	22	29	3	*15*	18	10	*12*	22	1,571,786,428
AR	69	139	21	*3*	24	65	*0*	65	806,944,941
CA	144	165	34	*71*	105	54	*35*	89	2,570,052,135
CO	43	47	11	*7*	18	10	*7*	17	1,242,144,735
CT	36	1	0	*6*	6	2	*0*	2	7,388,553
DE	7	4	1	*1*	2	4	*1*	5	9,637,854
DC	9	0	0	*1*	1	0	*0*	0	2,836,767
FL	27	92	14	*30*	44	41	*23*	64	819,549,370
GA	40	150	12	*11*	23	57	*10*	67	1,313,577,283
ID	37	45	9	*4*	13	12	*0*	12	529,928,818
IL	279	185	42	*42*	84	105	*44*	149	2,638,642,703
IN	60	262	26	*11*	37	93	*31*	124	1,202,829,047
IA	71	154	19	*3*	22	56	*4*	60	1,169,376,559
KS	94	154	16	*5*	21	32	*5*	37	1,798,428,546
KY	29	94	10	*10*	20	42	*2*	44	1,020,649,441
LA	71	208	16	*12*	28	105	*8*	113	515,286,986
ME	5	8	0	*0*	0	3	*0*	3	18,145,629
MD	9	13	0	*8*	8	6	*6*	12	244,168,145
MA	13	12	0	*12*	12	4	*4*	8	47,906,761
MI	63	161	24	*9*	33	54	*20*	74	356,338,310
MN	100	145	18	*4*	22	45	*22*	67	1,285,629,438
MS	80	148	25	*2*	27	59	*4*	63	512,984,693
MO	87	114	13	*12*	25	45	*3*	48	2,187,193,312
MT	43	24	1	*4*	5	10	*1*	11	1,300,648,606
NE	94	85	20	*3*	23	22	*2*	24	1,938,792,904
NV	13	6	2	*1*	3	3	*3*	6	1,514,563,840
NH	3	3	0	*0*	0	0	*0*	0	7,418,361
NJ	34	25	5	*20*	25	9	*7*	16	114,014,287
NM	20	17	5	*7*	12	9	*3*	12	1,529,200,188
NY	96	35	10	*28*	38	14	*17*	31	507,408,949
NC	32	145	12	*34*	46	48	*18*	66	412,151,521

TABLE 5a (Cont.)

State	Accidents	Grade-Crossing Incidents	Nontrespasser Fatalities	Trespasser *Fatalities*	Total Fatalities	Nontrespasser Injuries	*Trespasser Injuries*	Total Injuries	Estimated Car-km (loaded + unloaded)
ND	39	21	2	*3*	5	6	*1*	7	840,316,641
OH	67	232	37	*14*	51	84	*9*	93	1,846,397,308
OK	49	120	17	*3*	20	62	*7*	69	884,326,730
OR	38	42	2	*7*	9	12	*6*	18	398,404,221
PA	111	78	14	*15*	29	20	*11*	31	959,004,479
RI	2	2	0	*0*	0	1	*0*	1	233,340
SC	9	91	11	*14*	25	37	*4*	41	242,501,043
SD	29	29	1	*0*	1	11	*0*	11	242,434,253
TN	54	102	14	*4*	18	26	*6*	32	1,028,411,634
TX	229	533	58	*48*	106	237	*39*	276	4,146,480,400
UT	36	25	16	*3*	19	5	*0*	5	481,697,810
VT	3	5	0	*0*	0	1	*0*	1	24,521,742
VA	31	76	7	*15*	22	18	*4*	22	773,063,497
WA	64	72	4	*12*	16	21	*12*	33	763,949,078
WV	17	56	4	*4*	8	9	*12*	21	574,857,888
WI	84	179	14	*5*	19	74	*5*	79	659,075,466
WY	47	10	5	*3*	8	1	*0*	1	1,840,269,569
TOT.	2666	4522	587	*531*	1118	1721	*412*	2133	45,832,365,000

TABLE 5b Rail Freight Accidents, Incidents, Fatalities, and Injuries of Trespassers and Nontrespassers, plus Estimated Car-Kilometers, by State and Total, 1995

State	Accidents	Grade-Crossing Incidents	Nontrespasser Fatalities	*Trespasser Fatalities*	Total Fatalities	NonTrespasser Injuries	*Trespasser Injuries*	Total Injuries	Estimated Car-km (loaded + unloaded)
AL	21	171	16	*7*	23	80	*0*	80	994,026,853
AZ	38	36	2	*14*	16	11	*5*	16	1,676,992,801
AR	63	151	22	*0*	22	63	*2*	65	862,161,947
CA	126	148	7	*88*	95	53	*43*	96	2,740,981,095
CO	51	54	10	*2*	12	32	*5*	37	1,325,940,084
CT	17	2	1	*6*	7	0	*0*	0	7,860,251
DE	2	5	0	*0*	0	1	*0*	1	10,253,151
DC	4	0	0	*1*	1	0	*0*	0	3,017,871
FL	47	75	18	*24*	42	47	*20*	67	875,088,033
GA	39	144	13	*13*	26	42	*23*	65	1,402,691,823
ID	34	31	7	*3*	10	12	*3*	15	563,760,377
IL	255	235	30	*32*	62	110	*12*	122	2,807,098,149
IN	50	259	27	*11*	38	68	*21*	89	1,279,619,703
IA	86	120	9	*4*	13	63	*0*	63	1,250,346,432
KS	83	91	15	*2*	17	47	*0*	47	1,920,200,538
KY	22	100	7	*10*	17	46	*12*	58	1,085,809,440
LA	68	212	25	*6*	31	100	*20*	120	548,183,785
ME	4	10	0	*0*	0	3	*2*	5	19,304,076
MD	12	12	0	*9*	9	7	*6*	13	259,756,255
MA	12	8	3	*8*	11	2	*1*	3	53,247,324
MI	62	128	7	*9*	16	69	*2*	71	379,087,554
MN	96	145	19	*4*	23	31	*8*	39	1,372,280,481
MS	87	143	30	*0*	30	47	*0*	47	548,562,149
MO	87	114	19	*7*	26	53	*3*	56	2,336,324,715
MT	42	18	4	*5*	9	4	*6*	10	1,388,154,937
NE	100	78	8	*1*	9	28	*0*	28	2,070,014,844
NV	4	7	5	*2*	7	2	*1*	3	1,615,694,899
NH	2	4	0	*0*	0	3	*0*	3	7,891,962
NJ	22	18	2	*26*	28	3	*9*	12	121,293,154
NM	17	14	3	*9*	12	10	*2*	12	1,632,360,359
NY	111	31	6	*34*	40	7	*13*	20	542,515,378

TABLE 5b (Cont.)

State	Accidents	Grade-Crossing Incidents	Nontrespasser Fatalities	*Trespasser Fatalities*	Total Fatalities	NonTrespasser Injuries	*Trespasser Injuries*	Total Injuries	Estimated Car-km (loaded + unloaded)
NC	23	117	8	*18*	26	39	*4*	43	438,463,976
ND	37	33	6	*2*	8	18	*0*	18	896,238,604
OH	59	234	36	*6*	42	82	*8*	90	1,972,965,938
OK	54	109	15	*2*	17	64	*4*	68	940,783,655
OR	35	31	5	*7*	12	5	*6*	11	425,968,870
PA	90	71	12	*12*	24	13	*17*	30	1,020,228,959
RI	1	1	0	*0*	0	1	*0*	1	248,237
SC	25	99	5	*9*	14	0	*0*	0	257,982,723
SD	40	40	4	*0*	4	13	*0*	13	257,911,669
TN	48	97	13	*8*	21	32	*9*	41	1,094,067,185
TX	250	451	52	*52*	104	221	*41*	262	4,421,023,271
UT	19	31	4	*2*	6	15	*4*	19	514,890,458
VT	6	2	0	*1*	1	0	*0*	0	26,087,252
VA	34	70	5	*9*	14	22	*7*	29	826,040,171
WA	85	76	3	*21*	24	19	*16*	35	815,562,571
WV	22	34	1	*6*	7	9	*7*	16	701,151,966
WI	77	134	12	*5*	17	54	*0*	54	611,557,795
WY	46	11	0	*1*	1	2	*0*	2	1,964,553,276
TOT.	2615	4205	496	*498*	994	1653	*342*	1995	48,886,247,000

TABLE 5c Rail Freight Accidents, Incidents, Fatalities, and Injuries of Trespassers and Nontrespassers, plus Estimated Car-Kilometers, by State and Total, 1996

State	Accidents	Grade-Crossing Incidents (Frt.)	Non-Trespasser Fatalities	*Trespasser Fatalities*	Total Fatalities	Non-Trespasser Injuries	*Trespasser Injuries*	Total Injuries	Estimated Car-km (loaded + unloaded)
AL	40	147	16	*7*	23	67	*10*	77	1,051,895,976
AZ	23	29	4	*16*	20	5	*9*	14	1,795,591,760
AR	64	131	20	*5*	25	37	*2*	39	921,774,952
CA	138	164	19	*69*	88	51	*41*	92	2,879,831,493
CO	52	32	5	*5*	10	13	*3*	16	1,407,385,082
CT	14	5	0	*3*	3	0	*0*	0	6,637,737
DE	3	3	0	*1*	1	2	*1*	3	11,030,021
DC	8	1	0	*0*	0	0	*0*	0	3,302,060
FL	47	83	11	*24*	35	29	*12*	41	920,239,406
GA	50	143	18	*7*	25	44	*14*	58	1,503,161,695
ID	34	45	6	*1*	7	12	*0*	12	543,217,416
IL	262	200	36	*33*	69	69	*23*	92	2,902,943,782
IN	66	195	25	*10*	35	76	*1*	77	1,378,045,617
IA	84	116	8	*4*	12	38	*2*	40	1,400,064,062
KS	76	107	13	*6*	19	40	*0*	40	2,024,457,570
KY	41	74	3	*8*	11	24	*13*	37	1,156,058,771
LA	65	210	30	*5*	35	106	*0*	106	569,463,565
ME	6	7	0	*0*	0	1	*1*	2	19,793,012
MD	14	7	0	*7*	7	3	*1*	4	275,683,462
MA	12	16	1	*11*	12	4	*7*	11	53,525,248
MI	49	136	13	*9*	22	80	*6*	86	390,385,530
MN	99	141	14	*4*	18	46	*3*	49	1,229,458,163
MS	66	115	9	*1*	10	63	*4*	67	582,601,322
MO	79	122	19	*10*	29	35	*8*	43	2,462,205,125
MT	53	32	3	*4*	7	14	*2*	16	1,350,385,563
NE	80	60	7	*5*	12	20	*2*	22	1,945,463,048
NV	11	5	1	*2*	3	4	*0*	4	1,723,217,773
NH	1	0	1	*0*	1	0	*0*	0	7,643,704
NJ	19	23	2	*13*	15	13	*5*	18	141,856,012
NM	19	23	4	*6*	10	18	*12*	30	1,733,028,681
NY	116	22	4	*14*	18	12	*19*	31	541,302,705

TABLE 5c (Cont.)

State	Accidents	Grade-Crossing Incidents (Frt.)	Non-Trespasser Fatalities	*Trespasser Fatalities*	Total Fatalities	Non-Trespasser Injuries	*Trespasser Injuries*	Total Injuries	Estimated Car-km (loaded + unloaded)
NC	24	111	9	*16*	25	49	*16*	65	443,630,511
ND	37	27	4	*0*	4	12	*0*	12	818,545,463
OH	79	176	14	*15*	29	60	*0*	60	2,102,751,560
OK	42	74	22	*5*	27	37	*11*	48	995,477,024
OR	47	42	1	*5*	6	6	*12*	18	408,685,279
PA	90	67	3	*13*	16	24	*10*	34	1,122,524,299
RI	0	0	0	*1*	1	0	*0*	0	262,852
SC	20	77	4	*12*	16	36	*5*	41	279,361,958
SD	28	17	2	*0*	2	9	*0*	9	320,546,287
TN	42	121	9	*11*	20	26	*6*	32	1,131,533,017
TX	190	414	60	*57*	117	169	*75*	244	4,687,604,870
UT	35	35	11	*3*	14	7	*5*	12	536,616,905
VT	4	1	0	*0*	0	0	*0*	0	24,308,656
VA	54	67	4	*14*	18	21	*8*	29	951,914,181
WA	51	63	5	*13*	18	18	*10*	28	784,234,305
WV	28	22	2	*3*	5	6	*8*	14	838,301,271
WI	68	147	5	*3*	8	65	*8*	73	536,387,339
WY	49	8	2	*3*	5	5	*0*	5	2,115,098,909
TOT.	2579	3863	449	*464*	913	1476	*375*	1851	51,029,435,000

TABLE 6 Composite 1994-1996 State-Level Rail Freight Accident/Fatality/Injury Rates per Car-Kilometer[a]

State/ Parameter	Accidents per Car-Kilometer	Grade Crossing Incidents per Car-km	Nontresp. Fatalities/Car-Kilometer (Frt.)	Tresp. Fatalities/Car-Kilometer (Frt.)	All Fatalities/Car-Kilometer (Frt.)	Nontresp. Injuries/Car-Kilometer (Frt.)	Tresp. Injuries/Car-Kilometer (Frt.)	All Injuries/Car-Kilometer (Frt.)
AL	2.96E-08	1.67E-07	1.48E-08	6.38E-09	2.12E-08	7.53E-08	4.70E-09	8.00E-08
AZ	1.65E-08	1.86E-08	1.78E-09	8.92E-09	1.07E-08	5.15E-09	5.15E-09	1.03E-08
AR	7.56E-08	1.62E-07	2.43E-08	3.09E-09	2.74E-08	6.37E-08	1.54E-09	6.52E-08
CA	4.98E-08	5.82E-08	7.33E-09	2.78E-08	3.52E-08	1.93E-08	1.45E-08	3.38E-08
CO	3.67E-08	3.35E-08	6.54E-09	3.52E-09	1.01E-08	1.38E-08	3.77E-09	1.76E-08
CT	*3.06E-06*	3.66E-07	*4.57E-08*	*6.85E-07*	*7.31E-07*	9.14E-08	0	9.14E-08
DE	3.88E-07	3.88E-07	3.23E-08	6.47E-08	9.70E-08	2.26E-07	*6.47E-08*	2.91E-07
DC	*2.29E-06*	1.09E-07	0	2.18E-07	2.18E-07	0	0	1.17E-07
FL	4.63E-08	9.56E-08	1.64E-08	2.98E-08	4.63E-08	4.47E-08	2.10E-08	6.58E-08
GA	3.06E-08	1.04E-07	1.02E-08	7.35E-09	1.75E-08	3.39E-08	1.11E-08	4.50E-08
ID	6.41E-08	7.39E-08	1.34E-08	4.89E-09	1.83E-08	2.20E-08	1.83E-09	2.38E-08
IL	9.53E-08	7.43E-08	1.29E-08	1.28E-08	2.58E-08	3.40E-08	9.46E-09	4.35E-08
IN	4.56E-08	1.85E-07	2.02E-08	8.29E-09	2.85E-08	6.14E-08	1.37E-08	7.51E-08
IA	6.31E-08	1.02E-07	9.42E-09	2.88E-09	1.23E-08	4.11E-08	1.57E-09	4.27E-08
KS	4.41E-08	6.13E-08	7.66E-09	2.26E-09	9.92E-09	2.07E-08	8.71E-10	2.16E-08
KY	2.82E-08	8.21E-08	6.13E-09	8.58E-09	1.47E-08	3.43E-08	8.28E-09	4.26E-08
LA	1.25E-07	3.86E-07	*4.35E-08*	1.41E-08	5.76E-08	1.90E-07	1.71E-08	2.08E-07
ME	2.62E-07	4.37E-07	0	0	0	1.22E-07	5.24E-08	1.75E-07
MD	4.49E-08	4.10E-08	0	3.08E-08	3.08E-08	2.05E-08	1.67E-08	3.72E-08
MA	2.39E-07	2.33E-07	2.59E-08	2.00E-07	2.26E-07	6.46E-08	*7.76E-08*	1.42E-07
MI	1.55E-07	3.78E-07	3.91E-08	2.40E-08	6.31E-08	1.80E-07	2.49E-08	2.05E-07
MN	7.59E-08	1.11E-07	1.31E-08	3.09E-09	1.62E-08	3.14E-08	8.49E-09	3.99E-08
MS	1.42E-07	2.47E-07	*3.89E-08*	1.82E-09	4.08E-08	1.03E-07	4.87E-09	1.08E-07
MO	3.62E-08	5.01E-08	7.30E-09	4.15E-09	1.15E-08	1.90E-08	2.00E-09	2.10E-08
MT	3.42E-08	1.83E-08	1.98E-09	3.22E-09	5.20E-09	6.93E-09	2.23E-09	9.16E-09
NE	4.60E-08	3.75E-08	5.88E-09	1.51E-09	7.39E-09	1.18E-08	6.72E-10	1.24E-08
NV	5.77E-09	3.71E-09	1.65E-09	1.03E-09	2.68E-09	1.85E-09	8.24E-10	2.68E-09
NH	2.61E-07	3.05E-07	*4.36E-08*	0	4.36E-08	1.31E-07	0	1.31E-07
NJ	1.99E-07	1.75E-07	2.39E-08	1.56E-07	1.80E-07	6.63E-08	*5.57E-08*	1.22E-07
NM	1.14E-08	1.10E-08	2.45E-09	4.49E-09	6.95E-09	7.56E-09	3.47E-09	1.10E-08
NY	2.03E-07	5.53E-08	1.26E-08	4.78E-08	6.03E-08	2.07E-08	3.08E-08	5.15E-08

TABLE 6 (Cont.)

State/ Parameter	Accidents per Car-Kilometer	Grade Crossing Incidents per Car-km	Nontresp. Fatalities/Car-Kilometer (Frt.)	Tresp. Fatalities/Car-Kilometer (Frt.)	All Fatalities/Car-Kilometer (Frt.)	Nontresp. Injuries/Car-Kilometer (Frt.)	Tresp. Injuries/Car-Kilometer (Frt.)	All Injuries/Car-Kilometer (Frt.)
NC	6.10E-08	2.88E-07	2.24E-08	5.25E-08	7.49E-08	1.05E-07	2.94E-08	1.34E-07
ND	4.42E-08	3.17E-08	4.70E-09	1.96E-09	6.65E-09	1.41E-08	3.91E-10	1.45E-08
OH	3.46E-08	1.08E-07	1.47E-08	5.91E-09	2.06E-08	3.82E-08	2.87E-09	4.10E-08
OK	5.14E-08	1.07E-07	1.91E-08	3.55E-09	2.27E-08	5.78E-08	7.80E-09	6.56E-08
OR	9.73E-08	9.33E-08	6.49E-09	1.54E-08	2.19E-08	1.87E-08	1.95E-08	3.81E-08
PA	9.38E-08	6.96E-08	9.35E-09	1.29E-08	2.22E-08	1.84E-08	1.23E-08	3.06E-08
RI	*4.03E-06*	*4.03E-06*	0	*1.34E-06*	*1.34E-06*	*2.69E-06*	0	*2.69E-06*
SC	6.92E-08	3.42E-07	2.56E-08	4.49E-08	7.05E-08	9.36E-08	1.15E-08	1.05E-07
SD	1.18E-07	1.05E-07	8.53E-09	0	8.53E-09	4.02E-08	0	4.02E-08
TN	4.43E-08	9.83E-08	1.11E-08	7.07E-09	1.81E-08	2.58E-08	6.45E-09	3.23E-08
TX	5.05E-08	1.05E-07	1.28E-08	1.18E-08	2.47E-08	4.73E-08	1.17E-08	5.90E-08
UT	5.87E-08	5.94E-08	2.02E-08	5.22E-09	2.54E-08	1.76E-08	5.87E-09	2.35E-08
VT	1.74E-07	1.07E-07	0	1.33E-08	1.33E-08	1.33E-08	0	1.33E-08
VA	4.66E-08	8.35E-08	6.27E-09	1.49E-08	2.12E-08	2.39E-08	7.45E-09	3.14E-08
WA	8.46E-08	8.93E-08	5.08E-09	1.95E-08	2.45E-08	2.45E-08	1.61E-08	4.06E-08
WV	3.17E-08	5.30E-08	3.31E-09	6.15E-09	9.46E-09	1.14E-08	1.28E-08	2.41E-08
WI	1.27E-07	2.55E-07	1.72E-08	7.19E-09	2.43E-08	1.07E-07	7.19E-09	1.14E-07
WY	2.40E-08	4.90E-09	1.18E-09	1.18E-09	2.36E-09	1.35E-09	0	1.35E-09
TOT.	5.39E-08	8.64E-08	1.05E-08	1.02E-08	2.08E-08	3.33E-08	7.75E-09	4.10E-08
Mean Rate	2.74E-07	2.16E-07	1.38E-08	6.44E-08	7.82E-08	1.04E-07	1.25E-08	1.17E-07
Std. Dev.	7.61E-07	5.68E-07	1.16E-08	2.13E-07	2.15E-07	3.80E-07	1.64E-08	3.79E-07
5th Pctile.	1.95E-08	1.39E-08	1.86E-09	1.64E-09	5.78E-09	5.87E-09	6.72E-10	9.62E-09
Median	6.10E-08	1.02E-07	1.31E-08	8.92E-09	2.27E-08	3.40E-08	1.15E-08	4.26E-08
95th Pctile.	1.53E-06	3.87E-07	4.17E-08	2.11E-07	2.23E-07	1.86E-07	5.44E-08	2.07E-07

[a] Italicized values are equal to or greater than two standard deviations above the national mean rate for the column category.

8 STATISTICAL DATA AND TABLES OF RATES—WATERWAYS

TABLE 7 1995 and 1996 USCG and USACE Data for Waterborne Vessel Involvements, Fatalities (+ Missing), and Injuries, by State and Major Waterway Type[a]

	1995					1996				
State	I	F	M	J	Tons Handled (10^3)	I	F	M	J	Tons Handled (10^3)
AL	137	0	0	1	71,692	125	0	0	10	73,932
AR	49	0	0	0	13,228	44	0	0	0	13,695
CA	142	2	1	25	179,383	144	1	4	17	181,165
CT	12	0	0	0	16,405	9	0	0	0	18,324
DE	4	0	0	0	29,303	6	0	0	0	25,799
FL	230	5	0	17	117,600	1	0	0	0	747
GA	9	0	0	0	19,746	225	1	1	9	117,430
ID	2	0	0	0	1,611	12	0	0	0	19,979
IL	222	0	0	1	114,704	204	1	0	2	113,938
IN	24	0	0	0	80,521	24	0	0	0	80,341
IA	24	0	0	0	16,092	17	0	0	0	14,713
KY	69	1	0	0	79,077	62	0	0	8	81,605
LA	356	0	0	30	507,404	359	0	0	31	494,249
ME	63	0	0	5	14,858	67	0	0	6	18,323
MD	15	0	0	0	49,143	26	0	0	1	47,885
MA	57	1	0	3	22,191	51	0	0	0	25,960
MI	41	0	0	0	78,067	31	0	0	4	18,323
MN	34	0	0	0	50,519	27	0	0	0	52,195
MS	78	1	0	0	42,320	55	0	0	3	46,177
MO	35	0	0	2	27,590	N/A	N/A	N/A	N/A	None Recorded
NE	1	0	0	0	387	N/A	N/A	N/A	N/A	None Recorded
NH	8	0	0	1	3,914	5	0	0	0	3,709
NJ	42	0	0	0	97,919	42	0	0	1	98,985
NY	55	0	0	16	81,899	42	0	0	22	95,213
NC	74	1	0	2	13,050	77	0	1	5	13,983
OH	35	0	0	3	123,671	37	0	0	3	123,459
OK	1	0	0	0	3,181	1	0	0	0	10,816
OR	47	0	2	0	39,337	52	2	1	7	36,742
PA	26	0	0	0	121,791	39	0	0	0	108,162
RI	19	0	0	3	7,119	9	0	0	0	8,250
SC	27	0	0	0	16,033	18	0	0	0	16,345
TN	34	0	0	0	43,472	46	1	0	0	43,963
TX	274	4	0	11	350,102	305	2	0	4	385,585
VA	52	0	0	3	81,193	101	2	0	4	85,894
WA	80	2	0	5	121,699	51	0	0	1	116,931
WV	13	4	0	2	79,050	38	0	0	0	82,925
WI	38	0	0	0	40,642	24	0	0	0	37,966
USA	2429	21	3	130	1,984,661	2376	10	7	138	2,031,155

TABLE 7 (Cont.)

Waterway type	1995					1996				
	I	F	M	J	Shipment-km	I	F	M	J	Shipment-km
Lakewise	52	0	0	2	192,126,828	46	0	0	7	187,722,995
Coastwise	639	11	3	60	1,421,373,545	810	3	7	67	1,317,966,011
Internal	1738	10	0	68	985,767,044	1520	7	0	64	955,072,151

[a] Key: I = involvements, F = fatalities, M = missing, J = injuries.

TABLE 8a 1995-1996 Mean Rates per 500-ton Shipment for Waterborne Vessel Involvements, Fatalities (+ Missing), and Injuries Sustained during Involvements, by State

State	Involvements	Fatalities + Missing (Aggregate Rate)[a]	Injured[b]
AL	9.00E-04	0	3.78E-05
AR	1.73E-03	0	0
CA	3.97E-04	1.11E-05	5.82E-05
CT	3.02E-04	0	0
DC	6.69E-04	0	0
DE	9.07E-05	0	0
FL	9.68E-04	1.49E-05	5.53E-05
GA	2.64E-04	0	0
IA	6.65E-04	0	0
ID	6.21E-04	0	0
IL	9.32E-04	2.19E-06	6.56E-06
IN	1.49E-04	0	0
KY	4.08E-04	3.11E-06	2.49E-05
LA	3.57E-04	0	3.04E-05
MA	1.12E-03	1.04E-05	3.12E-05
MD	2.11E-04	0	5.15E-06
ME	1.96E-03	0	1.66E-04
MI	3.73E-04	0	2.07E-05
MN	2.97E-04	0	0
MO	5.76E-04	0	1.77E-05
MS	7.51E-04	5.65E-06	1.69E-05
NC	2.79E-03	3.70E-05	1.29E-04
NE	1.29E-03	0	0
NH	8.53E-04	0	6.56E-05
NJ	2.13E-04	0	2.54E-06
NY	2.74E-04	0	1.07E-04
OH	1.46E-04	0	1.21E-05
OK	7.14E-05	0	0
OR	6.51E-04	3.29E-05	4.60E-05
PA	1.41E-04	0	0
RI	9.11E-04	0	9.76E-05
SC	6.95E-04	0	0
TN	4.57E-04	5.72E-06	0
TX	3.94E-04	4.08E-06	1.02E-05
VA	4.58E-04	5.98E-06	2.09E-05
WA	2.74E-04	4.19E-06	1.26E-05
WI	3.94E-04	0	0
WV	1.57E-04	1.23E-05	6.17E-06

[a] For a zero value, substitute national mean of 5.20E-06.

[b] For a zero value, substitute national mean of 3.45E-05.

TABLE 8b Mean Rates per 500-ton Shipment-Kilometer for Waterborne Vessel Involvements, Fatalities (+ Missing), and Injuries Sustained during Involvements, by Domestic Waterway Type

Type	Involvements	Fatalities[a]	Injuries
Lakewise	2.58E-07	0.00E+00	2.37E-08
Coastwise	5.29E-07	8.76E-09	4.64E-08
Internal	1.68E-06	8.76E-09	6.80E-08

[a] For a zero value, substitute internal rate.

TABLE 9 Person Casualties Not Involving Damage to Ship: On- or Off-Board Incidental[a]

	1995			1996			Mean Rate per 500-ton Shipment	
State	Tonnage Expressed as 500-ton Shipments	Fatalities + Missing	Injuries	Tonnage Expressed as 500-ton Shipments	Fatalities + Missing	Injuries	Fatalities + Missing	Injured
AL	143,384	4	40	147,864	3	28	2.40E-05	2.33E-04
AR	26,456	1	18	27,390	1	8	3.71E-05	4.83E-04
CA	358,766	8	80	362,330	14	74	3.05E-05	2.14E-04
CT	32,810	0	6	36,648	0	6	*2.51E-05*	1.73E-04
DE	58,606	1	5	51,598	0	4	9.07E-06	8.17E-05
DC	N/A	N/A	N/A	1,494	1	1	6.69E-04	6.69E-04
FL	235,200	16	76	234,860	8	45	5.11E-05	2.57E-04
GA	39,492	0	1	39,958	0	3	*2.51E-05*	5.03E-05
ID	3,222	0	1	N/A	N/A	N/A	*2.51E-05*	3.10E-04
IL	229,408	2	68	227,876	1	55	6.56E-06	2.69E-04
IN	161,042	1	25	160,682	0	21	3.11E-06	1.43E-04
IA	32,184	1	11	29,426	0	4	1.62E-05	2.43E-04
KS	N/A	N/A	N/A	1,488	0	1	*2.51E-05*	6.72E-04
KY	158,154	2	38	163,210	0	42	6.22E-06	2.49E-04
LA	1,014,808	21	375	988,498	33	269	2.70E-05	3.21E-04
ME	29,716	4	12	36,646	2	10	9.04E-05	3.32E-04
MD	98,286	0	5	95,770	4	9	2.06E-05	7.21E-05
MA	44,382	1	31	51,920	2	10	3.12E-05	4.26E-04
MI	156,134	3	20	160,618	3	18	1.89E-05	1.20E-04
MN	101,038	0	9	104,390	0	3	*2.51E-05*	5.84E-05
MS	84,640	3	28	92,354	0	14	1.69E-05	2.37E-04
MO	55,180	1	24	57,644	1	12	1.77E-05	3.19E-04
NE	N/A	N/A	N/A	898	0	2	*2.51E-05*	2.23E-03
NH	7,828	1	2	N/A	N/A	N/A	1.28E-04	2.55E-04
NJ	195,838	3	31	197,970	3	18	1.52E-05	1.24E-04
NY	163,798	3	39	190,426	1	27	1.13E-05	1.86E-04
NC	26,100	3	27	27,966	5	17	1.48E-04	8.14E-04
OH	247,342	1	30	246,918	1	20	4.05E-06	1.01E-04
OR	78,674	3	32	73,484	4	23	4.60E-05	3.61E-04
PA	243,582	0	10	216,324	1	14	2.17E-06	5.22E-05
RI	14,238	1	1	16,500	0	7	3.25E-05	2.60E-04
SC	32,066	1	4	32,690	0	4	1.54E-05	1.24E-04
TN	86,944	2	13	87,926	1	21	1.72E-05	1.94E-04
TX	700,204	10	89	771,170	5	68	1.02E-05	1.07E-04
VA	162,386	0	12	171,788	2	9	5.98E-06	6.28E-05
WA	243,398	1	67	233,862	4	36	1.05E-05	2.16E-04
WV	158,100	2	19	165,850	1	21	9.26E-06	1.23E-04
WI	81,284	0	13	75,932	1	14	6.36E-06	1.72E-04

[a] Use of italics indicates national average rate applied to replace zero value.

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APPENDIX A:

STATISTICAL TESTS CONCERNING ACCIDENT RATE AND SPEED LIMIT

Between 1995 and 1996, 25 states raised the maximum daylight speed limit for cars and light trucks on interstate highways; these states are listed below:

Alabama
Arizona
California
Colorado
Delaware
Florida
Georgia
Idaho
Kansas
Mississippi
Missouri
Montana
Nebraska
Nevada
New Mexico
New York
North Carolina
Oklahoma
Pennsylvania
South Dakota
Tennessee
Texas
Utah
Washington
Wyoming

Although nominally restricted to a speed limit lower than the posted maximum, heavy combination trucks are often seen moving on rural interstates at speeds comparable with the rate of primary vehicular flow (i.e., the overall maximum limit). Using the accident data compiled for this study, we analyzed the relationship between maximum speed and accident rate. For this investigation, we examined only data for interstate highways by state for 1995 and 1996. Of the 47 states included in the study, five had incomplete road class information and one (Rhode Island) had no qualifying accidents. Therefore, these six states were excluded from the speed limit analysis.

The five states without road class information are Georgia, Louisiana, New York, Oregon, and South Carolina. Two of these states, Georgia and New York, raised the maximum speed limit: Georgia to 70 mph and New York to 65 mph. (Note that all accident rates are in units of 10^{-7} accidents/km.) The remaining states were separated into two groups: states that raised the speed limit during the 1995 to 1996 period (Group A) and those that did not (Group B). Presented below are observations that can be made on the basis of the accident rate data and the supporting statistical tests.

1. The mean overall accident rate in 1996 is 3.45, compared to 2.93 in 1995. The 1996 accident rate, however, is not significantly higher than that of 1995.

t-Test: Two-Sample Assuming Equal Variances

Item	*96A/I*	*95A/I*
Mean	3.45	2.93
Variance	5.56	3.62
Observations	42	42
Pooled Variance	4.59	
Hypothesized Mean Difference	0	
Df	82	
t Stat	1.10	
P(T<=t) one-tail	0.14	
t Critical one-tail	1.66	

2. The mean accident rate in 1995 is not significantly different for the two groups.

t-Test: Two-Sample Assuming Equal Variances

Item	*Group A*	*Group B*
Mean	2.70	3.22
Variance	3.05	4.36
Observations	23	19
Pooled Variance	3.64	
Hypothesized Mean Difference	0	
df	40	
t Stat	-0.87	
P(T<=t) one-tail	0.19	
t Critical one-tail	1.68	

3. The mean accident rate in 1996 is not significantly different for the two groups.

t-Test: Two-Sample Assuming Equal Variances

Item	*Group A*	*Group B*
Mean	3.69	3.15
Variance	3.93	7.68
Observations	23	19
Pooled Variance	5.62	
Hypothesized Mean Difference	0	
Df	40	
t Stat	0.74	
P(T<=t) one-tail	0.23	
t Critical one-tail	1.68	

4. The mean accident rate for Group A (raised limits) in 1996 is significantly higher than in 1995 (3.69 in 1996 vs. 2.70 in 1995). The null hypothesis is formulated to test if there is enough evidence to conclude that the mean accident rate is higher for Group A in 1996 than in 1995 at the 95% level. Therefore, the appropriate test is:

Null Hypothesis:	1996 Mean – 1995 Mean < 0
Alternative Hypothesis:	1996 Mean – 1995 Mean > 0

t-Test: Two-Sample Assuming Equal Variances

Item	*1996*	*1995*
Group A Mean	3.69	2.70
Variance	3.93	3.05
Observations	23	23
Pooled Variance	3.49	
Hypothesized Mean Difference	0	
df	44	
t Stat	1.81	
P(T<=t) one-tail	0.04	
t Critical one-tail	1.68	

From the above test, we can conclude at the 95% confidence level that the mean accident rate for Group A is higher in 1996 than in 1995.

5. The accident rate for Group B (did not raise limits) is 3.14 in 1996, compared to 3.21 in 1995. This difference is not significant at the 95% confidence level. The two-tail test indicates that there is not enough evidence to reject the null hypothesis that the means are equal.

t-Test: Two-Sample Assuming Equal Variances

Item	*1996*	*1995*
Group B Mean	3.15	3.22
Variance	7.68	4.36
Observations	19	19
Pooled Variance	6.02	
Hypothesized Mean Difference	0	
Df	36	
t Stat	-0.08	
P(T<=t) two-tail	0.93	
t Critical two-tail	2.03	

6. The accident rate for the states that raised the maximum speed limit to 75 mph or above is 3.97 in 1996. The mean accident rate for states with a maximum speed below 75 mph is 3.26. This difference is not statistically significant (i.e., there is not enough evidence to conclude that states with a speed limit above 75 mph have a higher accident rate).

t-Test: Two-Sample Assuming Equal Variances

Item	*Group A*	*Group B*
Mean	3.97	3.26
Variance	4.41	5.99
Observations	11	31
Pooled Variance	5.59	
Hypothesized Mean Difference	0	
Df	40	
t Stat	0.85	
P(T<=t) one-tail	0.20	
t Critical one-tail	1.68	

Note that prior to conducting the above tests, preliminary tests on the variances were performed. In all cases, the null hypothesis could not be rejected and equal variances were assumed.

Similar statistical tests were used to examine any differences in fatality rate between the two groups of states. The following states were excluded from the analysis because of incomplete information: Georgia, Louisiana, Maine, New York, Oregon, and South Carolina. Note that all fatality rates are expressed in units of 10^{-8} fatalities/truck-km.

7. The mean fatality rate in 1995 was 0.82, compared to a mean fatality rate of 0.92 in 1996. The increase, however, is not significant.

t-Test: Two-Sample Assuming Equal Variances

Item	*96F/I*	*95F/I*
Mean	0.92	0.82
Variance	0.37	0.29
Observations	41	41
Pooled Variance	0.33	
Hypothesized Mean Difference	0	
Df	80	
t Stat	0.79	
P(T<=t) one-tail	0.22	
t Critical one-tail	1.66	

8. The mean fatality rate in 1995 for Group A is 0.82, compared to 0.81 for Group B. The difference is not significant.

t-Test: Two-Sample Assuming Equal Variances

Item	*Group A*	*Group B*
Mean	0.82	0.81
Variance	0.22	0.39
Observations	23	18
Pooled Variance	0.29	
Hypothesized Mean Difference	0	
Df	39	
t Stat	0.06	
P(T<=t) one-tail	0.47	
t Critical one-tail	1.68	

9. The mean fatality rate in 1996 for Group A is 1.10, compared to 0.68 for Group B. The mean fatality rate is significantly higher in 1996 for those states that have a speed limit above 70 mph.

t-Test: Two-Sample Assuming Equal Variances

Item	*Group A*	*Group B*
Mean	1.10	0.68
Variance	0.40	0.25
Observations	23	18
Pooled Variance	0.33	
Hypothesized Mean Difference	0	
Df	39	
t Stat	2.30	
P(T<=t) one-tail	0.01	
t Critical one-tail	1.68	

10. The mean fatality rate in 1995 for Group B is 0.81, compared to 0.68 in 1996. The mean fatality rate is not significantly higher in 1996 for those states that have a speed limit below 70 mph.

t-Test: Two-Sample Assuming Equal Variances

Item	*1995*	*1996*
Group B Mean	0.81	0.68
Variance	0.39	0.25
Observations	18	18
Pooled Variance	0.32	
Hypothesized Mean Difference	0	
Df	34	
t Stat	0.68	
P(T<=t) one-tail	0.25	
t Critical one-tail	1.69	

11. The mean fatality rate in 1995 for Group A is 0.82, compared to 1.10 in 1996. The mean fatality rate is significantly higher in 1996 for those states that have a speed limit of 70 mph or above. Note that the t-statistic is only slightly higher than the critical value, meaning that the probability of obtaining a calculated t-statistic at least as extreme when the null hypothesis is true is nearly 5%.

t-Test: Two-Sample Assuming Equal Variances

Item	*1995*	*1996*
Group A Mean	0.82	1.10
Variance	0.22	0.40
Observations	23	23
Pooled Variance	0.31	
Hypothesized Mean Difference	0	
Df	44	
t Stat	-1.69	
P(T<=t) one-tail	0.05	
t Critical one-tail	1.68	

Note that prior to conducting the above tests, preliminary tests on the variances were performed. In all cases, the null hypothesis could not be rejected and equal variances were assumed.

Obviously, many factors enter into the difference between an accident occurring and its being avoided, and speed is only one of them. The ability to adjust to a rapidly developing dangerous situation on the roads can be impaired at higher-speed driving, but under some circumstances speed differences *within* the traffic stream, rather than its maximum speed, have greater importance. As described in Section 5, without access to comprehensive reports on individual accidents and their causes, it is premature to judge whether an increase in speed limits *per se* is inherently less safe for heavy combination truck movements.

APPENDIX B:
CORRIDOR ANALYSIS

Accident involvement counts of interstate-registered heavy combination trucks for the years 1994, 1995, and 1996 were pooled to conduct the following tests. From monthly counts, it appeared that there is seasonal variation in the number of accidents for the north corridor (west of Chicago) and less pronounced variation in the south corridor (entire Sun Belt). Results for the central corridor are mixed and may involve differences between routes (such as, for example, I-70 and I-80) that were not investigated. For purposes of this analysis, we wanted to test whether the number of accidents in the winter months is significantly higher than in the summer months. The months of December, January, and February are designated as winter and the months of June, July, and August are designated as summer. The t-tests below indicate that there is a statistically significant difference in the central corridor, although the t-statistic is fairly low and, as indicated above, does not account for possible differences among specific routes. The interseasonal difference in the north corridor is most pronounced and the t-statistic is quite high, indicating a very significant difference. There is no significant difference in the number of accidents in winter vs. summer in the south corridor states. A possible conclusion is that truck transport risk is sensitive to conditions associated with winter driving, such as short days and low-light conditions, snow, sleet, and ice, but relatively insensitive to conditions associated with extreme heat.

1. States and east-west interstate highways included in each corridor:

   Central: Colo., Ill., Iowa, Kans., Mo., Neb., Nev., Utah, Wyo.; I-44 (Mo.), I-70, I-76, I-80, I-88

   North: Idaho, Mich., Me., Mont., N.D., Ore., S.D., Wash., Wis.; I-82, I-84, I-86, I-90, I-94

   South: Ala., Ariz., Ark., Calif., Fla., Ga., La., Miss., N.M., N.C., Okla., S.C., Tenn., Texas, Va.; I-8, I-10, I-20, I-30, I-40, I-44 (Okla.)

2. Statistical result tables:

Central Corridor

Item	*Summer*	*Winter*
Mean	1220.222	1508
Variance	16168.19	139311.3
Observations	9	9
Pooled Variance	77739.72	
Hypothesized Mean Difference	0	
df	16	
t Stat	-2.18949	
P(T<=t) one-tail	0.021864	
t Critical one-tail	1.745884	
P(T<=t) two-tail	0.043728	
t Critical two-tail	2.119905	

North Corridor

Item	*Summer*	*Winter*
Mean	538.5556	873.6667
Variance	9168.278	45649.75
Observations	9	9
Pooled Variance	27409.01	
Hypothesized Mean Difference	0	
Df	16	
t Stat	-4.29386	
P(T<=t) one-tail	0.000279	
t Critical one-tail	1.745884	
P(T<=t) two-tail	0.000558	
t Critical two-tail	2.119905	

South Corridor

Item	*Summer*	*Winter*
Mean	1644.444	1625.667
Variance	25101.03	48326.25
Observations	9	9
Pooled Variance	36713.64	
Hypothesized Mean Difference	0	
df	16	
t Stat	0.207892	
P(T<=t) one-tail	0.418968	
t Critical one-tail	1.745884	
P(T<=t) two-tail	0.837937	
t Critical two-tail	2.119905	