1-1-2004

Investigating the crash interaction of younger and older (Y-O) drivers

Hossein Naraghi
Iowa State University

Investigating the crash interaction of younger and older (Y-O) drivers

by

Hossein Naraghi

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Civil Engineering (Transportation Engineering)

Program of Study Committee:
Reginald Souleyrette, Major Professor
Edward Kannel
William Q. Meeker, Jr.

Iowa State University

Ames, Iowa

2004

Graduate College
Iowa State University

This is to certify that the master's thesis of

Hossein Naraghi

has met the thesis requirements of Iowa State University

Signatures have been redacted for privacy

To Leyla and Ali

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Acknowledgements

Accomplishment of this research would not have been possible without the support and encouragement of so many. I am first and foremost grateful to almighty God whose blessing and guidance was always evident, particularly in difficult moments when it was needed most.

I would like to express the deepest appreciation to my advisor and major professor, Dr. Reginald Souleyrette, for his leadership and the invaluable time, advice, support, and endless commitment throughout my graduate career. Without his guidance and persistent help this research would not have been possible. I would also like to thank my committee members, Dr. Edward Kannel and Dr. William Q. Meeker for their time and feedback throughout the development of this research.

In addition, my sincere appreciation is extended to the staff and students at the Center for Transportation Research and Education for supplying the necessary resources to complete this research. Their professionalism and knowledge has been an invaluable asset to me during my research. I am especially grateful for the assistance which Mr. Zach Hans provided me. His expertise and help was of great benefit to me during the course of my research. I need to thank Mr. Steve Andrle for constant interests and encouragement. I would also like to thank Mr. Robert Thompson for his time and valuable advice.

I must acknowledge the contribution made by my family and friends toward achieving this goal. My parents and grandparents provided me the tools necessary to succeed in life and their sacrifices and commitment to my future made all this possible. I am forever grateful to my mother, Vajiheh Naraghi, for her prayers, sacrifice, support, and

encouragement throughout my life. I like to express my gratitude to my father, Esmaeel Naraghi, for teaching me good values in life and his prayers. Thanks also go to my sisters, Nayerehsadat, Fatemehsadat, and Monirolsadat Naraghi, and my brothers, Seyed Abbas and Seyed Hadi Naraghi, for their encouragement and support. My brother-in-law, Hassan Jarrahi, deserves a special thanks for his endless and unconditional support. I would like to express my deep appreciation to my father-in-law, Nasrollah Ostadrahim, for teaching me the value of honesty and dedication and always providing the unconditional support. I wish to thank my mother-in-law, Masoumeh Alibaba, for her prayers and kindness. I also wish to thank my other relatives- Naraghi, Ahmadi, Jarrahi, Ostadrahim, and Alibaba families, for their prayers and support. My wife's late grandmothers also deserve special thanks for their prayers, supports and respects.

Finally, I am truly grateful to my wife, Leyla, and my son, Ali, who made this journey possible with their consistent love and encouragement. Ali in his own way inspired me to complete my graduate program and I am thankful for his patience. Leyla demonstrated the true meaning of marital sacrifice through her undying love, patience, understanding, partnership, and endless support. I could not have done this without her. Words cannot express my gratitude and love for her.

Abstract

Many studies have identified that older (O) and younger (Y) drivers are the most at risk age groups on U.S. highways. However little information is available on the interaction of the cohorts. It would seem that the characteristics that make the two groups most risky would be compounded in situations where the two types of drivers meet on the road. As expected, statewide analysis of Y-O crashes, using VMT as a sole measure of exposure, reveals over-representation. However, when adjusted for over-involvement of Y-O drivers as groups, Y-O crashes are actually under-represented. Causal factors such as passenger load and type of roadway geometry are also investigated. Spatial and temporal variation of Y-O crashes reveal that some Iowa counties are overrepresented and that 3-4 p.m. is the most represented hour for Y-O crashes.

Chapter 1 - Introduction

Traffic safety analysts often study crash and roadway data to identify problem areas and define populations at risk. Risk usually represented by estimating crash involvement rates. It is well known that older and younger drivers experience and present the highest risk on U.S. highways.

The population of America is aging at an increasing rate. Census data indicate that 13 percent of the population, or about 35 million people, were 65 years or older as of 2000 (1). In fact, the 65 and older age group has grown three times faster than the total population in the last three decades (1).

Baby boomers begin to turn 65 around 2010. Consequently, estimates indicate that approximately 20 percent of the population will be 65 or older by 2030 (2). As this occurs, highway safety improvements benefiting older drivers will become increasingly important. Improvements will be needed to help maintain the personal mobility this generation expects without decreasing overall safety performance and increasing risks to drivers of all ages.

In 2000, U.S. drivers between the ages of 16 and 20 had the highest fatality and injury rates (3). Young drivers comprised 7 percent of the driving population (4) but represented 14 percent of crash fatalities. In addition, persons over 65 years of age made up 14 percent of driving population and accounted for 16 percent of all traffic fatalities (3). In total, younger and older (YO) drivers comprised 21 percent of the driving population but represented 30 percent of fatalities (3). The overrepresentation by both of these groups is well known and studied (3,4).

Iowa data for the year 2000 indicated that 16- to 19-year-old drivers comprised 7.4 percent of the driving population (5) but represented 18.1 percent of all 2-vehicle crashes (10), and 65-year-old drivers comprised 17 percent of driving population (5) but represented 10.7 percent of all 2-vehicle crashes (10).

In many studies, the age threshold for analyzing older driver issues is 65. We adopted this convention for this study. Since full licensing age is 16, and exposure data for 15-year-old drivers were not available, drivers of age 15 and below were excluded from the analysis. Therefore, in this study, "young drivers" refers to drivers who are 16 to 19 years of age.

Identifying overrepresentation of an age group is clearly dependent on categorization. It is also dependent on definition of crash type (fatal crashes, injury crashes, and all crashes) and exposure measures chosen (e.g., by population, licensed drivers, and miles driven) (8, 9).

Older Driver Issues

Census figures indicate that Iowa's older population (65 or older) increased by approximately 25 percent from 1970 to 2000. Between 1980 and 2000 (11), the median age increased from 30 to 36.6. The Census also estimates that Iowa's older population will increase from about 440,000, or 15 percent of the population, in 2000 to almost 690,000, or about 23 percent of the population, in 2025. This represents a 55 percent increase in only 25 years (11).

Iowa experienced an even more significant increase in the number of older licensed drivers from 1970 to 2000. In the early 1970s, about 60 percent of the older population held driver's licenses (comprising about 12 percent of driving population). By 2000,

approximately 80 percent of those over 65 were licensed (comprising about 17 percent of the driving population). This represents a 40 percent increase in the number of licensed older drivers during the period. In addition, over 20 percent of drivers are over 65 in 53 of Iowa's 99 counties. In sixteen of those counties, that figure is between 23 percent and 25 percent, and in three counties—Ringgold, Wayne, and Calhoun—drivers over 65 make up over one-quarter of the driving population.

It is difficult to predict the percentage of those over 65 who will be able to maintain a driver license. Falb (02) presents a range of projected values for the future percentage of older drivers with licenses: 80 percent to 87 percent. The lower number assumes no increase over the current licensing percentage, assuming 80 percent is the highest value that can be sustained (12). The higher figure assumes the proportion of licensed drivers will continue to increase with improvements in health care, advances in transportation technology, and the aging of large numbers of baby boomers.

Based on the 80 percent assumption, there would be 150,000 more older drivers, or a 44 percent increase, by 2025. If the 87 percent assumption holds, there will be a 56 percent increase in the number of older licensed drivers, or 200,000 more older drivers on Iowa roads (12).

Younger Driver Issues

Although the younger proportion of Iowa population decreased dramatically from the 1970s to the early 1990s, it has since begun to increase. "As the last members of the baby boom approached childbearing age during the 1980s, the number of births rose again, peaking in 1990." Although the number of births per capita is at an all time low, "the population continues to grow because of the children and grandchildren of the huge baby-boom generation" (13).

The proportion of the Iowa population between the ages of 16 and 19 increased considerably from 5.6 percent in 1991 to 6.2 percent in 2000 (14). While the proportion of the total Iowa population increased by approximately 4.8 percent during the same period, the proportion of young population increased by 10.7 percent (U.S. Census Bureau).

As is the case for older drivers, the proportion of young licensed drivers is growing, and in 2000, they made up 7.4 percent of the driving population (Iowa Crash Facts 2000). In fact, in Iowa, the proportion of young drivers is about 50 percent higher than the national average. Further, in 72 counties, more than 9 percent of drivers are younger than 19. In 23 of those counties, young residents account for 10 percent or more of the entire driving population. In Carroll, Delaware, and Sioux counties, young persons represent 11 percent of total driving population.

Problem Statement: Interaction of Younger and Older Drivers in Crashes

Many studies have identified that older and younger drivers are the most at risk age groups on U.S. highways (7, 15, 16, 17, 18, and 19). The executive committee of the

Transportation Research Board (TRB) identifies the aging population as a special safety and mobility challenge (6). While literature abounds related to overrepresentation of the two age groups, little is available on the interaction of the cohorts. It would seem that the characteristics that make the two groups most at risk would be compounded in situations where the two types of drivers meet on the road. Increased crash risks of older and younger drivers are caused by different factors: inexperience, poor judgment, and risk taking behavior of younger drivers and reductions in physical and cognitive capabilities of older drivers (7). Consider the following potentially dangerous situations:

- an overly aggressive and impatient young driver passing a slow, overly careful older driver to make a right turn
- a timid older driver having trouble judging a gap to turn onto a high speed expressway and who does not anticipate the high speed or unclear lane changing practice of an approaching inexperienced driver
- a young driver with experience in playing video games where you can "play again" following too closely behind an older driver who may be afraid to go much faster on the freeway

Thesis Objectives

This research has two objectives. The first objective is to test the hypothesis that two-vehicle crashes involving older and younger drivers are overrepresented even after accounting for the overrepresentation of the groups individually. And, if indeed overrepresentation exists, the thesis seeks to explore underlying causes and potential

mitigative strategies by analyzing geographic, demographic, and road-related characteristics of these crashes.

Many resources are being dedicated to reducing the crash rates and consequences related to older and younger drivers. To date, these measures have not specifically been coordinated to reduce the types of crashes involving both. This work begins by identifying and documenting the interaction of older and younger drivers and follows by drawing attention to the place, time, and other characteristics of the crashes involving both groups of drivers. It concludes by identifying practices that may be implemented to address these types of crashes. It is hoped that determining and understanding the main contributing factors of older and younger driver crashes can lead to appropriate recommendations for prevention and minimization of problems.

Chapter 2 – Literature Review

Because the literature on older-younger crash involvement is sparse, this chapter treats each group individually. Special attention is paid to characteristics of each group that may be compounded when younger and older drivers meet along the road.

Younger Drivers

Crash Characteristics

The risk of crash involvement per mile driven for 16- to 19-year-old drivers is four times the risk for older (65+) drivers (19). Of these, 16- and 17-year-old drivers have the highest risk (20). A look at the driving characteristics of the younger group reveals speeding as a principal factor of crash involvement. Tailgating, driver error, and single vehicle run-off-the-road crashes are the frequent results of this risky behavior (21). A study of Maryland crash data indicates that the highest driving death rate occurs at age 18 for both males and females. And, even though older drivers have more difficulty with night vision, the nighttime fatal crash rate for 18-year-old drivers has been estimated to be approximately three to four times that of older (65+) drivers (22).

Age or Experience?

We know that young drivers have higher crash rates than more experienced drivers (19). There are also age-related differences among teenage drivers, with crash rates of teenagers declining as expected with increasing age (15, 19, 23).

A study conducted by Daniel R. Mayhew et al. (23) determined the effects of experience by investigating month-to-month changes in crash involvement rates of teenage drivers. The results of the study indicated that crash rates dropped noticeably during the first six months of driving. As driver experience increased, the involvement in single vehicle run-off-the-road and night crashes decreased rapidly. It was found that teenage drivers improved their driving in a short period of time. Finally, it was indicated that a graduated driver-licensing program was a very effective method to ensure the driving improvements took place in a more forgiving environment (23).

Risky Driving

In response to a telephone survey conducted by the Los Angeles Times, 16- to 24-year-old drivers stated that they frequently engaged in aggressive driving, easily lost their temper behind the wheel, found enjoyment when passing others, enjoyed weaving through traffic, and engaged in other risky behaviors. Among those responding, the 16-19 age group reported driving the fewest numbers of miles. The study found that drivers who made offensive gestures and liked to argue with other drivers tended to be unlawful and dangerous. It also found that youth and aggression toward other drivers were two of the most significant correlates of risky driving (24).

Another study approached risk as a kind of decision-making process. This approach emphasized the importance of "decision plans" for young people. The study found that the decision-making process could be differentiated from the driver's skill. The driver visualized the condition, outcome, and crisis associated with a particular decision and then estimated the

threat of the situation. The perceived threat was high when the situation was beyond the driver's ability to control (25).

Another study reports that the crash risk is higher during adolescent development, where risky behavior and deficiency in decision-making is most pronounced (26).

Effects of Passenger(s)

Presence of the passenger in the vehicle "creates a social system that can affect driving behavior" (27). Many recent and earlier studies found that crash involvement of younger drivers was increased by the presence of passengers (29, 30, 31). The risk is particularly high when teenage drivers are accompanied by multiple teenage passengers. In fact more than half of all 16- to 17-year-old driver fatal crashes occur in the presence of young passengers and absence of an adult in the vehicle. However, the presence of all passengers may not always have a negative effect on driver behavior. The risk may be expected to vary by the nature of relationship of driver and passengers in the vehicle. In fact presence of parents or women in the car has been shown to positively affect the driving behavior of young drivers and indeed reduce the risk of crash involvement (27, 31). However, findings of an on-road driving study showed that young drivers with young male passengers drove faster and accepted smaller gaps at intersections (32). In another study, Baxter et al. concluded that the presence of female passengers caused male drivers to drive slower and not follow vehicles as closely as if they were driving alone (27).

Intervention

In many jurisdictions, repeated traffic violations result in severe penalties. The intervention process starts with warnings and proceeds through suspension or revocation of licenses. Studies of jurisdictions with graduated licensing programs that start the process earlier for novices (during the intermediate licensing stage) revealed that early intervention had a significant preventive effect on later crashes (32). In an experiment in Michigan, a short-term suspension was imposed on a random sample of young drivers after the first traffic offense. The group showed lower traffic violations after suspension. In graduated licensing programs a clean driving record during the learning period will lead to acquiring full driving privileges. For example, a Maryland law requires six months of violation-free driving prior to full licensing. The implementation of this law alone (only one element of the graduated licensing program) led to a 5 percent reduction in daytime crashes (32).

Graduated Licensing

The younger driver problem has been recognized worldwide but is more pervasive in the United States due to early licensure. In most states, a 16-year-old is allowed to have a full drivers license, while in many other countries, this privilege is withheld until age 18 (33, 34). While an early path to licensure greatly contributes to crash risk, only 30 states required a learner's permit in 1995. And, few of *those* states required permits to be held for more than a short period of time.

Graduated driver licensing is a systematic approach that has been introduced to help inexperienced drivers improve their skills while protecting them against high crash risks. Graduated licensing has different phases, starting with the supervised learner stage, followed

by an intermediate stage (unsupervised driving except in high-risk conditions), and finally full driving privileges (32).

The idea of graduated licensing was first introduced in early 1970s but was initially resisted. A full graduated licensing program was first introduced by New Zealand in 1987. Canadian provinces began using graduated licensing programs in 1994. Florida was the first U.S. state to adopt graduated licensing in 1996 (35).

Evaluation of the graduated licensing programs indicates a very positive effect on crash risk. In fact a 20 to 30 percent reduction in crashes was reported by jurisdictions that adopted this program (36).

Learner's permit period requirements vary by state. In 2003, 30 states required a six-month period, while 5 states required more than 6 months. It has been shown that extending the learner's period thereby increasing the time for improving driving skills has resulted in reduction of crash risk (32). Gregersen N.P. et al. (2000) studied the potential safety effects of the extended learner's period in Sweden. The extended permit program was independent from other changes in licensing since it was not part of a graduated licensing program. The learner's permit age was changed from 17.5 to 16. This change allowed young individuals to get a permit and drive with supervision of either professional driving school instructors or adults with instructor permits. Individuals who chose the early start had nearly 2.5 times the driving practice of others and had approximately 24 percent less crashes after the learning period was completed (37). Another study found that the introduction of a 12-month learner's period in Toronto correlated with a 16 percent reduction in crash rate per licensed driver (38). Also, based on the observation of a 5 percent reduction in crash rate per licensed drivers in a

trial, Quebec's graduated licensing law now requires a 12-month learner's period for all new drivers. (39).

Older Drivers

Today's elderly are relatively healthier, more active, and more likely to have a driver license compared to previous generations. However, fatal crash rates start to increase rapidly after retirement age. Part of the increase can be attributed to elderly fragility, but the increase is mostly related to behavior. Age related impairment of vision, cognition, and action are known to affect the ability to perceive danger and react to it quickly (41, 42).

Risk Assessment

One of the key steps in assessing risk for any population group is to determine exposure. Many studies show that the elderly drive fewer miles and limit their driving to mostly unchallenging, highly familiar situations and locations during daylight hours. This means that the crashes that do occur may indicate a much higher risk of older driver crashes per mile driven in equivalent conditions in other age groups (40).

Compounding physical and cognitive ageing problems are anxiety and stress which affect driving performance, particularly at high demand situations. This has been shown to explain why older drivers are over-involved in crashes at intersections (43).

Facing or Imposing Risks?

There are two apparent elements of risks for older drivers in traffic: risks that they are facing themselves and the risk they may impose to other road users. "There is near universal

agreement that society should take stronger measures to prevent its members from doing things that endanger others than to prevent them from doing things that endanger only themselves" (44).

Careful analysis of driving and crash characteristics of any age group enables safety analysts to determine which component of risk plays a greater role for that age group. These findings may affect licensing policy, legislation, enforcement, and any other measures that can be used to prevent that age group from posing a threat to other road users (41).

Most measures indicate that risk increases with drivers' age. According to one study, fragility was found to be the major contributing factor to the higher risks of older drivers (45).

In a series of studies using 1994-1996 United States crash data, Evans compared crashes among different age groups based on population, number of licensed drivers, and distance they traveled. Ignoring exposure, he found that licensing a 70-year-old male driver imposed approximately 40 percent less threat to other road users than licensing a 40-year-old male driver (43). By the same token, renewing the license of a 20-year-old male driver imposed about 200 percent more threat to other road users than renewing the license of a 70-year-old driver. However, taking the distance traveled into account, a 70-year-old driver imposed about 14 percent more threat to other road users than a 40-year-old driver for the same distance traveled (43). Evans finally concluded that licensing an 80-year-old driver did not impose a higher threat to other road users than licensing a 20-year-old driver. When a death occurred, the probability that it was a result of a traffic crash declined increasingly with age, from above 20 percent for late teens to under 1 percent at age 65 and about 0.5 percent at age 80 (43).

Effects of Fragility

Older drivers are more often at risk themselves than to other road users, largely because of their greater physical vulnerability. In a study by multiple national data systems were used to investigate the effect of fragility versus the crash over-involvement of older drivers per vehicle mile of travel (VMT). Deaths per driver involved in a crash and drivers involved in crash per VMT were computed to determine fragility and crash over-involvement for each age group respectively. Compared with middle age drivers, both younger than 20 and older than 75 drivers had much higher death rates per VMT. The drivers of age 80 or older appeared to have highest death rate per crash and also much higher death rate per VMT. Fragility, which accounted for 60 to 95 percent of excess death rates in older drivers, and beginning at age 60, steadily increases with age. Crash over-involvement in older drivers started only at age 75 and explained only 30 to 45 percent of the excess risk in this age group. Crash over-involvement per VMT accounted for 95 percent of the excess death rate among drivers younger than 20 and was the major factor contributing to high risk facing young drivers (46).

Crash Characteristics

Older drivers' crashes rarely involve speeding or major traffic offenses. However, older drivers largely have difficulty in driving circumstances requiring rapid response, full vision, and interaction with other drivers (47). Older drivers tend to have more two-vehicle crashes and less single-vehicle crashes compared to younger drivers (48).

A number of papers indicate why older drivers have more crashes at intersections than younger drivers. Typical violations included failure to yield right of way, improper

turning, failure to see and attend the road signs and incorrect lane changing (49, 18).

Crash Involvement

Age, of course, is not the only prediction factor of driving performance. Age-related health problems are also important. In fact, it has been shown that a small percentage of impaired drivers cause an increase in the average crash risk of all elderly drivers (41, 49, 50).

There are a variety of reasons that may contribute to crash involvement of elderly drivers, including: (43, 47, 51):

- Trouble maintaining control over the vehicle
- Problems with normal vision that arise with age
    - Low sensitivity to light
    - High sensitivity to glare
- Decline of perceptual abilities
    - Trouble in paying attention to surroundings
    - Difficulties in rapid change of attention from one situation to another as demanded
- Deterioration of information processing abilities
- Difficulties with driving tactics
    - Making good and quick decisions about how to respond to challenging situations
    - Choosing a safe position on the road

- Driving at an appropriate speed for the situation

- Incomplete knowledge and understanding of highway and traffic codes

As age increases, speed of information processing decreases. This reduction affects the performance of older drivers on many cognitive operations in terms of how rapidly tasks can be performed and what errors are made doing those tasks. Therefore, cognitive slowing and attention are two major factors which explain a pattern of trouble for older drivers, specifically at highly demanding and challenging situations such as intersections (47).

Older Drivers and Intersections

Many recent studies show that intersection-related maneuvers are the most difficult aspects of driving for elderly. Older drivers have been found to be overrepresented, especially in crashes at intersections (18, 47, 57). A study in Finland revealed that crash rates in complex traffic situations such as intersections increased from age 65 for males and from age 55 for females (47). Left turns were being made in 41 percent of non-fatal crashes while right turns accounted for only 6 percent of crashes. While the at-fault driver was turning into the main road, it was hit 59 percent of the time by vehicles coming from the right and 41 percent of the time by vehicles coming from the left (47).

A study by Preusser et al. (1998) revealed that 65- to 69-year-old drivers were 2.3 times more likely to be involved in intersection crashes than their middle aged counterparts. Drivers who were 85 or older were 10.6 times more likely to be involved in crashes at intersections. For those intersection crashes where the major cause was failure to yield right-of-way, the risk of crash involvement for drivers between the ages of 65 and 69 was 2.2

times higher than it was for drivers between the ages of 40 and 49 (18).

There are many causes associated with older driver problems at intersections. Attentional problems, cognitive slowing, and poor motor performance appear to be major contributing factors in elderly driver intersection crashes (43, 52).

A report from a Finnish road accident investigation team indicated that older drivers were less aware of getting into a crash than their middle age counterparts. For example, approximately 44 percent of older drivers were unaware of any hazard prior to a crash compared to 26 percent of middle age drivers (47). The high level of risk could also be explained by slower reaction time and motor skills. Upon entering an intersection, a driver performed a number of cognitive and motor functions. If too much time was spent performing all these tasks simultaneously, any remaining gap might not be sufficient to clear the intersection (47).

Older and Younger Drivers Studies

Several studies have compared and contrasted crash experience and propensity of younger and older drivers (see studies A, B, C, D, and E). However, only one study was found which specifically addressed younger-older driver interactions.

A. Comparison between Older and Younger Drivers in Carrying Passenger(s)

The main objective of this study was to find the effects of carrying passengers both in terms of the number and the age of passengers. Data were obtained from a case-control study in the Auckland region of New Zealand for 1998 and 1999. Data on the number and age of passengers were obtained from driver self-reports at the time of crash or at the time of

roadside survey. The results of the study showed no increase in risk for older drivers who carried two or more passengers, regardless of their ages. However, carrying two or more passengers significantly increased the risk of crash involvement for younger drivers (53).

B. Comparing Older and Younger Drivers in Collision Avoidance Judgments

The purpose of this study was to measure the age differences in three types of collision judgments: (a) when an object would collide another object, (b) whether two objects would collide with each other, and (c) whether an object would hit the observer. A computer simulation was used to implement the three judgment experiments on 8 younger drivers and 8 older drivers. The results of experiments revealed that judgments about potential collision were less accurate among older drivers compared to young drivers, which presumably increase the risk of crash involvement for older drivers. Driving performance might be related more to age differences in judgments about whether a collision would occur rather than about when a collision would occur. The study concluded that, in order to evaluate the age-related difference in crash rates, the ability to make judgments about potential collisions was an important factor (54).

C. Greatest Crash Risks for Older and Younger Drivers

The main objective of a Texas DOT study was to find the risks of crash involvement for older and younger drivers compared to other drivers. Crash data from the state of Texas between 1995 and 1999 were used to analyze crash characteristics of older (65+) and younger drivers (14-20), to compare that with all other drivers. The results of the analysis showed that the risk of involvement in fatal crashes was much higher for young drivers when

carrying at least two passengers. Further, the probability that drivers younger than 21 were unlicensed at the time of the crash was found to be three times higher than other drivers. The analysis also revealed that older drivers tended to disregard stop signs, lights or signals, failed to yield right of way, and had a higher risk of fatality when they were involved in two-vehicle right-angle crashes (55).

D. Comparing Crash Characteristics of Older and Younger Drivers

Maryland data for 2000 were analyzed in a study to investigate the crash characteristics of older drivers age 55 and over and younger drivers ages 15 to19. Older drivers were found to have a higher rate of seatbelt usage than young drivers (46 and 37 percent respectively). Young drivers had 39 percent of their crashes at night (between 6 p.m. and 6 a.m.), compared to older drivers with 20 percent. The study also showed that about 50 percent of older driver crashes happened during afternoon hours. It also revealed that the most common type of crash for both age groups was "same direction/rear end". However, young drivers were involved in single-vehicle crashes twice as much as old drivers. Also, older drivers were involved in relatively more angle crashes and sideswipes than their younger counterparts (56).

E. Speed Discrepancies between Older and Younger Drivers at Intersections

Attempts to explain older drivers' problems at intersections have mainly concentrated on characteristics and behavior of older drivers only, with no consideration of interaction between older drivers and other road users. However, a study in Sendai, Japan, investigated the interaction of older and younger drivers specifically on turning maneuver at T-shape

intersections. The study results revealed that turning maneuver behavior was closely related to driver age. The gap time was shortest when an older driver was turning and a younger driver was approaching on the main road. The study also showed that the gap was clearly shorter when a young motorcycle driver was approaching and an older driver was turning (52).

Chapter 3 - Statewide Analysis of Older-Younger Driver Crashes

After using prior research to identifying problem areas for older and younger drivers individually, this chapter presents an Iowa statewide analysis of the interaction of these age groups.

Age Group Comparison

In order to study the risk of older and younger drivers in Iowa, one needs to know something about exposure in each group. Figure 3.1 compares the age distribution of Iowa and U.S. drivers. It is interesting to note the overrepresentation of both older and younger drivers in the state.

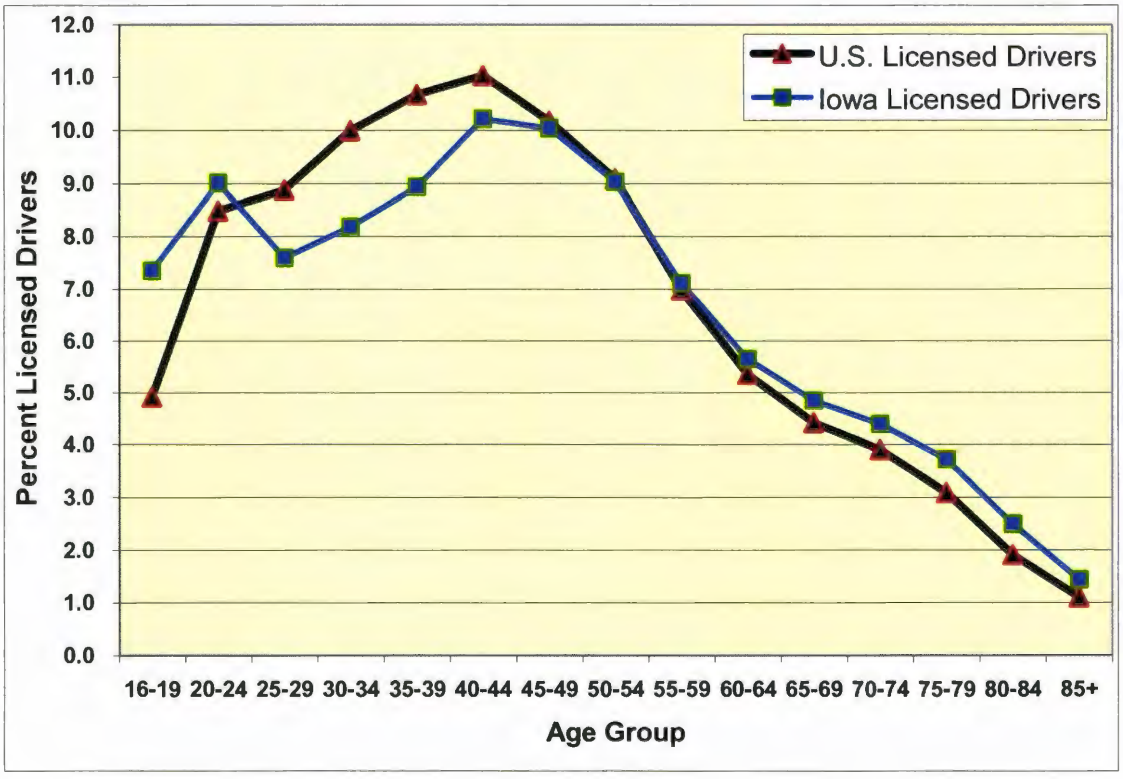


Figure 3.1: Iowa and U.S. licensed driver by age group proportions

However, existing Iowa data do not include information about driver or vehicle exposure by age. To obtain suitable exposure data, the National Household Travel Survey (NHTS) of 2001 (59) was used as a proxy exposure for desired age groups. The process of obtaining VMT for the desired age groups is shown in Appendix D. An estimate of vehicle miles traveled (VMT) for each age group in Iowa was calculated based on the national average amount of travel multiplied by the total number of Iowa drivers in that age group. VMTs are adjusted to Iowa control totals.

Figure 3.2 shows that the mileage traveled by each age group both in Iowa and the U.S. is closely related to the number of drivers in that age group. Comparing the ratio of mileage driven by younger drivers to total VMT, the Iowa percentage is about 54 percent higher than the national figure. Older driver VMT ratio is about 20 percent higher in Iowa as a percent of all VMT.

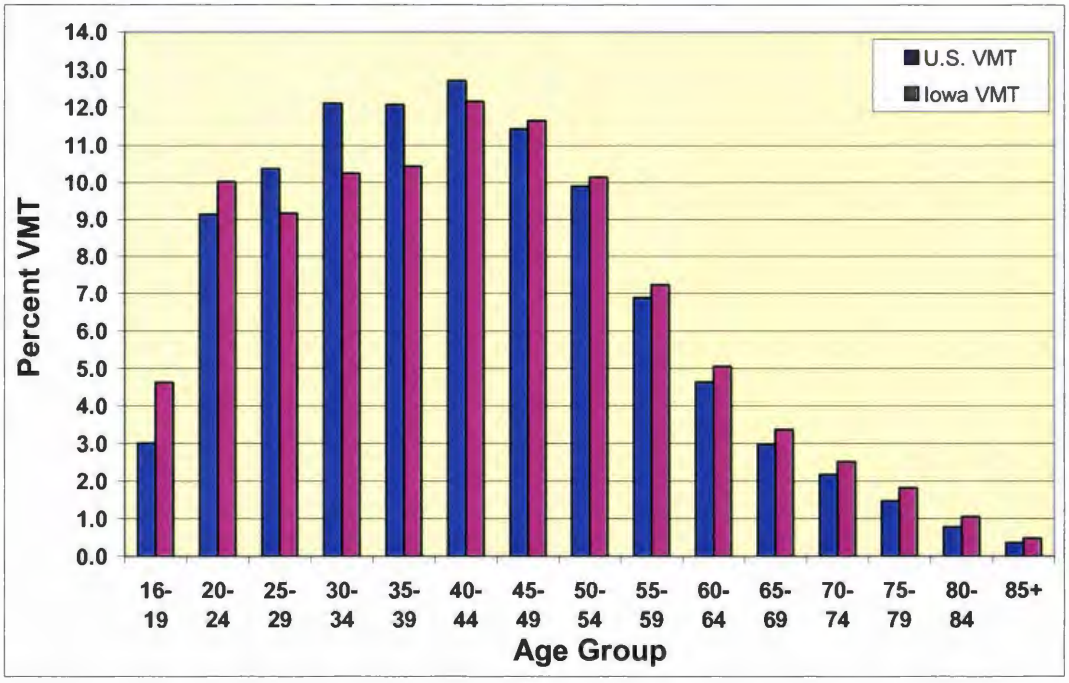


Figure 3.2: Vehicle miles traveled by age group proportions

Risk Assessment

There are different measures to assess driver crash risk including: crash involvement per capita, crash rate per licensed driver, or more commonly crash rate per hundred million VMT for highway links. For intersections, the most common measure is crash rate per million entering vehicles.

Statewide All 2-Vehicle Crash Involvement Rates

Crash involvement based on population data provides a means of estimating overall risk to an age group. The Iowa DOT 2000 crash database was used to calculate the number and percentage of drivers involved in 2-vehicle crashes by age group. Figure 3.3 shows that crash involvement per capita decreases as age increases. Younger drivers are involved in more than four times as many reported crashes as the older group. Adjusting for the number of licensed drivers, the younger group again is seen to have considerably higher rates than older drivers (about 4 times higher).

After adjusting the number of crashes for distance traveled by drivers in each age group, Figure 3.3 shows a different pattern of crash involvement. Clearly, the highest crash involvement rate per mile driven occurs for the youngest (16-19) and oldest (85+)drivers, with the rate of the younger drivers being almost three times that of all the older drivers, and even twice as high as that of the oldest age group (85+).

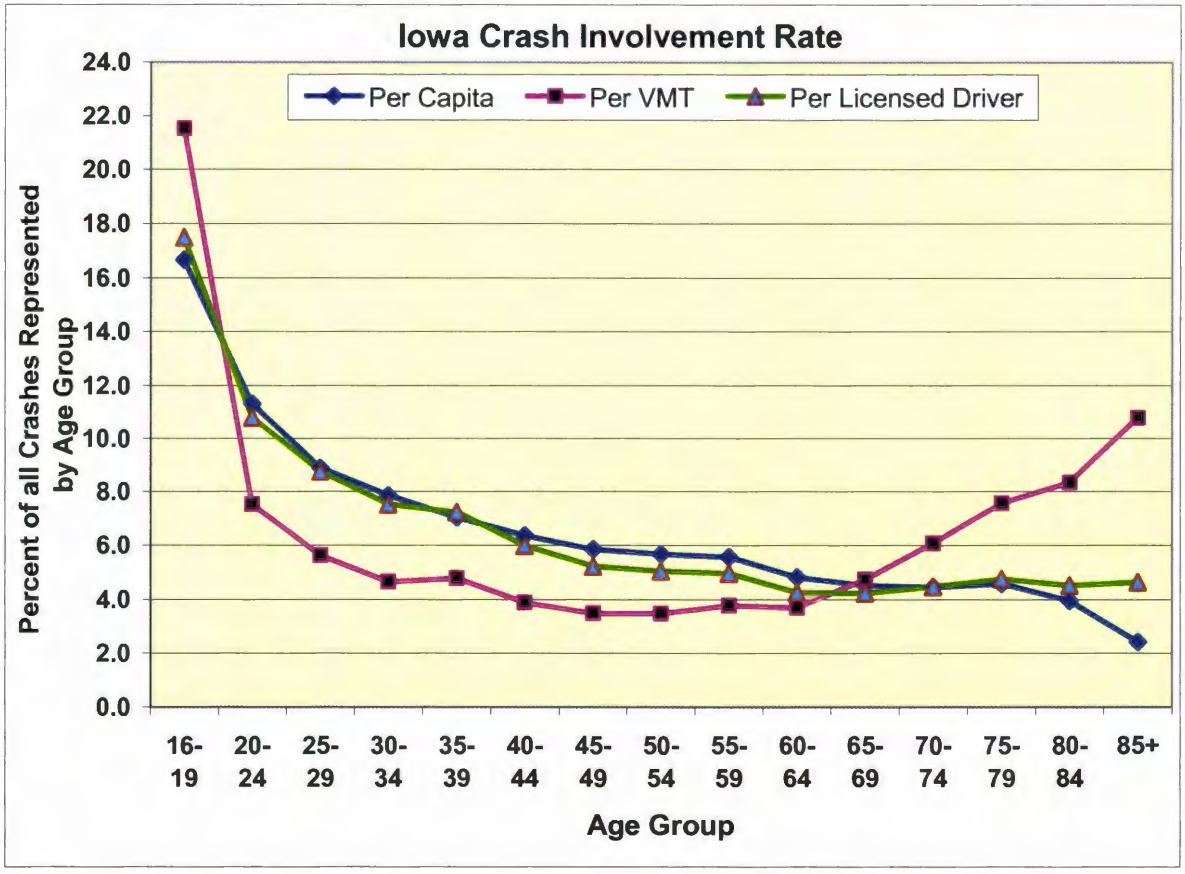


Figure 3.3: Crash involvement rates by age group proportions in Iowa

Statewide Fatal 2-Vehicle Crash Involvement Rates

The rate of involvement in 2-vehicle fatal crashes reveals that both younger and older drivers are at increased risk of fatality per capita. When adjusted for the number of licensed drivers, an 85-year or older driver has twice the risk of crash involvement of a younger driver as shown in Figure 3.4. A different pattern is noticeable when looking at the graph based on the total VMT. Crash involvement rate starts to increase considerably after age 60, increasing even faster after age 80. The involvement rate of an 85-year or older driver in fatal crashes based on total VMT is more than four times that of a young driver.

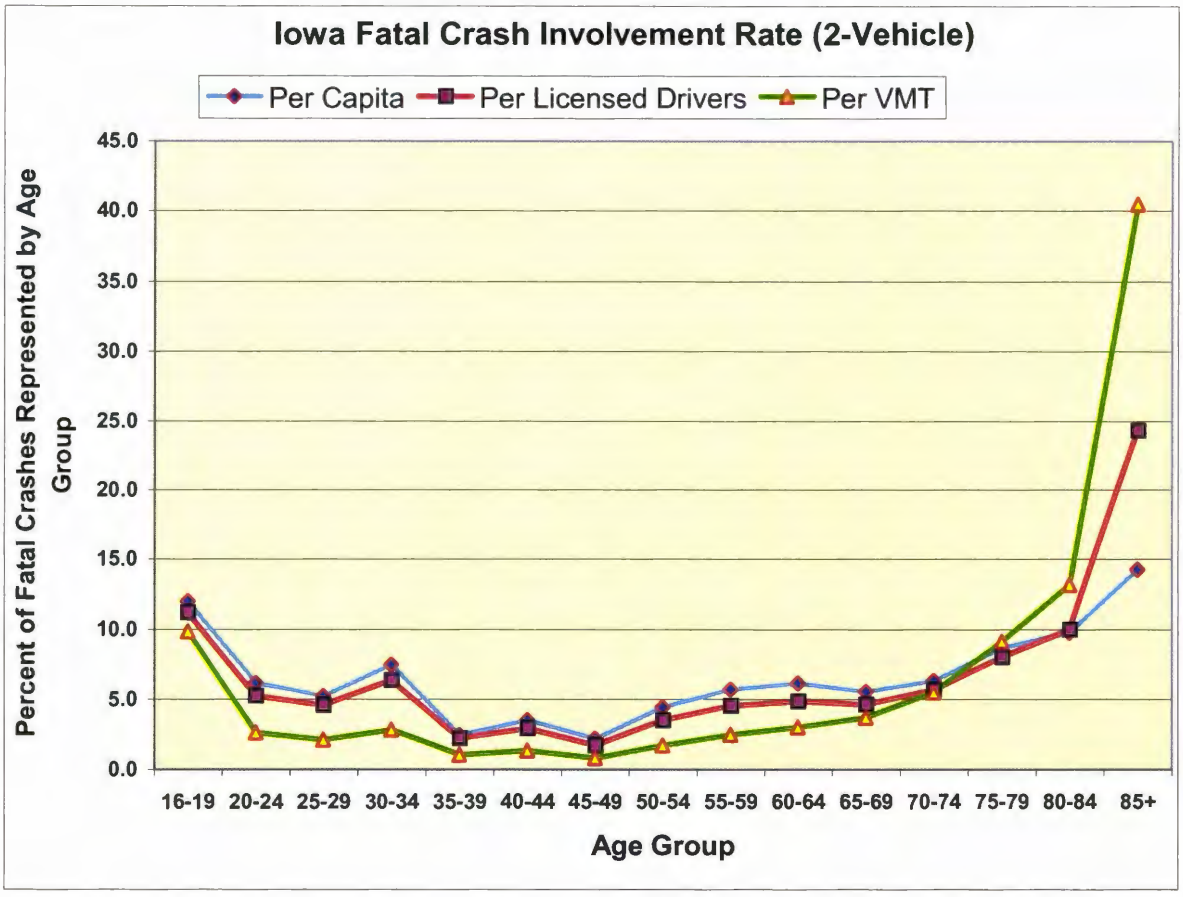


Figure 3.4: Crash involvement rate in all fatal crashes by age group in Iowa

Table 3.1 shows how risk was assessed for all driving age groups in Iowa. The table resulted in a risk factor computed for all age groups, which is a relative risk of involvement in 2-vehicle crashes, adjusted for exposure. Relative to all crash involvement, younger drivers experience four times the risk, and older drivers experience between 1.4 and 1.9 times the risk.

Table 3.1: Risk calculations for drivers by age group in Iowa

A Age Group	Ref # 1 B US-VMT per Year per Driver	Ref # 2 C # of Licensed Drivers (Iowa)	D = C*E Iowa-VMT per Year Million	F = D/E Iowa-VMT Percent of Total	Ref # 3 G # of Drivers Involve in 2-Veh Crashes per Year	I = G/H Percentage of Crash Involvement	J = I/F Risk Factor
16-19	8300	152351	1265	4.7	13424	18.1	3.9
20-24	14650	186864	2738	10.1	10160	13.7	1.4
25-29	15900	157381	2502	9.3	6945	9.4	1.0
30-34	16500	169701	2800	10.4	6438	8.7	0.8
35-39	15400	185368	2855	10.6	6755	9.1	0.9
40-44	15700	211677	3323	12.3	6383	8.6	0.7
45-49	15300	208084	3184	11.8	5490	7.4	0.6
50-54	14800	177170	2622	9.7	4509	6.1	0.6
55-59	13400	137454	1842	6.8	3415	4.6	0.7
60-64	11800	117027	1381	5.1	2518	3.4	0.7
65-69	9150	100330	918	3.4	2146	2.9	0.9
70-74	7550	90840	686	2.5	2053	2.8	1.1
75-79	6450	76985	497	1.8	1850	2.5	1.4
80-84	5550	51715	287	1.1	1181	1.6	1.5
85+	4400	29748	131	0.5	696	0.9	1.9
TOTAL		2052695	27029	100.0	73963	100.0	

E = 27029 **H =73963**

558 2-vehicle crashes for Age Group less than 16 were excluded from analysis

Ref # 1: 2001 National Household Travel Survey, US DOT FHWA

Ref # 2: Iowa Crash Facts 2000

Ref # 3: 2000 Iowa DOT crash database

Crash Involvement and Exposure

Figure 3.5 reveals crash involvement and exposure by age group proportions. The difference between the percent of crash involvement and the percent of exposure indicates the relative risk for that age group. The higher the relative difference between crash involvement and exposure, the greater the risk associated with that age group.

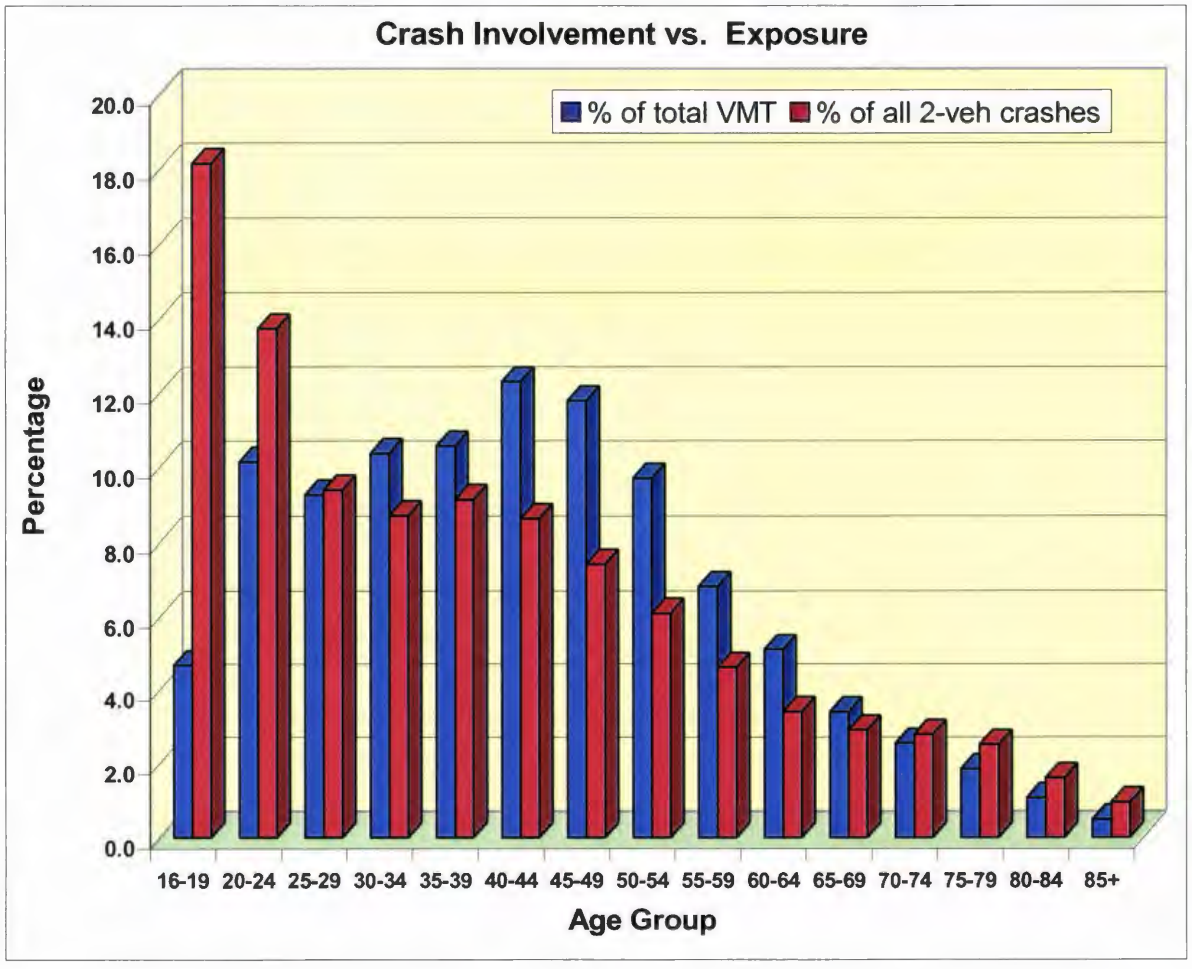


Figure 3.5: 2-vehicle crash involvement versus exposure by age group proportions in Iowa

Risk Factor

The differences between the proportion of drivers involved in 2-vehicle crashes and their exposure were used to find a risk factor for each age group. The percent of crash involvement was divided by the percent of exposure to obtain the risk factor associated with each age group, which is illustrated in Figure 3.6. A younger (16-19) driver faces more than two times the risk of an 85-year or older driver and about 7 times the risk of a driver from the safest driving age group (45-54). The related risk of the oldest age group (85+) is almost 3 times higher than that of the safest age group.

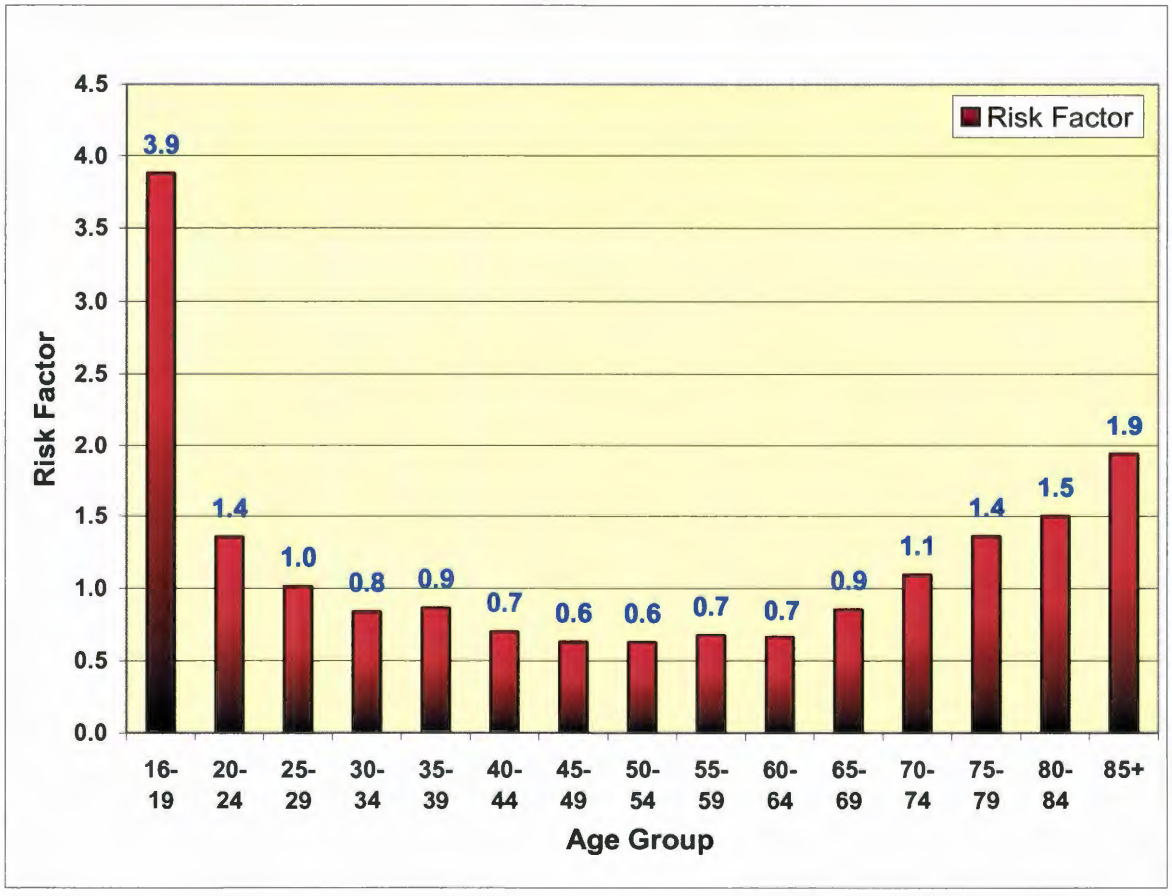


Figure 3.6: The risk of exposure that each driving age group is facing in Iowa

Statewide Interaction of Younger and Older Drivers

Although many studies have indicated that older and younger drivers are overrepresented in crashes as individual groups, the interaction in crashes between these groups has not been investigated and is the objective of this research. The involvement of older AND younger drivers in 2-vehicle crashes is analyzed based on two conditions:

1. No knowledge of crash over-involvement by individual age groups **(unadjusted, based on exposure (VMT) only)**
2. Initial knowledge of crash overrepresentation by individual age groups **(adjusted for age)**

Overrepresentation in 2-Vehicle Crashes, Unadjusted

To test a hypothesis of overrepresentation in 2-vehicle crashes, the expected number of crashes is calculated and compared with the observed number of crashes that involved both older and younger drivers. In this approach, the expected number of 2-vehicle crashes for any age group combination is calculated based on the measure of exposure of drivers of individual age groups.

The probability that a driver involved in a 2-vehicle crash (based on exposure, VMT) belongs to a given age group is calculated according to Equation 3.1.

$$P(Age\ Group) = \frac{VMT_{AgeGroup}}{\sum VMT} \qquad \text{[Equation 3.1]}$$

Where:

P(Age Group) = Probability a driver is from a specific age group involved in 2-vehicle crashes

$VMT_{AgeGroup}$ = Total vehicle miles traveled by specific age group

$\sum VMT$ = Vehicle Miles Traveled by all age groups

The following steps show the calculations of the probabilities of 2-vehicle crash involvements in Iowa by drivers of each age group based on exposure.

$$P(Younger\ Drivers) = \frac{VMT_{Younger}}{\sum VMT} = \frac{1265\ MVMT}{27029\ MVMT} = 0.047$$

$$P(Middle\ Age\ Drivers) = \frac{VMT_{Middle\ Age}}{\sum VMT} = \frac{23247\ MVMT}{27029\ MVMT} = 0.86$$

$$P(Older\ Drivers) = \frac{VMT_{Older}}{\sum VMT} = \frac{2519\ MVMT}{27029\ MVMT} = 0.093$$

Where

$P(Younger\ Drivers)$ = Probability of a younger (16-19) driver involved in a 2-vehicle crash

$P(Middle\ Age\ Drivers)$ = Probability of a middle age (20-64) driver involved in a 2-vehicle crash

$P(Older\ Drivers)$ = Probability of an older (65+) driver involved in a 2-vehicle crash

$VMT_{Younger}$ = Vehicle Miles Traveled by younger (16-19) age group (millions)

$VMT_{Middle\ Age}$ = Vehicle Miles Traveled by middle (20-64) age group (millions)

VMT_{Older} = Vehicle Miles Traveled by older (65+) age group (millions)

Based on exposure (VMT), there is a 4.7 percent chance that a given driver is young, 86 percent chance he or she is middle aged, and 9.3 percent chance of being an older drivers.

Table 3.2: Probability of 2-vehicle crash outcome for all age group drivers

Crash Outcome	Probability
Younger & Younger (16-19) & (16-19)	**P(Y) * P(Y)**
Younger & Middle age (16-19) & (20-64)	**P(Y) * P(M) + P(M) * P(Y)**
Younger & Older (16-19) & (65+)	**P(Y) * P(O) + P(O) * P(Y)**
Middle age & Middle age (20-64) & (20-64)	**P(M) * P(M)**
Middle age & Older (20-64) & (65+)	**P(M) * P(O) + P(O) * P(M)**
Older & Older (65+) & (65+)	**P(O) * P(O)**
TOTAL	**1**

Table 3.2 shows the probabilities of 2-vehicle crash outcomes for all age groups. The sum of all probabilities for all possible crash outcomes is 1.

Knowing the probability of crash involvement by individual age group, expected 2-vehicle crashes for all age group combinations, based on exposure (VMT), are calculated using Equation 3.2.

$$E_1 \text{ (Age Group1 – Age Group2)} = \left(\frac{VMT_{Age\ Group1}}{\sum VMT}\right)*\left(\frac{VMT_{Age\ Group2}}{\sum VMT}\right)*\sum 2\,Veh\ Crashes$$

[Equation 3.2]

Where:

E_1 (Age Group1 – Age Group2) = Expected # of 2-vehicle Crashes between drivers of age group 1 and age group 2, unadjusted for age

$\sum 2\,Veh\ Crashes$ = All 2-Vehicle crashes

The following steps show the sample calculations for expected 2-vehicle crash involvements by age group combination.

$$E_1\text{ (Y-Y)} = \left(\frac{VMT_{Younger}}{\sum VMT}\right)*\left(\frac{VMT_{Younger}}{\sum VMT}\right) = (0.047*0.047)*\ 34{,}262 = 76$$

$$E_1\text{ (Y-M)} = \left(\frac{VMT_{Younger}}{\sum VMT}\right)*\left(\frac{VMT_{Middle\ Age}}{\sum VMT}\right) = (0.047*0.86)*\ 34{,}262 = 1{,}385$$

$$E_1\text{ (M-Y)} = \left(\frac{VMT_{Middle\ Age}}{\sum VMT}\right)*\left(\frac{VMT_{Younger}}{\sum VMT}\right) = (0.86*0.047)*\ 34{,}262 = 1{,}385$$

$$E_1\text{ (Y-O)} = \left(\frac{VMT_{Younger}}{\sum VMT}\right)*\left(\frac{VMT_{Older}}{\sum VMT}\right) = (0.047*0.093)*\ 34{,}262 = 150$$

$$E_1\text{ (O-Y)} = \left(\frac{VMT_{Older}}{\sum VMT}\right)*\left(\frac{VMT_{Younger}}{\sum VMT}\right) = (0.093*0.047)*\ 34{,}262 = 150$$

$$E_1\text{ (M-M)} = \left(\frac{VMT_{Middle\ Age}}{\sum VMT}\right)*\left(\frac{VMT_{Middle\ Age}}{\sum VMT}\right) = (0.86*0.86)*34{,}262 = 25{,}340$$

$$E_1\text{ (M-O)} = \left(\frac{VMT_{Middle\ Age}}{\sum VMT}\right)*\left(\frac{VMT_{Older}}{\sum VMT}\right) = (0.86*0.093)*\ 34{,}262 = 2{,}741$$

$$E_1\text{ (O-M)} = \left(\frac{VMT_{Older}}{\sum VMT}\right)*\left(\frac{VMT_{Middle\ Age}}{\sum VMT}\right) = (0.093*0.86)*\ 34{,}262 = 2{,}741$$

$$E_1\text{ (O-O)} = \left(\frac{VMT_{Older}}{\sum VMT}\right)*\left(\frac{VMT_{Older}}{\sum VMT}\right) = (0.093*0.093)*\ 34{,}262 = 296$$

Where:

E_1 (Y-Y) = Statewide expected number of crashes between younger (16-19) and younger (16-19) drivers

E_1 (Y-M) = Statewide expected number of crashes between younger (16-19) and middle age (20- 64) drivers

E_1 (M-Y) = Statewide expected number of crashes between middle age (20-64) and younger (16-19) drivers

E_1 (Y-O) = Statewide expected number of crashes between younger (16-19) and older (65+) drivers

E_1 (O-Y) = Statewide expected number of crashes between older (65+) and younger (16-19) drivers

E_1 (M-M) = Statewide expected number of crashes between middle age (20-64) and middle age (20- 64) drivers

E_1 (M-O) = Statewide expected number of crashes between middle age (20-64) and older (65+) drivers

E_1 (O-M) = Statewide expected number of crashes between older (65+) and middle age (20-64) drivers

E_1 (O-O) = Statewide expected number of crashes between older (65+) and older (65+) drivers

34,262 = Total number of all 2-vehicle crashes

Table 3.3 reveals how the expected result of all 34,262 2-vehicle crashes is distributed among all age group combinations based on exposure to roadways. Recall that crashes that involved drivers less than 16 years of age and drivers with unknown age were excluded from the analysis.

Table 3.3: Expected number of 2-vehicle crashes by age group combination, based on exposure (unadjusted)

Crash Outcome	Expected 2-vehicle Crashes	Total
Younger & Younger (16-19) & (16-19)	E_1(Y-Y) 76	76
Younger & Middle age (16-19) & (20-64)	E_1(Y-M) + E_1(M-Y) 1,385 + 1,385	2,770
Younger & Older (16-19) & (65+)	E_1(Y-O) + E_1(O-Y) **150 + 150**	**300**
Middle age & Middle age (20-64) & (20-64)	E_1(M-M) 25,340	25,340
Middle age & Older (20-64) & (65+)	E_1(M-O) + E_1(O-M) 2741 + 2741	5,482
Older & Older (65+) & (65+)	E_1(O-O) 296	296
TOTAL		**34,262**

Overrepresentation in 2-Vehicle Crashes (Adjusted)

In the above analysis, results are biased as no accounting for individual group's overrepresentation was made (the age effect). In this approach, the expected number of crash involvement by individual age group is isolated from the age effect. Table 3.4 shows the observed number of 2-vehicle crashes and drivers involved for combinations of all age groups.

The number of drivers involved in 2-vehicle crashes by individual age group is as follows:

Younger Drivers = 2,970 + 8,234 + 1,084 = 12,288

Middle Age Drivers = 8,234 + 35,444 + 5,207 = 48,885

Older Drivers = 1,084 + 5,207 + 1,060 = 7,351

Table 3.4: Observed number of 2-vehicle crashes and drivers involved by age group

Crash Outcome	Observed 2-vehicle Crashes	Observed Drivers Involved 2-vehicle Crashes
Younger & Younger (16-19) & (16-19)	1,485	2,970
Younger & Middle age (16-19) & (20-64)	8,234	16,468
Younger & Old (16-19) & (65+)	**1,084**	**2,168**
Middle age & Middle age (20-64) & (20-64)	17,722	35,444
Middle age & Older (20-64) & (65+)	5,207	10,414
Older & Older (65+) & (65+)	530	1,060
TOTAL	**34,262**	**68,524**

The actual probability that a driver involved in a 2-vehicle crash (accounting for overrepresentation by age) belongs to a given age group is calculated according to Equation 3.3.

$$P(Age\ Group) = \frac{Age\ Group_{Crash\ Involvement}}{\sum Drivers_{Crash\ Involvement}} \qquad \text{[Equation 3.3]}$$

The following steps show the calculations of the probabilities of 2-vehicle crash involvements by drivers of each age group.

$$P(Younger\ Drivers) = \frac{Younger_{Crash\ Involvement}}{\sum Drivers_{Crash\ Involvement}} = \frac{12,288}{68,524} = 0.18$$

$$P(Middle\ Age\ Drivers) = \frac{Middle\ Age_{Crash\ Involvement}}{\sum Drivers_{Crash\ Involvement}} = \frac{48{,}885}{68{,}524} = 0.71$$

$$P(Older\ Drivers) = \frac{Older_{Crash\ Involvement}}{\sum Drivers_{Crash\ Involvement}} = \frac{7{,}351}{68{,}524} = 0.11$$

$Younger_{Crash\ Involvement}$ = Number of younger (16-19) drivers involved in 2-vehicle crashes

$Middle\ Age_{Crash\ Involvement}$ = Number of middle age (20-64) drivers involved in 2-vehicle crashes

$Older_{Crash\ Involvement}$ = Number of older (65+) drivers involved in 2-vehicle crashes

12,288 = Statewide Younger Drivers (16-19) Involved in 2-vehicle Crashes

48,885 = Statewide Middle Age Drivers (20-64) Involved in 2-vehicle Crashes

7,351 = Statewide Older Drivers (65+) Involved in 2-vehicle Crashes

68,524 = Statewide All drivers involved in 2-vehicle crashes

The actual probability of crash involvement for both young and older drivers is higher than that calculated based only on VMT, while it is lower for middle age drivers, reflecting the relative risk of each of these groups, we call this the age adjusted probability.

Equation 3.4 is used to determine the expected number of crashes for interacting age groups when isolated from the age effect, and results are shown in Table 3.5.

$$E_2\ (AG1 - AG2) = \left(\frac{AG1_{Crash\ Involvement}}{\sum Drivers_{Crash\ Involvement}}\right) * \left(\frac{AG2_{Crash\ Involvement}}{\sum Drivers_{Crash\ Involvement}}\right) * \sum 2Veh\ Crashes$$

[Equation 3.4]

Where:

E_2 (AG1- AG2) = Expected # of 2-vehicle Crashes between drivers of age group1 and Age group 2, based on number of observed crashes (adjusted for age)

Table 3.5: Expected number of 2-vehicle crashes for all age group combinations, age adjusted

Crash Outcome	Expected 2-vehicle Crashes	Total
Younger & Younger (16-19) & (16-19)	E(Y-Y) 1,102	1,102
Younger & Middle age (16-19) & (20-64)	E(Y-M) + E(M-Y) 4,383 + 4,383	8,766
Younger & Old (16-19) & (65+)	E(Y-O) + E(O-Y) 659 + 659	**1,318**
Middle age & Middle age (20-64) & (20-64)	E(M-M) 17,438	17,438
Middle age & Older (20-64) & (65+)	E(M-O) + E(O-M) 2,622 + 2622	5,244
Older & Older (65+) & (65+)	E(O-O) 394	394
TOTAL		**34,262**

The same steps used for determining the expected number of crashes based on exposure (unadjusted) are used to calculate the expected number of crashes when adjusted for age.

Summary of Statewide Unadjusted and Adjusted Overrepresentation

The interactions in 2-vehicle crashes for all age groups in Iowa are shown in Table 3.6. To determine the possible overrepresentation in 2-vehicle crashes for all age groups, the expected number of crashes is compared with the observed value. Results show that statewide, Y-O crashes are overrepresented by 260 percent. However when isolating the expected number of crashes from the age effect, statewide Y-O crashes are actually underrepresented by approximately 18 percent. However, there is approximately a 35 percent overrepresentation in Y-Y and O-O crashes even after adjusting the expected number of crashes for age, Although, the over-involvement is much higher for Y-Y crashes than it is for O-O crashes (1850 percent vs. 79 percent) when the expected number of crashes is based on exposure (VMT only). Crashes between middle age and young drivers are overrepresented by 200 percent when unadjusted, but underrepresented by approximately 6 percent when adjusted for age. Finally, M-O crashes are underrepresented by 5 percent and 1 percent, before and after adjustment respectively.

Table 3.6: Statewide overrepresentation in 2-vehicle crashes by age group combination

Crash Interaction	Actual (observed) # of 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted for age	
		Expected # of 2-Veh Crashes	% Overrepresentation	Expected # of 2-Veh Crashes	% Overrepresentation
Younger & Younger (16-19) & (16-19)	1,485	76	**+1,854**	1,102	**+34.8**
Younger & Middle age (16-19) & (20-64)	8,234	2,770	**+197**	8,766	**-6.1**
Younger & Older (16-19) & (65+)	**1,084**	**300**	**+262**	**1,318**	**-17.8**
Middle age & Middle age (20-64) & (20-64)	17,722	25,341	**-30**	17,438	**+1.6**
Middle age & Older (20-64) & (65+)	5,207	5,481	**-5**	5,244	**-0.7**
Older & Older (65+) & (65+)	530	296	**+79**	395	**+34.2**
TOTAL	**34,262**	**34,262**		**34,262**	

* Actual numbers of 2-vehicle crashes are from Iowa Department of Transportation crash database (year 2000).

Statewide Chi-Square Analysis, Unadjusted

To test the significance of the findings in the previous section, a Chi-square analysis is performed. Chi square is a test of statistical significance. Any appropriately performed test of statistical significance identifies the degree of confidence in accepting or rejecting a hypothesis. The Chi-square statistic can be used to test if the difference between expected (E) and observed (O) data is an unusual one, or if it can be observed rather often (by chance).

Chi-Square Requirements

The requirements of a Chi-square test are as follows:

- Random sample
- Independent variables
- Data must be reported in raw frequencies
- Expected frequencies in each cell should be at least 5
- Outcomes are mutually exclusive

Null Hypothesis

To find if the difference between observed and expected crashes is indeed statistically significant, first, a null hypothesis needs to be defined. We define the null hypothesis as follows: The observed number of 2-vehicle crashes for combinations of all age groups is not significantly different from what is expected under random occurrences.

The Chi-square table of outcomes for combinations of all age groups in Iowa is generated, and, subsequently, Equation 3.5 is used to calculate the Chi-square values for 2-

vehicle crashes based on exposure, as shown in Table 3.7.

$$\chi^2 = \sum \frac{(O-E)^2}{E} \qquad \text{[Equation 3.5]}$$

Where:

χ^2 = Chi-square

E = expected number of 2-vehicle crashes

O = observed number of 2-vehicle crashes

Table 3.7: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Iowa (unadjusted, based on exposure, VMT).

# of Crashes					
2-Veh Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**(O - E)^2**	**chi square**
Young - Young	1,485	76	1,409	1,986,169	26,243
Young - Middle	8,234	2,770	5,464	29,858,136	10,780
Young - Older	1,084	300	784	615,411	2,055
Middle Age – Middle Age	17,722	25,340	-7,618	58,036,593	2,290
Middle Age - Older	5,207	5,481	-274	74,829	14
Older - Older	530	296	234	54,601	184
Total	**34,262**	**34,262**		**90,625,741**	**41,566**

The objective of the analysis is to determine if the value of chi square as large as 41,566 is greater than the critical value. A critical factor in using chi-square test is the degree of freedom, which is essentially the number of independent variables involved. Under the general model, there are 6 outcomes and three independent variables. Therefore the degree of freedom for this problem is 3. By looking at the chi-square distribution table, the chi-square value of 41,566 is much greater than the critical value of about 16 at the 0.001 significance level and 3 degrees of freedom. There is a significant difference between the observed and the expected number of 2-vehicle crashes, based on exposure.

Statewide Chi-Square Analysis, Adjusted for Age

Table 3.8 shows the chi-square values for all 2-vehicle crashes, isolated from the age effect. The chi-square value is calculated to be 261 using Equation 3.5.

Table 3.8: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Iowa (adjusted for age)

# of Crashes					
2-Veh Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Young - Young	1485	1102	383	146,689	133
Young - Middle	8,234	8,766	-532	283,024	32
Young - Older	1084	1318	-234	54,756	42
Middle Age – Middle Age	17,722	17,438	284	80,656	5
Middle Age - Older	5,207	5,244	-37	1369	0
Older - Older	530	395	135	18225	46
Total	34,262	34,262		584,719	**258**

The chi-square value of 261 is also much greater than the critical value of about 16 for 3 degrees of freedom and 0.001 probability of exceeding the critical value. The observed numbers of 2-vehicle crashes are significantly different from the expected numbers, even after isolating expected 2-vehicle crashes from the age effect, adjusted.

Y-O Interaction Demonstration (Venn Diagram)

Venn diagrams are presented in Figures 3.7 through 3.9 to illustrate the subsets of older and younger drivers in the set of all 2-vehicle crashes and the results. The intersections of two age groups in the diagrams represent the interaction of older and younger drivers in 2-vehicle crashes.

Figure 3.7 shows the interaction between two age groups based only on the measure of exposure, VMT by each age group. The expected number 300 is based on the addition of expected Y-O and O-Y crashes (150 + 150 = 300), as shown in Table 3.2. The unadjusted Y-O interaction reveals 300 percent more crash involvement than expected, based on exposure (VMT only).

The Venn diagram of Figure 3.8 reveals the Y-O interaction when adjusted for age. The expected number 1,318 in this diagram is a combination of Y-O and O-Y crashes (659 + 659 = 1,318), as demonstrated in Table 3.4. Comparing the observed with the expected data, adjusted for age, Y-O crashes are slightly underrepresented—18 percent less crash involvement than expected.

The Venn diagram in Figure 3.9 represents the observed number of Y-O crashes. There are 1,084 observed 2-vehicle crashes involving both older and younger drivers.

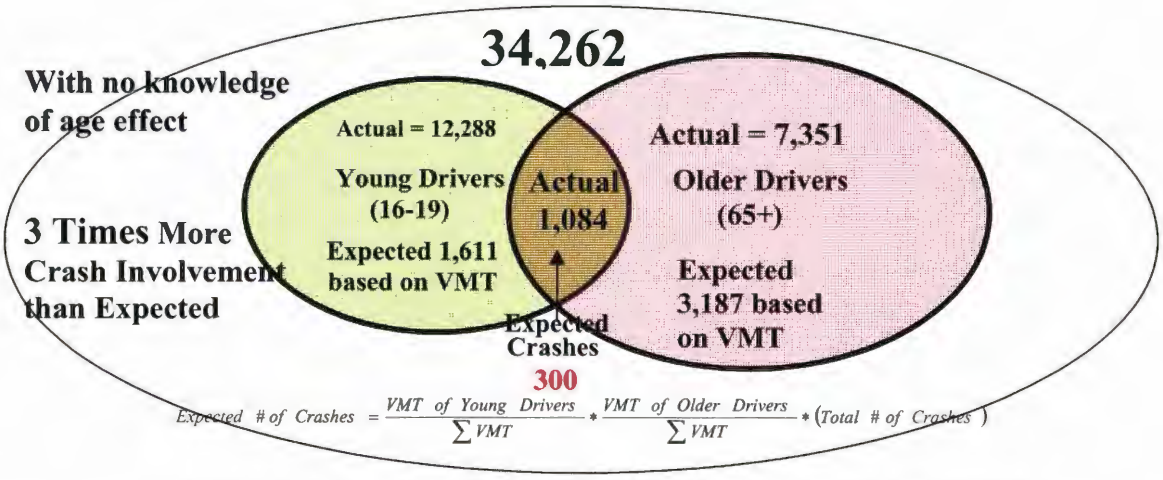


Figure 3.7: Expected Y-O crashes, based on exposure, unadjusted

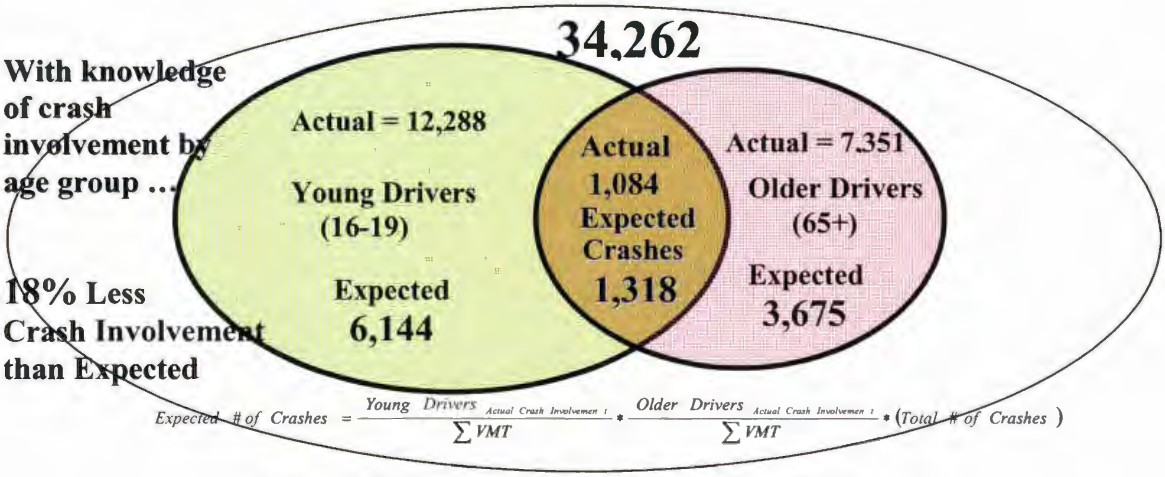


Figure 3.8: Expected Y-O crashes, adjusted for age

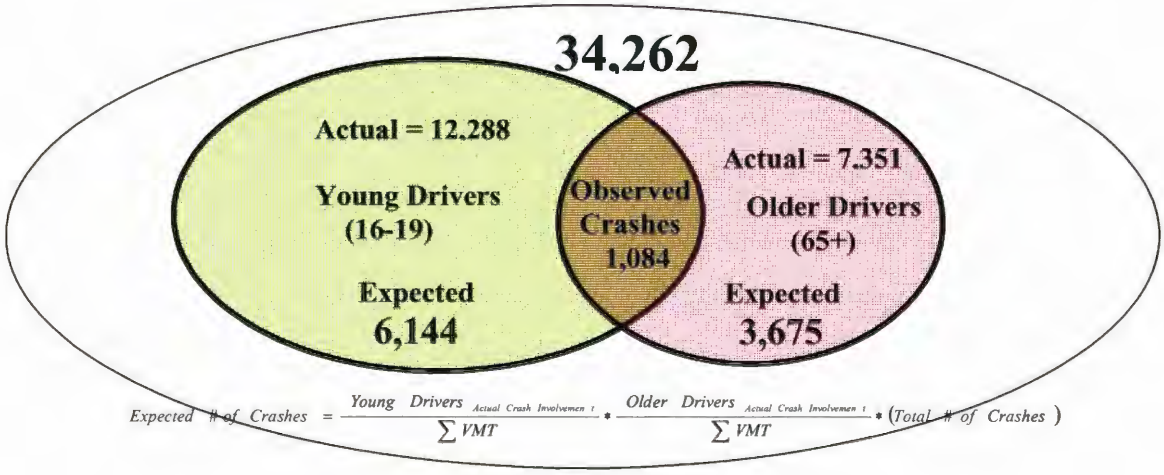


Figure 3.9: Observed number of Y-O crashes

Chapter 4 – Caused, Spatial, and Temporal Analysis of Y-O Crashes

Analysis of Y-O crashes in previous chapter does not indicate any overrepresentation at statewide level. In this chapter we explore underlying causes and perform spatial, geometric, and temporal analysis to identify crash characteristics, specific locations, time, and road-related characteristics which may explain involvement in Y-O crashes.

Crash Causation

This section explores the characteristics of Y-O crashes as compared to crashes of other types.

Crashes by Major Cause

Failure to yield right of way (FTYROW) from stop sign is the leading major cause of Y-O crashes (14 percent). FTYROW in making left turns, ran traffic signal, and failure to have control, with 13 percent, 6 percent, and 5 percent respectively, are the next major causes of Y-O crashes, as shown in Figure 4.1.

FTYROW from stop sign is the principal major cause in all 2-vehicle crashes and it varies among age group combinations, (17 percent for O-O crashes, while only 9 percent for M-M crashes). Amongst FTYROW left turn crashes, Y-O is the most represented type, while Y-Y is actually the lowest. Ran traffic signal is another major cause of 2-vehicle crashes for older drivers (7 percent for both O-M and O-O crashes, and 6 percent for Y-O crashes). Following too closely is a substantial major cause for Y-Y crashes. Failure to have control is

a significant major cause of crashes for all age group combinations except O-O crashes. This is most significant for 2-vehicle crashes involving middle-age drivers (Y-M and M-M).

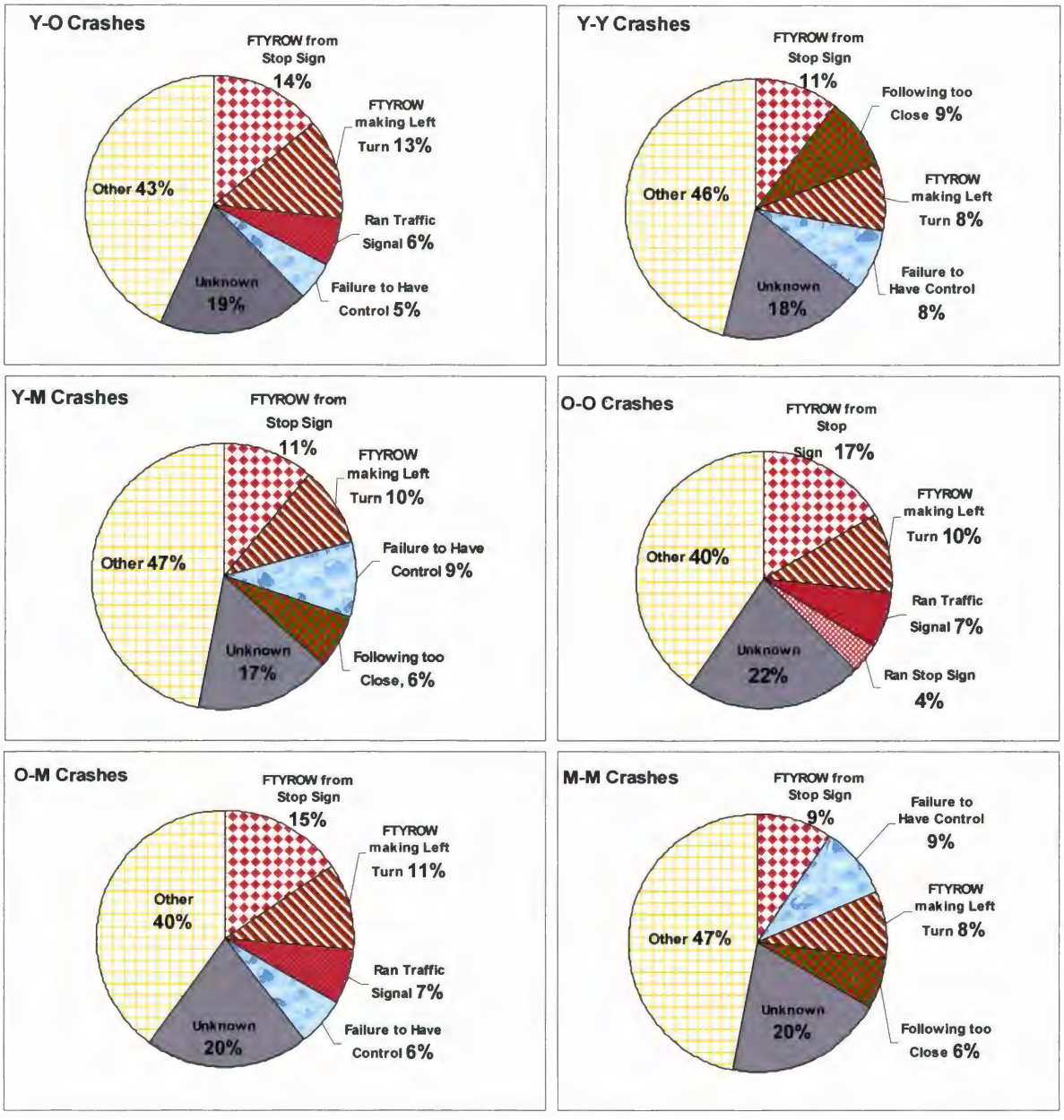


Figure 4.1: Major cause of 2-vehicle crashes for all age group combinations

Driver Contributing Factors

The probability that an older driver would be at fault in Y-O crashes is only slightly higher than that of a younger driver, as shown in Figure 4.2. In 443 out of 1084 Y-O crashes, the major cause of crash was attributed to older drivers. The major cause of crash was attributed to young drivers in 416 cases, was unknown in 208 crashes, and was attributed to both drivers in only 17 cases.

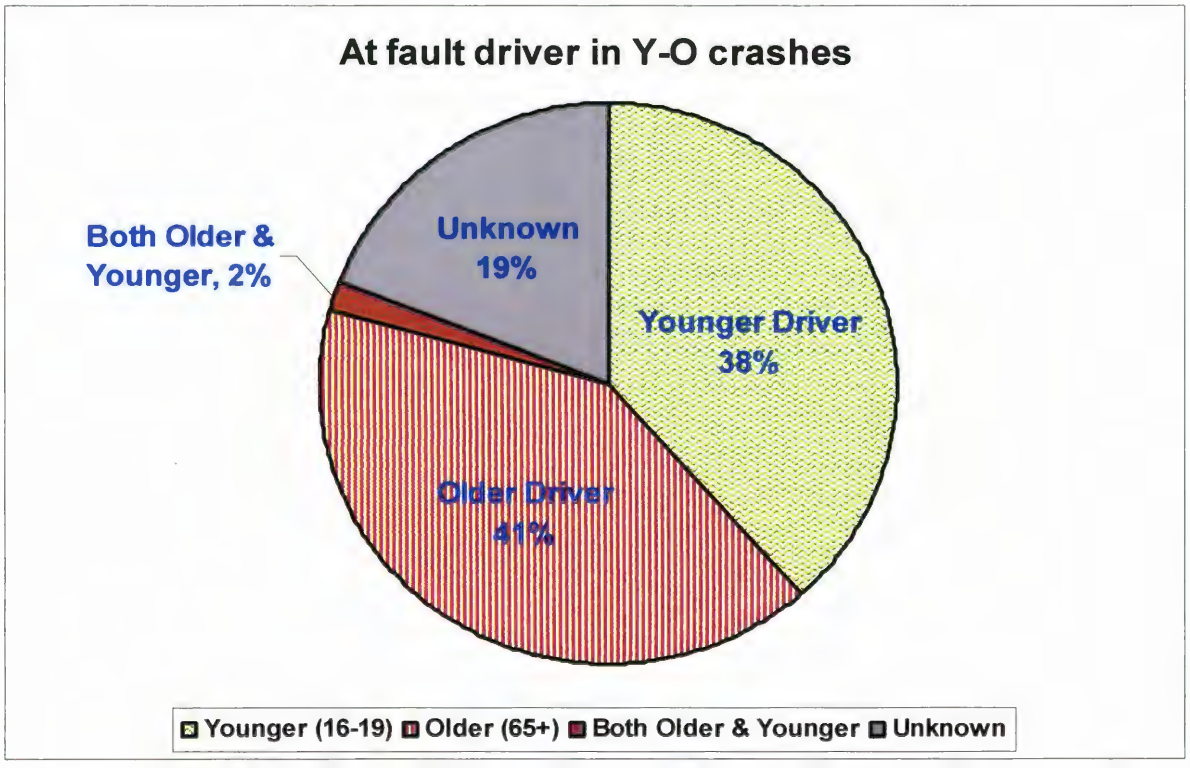


Figure 4.2: Major Cause of the crash attributed to either or both drivers

Light Condition at Time of Crash

The proportion of daylight and night crashes varies considerably between older and younger drivers. Almost 90 percent of older driver crashes occur during daylight hours compared to 72 percent of young driver crashes, as shown in Figure 4.3. After-dark crash involvement for young drivers is 180 percent higher than for older drivers. The pattern of Y-O crashes is very similar to that of older drivers. About 88 percent of Y-O crashes occur during daylight and nearly 12 percent happen after dark. The most after-dark Y-O crashes occur on dark-lighted roadways, as is the case for young drivers.

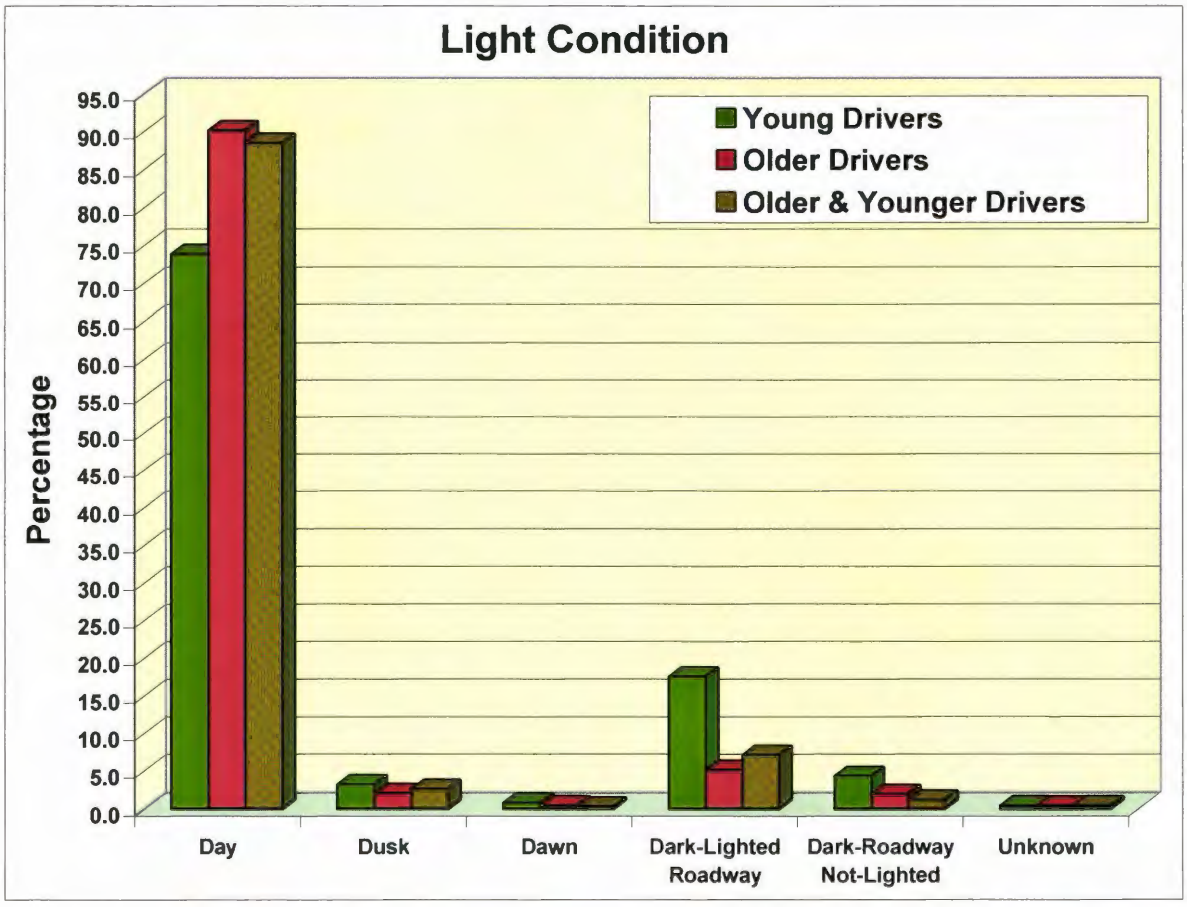


Figure 4.3: Light condition at time of 2-vehicle crashes involving older, young, and both drivers

Correlation between Number of Passenger(s) and Driving Performance

The presence of passenger(s) has a harmful impact on younger driver crash rates, but a beneficial effect on older driver crash rates in Iowa. Figure 4.4 shows the percentage of crashes that occur in the presence of 0, 1, or 2 or more passengers. Clearly, most crashes occur with no passenger. However, it is more likely that a younger driver will be involved in a crash involving 2 or more passengers, as compared to drivers of other ages. Older drivers, on the other hand, are underrepresented in crashes involving 2 or more passengers. While these observations may be reflecting the actual number of passengers typically carried by these drivers, it indicates a potential area for future study.

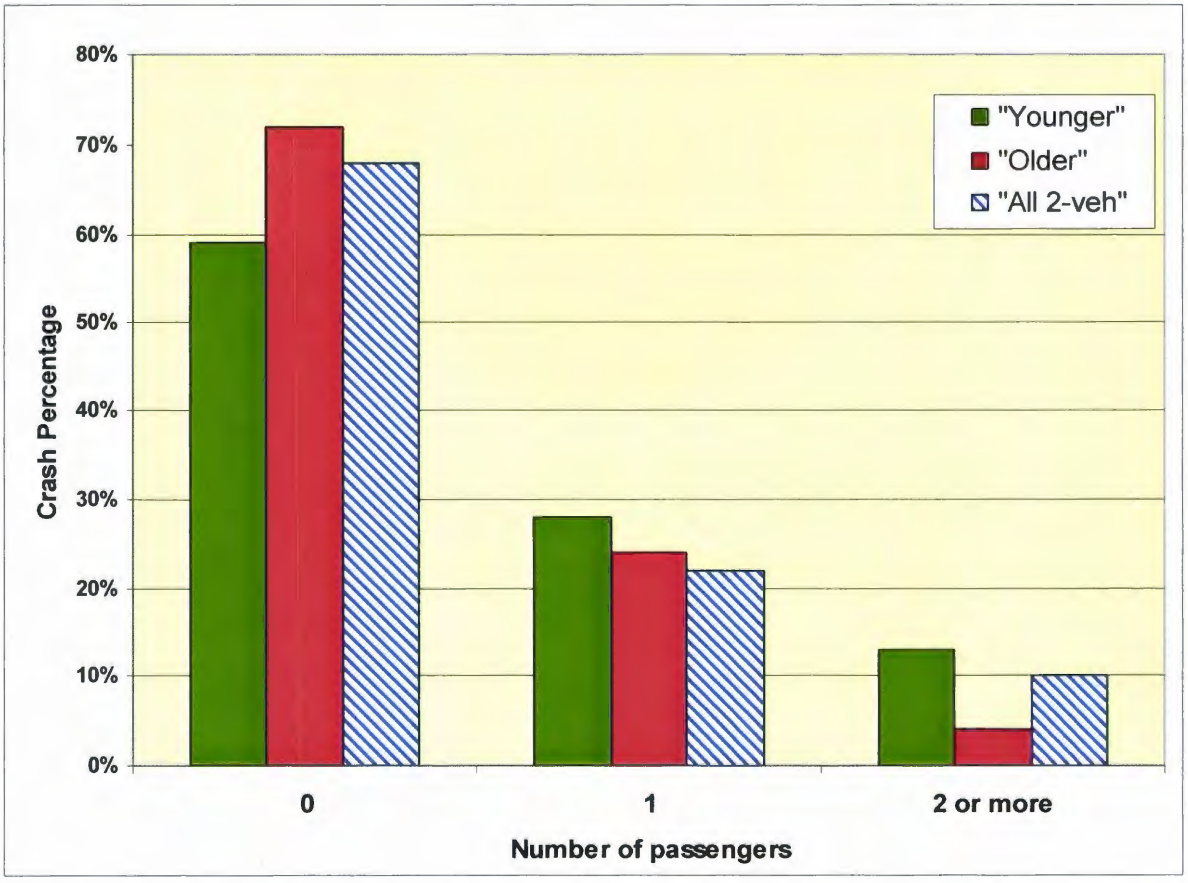


Figure 4.4: Passenger(s) correlation with driving performance of older and young drivers

Spatial Analysis

Statewide analysis does not indicate overrepresentation of Y-O crashes. This may be due to younger and older drivers not driving in the same places. However, there may be locations in the state where they do drive in the same places. Spatial analysis can be used to indicate regional variations in crash patterns. This section explores those variations.

Y-O Over-Involvement by County

Total vehicle miles traveled by each age group is obtained using the number of licensed drivers by county and age group and the estimate of exposure derived from National Household Travel Survey (2001). A complete table of the number of drivers and their exposure (VMT) by age group and county for all 99 counties in Iowa is shown in Appendix A. Ranking of Iowa counties based on the total percent of older and younger drivers is shown in Appendix B. As a case study, a sample analysis for Polk County is shown in the following section.

Polk County Y-O Overrepresentation (Unadjusted)

Table 4.1 shows VMT by age group for Polk County, the most populous county in the state. Younger and older drivers are the smallest groups of licensed drivers and therefore have lower exposure than the statewide average. Middle age drivers represent about 90 percent of drivers in Polk County as compared to 86 percent statewide.

The unadjusted procedure used for statewide analysis was used to calculate expected numbers of drivers involved in 2-vehicle crashes based on exposure in Polk County.

Expected numbers of drivers involved in 2-vehicle crashes for all age group combinations are shown in Table 4.2. Crash analysis at the county level is performed based on the number of drivers involved in all 2-vehicle crashes in order to have larger sample sizes for Chi-square analysis. Since the analysis involves 2-vehicle crashes, the number of crashes is half the number of drivers in any step of the process.

Table 4.1: Measure of exposure (VMT) by age group in Polk County

Age Group	VMT (Million)	Percent
Young (16-19)	135.5	3.6
Middle Age (20-64)	3360.4	89.9
Older (65+)	240.2	6.4
Total	**3736**	**100.0**

Table 4.2: Polk County expected number of drivers involved in 2-vehicle crashes, unadjusted (based on exposure, VMT)

Crash Outcome	Expected # of Drivers Involved in 2-Vehicle Crashes	Total
Younger & Younger (16-19) & (16-19)	E_1(Y-Y) 18	18
Younger & Middle age (16-19) & (20-64)	E_1(Y-M) + E(M-Y) 437 + 437	874
Younger & Older (16-19) & (65+)	E_1(Y-O) + E(O-Y) **31 + 31**	**62**
Middle age & Middle age (20-64) & (20-64)	E_1(M-M) 10,829	10,829
Middle age & Older (20-64) & (65+)	E_1(M-O) + E(O-M) 774 + 774	1,548
Older & Older (65+) & (65+)	E_1(O-O) 55	55
TOTAL		**13,386**

As in the statewide analysis, the expected number of drivers involved in 2-vehicle crashes was adjusted for age effects. Table 4.3 shows the observed numbers of 2-vehicle crashes and drivers involved for combinations of all age groups involved in 2-vehicle crashes in Polk County.

Table 4.3: Actual number of drivers involved 2-vehicle crashes in Polk County

Crash Outcome	Observed 2-Vehicle Crashes	Observed Drivers Involved 2-Vehicle Crashes
Younger & Younger (16-19) & (16-19)	196	392
Young & Middle age (16-19) & (20-64)	1,510	3,020
Younger & Older (16-19) & (65+)	**133**	**266**
Middle age & Middle age (20-64) & (20-64)	4,016	8,032
Middle age & Older (20-64) & (65+)	794	1,588
Older & Older (65+) & (65+)	44	88
TOTAL	**6,693**	**13,386**

The probability that a driver involved in a 2-vehicle crash belongs to a given age group is 15 percent, 77 percent, and 8 percent for young, middle, and older drivers, respectively, which are calculated using the statewide analysis process.

Polk County Y-O Overrepresentation (Adjusted)

The statewide adjusted calculation process is used to determine the expected number of drivers involved in 2-vehicle crashes for combinations of all age groups in Polk County, and results are shown in Table 4.4. There are 13,386 drivers involved in 2-vehicle crashes in Polk County compared to 68,528 drivers statewide.

Table 4.4: Polk County expected number of drivers involved in 2-vehicle crashes, age adjusted

Crash Outcome	Observed # of Drivers Involved in 2-Vehicle Crashes	Total
Younger & Younger (16-19) & (16-19)	E_2(Y-Y) 309	309
Young & Middle age (16-19) & (20-64)	E_2(Y-M) + E(M-Y) 1,571 + 1,571	3,142
Younger & Older (16-19) & (65+)	E_2(Y-O) + E(O-Y) **154 + 154**	**308**
Middle age & Middle age (20-64) & (20-64)	E_2(M-M) 7,981	7,982
Middle age & Older (20-64) & (65+)	E_2(M-O) + E(O-M) 784 + 784	1,568
Older & Older (65+) & (65+)	E_2(O-O) 77	77
TOTAL		**13,386**

Summary of Polk County Unadjusted and Adjusted Overrepresentation

Results of 2-vehicle crash analysis for Polk County are summarized in Table 4.5. Y-O crashes in Polk County are overrepresented by 326 percent. However, similar to statewide

analysis, when the expected number of crashes is isolated from the age effect, Y-O crashes are again underrepresented by 14 percent. While the unadjusted Y-O overrepresentation is 25 percent higher, adjusted Y-O crashes are 30 percent lower in Polk County.

Although the probability of young driver's 2-vehicle crash involvement based on exposure is 30 percent lower than statewide (4.7 versus 3.6 percent), Y-Y unadjusted over-involvement increased from 1,854 percent to 2,128 percent and adjusted underrepresentation decreased from 35 percent to 27 percent. Y-M unadjusted overrepresentation increased from 197 percent to 246 percent and adjusted underrepresentation decreased from -6.1 percent to -4 percent.

The probability of older driver's crash involvement based on VMT decreased to 6.4 percent in Polk County from 9.3 percent statewide. The unadjusted O-O overrepresentation dropped as expected. There was a significant decrease in O-O over-involvement from 34 percent to 14 percent when adjusted for age. A significant increase of 267 percent (unadjusted) and 286 percent (adjusted) for O-M overrepresentation was also observed.

Table 4.5: Polk County overrepresentation in 2-vehicle crashes by age group combination

Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted for age	
		Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Y-Y	392	18	+2,128	309	+27
Y-M	3,020	873	+246	3,142	-4
Y-O	266	62	**+326**	308	**-14**
M-M	8,032	10,829	-26	7,982	+1
M-O	1,588	1,548	+3	1,568	+1
O-O	88	55	+59	77	+14
TOTAL	13,386	13,386		13,386	

Summary of Osceola County Unadjusted and Adjusted Overrepresentation

Using the process performed for Polk County, results of 2-vehicle crash analysis for Osceola County are summarized in Table 4.6. Y-O crashes in Osceola County are overrepresented by 1007 percent when unadjusted. However, Y-O crashes remain overrepresented by 113 percent even after adjustment for age.

Table 4.6: Osceola County overrepresentation in 2-vehicle crashes by age group combinations

Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted for age	
		Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Y-Y	2	0	+717	3	-29
Y-M	14	7	+92	19	-25
Y-O	12	1	**+1007**	6	**+113**
M-M	38	54	-30	31	+22
M-O	10	16	-38	19	-47
O-O	4	1	+233	3	42
TOTAL	80	80		80	

Tables 4.5 and 4.6 present data for sample counties discussed here. The results of overrepresentation in 2-vehicle crashes in all 99 Iowa counties for all age group combinations are presented in Appendix C.

Chi-Square Analysis for Counties, Unadjusted

Chi-square analysis was performed for all counties with relatively large sample sizes (expected number of drivers involved in 2-vehicle crashes equal to or greater than 5 for all age group combinations). Table 4.7 shows Y-O overrepresentation for counties with expected number of drivers involved in 2-vehicle crashes being equal or greater than 5. The unadjusted over-involvement in Polk County is higher than statewide. The Y-O over-involvement in Scott, Blackhawk, and Pottawattamie counties are not much different from

the statewide average.

Table 4.7: Counties with expected sample sizes equal or greater than 5 (fulfilling chi-square test requirements)

County	Rank	Actual # of Y-O Drivers Involved 2-Vehicle Crashes	Expected # of Y-O Drivers Involved 2-Vehicle Crashes	Percent Over-Involvement
Polk	40	266	62	326
Scott	54	130	35	276
Black Hawk	56	86	23	269
Pottawattamie	57	62	17	269
Dubuque	66	64	20	223

A chi-square table of outcomes was generated for combinations of all age groups, and, subsequently, Equation 3.5 was used to calculate the chi-square values for drivers involved in 2-vehicle crashes based on exposure, as shown in Tables 4.8 through 4.12 for counties with expected cell size greater than or equal to 5.

Table 4.8: The Chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Polk County (unadjusted)

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	392	18	374	140,175	7,965
Younger – Middle	3,020	873	2,147	4,609,394	5,280
Younger - Older	266	62	204	41,449	664
Middle Age – Middle Age	8,032	10,829	-2,797	7,824,831	723
Middle Age - Older	1,588	1,548	40	1,575	1
Older - Older	88	55	33	1,067	19
Total	**13,386**	**13,386**		**12,618,492**	**14,651**

The chi-square value of 14,651 is much greater than the critical value of about 16 at the 0.001 probability of exceeding the critical value and 3 degrees of freedom. All counties (Scott, Black Hawk, Pottawattamie, and Dubuque) have chi-square values greater than the critical value. Therefore, there is a significant difference between the observed numbers of drivers involved in 2-vehicle crashes and the expected numbers, based on exposure but unadjusted for age.

Table 4.9: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Scott County (unadjusted)

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	186	10	176	30,913	3,037
Younger – Middle	1,228	418	810	656,651	1,572
Younger - Older	130	35	95	9,099	263
Middle Age – Middle Age	3,138	4,282	-1,144	1,309,789	306
Middle Age - Older	756	710	46	2,145	3
Older - Older	46	29	17	276	9
Total	**5,484**	**5,484**		**2,008,872**	**5,190**

Table 4.10: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Black Hawk County (unadjusted)

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	142	5	137	18,662	3,462
Younger - Middle	764	231	533	284,430	1,233
Younger - Older	86	23	63	3,931	169
Middle Age – Middle Age	1,694	2,470	-776	602,626	244
Middle Age - Older	512	499	13	166	0.3
Older - Older	56	25	31	948	38
Total	**3,254**	**3,254**		**910,764**	**5,146**

Table 4.11: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Pottawattamie County (unadjusted)

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	78	4	74	5,458	1,325
Younger - Middle	590	170	420	176,123	1,034
Younger - Older	62	17	45	2,042	122
Middle Age – Middle Age	1,242	1,762	-520	270,223	153
Middle Age - Older	326	348	-22	473	1
Older - Older	20	17	3	8	1
Total	**2,318**	**2,318**		**454,328**	**2,636**

Table 4.12: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Dubuque County (unadjusted)

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	122	5	117	136,212	2,575
Younger – Middle	610	195	415	172,267	884
Younger - Older	64	20	44	1,953	99
Middle Age – Middle Age	1,190	1,795	-605	365,602	204
Middle Age - Older	362	365	-3	8	0
Older - Older	50	19	31	990	53
Total	**2,398**	**2,398**		**554,440**	**3,814**

Chi-Square Analysis for Counties, Adjusted for Age

The chi-square analysis was then performed for expected number of drivers involved in 2-vehicle crashes adjusted for the age effect. The chi-square table of outcomes was generated for all age group combinations, and Equation 3.5 was used to calculate the chi-square values for all counties with expected sample size greater than or equal to 5, as shown in Table 4.18. Tables 4.13 through 4.17 are sample tables of outcomes and chi-square calculations.

The chi-square values are much smaller when compared to unadjusted numbers (35 versus 14,651 for Polk County). However The value of 35 is still larger than the critical value of about 16 with 0.001 probability of exceeding the critical value and 3 degrees of freedom. This is also true for the other counties, which all have chi-square values greater than the critical value of about 16. There is a significant difference between the expected and observed numbers of drivers involved in 2-vehicle crashes even after considering the age effect.

Table 4.13: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Polk County, adjusted for age

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	392	309	-83	6,856	22
Younger - Middle	3,020	3,143	123	15,031	5
Younger - Older	266	309	43	1,815	6
Middle Age – Middle Age	8,032	7,981	-51	2,601	0.33
Middle Age - Older	1,588	1,568	-20	416	0.27
Older - Older	88	77	-11	121	2
Total	13,386	13,386		26,840	**35**

The Chi-square value of 3.7 is larger than 2.4 and smaller than 4.1 at 0.25 significance level for Pottawattamie county. The probability of exceeding the critical value is between 0.25 and 0.50. The critical value at 90 percent significance level with 3 degrees of freedom is 6.25, which is greater than 3.7. Therefore there is no significant difference between the expected and observed numbers of drivers involved in 2-vehicle crashes in Pottawattamie County.

Table 4.14: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Scott County, adjusted for age

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	186	136	50	2,500	18.4
Younger - Middle	1,228	1,303	-75	5,625	4.3
Younger - Older	130	154	-24	576	3.7
Middle Age – Middle Age	3,138	3,110	28	784	0.3
Middle Age - Older	756	737	19	361	0.5
Older - Older	46	44	2	4	0.1
Total	5,484	5,484		9,850	**27.3**

Table 4.15: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Pottawattamie County, adjusted for age

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	78	70	8	64	0.9
Younger - Middle	590	593	-3	9	0.1
Younger - Older	62	75	-13	169	2.3
Middle Age – Middle Age	1,242	1,247	-5	25	0.1
Middle Age - Older	326	314	12	144	0.5
Older - Older	20	20	0	0	0.0
Total	2,318	2,319		411	**3.7**

Table 4.16: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Black Hawk County, adjusted for age

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	142	99	43	1,849	19
Younger - Middle	764	813	-49	2,401	3
Younger - Older	86	124	-38	1,444	12
Middle Age – Middle Age	1,694	1,671	23	529	0.3
Middle Age - Older	512	509	3	9	0.1
Older - Older	56	39	17	289	7
Total	3,254	3,254		6,521	**41.4**

Table 4.17: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in Dubuque County, adjusted for age

# of Drivers Involved 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	122	88	34	1,156	13
Younger - Middle	610	642	-32	1,024	1.6
Younger - Older	64	101	-37	1,369	14
Middle Age – Middle Age	1,190	1,171	19	361	0.3
Middle Age - Older	362	368	-6	36	0.1
Older - Older	50	29	21	441	15
Total	2,398	2,398		4,387	**44**

Comparing Counties Y-O Crash Experience

To summarize the county experience of Y-O crashes, three maps are presented. In the first, counties with expected unadjusted cell frequency of 5 or greater are selected to fulfill the chi-square requirement and eliminate the low sample size effects. The overrepresented counties are shown in Figure 4.5. There are 13 counties with Y-O crashes overrepresented by 300 to 500 percent compared to 260 percent statewide. Mahaska, Des Moines, and Story counties are overrepresented by more than 450 percent. There are 8 counties with 200 to 300 percent over-involvement in Y-O crashes. Jasper and Wapello counties show lower overrepresentation than statewide average, with 158 and 102 percent respectively. The results for all 99 counties in Iowa are shown in Table 4.18.

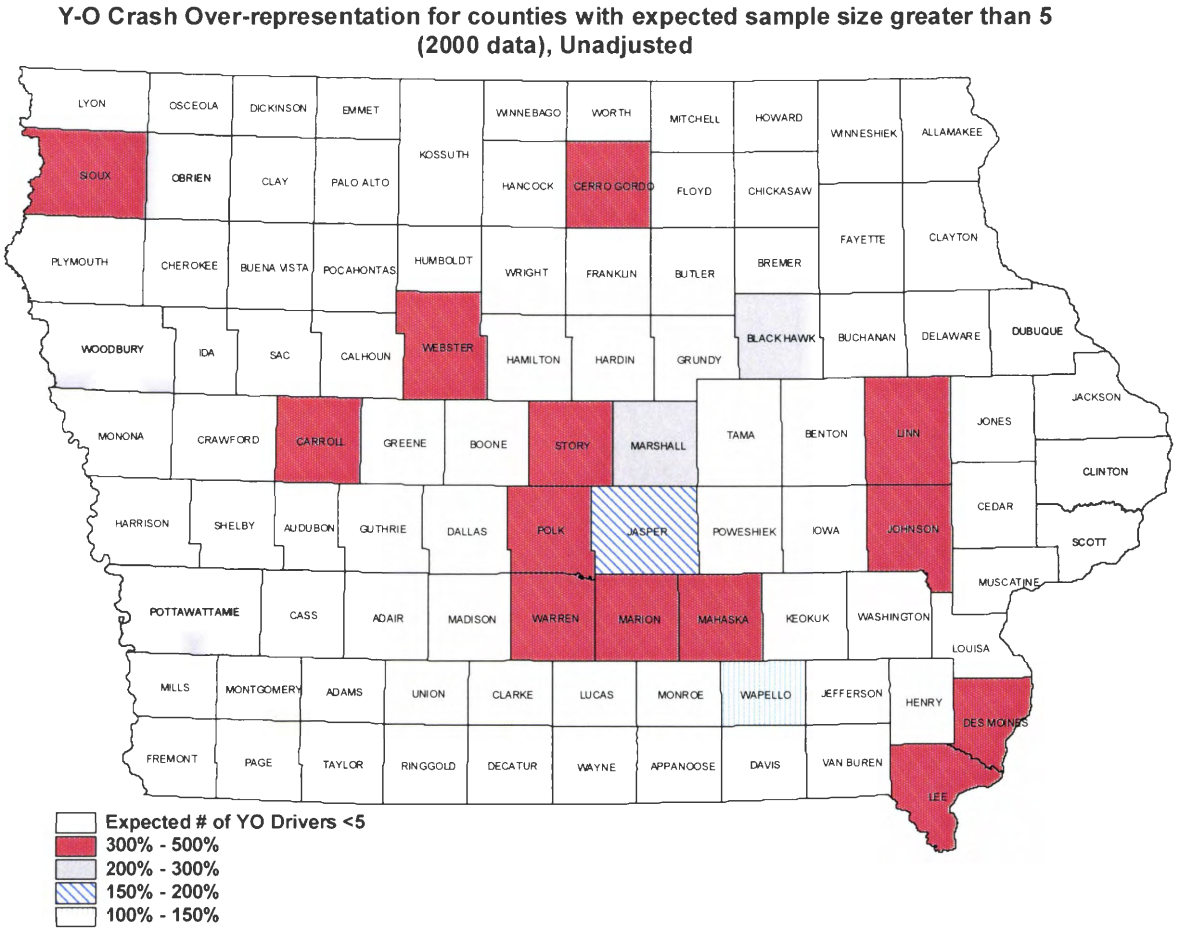


Figure 4.5: Y-O crash over-involvement for counties with large sample size

In a second analysis counties with unadjusted expected cell frequency of 3 to 5 are selected. Figure 4.6 reveals that Cherokee and Winneshiek counties are overrepresented in Y-O crashes by more than 500 percent. There are 7 counties with 300 to 500 percent overrepresentation.

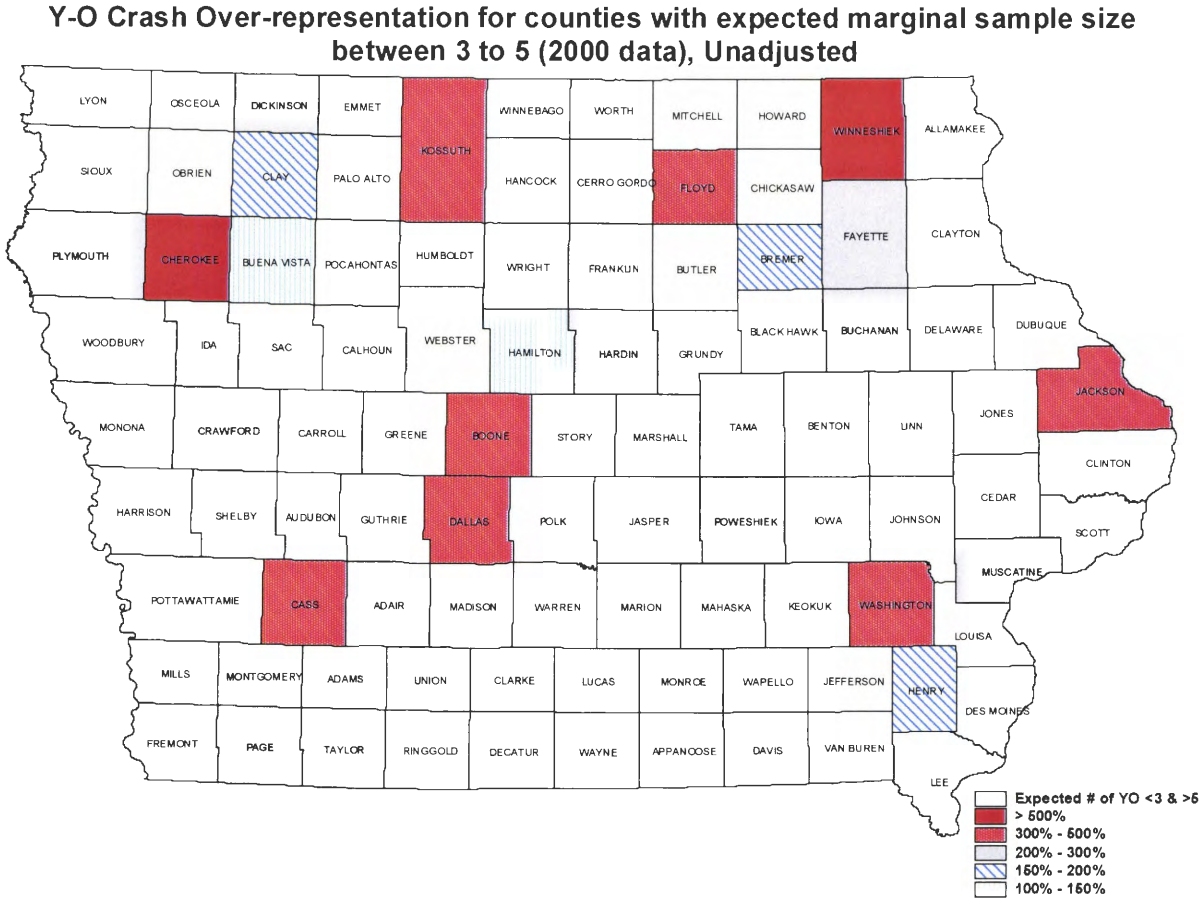


Figure 4.6: Y-O crash over-involvement for counties with marginal sample size

Over-involvement in Floyd, Kossuth, and Jackson counties is greater than 400 percent. There are 8 counties with nearly the same over-involvement as the statewide average. Clay, Bremer, Henry, Hamilton, and Buena Vista counties experienced less Y-O crash over-involvement than the statewide average.

A third analysis, accounting for age of drivers, is displayed in figure 4.7. Osceola, Greene, and Iowa counties are overrepresented by more than 50 percent when considering

the age effect. There are 18 counties with 0 to 50 percent over-involvement, 22 counties with similar underrepresentation as the statewide, and 35 counties with more underrepresentation than the statewide average. The results of the analysis for all 99 counties in Iowa are shown in Table 4.18.

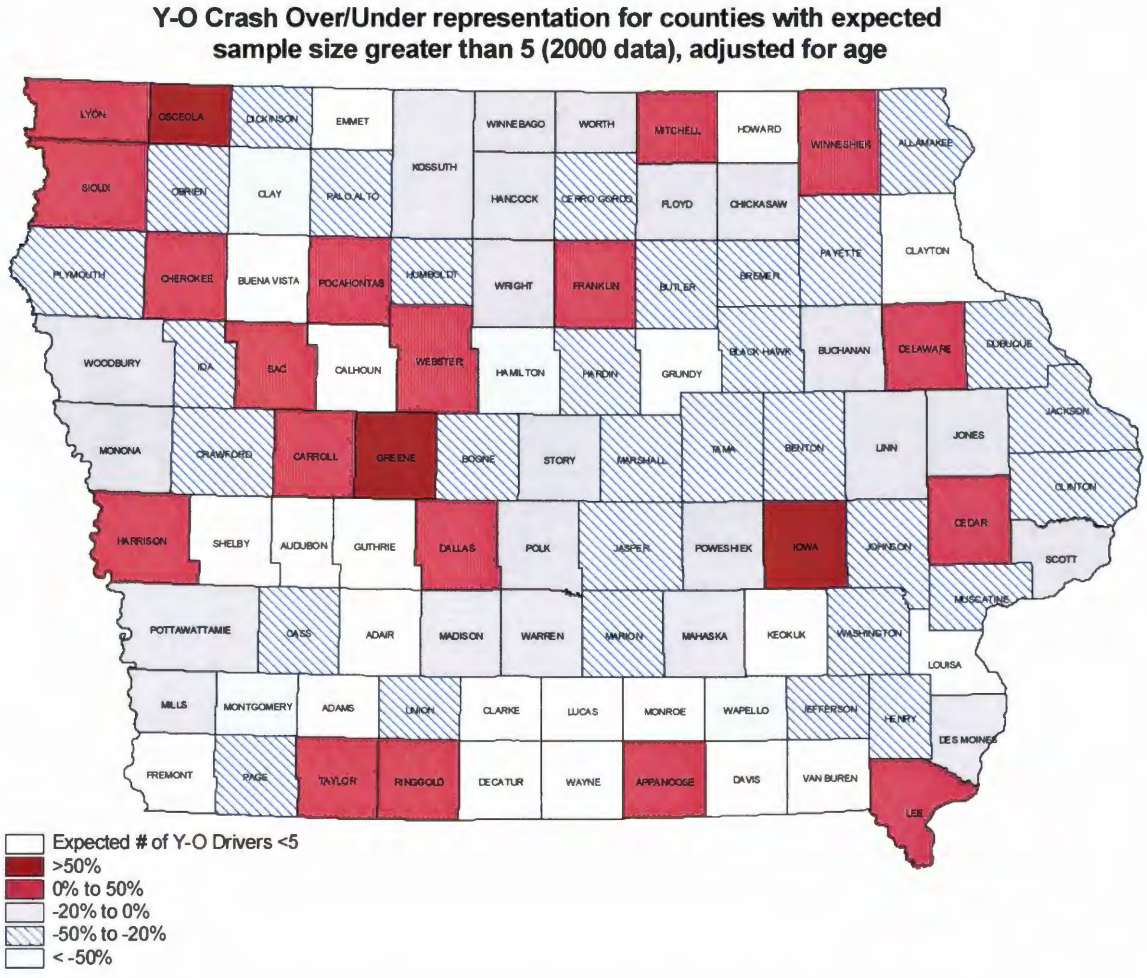


Figure 4.7: Y-O crash over-involvement for counties, adjusted for age

Table 4.18: Counties ranked by overrepresentation in Y-O crashes

County	* Rank	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		(adjusted for age)		Chi Square	Percent Confidence
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation		
Osceola	1	12	1	1007	6	113	13.83	99.5%
Greene	2	14	2	511	8	66	S	-
Iowa	3	10	2	311	6	63	6.73	90.0%
Cherokee	4	22	3	616	15	44	6.55	90.0%
Cedar	5	12	3	355	9	40	8.12	95.0%
Delaware	6	14	3	382	10	35	7.09	90.0%
Ringgold	7	8	1	818	6	32	14.89	99.9%
Lyon	8	12	2	488	9	28	6.36	90.0%
Harrison	9	16	2	543	13	25	4.82	75.0%
Taylor	10	8	1	972	6	24	S	-
Franklin	11	10	3	290	8	21	5.20	75.0%
Webster	12	76	14	437	68	11	8.32	75.0%
Pocahontas	13	8	1	457	7	9	0.94	10.0%
Appanoose	14	20	3	658	18	9	13.00	97.5%
Mitchell	15	10	2	334	9	8	6.01	75.0%
Sioux	16	34	6	449	32	7	26.82	99.9%
Winneshie	17	30	4	604	28	6	1.60	25.0%
Carroll	18	30	6	403	29	4	0.82	10.0%
Lee	19	36	7	391	35	4	0.24	2.5%
Sac	20	8	2	263	8	1	S	-
Dallas	21	22	4	390	22	1	10.65	97.5%
Hancock	22	8	2	298	8	0	6.06	75.0%
Mahaska	23	32	5	486	32	0	0.01	< 0.5%
Adams	24	2	1	174	2	0	S	-
Story	25	56	10	451	58	-4	16.00	99.9%
Jones	26	14	3	400	15	-4	14.76	99.9%
Des Moine	27	54	9	475	58	-7	33.81	99.9%
Linn	28	156	35	349	169	-8	15.25	99.9%

County	* Rank	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		(adjusted for age)		Chi Square	Percent Confidence
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation		
Warren	29	28	5	418	31	-9	11.57	99.0%
Floyd	30	22	4	444	24	-9	12.23	99.0%
Woodbury	31	60	15	288	67	-10	10.06	97.5%
Mills	32	8	2	411	9	-11	7.02	90.0%
Buchanan	33	14	4	271	16	-11	6.06	75.0%
Polk	34	266	62	326	309	-14	35.27	99.9%
Winnebago	35	6	2	266	7	-14	S	-
Chickasaw	36	10	3	256	12	-14	7.85	95.0%
Madison	37	10	1	567	12	-15	4.70	75.0%
Kossuth	38	22	4	429	26	-16	5.64	75.0%
Scott	39	130	35	276	154	-16	27.27	99.9%
Wright	40	12	2	394	14	-17	4.11	50.0%
Pottawatta	41	62	17	269	75	-17	3.66	50.0%
Worth	42	6	1	559	8	-20	S	-
Poweshiek	43	16	4	292	20	-20	5.39	75.0%
Monona	44	14	2	591	18	-20	22.97	99.9%
Cerro Gord	45	60	14	334	76	-21	6.16	75.0%
Butler	46	8	2	330	10	-22	13.80	97.5%
Jackson	47	18	3	424	23	-22	6.01	75.0%
Crawford	48	14	4	298	18	-23	9.64	97.5%
Plymouth	49	18	5	282	23	-23	5.60	75.0%
Washingto	50	16	3	369	21	-23	8.24	95.0%
Hardin	51	12	4	242	16	-24	7.27	90.0%
Marion	52	26	5	374	35	-26	4.11	50.0%
Ida	53	6	2	247	8	-28	5.24	75.0%
Benton	54	14	3	372	20	-28	2.87	50.0%
O'Brien	55	18	5	233	25	-29	3.25	25.0%
Lucas	56	4	1	214	6	-30	S	-
Johnson	57	42	10	303	60	-30	16.74	99.9%
Black Haw	58	86	23	269	124	-30	41.00	99.9%
Cass	59	14	3	362	20	-31	9.84	97.5%

County	* Rank	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		(adjusted for age)		Chi Square	Percent Confidence
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation		
Boone	60	22	5	377	32	-32	11.68	99.0%
Marshall	61	34	9	291	51	-33	9.53	97.5%
Humboldt	62	8	3	192	12	-33	15.41	99.5%
Dickinson	63	14	4	244	22	-36	26.44	99.9%
Grundy	64	4	2	154	6	-36	S	-
Henry	65	12	4	192	19	-36	6.52	90.0%
Dubuque	66	64	20	223	101	-36	43.90	99.9%
Jefferson	67	8	2	223	13	-37	3.47	50.0%
Allamakee	68	10	3	282	16	-37	4.17	75.0%
Clinton	69	44	14	211	71	-38	18.25	99.9%
Guthrie	70	4	1	208	7	-39	S	-
Muscatine	71	18	5	278	30	-41	7.16	90.0%
Bremer	72	10	4	159	17	-41	12.50	99.0%
Fayette	73	12	4	216	21	-42	14.95	99.5%
Palo Alto	74	6	2	181	10	-42	4.88	75.0%
Louisa	75	4	1	323	7	-43	2.23	25.0%
Union	76	8	3	184	14	-44	8.24	95.0%
Page	77	12	3	283	22	-45	12.77	99.5%
Jasper	78	16	6	158	29	-45	18.99	99.9%
Van Buren	79	2	1	165	4	-46	S	-
Tama	80	6	3	123	12	-48	5.54	75.0%
Audubon	81	2	1	62	4	-49	S	-
Fremont	82	2	1	103	4	-49	S	-
Hamilton	83	8	4	100	16	-50	6.13	75.0%
Calhoun	84	4	2	89	9	-55	17.00	99.9%
Monroe	85	4	1	209	9	-55	5.81	75.0%
Clay	86	12	5	154	28	-58	14.36	99.5%
Montgome	87	6	2	201	15	-59	9.90	97.5%
Wapello	88	14	7	102	35	-60	21.56	99.9%
Clarke	89	4	2	85	10	-61	7.79	90.0%

County	* Rank	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		(adjusted for age)		Chi Square	Percent Confidence
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation		
Clayton	90	4	2	87	11	-64	8.05	95.0%
Decatur	91	2	1	95	6	-66	31.95	99.9%
Keokuk	92	2	1	125	7	-71	15.19	99.5%
Buena Vis	93	4	4	12	16	-75	14.97	99.5%
Howard	94	2	2	4	10	-80	13.45	99.0%
Shelby	95	2	2	-13	12	-83	15.80	99.5%
Emmet	96	2	3	-30	23	-91	76.92	99.9%
Wayne	97	0	1	-100	2	-100	S	-
Davis	98	0	1	-100	7	-100	33.20	99.9%
Adair	99	0	2	-100	5	-100	S	-

S Represents small sample size

Crashes in the Vicinity of High Schools

The vicinity of schools is a possible location for a significant number of Y-O crashes. Indeed, approximately 71.5 percent of all Y-O crashes occur within a 1.5-mile radius of high schools. It is expected that Y-O crashes would occur most frequently where high population of older and younger drivers may be found. However, no data is available to indicate variation in exposure over space. The percent of Y-O crashes occurring near schools is higher than other types of crashes involving all other age group combinations, individual age groups, and total 2-vehicle crashes at a distance within 1.5 mile from high schools. Even within a one-mile radius from high schools, fractions of Y-Y and Y-O crashes are nearly equal.

Table 4.19: Y-O percent 2-vehicle crashes by age group combination around high schools

Age Group	2-Vehicle Crashes in the Vicinity of High Schools/All 2-veh crashes by groups							
	1/4 Mile	%	1/2 Mile	%	1 Mile	%	1.5 Mile	%
Young (16-19)	787/11939	6.5	2294/11939	19.2	5690/11939	47.7	7944/11939	66.5
Middle (20-64)	1387/34891	4.0	4988/34891	14.3	14267/34891	41.0	21762/34891	62.4
Older (65+)	347/7396	4.7	1225/7396	16.6	3381/7396	45.7	4823/7396	65.2
All 2-Veh Crashes	1796/39701	4.5	6087/39701	15.3	16747/39701	42.2	25052/39701	63.1
Y-Y	175/1485	**11.8**	396/1485	**26.6**	809/1485	**54.5**	1056/1485	71.0
Y-O	75/1084	6.9	247/1084	22.8	581/1084	53.6	775/1084	**71.5**
Y-M	437/8234	5.3	1390/8234	16.9	3727/8234	45.3	5372/8234	65.2
M-M	546/17722	3.1	2205/17722	12.4	6712/17722	37.9	10735/17722	60.1
O-M	213/5207	4.0	783/5207	15.0	2283/5207	43.8	3330/5207	64.0
O-O	16/530	3.0	89/530	16.8	240/530	45.3	346/530	65.3

The percentage of Y-O crashes within a half mile from high schools is approximately 18 percent lower than that of Y-Y crashes; however, it is 84 percent higher than that of M-M crashes, 52 percent greater than that of O-M crashes, 35 percent higher than that of Y-M and O-O crashes, and approximately 50 percent greater than that of all 2-vehicle crashes. Table 4.19 and Figure 4.8 present the results of 2-vehicle crashes by age group combination and distance from high schools. Y-O crashes are lower than Y-Y crashes up to some distance from high schools but start to increase when the radius increases and passes 1.25 mile, as shown in Figure 4.8. Interestingly, the fraction of O-O crashes in the vicinity of high schools is higher than those of M-M and O-M crashes and almost the same as Y-M crashes.

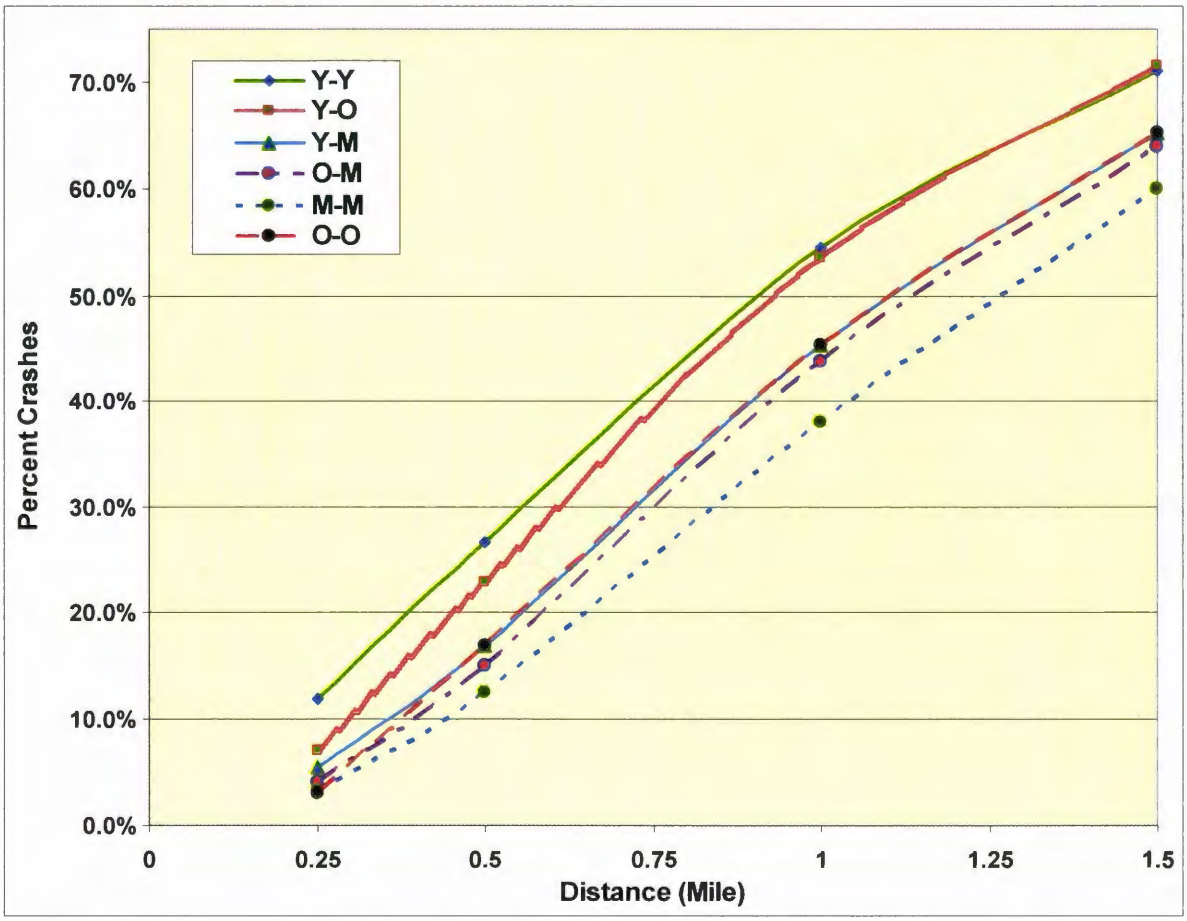


Figure 4.8: 2-vehicle crash percentage by age group combination and distance from high schools

2-Vehicle Crashes at Urban or Rural Locations

Figure 4.9 shows that M-M crashes at 77 percent have a higher fraction of 2-vehicle crashes at urban locations than any other age group combination. Nearly 70 percent of Y-O crashes occur in the urban area, compared to 67 percent for Y-Y crashes and 63 percent for O-O crashes.

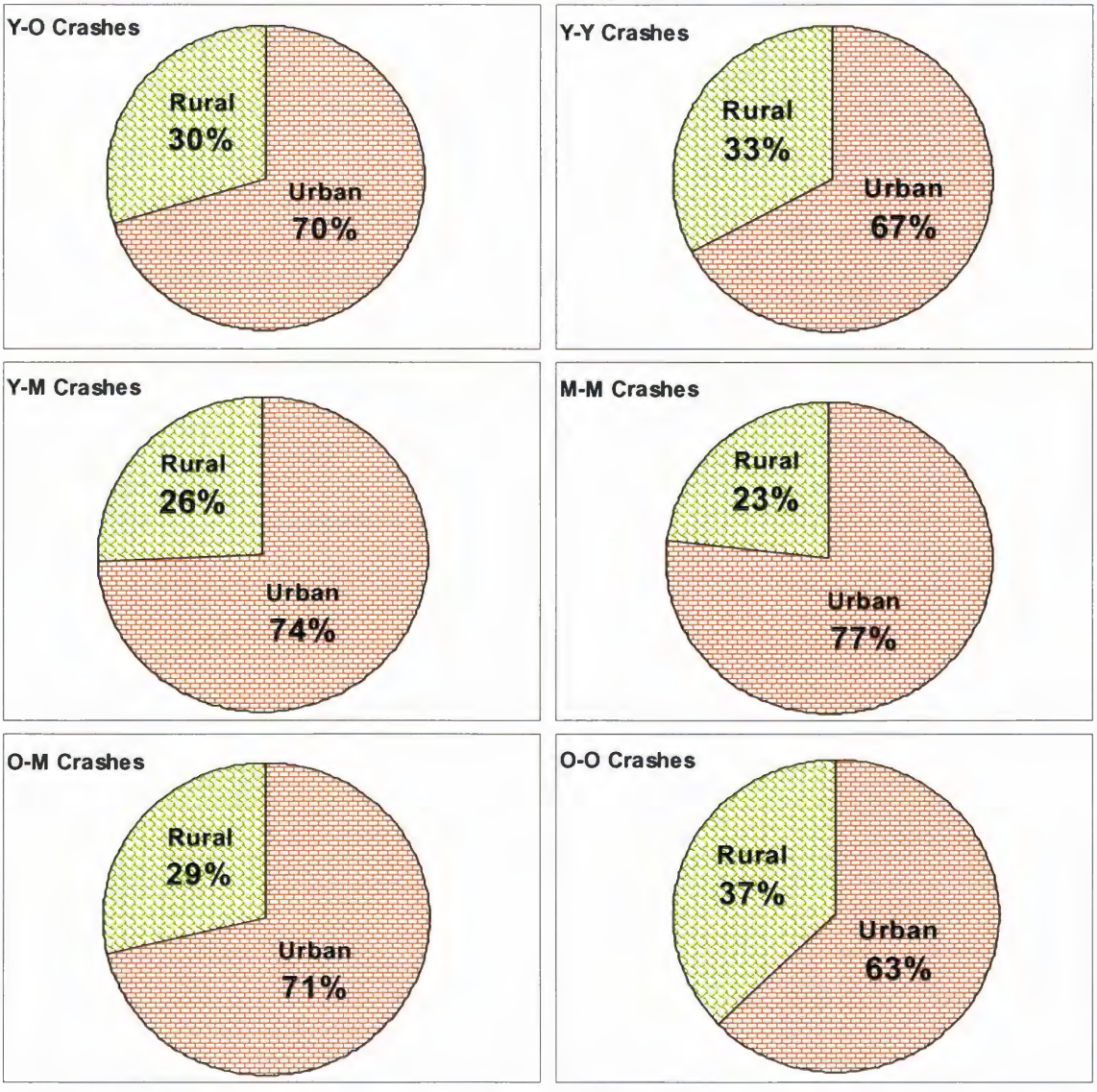


Figure 4.9: 2-vehicle crashes at urban and rural areas by age group combination

Geometric Analysis

In this section, 2-vehicle crashes are analyzed with consideration of road characteristics and intersection classifications to determine the type of roadways and intersections that present higher risk to both older and younger drivers.

Functional Class of Road Intersections

For various combinations of functional classes at intersections, Y-O crashes are compared to all 2-vehicle crashes as shown in Table 4.20 and in Figure 4.10. Y-O crashes are underrepresented at Interstate/ Interstate, Interstate/US or State highway, and Interstate/City or County road. At the intersections of US or State highways with other roads, Y-O crashes are overrepresented by approximately 40 percent.

Table 4.20: Comparing Y-O to All 2-Vehicle Crashes by Intersection Functional Class

All 2-Vehicle Intersection Classification	# of 2-Vehicle Crashes	Percent All 2-Vehicle	# of Y-O Crashes	Percent Y-O Crashes	Percent Difference
Interstate/Interstate	931	0.69%	10	0.22%	-210%
Interstate/US or State Highway	3,154	2.33%	41	0.91%	-157%
Interstate/City or County Road	3,091	2.28%	36	0.80%	-187%
US or State Highway/US or State Highway	5,120	3.78%	175	3.87%	2.4%
US or State Highway/County Road or City Street	43,162	31.87%	1,481	32.77%	2.7%
US-State Highway/Other	92	0.07%	5	0.11%	39%
County Road or City Street/County Road or City Street	79,872	58.98%	2,772	61.33%	3.8%
TOTAL	**135,422**	**100.00%**	**4520**	**100.00%**	

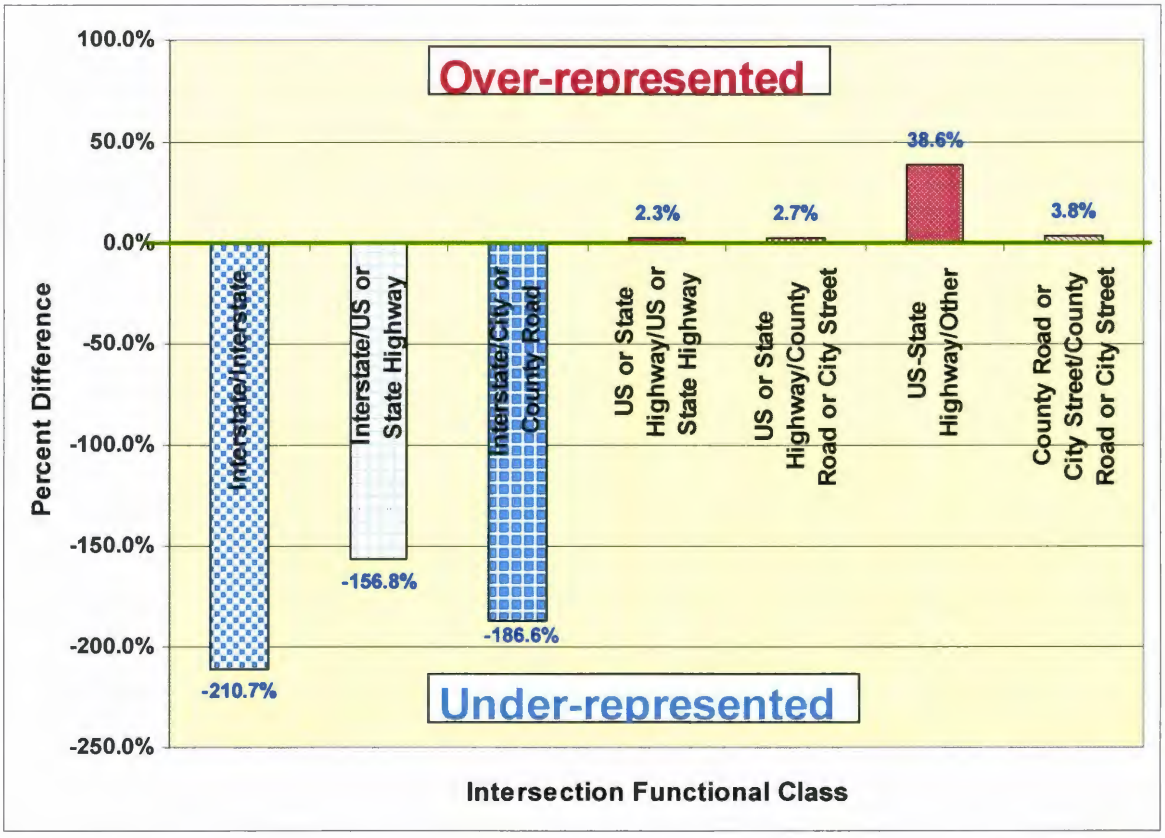


Figure 4.10: Comparison of Y-O crashes to all 2-vehicle crashes by intersection functional class

There is no significant difference between Y-O crashes and all 2-vehicle crashes at intersections with high percentages of 2-vehicle crashes such as US or State highway/County road or City street (32 percent) and County road or City street/ County road or City street (60 percent), as shown in Table 4.20.

Evaluating 2-Vehicle Crashes at Intersections

The majority of 2-vehicle crashes occur at intersections, but proportions are different for various age group combinations, as shown in Figure 4.11. The fraction of Y-O crashes at intersections (71 percent) is the highest proportion among all age group combinations. The percentage of Y-Y crashes occurring at intersections is 60 percent, which is interestingly the

lowest compared to all other age group combinations. The fraction of Y-M, O-M, and O-O crashes occurring at intersections are almost the same, at about 65 percent.

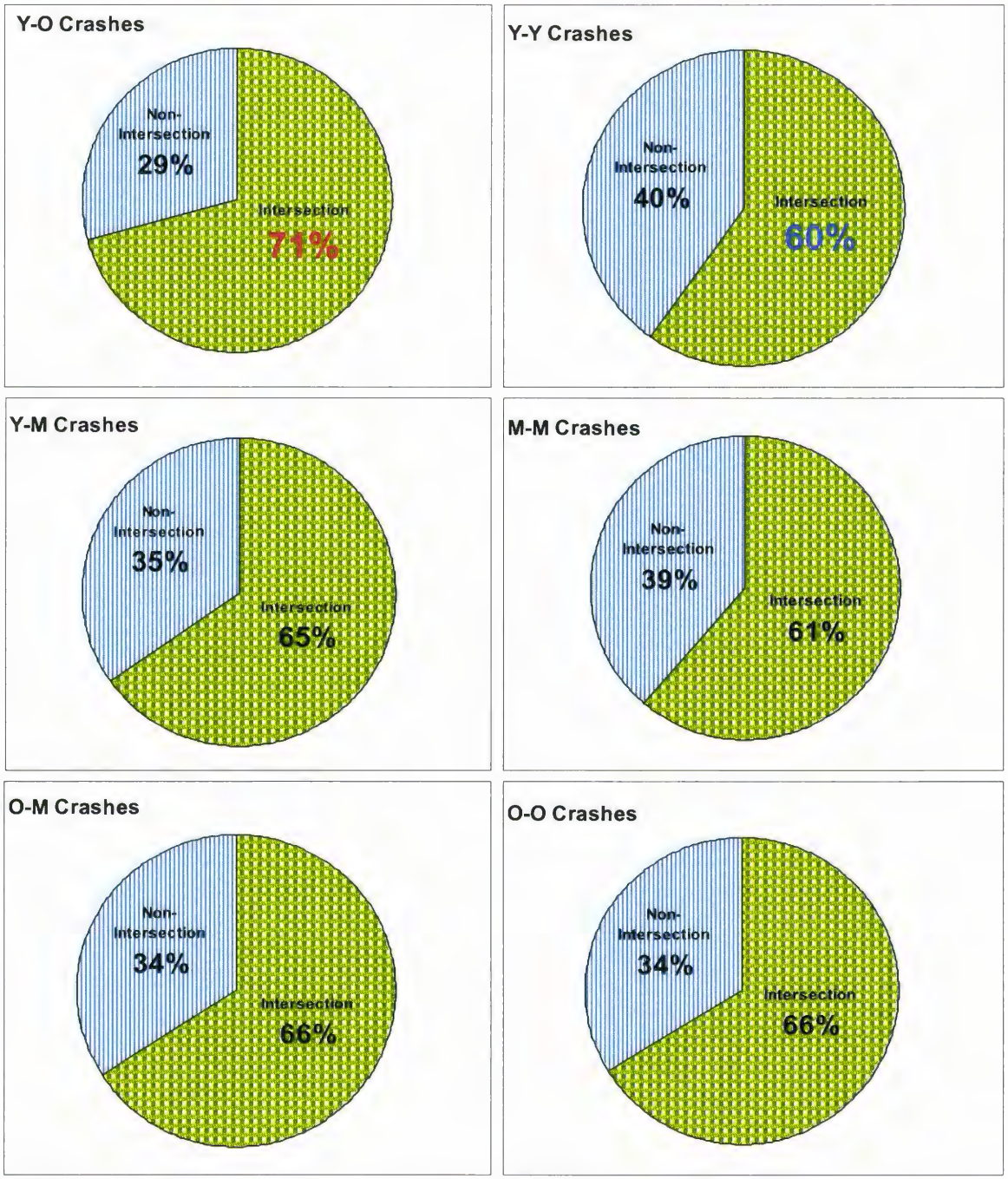


Figure 4.11: 2-vehicle crash involvement at intersections by age group combination

2-Vehicle Crashes at Intersection of Divided Expressways

Intersections present a very demanding situation for both older and younger drivers. The problem becomes even more challenging for some types of intersections such as divided expressways. Table 4.21 shows the breakdown of 2-vehicle crashes at divided highway intersections in Iowa for the year 2000. The fraction of 2-vehicle crashes by age group combination is compared to all 2-vehicle crashes at these locations. Older drivers have higher crash proportions at divided road intersections than their younger counterparts, as shown in the Figure 4.12. The proportion of Y-O crashes at divided road intersections is higher than that of all 2-vehicle, Y-Y, and Y-M crashes by 45 percent, 160 percent, and 76 percent respectively.

Table 4.21: Comparing 2-vehicle crashes by age group combination to all 2-vehicle crashes at intersections of divided roads, not age adjusted

2-Vehicle Crashes	# of Crashes at Divided Road Intersections	All 2-Vehicle Crashes	Percent of All Group Crashes that are on Divided Road Intersections	(A) Percent of VMT	(B) Percent of Divided Road Intersection Crashes	(C = B/A) Over-Involvement in Divided Road Intersection Crashes Based on VMT
All	1,609	34,264	4.70	100	100	1.00
Y-Y	39	1,485	2.63	0.22	2.42	10.97
Y-M	319	8,234	3.87	4.04	19.83	4.91
Y-O	**74**	**1,084**	**6.83**	**0.44**	**4.60**	**10.52**
M-M	845	17,722	4.77	74.00	52.52	0.71
O-M	303	5,207	5.82	8.00	18.83	2.35
O-O	29	530	5.47	0.87	1.80	2.08

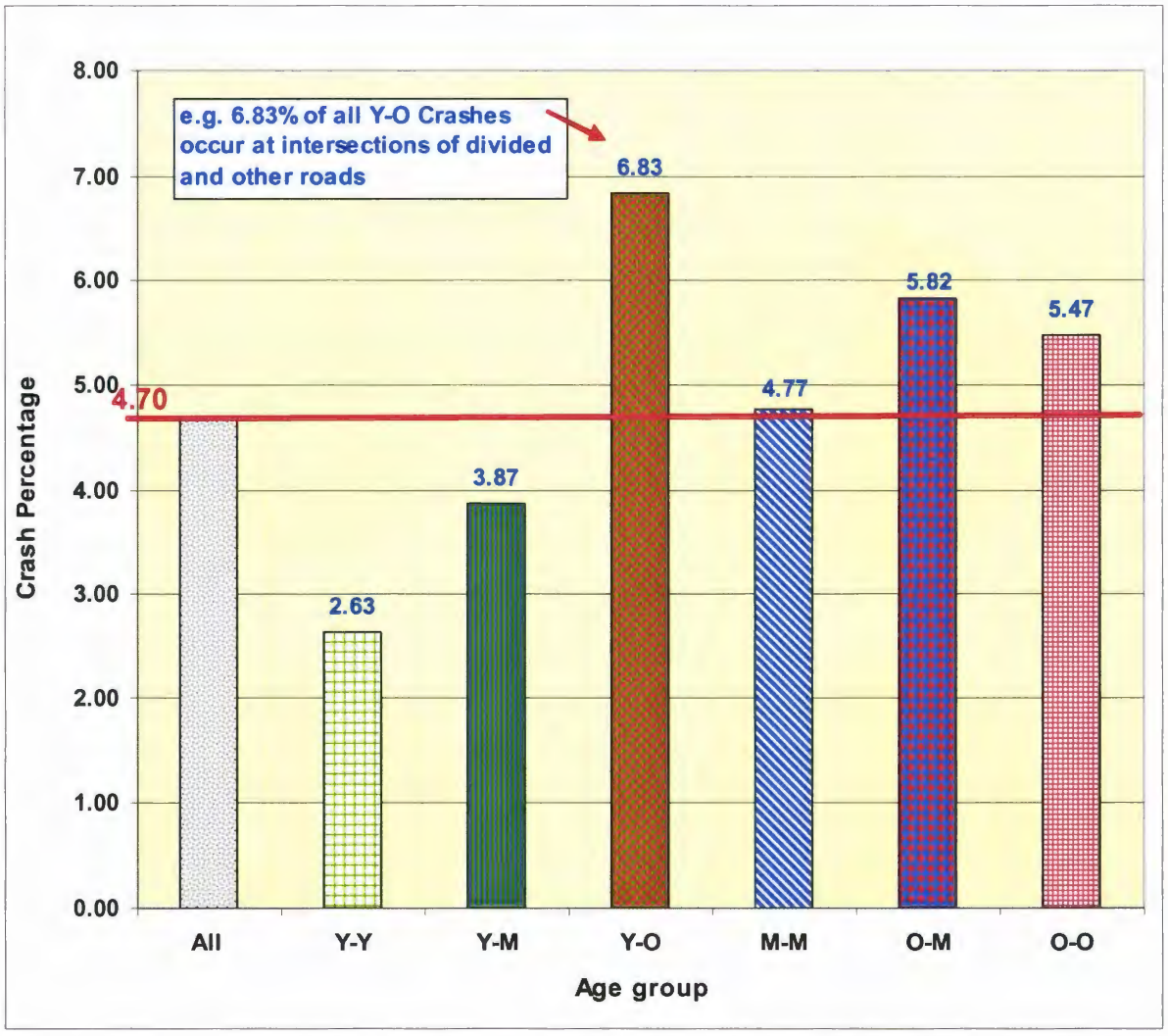


Figure 4.12: 2-vehicle crashes at intersections of divided roads by age group combination as fraction of all 2-vehicle crashes

The situation is somewhat different when taking age and exposure into account. Younger drivers face a higher risk, when the crash rate is calculated based on the overall age group exposure (VMT). Figure 4.13 reveals that Y-O, Y-Y, and Y-M crashes are overrepresented significantly. Over-involvement for O-M and O-O crashes is considerably lower than for any crashes involving young drivers.

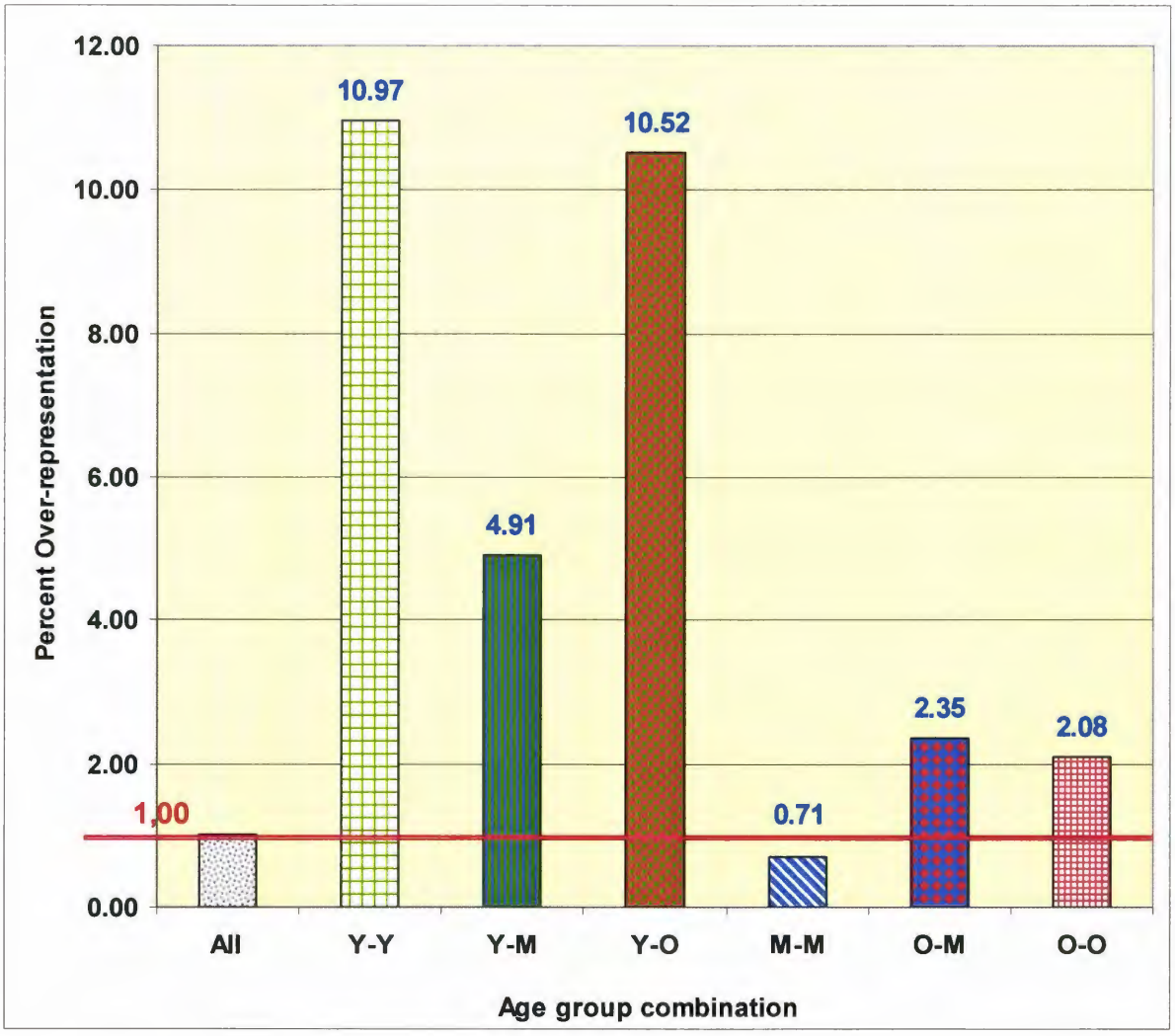


Figure 4.13: Overrepresentation in 2-vehicle crashes at intersections of divided roads based on exposure (VMT) by age group combination

Figure 4.14 shows the statewide locations of Y-O crashes at intersections of divided roads. Figures 4.15 and 4.16 show Y-O crashes at intersections of divided roads in urban and rural areas respectively.

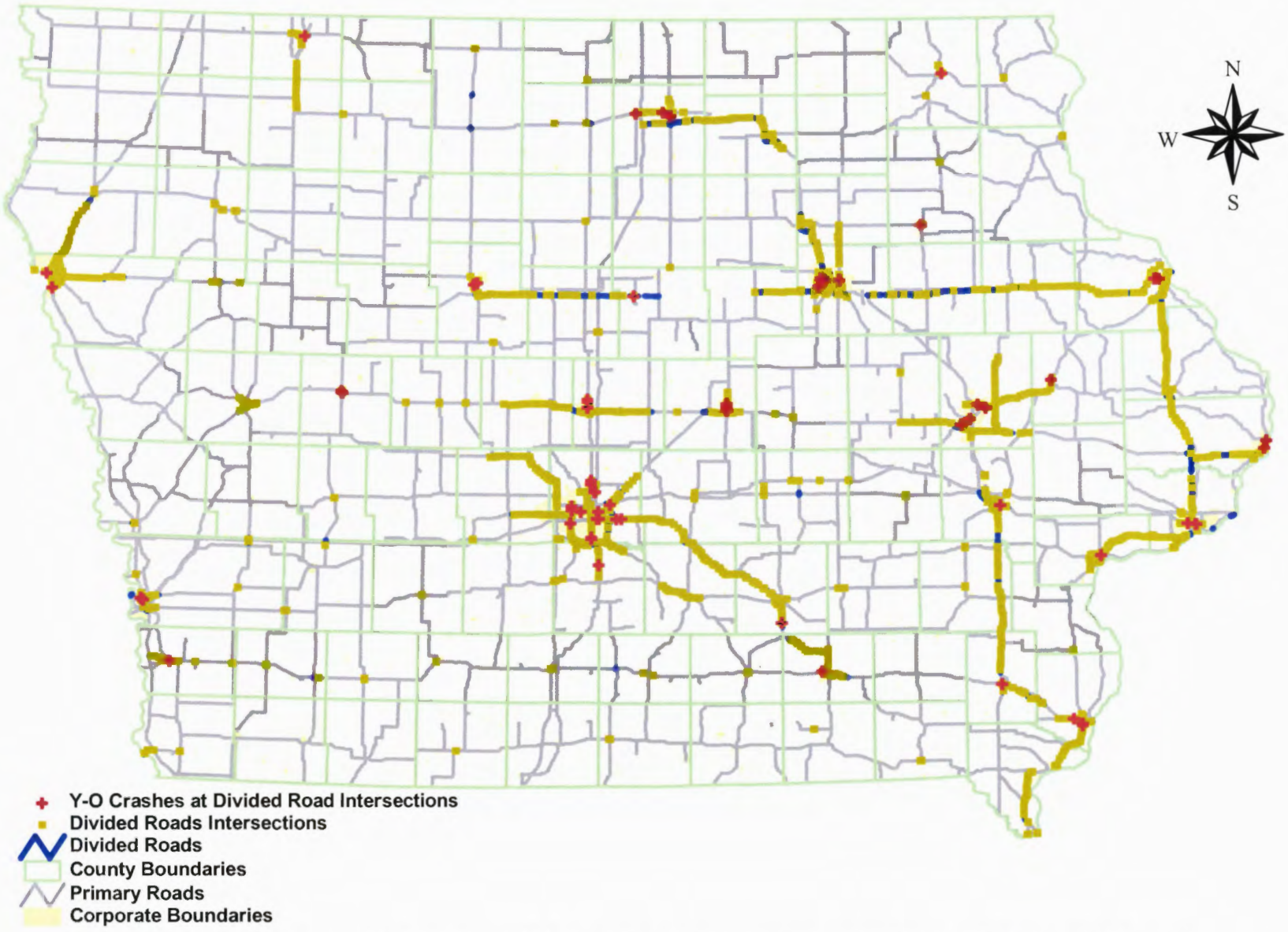


Figure 4.14: Statewide locations of Y-O crashes at intersections of divided roads (Iowa 2000 data)

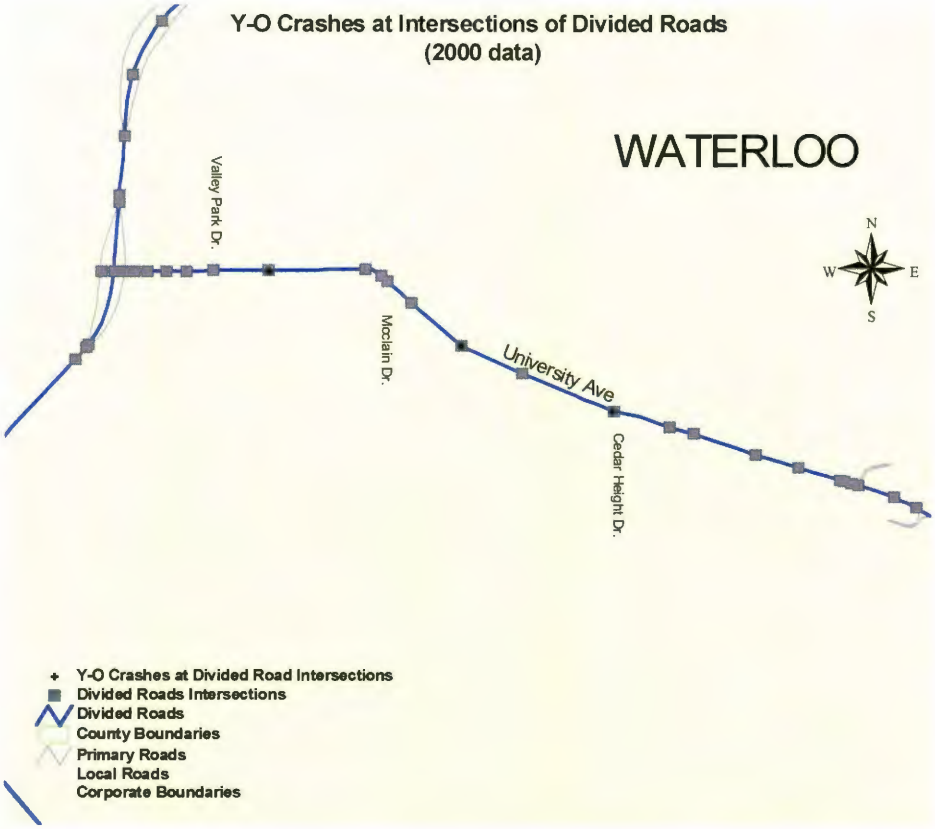


Figure 4.15: Locations of Y-O crashes at intersections of divided roads in an urban area

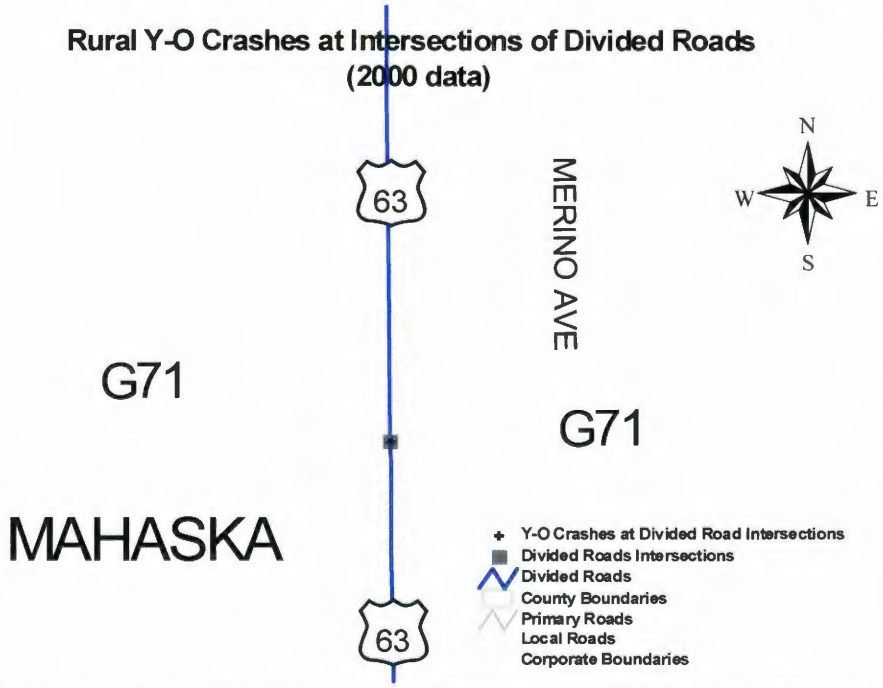


Figure 4.16: Locations of Y-O crashes at intersections of divided roads in a rural area

Temporal Analysis

Statewide underrepresentation of Y-O crashes may also be explained if younger and older drivers do not drive during the same hours. In this part of study, temporal variations and their effects on crash involvement and injury risks are investigated. First, 2-vehicle crash involvement proportion by time of day for all age group combinations is examined. Second, 2-vehicle crashes at peak time periods which represent the highest involvement ratio, are inspected to determine representation by age group combination.

Crash Risk Analysis by Time of Day

Time patterns of two-vehicle crash involvement by drivers for all age groups are illustrated in Figures 4.17 and 4.18 for all 2-vehicle and fatal and injury 2-vehicle crashes, respectively. These two figures exhibit similar temporal patterns for all age groups involved.

Younger driver crash patterns show two peak periods: a small peak during the morning rush hour from 7:00 to 9:00 and a large peak in the afternoon from 15:00 to 16:00. After 16:00, the crash involvement ratio decreases rapidly until about 20:00 and then remains flat until 23:00. After 23:00, the younger drivers crash involvement rate declines slowly until about 6:00 a.m.

Older driver crashes on the other hand show a steady increase from 6:00 a.m. to 12:00 p.m. and remain flat until about 15:00. There is a small peak from 15:00 to 16:00 contemporal with the larger young driver crash peak. The crash involvement ratio of elderly drivers decreases rapidly from 16:00 to 21:00 and then is negligible until 6:00 a.m. Note that all 2-vehicle crashes peak from 15:00 to 16:00.

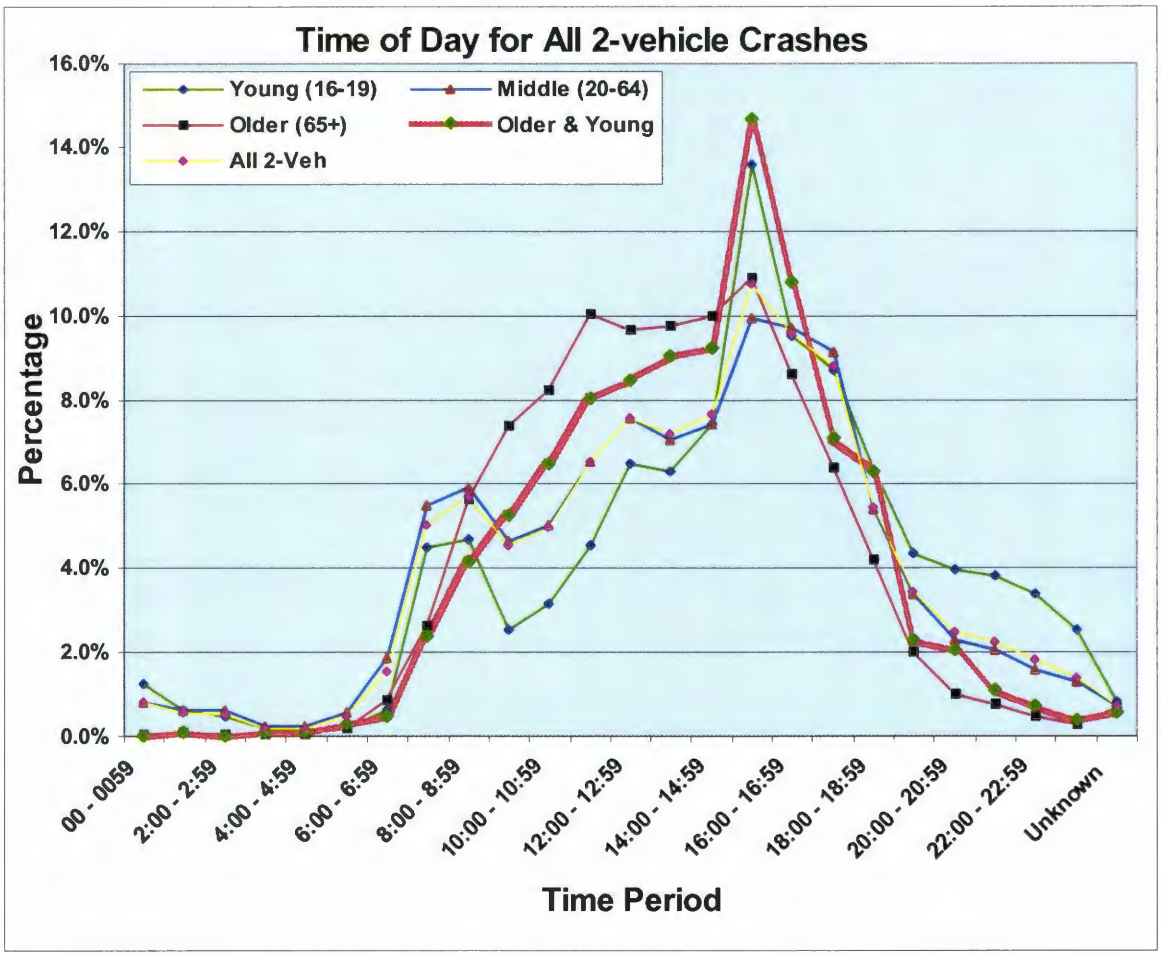


Figure 4.17: Fraction of 2-vehicle crashes in Iowa by age group and time Period

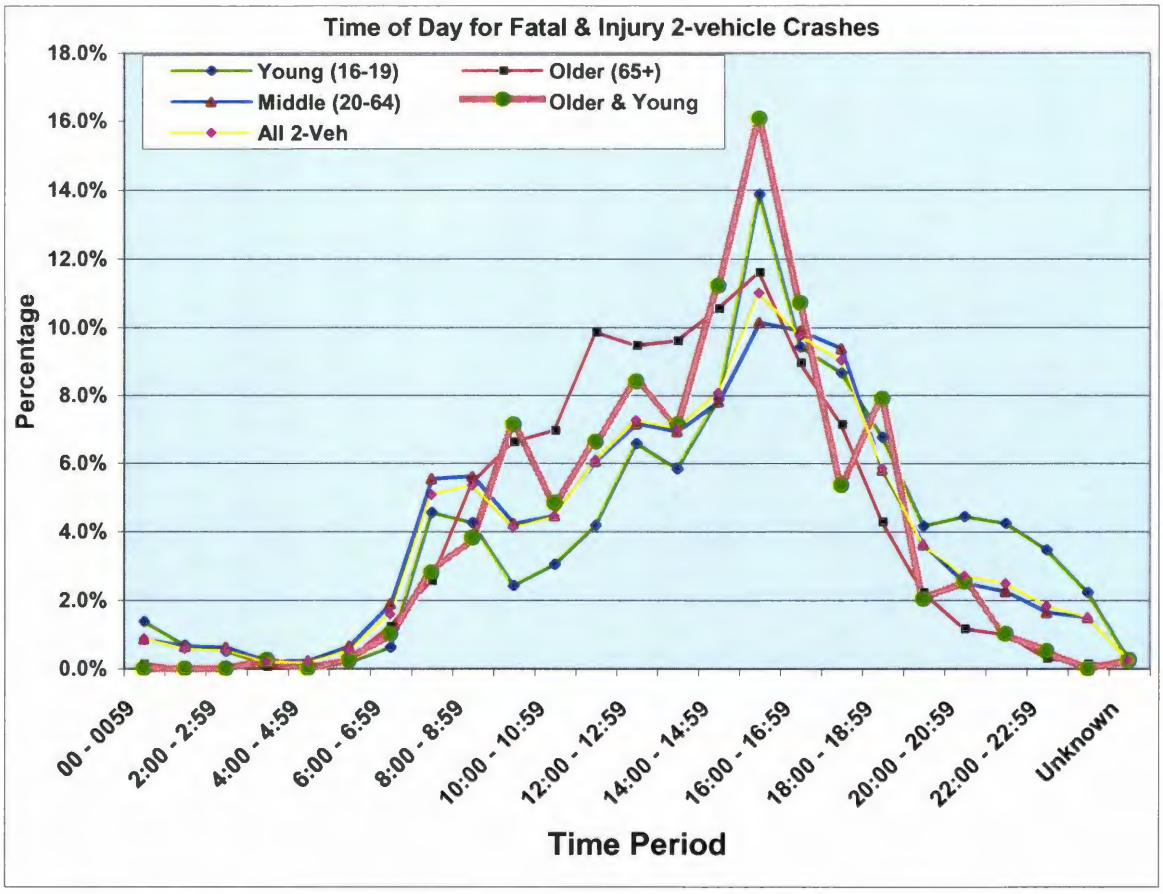


Figure 4.18: Fraction of fatal and injury 2-vehicle crashes in Iowa by age group and time period

Figure 4.19 shows 2-vehicle crashes involving both older and younger drivers as a fraction of all 2-vehicle crashes. Approximately one third of older drivers' 2-vehicle crashes are with younger drivers. The older drivers fraction of crashes with younger drivers is twice as high as the fraction of younger drivers crashes with older drivers. However, this relationship does not hold for all hours of the day. Infact, approximately 35 percent of young driver 2-vehicle crashes between 9 a.m. and 10 a.m. are with older drivers while 20 percent of older driver crashes are with young drivers during the same period.

Figure 4.19: Older and younger drivers' Y-O crashes as a proportion of all 2-vehicle crashes

Overrepresentation in 2-Vehicle Crashes between 3 p.m. and 4 p.m. (Unadjusted)

The time period from 3 p.m. to 4 p.m. is identified as the peak period for all age groups involved in 2-vehicle crashes in Iowa. To study overrepresentation in 2-vehicle crashes for this time period, the expected number of crashes by age group is calculated and compared with the observed number of crashes that involved both older and younger drivers. In this approach, the expected number of 2-vehicle crashes is calculated based on exposure (VMT) by age group.

The probability that a driver involved in a 2-vehicle crash from 3 p.m. to 4 p.m. (based on exposure, VMT) belongs to a given age group is calculated according to Equation 3.1 using exposure data from 2001 National Household Travel Survey (NHTS). Tables representing VMT by age group and time periods are shown in Appendix D.

The following steps show the calculations of the probabilities of 2-vehicle crash involvements by drivers of each age group from 3 p.m. to 4 p.m. based on exposure.

$$P(Younger\ Drivers(3-4)) = \frac{VMT_{Younger(3-4)}}{\sum VMT_{(3-4)}} = \frac{1{,}265\ (0.069^*)MVMT}{27{,}029(0.076^*)\ MVMT} = 0.04$$

$$P(Middle\ Age\ Drivers(3-4)) = \frac{VMT_{Middle\ Age(3-4)}}{\sum VMT_{(3-4)}} = \frac{23{,}247(0.075^*)\ MVMT}{27{,}029(0.076^*)\ MVMT} = 0.85$$

$$P(Older\ Drivers(3-4)) = \frac{VMT_{Older(3-4)}}{\sum VMT_{(3-4)}} = \frac{2{,}519\ (0.082^*)MVMT}{27{,}029(0.076^*)\ MVMT} = 0.11$$

* Numbers in parenthesis represent the percentages of VMT from 3 p.m. to 4 p.m. by that age group.

Based on the exposure (VMT), younger drivers (4 percent) are least expected to be involved in 2-vehicle crash involvement compared to 85 percent for middle-age drivers and 11 percent for older drivers.

Expected 2-vehicle crashes between 3 p.m. and 4 p.m. for all age group combinations are calculated using Equation 3.2 as follows:

$$E_1\ (\text{Y-Y}) = \left(\frac{VMT_{Younger(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Younger(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.04*0.04)*\ 3{,}719 = 6$$

$$E_1\ (\text{Y-M}) = \left(\frac{VMT_{Younger(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Middle\ Age(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.04*0.85)*\ 3{,}719 = 127$$

$$E_1\ (\text{M-Y}) = \left(\frac{VMT_{Middle\ Age(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Younger(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.85*0.04)*\ 3{,}719 = 127$$

$$E_1\ (\text{Y-O}) = \left(\frac{VMT_{Younger(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Older(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.04*0.11)*\ 3{,}719 = 17$$

$$E_1\ (\text{O-Y}) = \left(\frac{VMT_{Older(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Younger(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.11*0.04)*\ 3{,}719 = 17$$

$$E_1\ (\text{M-M}) = \left(\frac{VMT_{Middle\ Age(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Middle\ Age(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.85*0.85)*3{,}719 = 2{,}687$$

$$E_1\ (\text{M-O}) = \left(\frac{VMT_{Middle\ Age(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Older(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.85*0.11)*\ 3{,}719 = 347$$

$$E_1\ (\text{O-M}) = \left(\frac{VMT_{Older(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Middle\ Age(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.11*0.85)*\ 3{,}719 = 347$$

$$E_1\ (\text{O-O}) = \left(\frac{VMT_{Older(3-4)}}{\sum VMT_{(3-4)}}\right)*\left(\frac{VMT_{Older(3-4)}}{\sum VMT_{(3-4)}}\right) = (0.11*0.11)*\ 3{,}719 = 45$$

3,719 = Total number of all 2-vehicle crashes between 3 p.m. and 4 p.m.

Table 4.22: Expected number of 2-vehicle crashes for all age group combinations (unadjusted)

Crash Outcome	Expected 2-Vehicle Crashes	Total
Younger & Younger (16-19) & (16-19)	E_1(Y-Y) 6	6
Younger & Middle age (16-19) & (20-64)	E_1(Y-M) + E_1(M-Y) 127 + 127	254
Younger & Older (16-19) & (65+)	E_1(Y-O) + E_1(O-Y) 17 + 17	34
Middle age & Middle age (20-64) & (20-64)	E_1(M-M) 2,687	2,687
Middle age & Older (20-64) & (65+)	E_1(M-O) + E_1(O-M) 347 + 347	694
Older & Older (65+) & (65+)	E_1(O-O) 45	45
TOTAL		**3,719**

Table 4.22 shows the expected results of all 3719 2-vehicle crashes between 3 p.m. and 4 p.m. for all age group combinations based on exposure to roadways.

Overrepresentation in 2-Vehicle Crashes between 3 p.m. and 4 p.m. (Adjusted)

In this approach, the expected number of crash involvement is adjusted for age. Table 4.23 shows the observed number of 2-vehicle crashes and drivers involved for all age group combinations between 3 p.m. and 4 p.m.

The number of drivers involved in 2-vehicle crashes by individual age group is as follows:

Younger Drivers = 542 + 993 + 159 = 1,694

Middle Age Drivers = 993 + 3,406 + 542 = 4,941

Older Drivers = 159 + 542 + 104 = 805

Table 4.23: Observed number of 2-vehicle crashes and drivers involved by age group

Crash Outcome	Observed 2-Vehicle Crashes	Observed Drivers Involved 2-Vehicle Crashes
Younger & Younger (16-19) & (16-19)	271	542
Younger & Middle age (16-19) & (20-64)	993	1,986
Younger & Older (16-19) & (65+)	**159**	**318**
Middle age & Middle age (20-64) & (20-64)	1,703	3,406
Middle age & Older (20-64) & (65+)	542	1,084
Older & Older (65+) & (65+)	52	104
TOTAL	**3,719**	**7,438**

The probability that a driver involved in a 2-vehicle crash (accounting for overrepresentation by age) belongs to a given age group is calculated according to Equation 3.3 as follows:

$$P(Young\ Drivers(3-4)) = \frac{Younger_{Crash\ Involvement(3-4)}}{\sum Drivers_{Crash\ Involvement(3-4)}} = \frac{1{,}694}{7{,}438} = 0.23$$

$$P(Middle\ Age\ Drivers(3-4)) = \frac{Middle\ Age_{Crash\ Involvement(3-4)}}{\sum Drivers_{Crash\ Involvement(3-4)}} = \frac{4{,}941}{7{,}438} = 0.66$$

$$P(Older\ Drivers(3-4)) = \frac{Older_{Crash\ Involvement(3-4)}}{\sum Drivers_{Crash\ Involvement(3-4)}} = \frac{805}{7{,}438} = 0.11$$

7,438 = Drivers involved in 2-vehicle crashes between 3 p.m. and 4 p.m.

The probability of crash involvement for drivers of most individual age groups is different when adjusted for age. While older drivers with 11 percent have the same probability of crash involvement when unadjusted, young drivers, on the other hand, have much higher probability of crash involvement, with 23 percent compared to 4 percent unadjusted. Middle age drivers have a lower probability of crash involvement, with 66 percent compared to 85 percent unadjusted.

The statewide adjustment process was used to determine the expected number of crashes for all age groups when isolated from the age effect, and results are shown in Table 4.24.

Table 4.24: Expected number of 2-vehicle crashes for drivers of all age groups, adjusted for age

Crash Outcome	Expected 2-Vehicle Crashes	Total
Younger & Younger (16-19) & (16-19)	E(Y-Y) 193	193
Younger & Middle age (16-19) & (20-64)	E(Y-M) + E(M-Y) 562 + 562	1,124
Younger & Older (16-19) & (65+)	E(Y-O) + E(O-Y) 92 +92	184
Middle age & Middle age (20-64) & (20-64)	E(M-M) 1640	1,640
Middle age & Older (20-64) & (65+)	E(M-O) + E(O-M) 268 + 268	536
Older & Older (65+) & (65+)	E(O-O) 43	43
TOTAL		**3,719**

Summary of Unadjusted and Adjusted Peak Hour Overrepresentation

Results of 2-vehicle crashes between 3 p.m. and 4 p.m. in Iowa for all age group combinations are shown in Table 4.25. To quantify overrepresentation, the expected numbers of crashes are compared with observed values. In short, adjusted Y-O crashes are still slightly underrepresented (-13% vs. -18%) as they were for the 24 hour analysis

Table 4.25: Statewide overrepresentation in 2-vehicle crashes by age group combination

Crash Interaction	Actual # of Drivers Involved 2-Vehicle Crashes	Unadjusted, based on exposure (VMT only)		Adjusted for age	
		Expected # of YO Drivers Involved 2-Vehicle Crashes	percent Overrepresentation	Expected # of YO Drivers Involved 2-Vehicle Crashes	percent Overrepresentation
Younger & Younger (16-19) & (16-19)	271	6	**+4,417**	193	**40.4**
Younger & Middle age (16-19) & (20-64)	993	254	**+292**	1,124	**-11.7**
Younger & Older (16-19) & (65+)	159	34	**+382**	184	**-13.1**
Middle age & Middle age (20-64) & (20-64)	1,703	2,687	**-37**	1,640	**3.8**
Middle age & Older (20-64) & (65+)	542	694	**-22**	536	**1.3**
Older & Older (65+) & (65+)	52	45	**+16**	43	**21.0**
TOTAL	**3,719**	**3,719**		**3,719**	

Peak Hour Chi-Square Analysis, Unadjusted

A chi-square table of outcomes for combinations of all age groups involved in 2-vehicle crashes between 3 p.m. and 4 p.m. in Iowa was generated, and Equation 3.5 was used to calculate the chi-square values for 2-vehicle crashes based on exposure, as shown in Table 4.26. The chi-square value of 14,745 is much greater than the critical value of about 16 at the 0.001 significance level and 3 degrees of freedom.

Table 4.26: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in peak period (unadjusted)

# of 2-Vehicle Crashes					
2-Vehicle Crash Outcome	**Observed (O)**	**Expected (E)**	**(O - E)**	**$(O - E)^2$**	**chi square**
Younger - Younger	271	6	265	70,225	11,704
Younger – Middle age	993	253	740	547,600	2,164
Younger - Older	159	33	126	15,876	481
Middle age – Middle age	1,702	2,687	-985	970,225	361
Middle Age - Older	542	695	-153	23,409	34
Older - Older	52	45	7	49	1
Total	**3,719**	**3,719**		**6,509,536**	**14,745**

Peak Hour Chi-Square Analysis, Adjusted for Age

Table 4.27 shows the chi-square values for all 2-vehicle crashes in peak period, adjusted for the age effect. The Chi-square value is calculated to be 55 using Equation 3.5. The chi-square value of 55 is also greater than the critical value of about 16 for 3 degrees of freedom and 0.001 probability of exceeding the critical value.

Table 4.27: The chi-square table of outcomes for combinations of all age groups' 2-vehicle crashes in peak period (adjusted for age)

# of 2-Vehicle Crashes					
2-Vehicle Crash Outcome	Observed (O)	Expected (E)	(O - E)	$(O - E)^2$	chi square
Younger - Younger	271	193	78	6,084	32
Young age – Middle age	993	1,125	-132	17,424	15
Younger - Older	159	183	-24	576	3
Middle age – Middle age	1,702	1,640	62	3,844	2
Middle Age - Older	542	535	7	49	0.1
Older - Older	52	43	9	81	2
Total	3,719	,3719		28,058	55

Chapter 5 - Conclusions, Interpretations, and Limitations

Past studies indicate that older and younger drivers as individual age groups experience high crash involvement rates. Rapid growth of these most at risk age groups, especially older drivers, creates a major concern for the safety of these age groups on the nation's highways. Since Iowa has higher percentages of both older and younger drivers than nationwide, it is even more important for state safety officials and policy makers to understand the nature of crashes that involve these age groups and explore possible mitigation strategies to improve the safety of the most at risk drivers. Attempts were made here to find characteristics which cause even higher risk where older and younger drivers encounter each other on roadways.

Findings of an Iowa statewide 2-vehicle crash analysis using 2000 data showed that younger drivers' 2-vehicle crash involvement was approximately 4 times higher per capita and per licensed driver than that of older drivers. When adjusting the number of crashes for VMT, younger drivers were involved 3 times as often as the older group. Analysis of fatal crashes reveals the 2-vehicle crash involvement rate in Iowa starts to increase considerably after age 60 and increases at a much faster rate after age 80. The involvement rate of an older driver in fatal crashes based on exposure (VMT) is four times higher than that of a young driver, and may be due to the greater physical vulnerability of older drivers.

In Iowa, a younger driver faces a risk of crash involvement more than twice as high as the oldest (85+) drivers and faces an approximately 7 times higher risk than a driver from the safest driving age group (45-54) based on exposure. By the same token, the relative risk

of crash involvement for the oldest age group is almost 3 times higher than that for the safest age group.

The results of a statewide 2-vehicle crash analysis implied that Y-O crashes in Iowa are overrepresented by 260% when the expected number of Y-O crashes is based on exposure alone. However, when the expected number of crashes is isolated from the age effect, statewide Y-O crashes are actually underrepresented by 18%. Furthermore, both Y-Y and O-O crashes are overrepresented by 35 percent even after isolation from the age effect. From the results, it can be interpreted that underrepresentation of Y-O crashes may be because these two age groups tend to drive at different locations and times.

There are limitations associated with the results of this research. Exposure data is a proxy measure using nationwide data. Nationwide exposure data is based on the survey of people who actually drive, but the proxy measure of Iowa VMT by age group is based on the number of licensed drivers. There is no information about the percentage of licensed drivers who drive very little or are not driving at all.

A large chi-square value revealed a significant difference between the observed and expected 2-vehicle crashes for all age group combinations when the analysis is based on exposure. There is also a significant difference between observed and expected 2-vehicle crashes for the combinations of all age groups with a relatively large chi-square value when considering interactions (isolating the age effect).

When the at-fault driver was studied, older drivers were slightly more often at fault in Y-O crashes than younger drivers.

Failure to yield right of way (FTYROW) in making left turns is one of the most noticeable major causes of Y-O crashes. When considering FTYROW in making left turns as

the major cause, the proportion of Y-O crashes is 30 percent higher than O-O crashes and 65 percent higher than Y-Y crashes. It seems that the problem of making left turns becomes more complicated when these two age groups encounter each other on road. It is suspected that a combination of characteristics of older and younger drivers increases the risk of crash involvement when they run into each other on the roadway.

A noticeable portion of Y-O after dark crashes occurs at dark-lighted roadways. The limitation of this study is the lack of information about exposure of drivers by age group under this light condition.

Data on vehicle occupancy indicated that carrying passenger(s) has a negative impact on young drivers but a positive effect on older driver's 2-vehicle crash involvement ratios. Young drivers face a higher risk of crash involvement than older drivers when they carry two or more passengers. The finding of this study is limited to the number of drivers involved in 2-vehicle crashes. There are no non-crash data indicating the percentage of passenger(s) carried by all younger and older drivers.

A spatial analysis of 2-vehicle crashes at the county level indicated that Y-O crashes in Osceola, Greene, and Iowa counties are overrepresented by more than 60 percent even after considering age effects. Eighteen counties are overrepresented by between 0 percent and 50 percent when adjusted for the age effect. A limitation associated with this study is VMT by age group and county. Existing licensed driver data by county is limited to predefined age groups (e.g., 15-19). To obtain data from licensed drivers in the 16 to 19 age group, it was assumed that the percentage of 15-year-old drivers in all counties is the same as the statewide figure. Then the percentage of 15-year-old drivers was excluded from the 15-19 age group to derive the 16-19 age group. This may affect overrepresentation results by

county. Another limitation of this study is the problem of small sample sizes in many low-populated counties.

Results of 2-vehicle crashes in the vicinity of high schools showed that Y-O crashes have the highest proportion of 2-vehicle crashes compared to all age group combinations, individual age groups, and all 2-vehicle crashes within a distance of 1.5 mile from high schools. A limitation of this study is the lack of data indicating exposure of older drivers in the vicinity of high schools.

Results of a location study revealed that Y-O crashes are more frequently urban than both Y-Y and O-O crashes, though less than M-M crashes. Restrictions associated with this analysis are again exposure in rural or urban areas by age group.

When crashes by roadway functional class were examined, Y-O crashes were found to be overrepresented at intersections of US or State highway with any other roads and considerably underrepresented at intersections of interstate highways with any other roads. There is no data on exposure for each class of roadway, i.e., how much these age groups are actually driving on each type of roadway.

One of the main findings of this research reveals that Y-O crashes occurring at intersections have the highest proportion compared to all other age group combinations in 2-vehicle crashes. Interestingly, Y-Y crashes have the lowest proportion of 2-vehicle crashes at intersections. Again, these findings are limited to crash data, and there is no information of exposure to intersections by age groups.

Older drivers experience more difficulty at divided road intersections than their younger counterparts, particularly in situations where they come across younger drivers. The proportion of Y-O crashes at divided expressways is higher than that of all 2-vehicle crashes,

Y-Y crashes, and even O-O crashes. It seems the high risk characteristics of older and younger drivers are compounded when they encounter each other at divided road intersections. The result here is consistent with the findings of FTYROW in making left turn as a major cause of Y-O crashes.

From time of day analysis, it was seen that the peak period of Y-O crashes occurs between 3:00 p.m. and 4:00 p.m. During the peak period, statewide Y-O crashes are overrepresented compared to all hours when the analysis is based only on exposure, although they are underrepresented when age effects are considered. After-school hours are the most risky time of driving for both age groups. A limitation of this study was the necessary proxy measure used for VMT for peak periods by each age group based on the nationwide data. Iowa younger and older drivers exposure may be different during this time period.

The older driver proportion of crash involvement with younger drivers is 32%, expressed as a ratio of all older driver 2-vehicle crashes, while it is only 14% for the younger driver crashes with older drivers. Again, the lack of site-specific exposure data is an important limitation of this study. There are no data indicating how many older drivers in fact meet younger drivers on the roadway.

In summary, it can be concluded from the results of interactions that Y-O crashes are somewhat underrepresented at the statewide level. However, there are some counties which are significantly overrepresented in Y-O crashes. In addition, there are some locations such as the vicinity of high schools and time periods such as 3 p.m. to 4 p.m. that show a high Y-O crash frequency. Still, more comprehensive exposure data are needed to determine if Y-O crashes are indeed overrepresented at these locations and time periods.

Recommendations

Following are some strategies that may be helpful in reducing older and younger driver crashes.

1) Since the presence of passengers has a negative effect on driving performance of younger drivers, limit younger drivers to carrying no more than one passenger. Educate older drivers about passenger and improvement in driving performance.

2) Older drivers could be educated about the risk they are facing when they are driving before and especially after school hours, which happen to be the peak hours of Y-O crashes.

3) Create and maintain a database for the number of licensed drivers by county and by age in single year increments to assist in analysis of crash involvement and overrepresentation by specific age groups.

4) There is a need for more comprehensive and recent exposure data by age group to understand driving behavior and patterns, which may include exposure

- at intersections
- by time of day
- by roadway functional class
- by rural/urban areas
- by distance from high schools or other land uses
- at divided expressway intersections

To understand difficulties in driving maneuvers of older and younger drivers a survey could be designed with the following questions for older drivers:

- What is your age?

- Do you currently drive?
- What are your major means of transportation?
- How frequently do you drive your car?
- If your driving is limited, how? If limited what types of trips do you still make?
- What is your most difficult driving maneuver(s)?
- How often do you carry passenger(s) in your car?
- Do you avoid certain areas or times of driving? Explain

The survey may include the following questions for younger drivers:

- What is your age?
- Do you have a valid driver license?
- At what age did you first start driving?
- Have you been through graduated driver licensing (GDL)?
- What was the duration of each stage of your GDL?
- What is the most difficult driving maneuver(s) for you?
- Do you drive to school?
- How frequently do you drive?
- How often do you carry passenger(s) in your car?
- Have you ever been cited? How many times?
- What was the cause for citation(s)?
- How far from your high school do you live?

Future Research

The existing exposure data proved to be a limitation of some areas of this research. The following discusses some areas that could be the focus of future research.

More detailed study could be conducted to investigate whether older drivers cause more crashes than their younger counterparts and also to determine whether there are particular types of crashes that occur more often (e.g., rear-end, head-on, left turn, and sideswipe) than expected.

The vicinity of high schools is a place that has a high proportion of Y-O crashes. Investigate the overrepresentation in Y-O crashes in the vicinity of high schools by time of day and distance from high schools.

Another useful study would be to investigate safety implications of Y-O crashes by roadway functional class (e.g., expressways, county roads, and city streets) to clarify what type of roadway presents a higher risk to older and younger drivers.

There are other characteristics of Y-O crashes that can be investigated, such as roadway, vehicle, and weather contributing factors, day of the week, month of the year, type of vehicle, type of traffic control, driving under influence, and license restrictions.

The over-involvement in Y-O crashes by gender is another study that could examine the effect of gender on complex decision-making process and interaction.

Another potentially fruitful area of future study would be a comparison of overrepresentation in Y-O crashes in rural and urban areas.

Appendix A - Number of Drivers and their Exposure in Iowa

Table A.1: Number of Licensed Drivers by County and Age Group in Iowa (Ages 16-24)

County	All Ages			16-19		20-24	
	Total	Female	Male	Driver	Percent	Driver	Percent
Adair	6243	3135	3108	482	8	509	8
Adams	3574	1808	1766	269	8	270	8
Allamakee	10626	5241	5385	853	8	849	8
Appanoose	10114	5154	4960	666	7	779	8
Audubon	5276	2693	2583	445	8	367	7
Benton	18351	9191	9160	1463	8	1408	8
Black Hawk	88676	45356	43320	5645	6	9355	11
Boone	18790	9587	9203	1306	7	1585	8
Bremer	17411	8925	8486	1344	8	1512	9
Buchanan	14639	7433	7206	1197	8	1218	8
Buena Vista	14412	7088	7324	1096	8	1359	9
Butler	11803	5983	5820	851	7	880	7
Calhoun	8153	4219	3934	604	7	621	8
Carroll	16530	8342	8188	1574	10	1509	9
Cass	11185	5686	5499	823	7	880	8
Cedar	13166	6600	6566	921	7	981	7
Cerro Gordo	33778	17478	16300	2273	7	2783	8
Cherokee	9886	5006	4880	706	7	776	8
Chickasaw	10114	5009	5105	813	8	869	9
Clarke	6887	3480	3407	553	8	571	8
Clay	13268	6821	6447	966	7	1146	9
Clayton	13975	6904	7071	1083	8	1137	8
Clinton	36152	18505	17647	2610	7	2983	8
Crawford	12269	6025	6244	1029	8	1058	9
Dallas	26854	13538	13316	2046	8	1989	7
Davis	5687	2855	2832	419	7	443	8
Decatur	5714	2889	2825	408	7	480	8
Delaware	13860	6905	6955	1272	9	1237	9
Des Moines	30702	15759	14943	2018	7	2514	8
Dickinson	13012	6610	6402	801	6	1013	8
Dubuque	63926	32323	31603	4683	7	5832	9
Emmet	8144	4147	3997	582	7	713	9
Fayette	15978	8161	7817	1230	8	1284	8
Floyd	12458	6365	6093	913	7	965	8
Franklin	8220	4129	4091	622	8	625	8
Fremont	6020	3039	2981	447	7	479	8
Greene	7869	4000	3869	642	8	611	8
Grundy	9164	4616	4548	665	7	656	7
Guthrie	8526	4338	4188	595	7	604	7
Hamilton	11961	6012	5949	827	7	847	7
Hancock	9158	4629	4529	743	8	749	8
Hardin	14047	7156	6891	1048	7	1175	8
Harrison	11890	5925	5965	930	8	908	8
Henry	14534	7422	7112	1114	8	1216	8
Howard	7503	3732	3771	615	8	665	9
Humboldt	7878	3996	3882	622	8	618	8

County	All Ages			16-19		20-24	
	Total	Female	Male	Driver	Percent	Driver	Percent
Ida	6047	3062	2985	532	9	477	8
Iowa	11873	6041	5832	862	7	929	8
Jackson	15151	7597	7554	1227	8	1192	8
Jasper	26865	13703	13162	1813	7	2061	8
Jefferson	12224	6116	6108	875	7	976	8
Johnson	74495	37602	36893	4191	6	9067	12
Jones	14008	7069	6939	1009	7	1071	8
Keokuk	8449	4293	4156	605	7	658	8
Kossuth	13600	6763	6837	1195	9	1129	8
Lee	26873	13785	13088	1915	7	2207	8
Linn	142375	72482	69893	8884	6	12543	9
Louisa	8222	4040	4182	560	7	643	8
Lucas	6932	3506	3426	467	7	553	8
Lyon	8830	4422	4408	732	8	801	9
Madison	10355	5209	5146	808	8	844	8
Mahaska	15948	8000	7948	1196	7	1405	9
Marion	23633	11879	11754	1864	8	1947	8
Marshall	28002	14089	13913	1904	7	2342	8
Mills	10680	5321	5359	829	8	850	8
Mitchell	8239	4164	4075	652	8	627	8
Monona	7317	3750	3567	526	7	521	7
Monroe	5941	2981	2960	457	8	465	8
Montgomery	8837	4546	4291	628	7	641	7
Muscatine	29919	14963	14956	1974	7	2584	9
O'Brien	11515	5854	5661	965	8	1014	9
Osceola	5335	2707	2628	438	8	438	8
Page	11973	6184	5789	796	7	974	8
Palo Alto	7467	3816	3651	610	8	648	9
Plymouth	18099	9075	9024	1565	9	1591	9
Pocahontas	6669	3371	3298	575	9	470	7
Polk	277695	142249	135446	16320	6	24091	9
Pottawattamie	63958	32437	31521	4237	7	5618	9
Poweshiek	13654	6937	6717	965	7	1053	8
Ringgold	4058	2045	2013	300	7	336	8
Sac	8779	4406	4373	664	8	737	8
Scott	115004	58772	56232	7892	7	10339	9
Shelby	9940	4959	4981	786	8	765	8
Sioux	22286	11235	11051	2030	9	2385	11
Story	54101	26588	27513	3433	6	7791	14
Tama	12971	6603	6368	925	7	975	8
Taylor	5164	2601	2563	377	7	454	9
Union	9321	4775	4546	598	6	778	8
Van Buren	5601	2792	2809	420	8	418	7
Wapello	25127	12866	12261	1482	6	2016	8
Warren	28703	14711	13992	2171	8	2299	8
Washington	14791	7491	7300	1020	7	1137	8
Wayne	4974	2540	2434	391	8	342	7
Webster	28160	14398	13762	2089	7	2478	9

County	All Ages			16-19		20-24	
	Total	Female	Male	Driver	Percent	Driver	Percent
Winnebago	9045	4542	4503	748	8	824	9
Winneshiek	15075	7465	7610	1253	8	1393	9
Woodbury	69725	35023	34702	4817	7	6700	10
Worth	5966	2997	2969	412	7	478	8
Wright	10450	5360	5090	720	7	761	7
Total	2118809	1074397	1044412	147523	7	186864	9

Table A.1. (Ages 25-34)

County	All Ages			25-29		30-34	
	Total	Female	Male	Driver	Percent	Driver	Percent
Adair	6243	3135	3108	358	6	349	6
Adams	3574	1808	1766	179	5	200	6
Allamakee	10626	5241	5385	621	6	670	6
Appanoose	10114	5154	4960	637	6	688	7
Audubon	5276	2693	2583	268	5	298	6
Benton	18351	9191	9160	1087	6	1396	8
Black Hawk	88676	45356	43320	7402	8	7009	8
Boone	18790	9587	9203	1233	7	1414	8
Bremer	17411	8925	8486	1018	6	1147	7
Buchanan	14639	7433	7206	946	6	1004	7
Buena Vista	14412	7088	7324	926	6	1014	7
Butler	11803	5983	5820	695	6	759	6
Calhoun	8153	4219	3934	397	5	453	6
Carroll	16530	8342	8188	1059	6	1073	6
Cass	11185	5686	5499	640	6	690	6
Cedar	13166	6600	6566	789	6	943	7
Cerro Gordo	33778	17478	16300	2203	7	2325	7
Cherokee	9886	5006	4880	503	5	563	6
Chickasaw	10114	5009	5105	549	5	650	6
Clarke	6887	3480	3407	484	7	496	7
Clay	13268	6821	6447	865	7	890	7
Clayton	13975	6904	7071	750	5	912	7
Clinton	36152	18505	17647	2336	6	2659	7
Crawford	12269	6025	6244	757	6	821	7
Dallas	26854	13538	13316	1777	7	2372	9
Davis	5687	2855	2832	313	6	380	7
Decatur	5714	2889	2825	379	7	335	6
Delaware	13860	6905	6955	823	6	949	7
Des Moines	30702	15759	14943	2081	7	2211	7
Dickinson	13012	6610	6402	748	6	867	7
Dubuque	63926	32323	31603	4497	7	5059	8
Emmet	8144	4147	3997	552	7	505	6
Fayette	15978	8161	7817	923	6	999	6
Floyd	12458	6365	6093	743	6	865	7
Franklin	8220	4129	4091	441	5	512	6
Fremont	6020	3039	2981	334	6	414	7
Greene	7869	4000	3869	384	5	456	6

County	All Ages			25-29		30-34	
	Total	Female	Male	Driver	Percent	Driver	Percent
Grundy	9164	4616	4548	467	5	565	6
Guthrie	8526	4338	4188	487	6	539	6
Hamilton	11961	6012	5949	863	7	819	7
Hancock	9158	4629	4529	498	5	566	6
Hardin	14047	7156	6891	833	6	852	6
Harrison	11890	5925	5965	783	7	887	7
Henry	14534	7422	7112	956	7	1162	8
Howard	7503	3732	3771	442	6	492	7
Humboldt	7878	3996	3882	400	5	446	6
Ida	6047	3062	2985	319	5	355	6
Iowa	11873	6041	5832	683	6	891	8
Jackson	15151	7597	7554	861	6	1025	7
Jasper	26865	13703	13162	1715	6	2066	8
Jefferson	12224	6116	6108	778	6	818	7
Johnson	74495	37602	36893	8973	12	7991	11
Jones	14008	7069	6939	872	6	986	7
Keokuk	8449	4293	4156	484	6	573	7
Kossuth	13600	6763	6837	695	5	742	5
Lee	26873	13785	13088	1642	6	1855	7
Linn	142375	72482	69893	12244	9	13383	9
Louisa	8222	4040	4182	605	7	670	8
Lucas	6932	3506	3426	412	6	505	7
Lyon	8830	4422	4408	580	7	581	7
Madison	10355	5209	5146	620	6	824	8
Mahaska	15948	8000	7948	1185	7	1169	7
Marion	23633	11879	11754	1678	7	1762	7
Marshall	28002	14089	13913	1800	6	2074	7
Mills	10680	5321	5359	682	6	805	8
Mitchell	8239	4164	4075	432	5	490	6
Monona	7317	3750	3567	398	5	441	6
Monroe	5941	2981	2960	348	6	432	7
Montgomery	8837	4546	4291	608	7	656	7
Muscatine	29919	14963	14956	2322	8	2472	8
O'Brien	11515	5854	5661	707	6	693	6
Osceola	5335	2707	2628	277	5	361	7
Page	11973	6184	5789	784	7	747	6
Palo Alto	7467	3816	3651	450	6	420	6
Plymouth	18099	9075	9024	1094	6	1292	7
Pocahontas	6669	3371	3298	283	4	333	5
Polk	277695	142249	135446	25918	9	29540	11
Pottawattamie	63958	32437	31521	4899	8	5068	8
Poweshiek	13654	6937	6717	800	6	919	7
Ringgold	4058	2045	2013	210	5	223	5
Sac	8779	4406	4373	441	5	519	6
Scott	115004	58772	56232	9366	8	10115	9
Shelby	9940	4959	4981	512	5	605	6
Sioux	22286	11235	11051	1501	7	1516	7
Story	54101	26588	27513	6123	11	4688	9

County	All Ages			25-29		30-34	
	Total	Female	Male	Driver	Percent	Driver	Percent
Tama	12971	6603	6368	710	5	939	7
Taylor	5164	2601	2563	298	6	306	6
Union	9321	4775	4546	604	6	625	7
Van Buren	5601	2792	2809	308	5	358	6
Wapello	25127	12866	12261	1694	7	1822	7
Warren	28703	14711	13992	1830	6	2294	8
Washington	14791	7491	7300	945	6	1091	7
Wayne	4974	2540	2434	237	5	269	5
Webster	28160	14398	13762	1832	7	1947	7
Winnebago	9045	4542	4503	521	6	587	6
Winneshiek	15075	7465	7610	924	6	987	7
Woodbury	69725	35023	34702	5860	8	6127	9
Worth	5966	2997	2969	332	6	419	7
Wright	10450	5360	5090	558	5	650	6
Total	2118809	1074397	1044412	157381	7	169701	8

Table A.1. (Ages 35-44)

County	All Ages			35-39		40-44	
	Total	Female	Male	Driver	Percent	Driver	Percent
Adair	6243	3135	3108	459	7	615	10
Adams	3574	1808	1766	263	7	368	10
Allamakee	10626	5241	5385	866	8	1035	10
Appanoose	10114	5154	4960	807	8	898	9
Audubon	5276	2693	2583	418	8	470	9
Benton	18351	9191	9160	1871	10	2055	11
Black Hawk	88676	45356	43320	7079	8	7945	9
Boone	18790	9587	9203	1534	8	1922	10
Bremer	17411	8925	8486	1377	8	1644	9
Buchanan	14639	7433	7206	1248	9	1515	10
Buena Vista	14412	7088	7324	1212	8	1420	10
Butler	11803	5983	5820	871	7	1107	9
Calhoun	8153	4219	3934	525	6	721	9
Carroll	16530	8342	8188	1330	8	1643	10
Cass	11185	5686	5499	845	8	1102	10
Cedar	13166	6600	6566	1162	9	1412	11
Cerro Gordo	33778	17478	16300	2674	8	3361	10
Cherokee	9886	5006	4880	668	7	987	10
Chickasaw	10114	5009	5105	814	8	1015	10
Clarke	6887	3480	3407	565	8	694	10
Clay	13268	6821	6447	1019	8	1326	10
Clayton	13975	6904	7071	1078	8	1444	10
Clinton	36152	18505	17647	3186	9	3669	10
Crawford	12269	6025	6244	951	8	1190	10
Dallas	26854	13538	13316	2658	10	3103	12
Davis	5687	2855	2832	469	8	554	10
Decatur	5714	2889	2825	417	7	506	9
Delaware	13860	6905	6955	1247	9	1527	11

County	All Ages			35-39		40-44	
	Total	Female	Male	Driver	Percent	Driver	Percent
Des Moines	30702	15759	14943	2552	8	2829	9
Dickinson	13012	6610	6402	883	7	1170	9
Dubuque	63926	32323	31603	5852	9	6388	10
Emmet	8144	4147	3997	586	7	712	9
Fayette	15978	8161	7817	1267	8	1536	10
Floyd	12458	6365	6093	971	8	1092	9
Franklin	8220	4129	4091	588	7	701	9
Fremont	6020	3039	2981	447	7	568	9
Greene	7869	4000	3869	602	8	768	10
Grundy	9164	4616	4548	736	8	856	9
Guthrie	8526	4338	4188	657	8	829	10
Hamilton	11961	6012	5949	964	8	1191	10
Hancock	9158	4629	4529	703	8	917	10
Hardin	14047	7156	6891	1009	7	1313	9
Harrison	11890	5925	5965	1028	9	1279	11
Henry	14534	7422	7112	1262	9	1438	10
Howard	7503	3732	3771	605	8	735	10
Humboldt	7878	3996	3882	580	7	782	10
Ida	6047	3062	2985	407	7	585	10
Iowa	11873	6041	5832	1091	9	1334	11
Jackson	15151	7597	7554	1335	9	1568	10
Jasper	26865	13703	13162	2349	9	2712	10
Jefferson	12224	6116	6108	797	7	1008	8
Johnson	74495	37602	36893	7144	10	7268	10
Jones	14008	7069	6939	1158	8	1437	10
Keokuk	8449	4293	4156	666	8	845	10
Kossuth	13600	6763	6837	970	7	1318	10
Lee	26873	13785	13088	2168	8	2659	10
Linn	142375	72482	69893	14020	10	14625	10
Louisa	8222	4040	4182	783	10	846	10
Lucas	6932	3506	3426	572	8	632	9
Lyon	8830	4422	4408	703	8	793	9
Madison	10355	5209	5146	938	9	1068	10
Mahaska	15948	8000	7948	1280	8	1609	10
Marion	23633	11879	11754	2085	9	2436	10
Marshall	28002	14089	13913	2322	8	2636	9
Mills	10680	5321	5359	924	9	1154	11
Mitchell	8239	4164	4075	654	8	804	10
Monona	7317	3750	3567	458	6	732	10
Monroe	5941	2981	2960	468	8	568	10
Montgomery	8837	4546	4291	668	8	788	9
Muscatine	29919	14963	14956	2779	9	3167	11
O'Brien	11515	5854	5661	793	7	1066	9
Osceola	5335	2707	2628	426	8	548	10
Page	11973	6184	5789	816	7	1053	9
Palo Alto	7467	3816	3651	507	7	700	9
Plymouth	18099	9075	9024	1429	8	1927	11
Pocahontas	6669	3371	3298	480	7	648	10

County	All Ages			35-39		40-44	
	Total	Female	Male	Driver	Percent	Driver	Percent
Polk	277695	142249	135446	29144	10	29700	11
Pottawattamie	63958	32437	31521	5774	9	6628	10
Poweshiek	13654	6937	6717	1133	8	1330	10
Ringgold	4058	2045	2013	273	7	345	9
Sac	8779	4406	4373	611	7	797	9
Scott	115004	58772	56232	10673	9	11770	10
Shelby	9940	4959	4981	776	8	1010	10
Sioux	22286	11235	11051	1718	8	2094	9
Story	54101	26588	27513	4421	8	4845	9
Tama	12971	6603	6368	1095	8	1240	10
Taylor	5164	2601	2563	390	8	460	9
Union	9321	4775	4546	703	8	943	10
Van Buren	5601	2792	2809	409	7	501	9
Wapello	25127	12866	12261	1991	8	2438	10
Warren	28703	14711	13992	2769	10	3095	11
Washington	14791	7491	7300	1319	9	1483	10
Wayne	4974	2540	2434	367	7	463	9
Webster	28160	14398	13762	2123	8	2820	10
Winnebago	9045	4542	4503	654	7	837	9
Winneshiek	15075	7465	7610	1259	8	1543	10
Woodbury	69725	35023	34702	6428	9	6883	10
Worth	5966	2997	2969	491	8	578	10
Wright	10450	5360	5090	751	7	988	9
Total	2118809	1074397	1044412	185368	9	211677	10

Table A.1. (Ages 45-54)

County	All Ages			45-49		50-54	
	Total	Female	Male	Driver	Percent	Driver	Percent
Adair	6243	3135	3108	585	9	508	8
Adams	3574	1808	1766	322	9	286	8
Allamakee	10626	5241	5385	1001	9	909	9
Appanoose	10114	5154	4960	989	10	833	8
Audubon	5276	2693	2583	481	9	399	8
Benton	18351	9191	9160	1735	9	1518	8
Black Hawk	88676	45356	43320	8854	10	8254	9
Boone	18790	9587	9203	1911	10	1678	9
Bremer	17411	8925	8486	1607	9	1553	9
Buchanan	14639	7433	7206	1405	10	1287	9
Buena Vista	14412	7088	7324	1468	10	1235	9
Butler	11803	5983	5820	1131	10	1055	9
Calhoun	8153	4219	3934	841	10	697	9
Carroll	16530	8342	8188	1598	10	1293	8
Cass	11185	5686	5499	1057	9	992	9
Cedar	13166	6600	6566	1319	10	1244	9
Cerro Gordo	33778	17478	16300	3321	10	3171	9
Cherokee	9886	5006	4880	1019	10	882	9
Chickasaw	10114	5009	5105	947	9	822	8

County	All Ages			45-49		50-54	
	Total	Female	Male	Driver	Percent	Driver	Percent
Clarke	6887	3480	3407	652	9	589	9
Clay	13268	6821	6447	1404	11	1163	9
Clayton	13975	6904	7071	1428	10	1177	8
Clinton	36152	18505	17647	3505	10	3174	9
Crawford	12269	6025	6244	1155	9	1009	8
Dallas	26854	13538	13316	2808	10	2393	9
Davis	5687	2855	2832	549	10	515	9
Decatur	5714	2889	2825	530	9	508	9
Delaware	13860	6905	6955	1342	10	1092	8
Des Moines	30702	15759	14943	2940	10	2966	10
Dickinson	13012	6610	6402	1238	10	1247	10
Dubuque	63926	32323	31603	6347	10	5810	9
Emmet	8144	4147	3997	794	10	739	9
Fayette	15978	8161	7817	1570	10	1333	8
Floyd	12458	6365	6093	1102	9	1142	9
Franklin	8220	4129	4091	846	10	674	8
Fremont	6020	3039	2981	588	10	566	9
Greene	7869	4000	3869	719	9	665	8
Grundy	9164	4616	4548	925	10	776	8
Guthrie	8526	4338	4188	783	9	719	8
Hamilton	11961	6012	5949	1113	9	1000	8
Hancock	9158	4629	4529	888	10	811	9
Hardin	14047	7156	6891	1336	10	1165	8
Harrison	11890	5925	5965	1101	9	1004	8
Henry	14534	7422	7112	1371	9	1352	9
Howard	7503	3732	3771	680	9	565	8
Humboldt	7878	3996	3882	771	10	656	8
Ida	6047	3062	2985	582	10	496	8
Iowa	11873	6041	5832	1211	10	978	8
Jackson	15151	7597	7554	1447	10	1240	8
Jasper	26865	13703	13162	2617	10	2445	9
Jefferson	12224	6116	6108	1520	12	1778	15
Johnson	74495	37602	36893	7209	10	6509	9
Jones	14008	7069	6939	1356	10	1251	9
Keokuk	8449	4293	4156	836	10	658	8
Kossuth	13600	6763	6837	1303	10	1144	8
Lee	26873	13785	13088	2696	10	2514	9
Linn	142375	72482	69893	14000	10	12562	9
Louisa	8222	4040	4182	789	10	703	9
Lucas	6932	3506	3426	614	9	566	8
Lyon	8830	4422	4408	869	10	667	8
Madison	10355	5209	5146	1068	10	928	9
Mahaska	15948	8000	7948	1514	9	1419	9
Marion	23633	11879	11754	2291	10	1999	8
Marshall	28002	14089	13913	2717	10	2688	10
Mills	10680	5321	5359	1146	11	1081	10
Mitchell	8239	4164	4075	769	9	644	8
Monona	7317	3750	3567	671	9	602	8

County	All Ages			45-49		50-54	
	Total	Female	Male	Driver	Percent	Driver	Percent
Monroe	5941	2981	2960	542	9	501	8
Montgomery	8837	4546	4291	858	10	798	9
Muscatine	29919	14963	14956	3028	10	2725	9
O'Brien	11515	5854	5661	1132	10	905	8
Osceola	5335	2707	2628	535	10	368	7
Page	11973	6184	5789	1193	10	1075	9
Palo Alto	7467	3816	3651	664	9	608	8
Plymouth	18099	9075	9024	1832	10	1560	9
Pocahontas	6669	3371	3298	648	10	566	8
Polk	277695	142249	135446	27268	10	24505	9
Pottawattamie	63958	32437	31521	6502	10	5857	9
Poweshiek	13654	6937	6717	1316	10	1187	9
Ringgold	4058	2045	2013	337	8	321	8
Sac	8779	4406	4373	821	9	734	8
Scott	115004	58772	56232	11821	10	10721	9
Shelby	9940	4959	4981	988	10	805	8
Sioux	22286	11235	11051	2109	9	1792	8
Story	54101	26588	27513	4935	9	4285	8
Tama	12971	6603	6368	1247	10	1087	8
Taylor	5164	2601	2563	442	9	434	8
Union	9321	4775	4546	834	9	850	9
Van Buren	5601	2792	2809	531	9	506	9
Wapello	25127	12866	12261	2594	10	2283	9
Warren	28703	14711	13992	2953	10	2634	9
Washington	14791	7491	7300	1487	10	1267	9
Wayne	4974	2540	2434	461	9	381	8
Webster	28160	14398	13762	2789	10	2423	9
Winnebago	9045	4542	4503	939	10	812	9
Winneshiek	15075	7465	7610	1511	10	1255	8
Woodbury	69725	35023	34702	6813	10	6240	9
Worth	5966	2997	2969	624	10	508	9
Wright	10450	5360	5090	1029	10	879	8
Total	2118809	1074397	1044412	208084	10	187170	9

Table A.1. (Ages 55-64)

County	All Ages			55-59		60-64	
	Total	Female	Male	Driver	Percent	Driver	Percent
Adair	6243	3135	3108	409	7	389	6
Adams	3574	1808	1766	246	7	261	7
Allamakee	10626	5241	5385	754	7	706	7
Appanoose	10114	5154	4960	775	8	676	7
Audubon	5276	2693	2583	368	7	329	6
Benton	18351	9191	9160	1207	7	1006	5
Black Hawk	88676	45356	43320	6292	7	4859	5
Boone	18790	9587	9203	1323	7	1074	6
Bremer	17411	8925	8486	1359	8	1145	7
Buchanan	14639	7433	7206	1017	7	889	6

County	All Ages			55-59		60-64	
	Total	Female	Male	Driver	Percent	Driver	Percent
Buena Vista	14412	7088	7324	864	6	669	5
Butler	11803	5983	5820	906	8	708	6
Calhoun	8153	4219	3934	563	7	482	6
Carroll	16530	8342	8188	912	6	892	5
Cass	11185	5686	5499	805	7	703	6
Cedar	13166	6600	6566	931	7	755	6
Cerro Gordo	33778	17478	16300	2378	7	1949	6
Cherokee	9886	5006	4880	685	7	597	6
Chickasaw	10114	5009	5105	718	7	622	6
Clarke	6887	3480	3407	474	7	387	6
Clay	13268	6821	6447	880	7	708	5
Clayton	13975	6904	7071	987	7	824	6
Clinton	36152	18505	17647	2641	7	2216	6
Crawford	12269	6025	6244	934	8	717	6
Dallas	26854	13538	13316	1827	7	1363	5
Davis	5687	2855	2832	393	7	391	7
Decatur	5714	2889	2825	412	7	379	7
Delaware	13860	6905	6955	824	6	802	6
Des Moines	30702	15759	14943	2458	8	1938	6
Dickinson	13012	6610	6402	990	8	824	6
Dubuque	63926	32323	31603	4342	7	3687	6
Emmet	8144	4147	3997	530	7	504	6
Fayette	15978	8161	7817	1085	7	992	6
Floyd	12458	6365	6093	925	7	840	7
Franklin	8220	4129	4091	611	7	508	6
Fremont	6020	3039	2981	439	7	353	6
Greene	7869	4000	3869	522	7	467	6
Grundy	9164	4616	4548	681	7	585	6
Guthrie	8526	4338	4188	654	8	542	6
Hamilton	11961	6012	5949	846	7	694	6
Hancock	9158	4629	4529	624	7	530	6
Hardin	14047	7156	6891	958	7	875	6
Harrison	11890	5925	5965	806	7	709	6
Henry	14534	7422	7112	1081	7	802	6
Howard	7503	3732	3771	497	7	431	6
Humboldt	7878	3996	3882	502	6	502	6
Ida	6047	3062	2985	401	7	323	5
Iowa	11873	6041	5832	725	6	674	6
Jackson	15151	7597	7554	1112	7	896	6
Jasper	26865	13703	13162	1973	7	1556	6
Jefferson	12224	6116	6108	1049	9	594	5
Johnson	74495	37602	36893	4606	6	3016	4
Jones	14008	7069	6939	1024	7	849	6
Keokuk	8449	4293	4156	572	7	491	6
Kossuth	13600	6763	6837	865	6	823	6
Lee	26873	13785	13088	2155	8	1703	6
Linn	142375	72482	69893	9993	7	7427	5
Louisa	8222	4040	4182	557	7	464	6

County	All Ages			55-59		60-64	
	Total	Female	Male	Driver	Percent	Driver	Percent
Lucas	6932	3506	3426	515	7	464	7
Lyon	8830	4422	4408	549	6	456	5
Madison	10355	5209	5146	741	7	628	6
Mahaska	15948	8000	7948	1058	7	861	5
Marion	23633	11879	11754	1596	7	1329	6
Marshall	28002	14089	13913	2139	8	1748	6
Mills	10680	5321	5359	834	8	601	6
Mitchell	8239	4164	4075	539	7	503	6
Monona	7317	3750	3567	537	7	511	7
Monroe	5941	2981	2960	450	8	360	6
Montgomery	8837	4546	4291	607	7	541	6
Muscatine	29919	14963	14956	2239	7	1659	6
O'Brien	11515	5854	5661	698	6	606	5
Osceola	5335	2707	2628	373	7	295	6
Page	11973	6184	5789	909	8	674	6
Palo Alto	7467	3816	3651	466	6	416	6
Plymouth	18099	9075	9024	1172	6	911	5
Pocahontas	6669	3371	3298	466	7	415	6
Polk	277695	142249	135446	18916	7	13519	5
Pottawattamie	63958	32437	31521	4661	7	3572	6
Poweshiek	13654	6937	6717	1015	7	893	7
Ringgold	4058	2045	2013	312	8	265	7
Sac	8779	4406	4373	580	7	527	6
Scott	115004	58772	56232	8558	7	6155	5
Shelby	9940	4959	4981	669	7	560	6
Sioux	22286	11235	11051	1251	6	1152	5
Story	54101	26588	27513	3177	6	2396	4
Tama	12971	6603	6368	938	7	836	6
Taylor	5164	2601	2563	360	7	311	6
Union	9321	4775	4546	689	7	557	6
Van Buren	5601	2792	2809	385	7	384	7
Wapello	25127	12866	12261	1821	7	1553	6
Warren	28703	14711	13992	2231	8	1676	6
Washington	14791	7491	7300	1034	7	817	6
Wayne	4974	2540	2434	343	7	331	7
Webster	28160	14398	13762	1951	7	1560	6
Winnebago	9045	4542	4503	593	7	493	5
Winneshiek	15075	7465	7610	941	6	873	6
Woodbury	69725	35023	34702	4546	7	3498	5
Worth	5966	2997	2969	407	7	359	6
Wright	10450	5360	5090	719	7	665	6
Total	2118809	1074397	1044412	147454	7	117027	6

Table A.1. (Ages 65-74)

County	All Ages			65-69		70-74	
	Total	Female	Male	Driver	Percent	Driver	Percent
Adair	6243	3135	3108	376	6	349	6
Adams	3574	1808	1766	217	6	176	5
Allamakee	10626	5241	5385	622	6	535	5
Appanoose	10114	5154	4960	577	6	530	5
Audubon	5276	2693	2583	316	6	313	6
Benton	18351	9191	9160	882	5	785	4
Black Hawk	88676	45356	43320	4051	5	3685	4
Boone	18790	9587	9203	943	5	896	5
Bremer	17411	8925	8486	919	5	788	5
Buchanan	14639	7433	7206	768	5	627	4
Buena Vista	14412	7088	7324	652	5	715	5
Butler	11803	5983	5820	650	6	629	5
Calhoun	8153	4219	3934	531	7	478	6
Carroll	16530	8342	8188	774	5	854	5
Cass	11185	5686	5499	648	6	581	5
Cedar	13166	6600	6566	665	5	592	4
Cerro Gordo	33778	17478	16300	1751	5	1825	5
Cherokee	9886	5006	4880	613	6	621	6
Chickasaw	10114	5009	5105	550	5	520	5
Clarke	6887	3480	3407	340	5	339	5
Clay	13268	6821	6447	679	5	629	5
Clayton	13975	6904	7071	823	6	750	5
Clinton	36152	18505	17647	1823	5	1623	4
Crawford	12269	6025	6244	633	5	595	5
Dallas	26854	13538	13316	1130	4	953	4
Davis	5687	2855	2832	336	6	281	5
Decatur	5714	2889	2825	365	6	330	6
Delaware	13860	6905	6955	678	5	614	4
Des Moines	30702	15759	14943	1514	5	1414	5
Dickinson	13012	6610	6402	811	6	788	6
Dubuque	63926	32323	31603	3043	5	2775	4
Emmet	8144	4147	3997	452	6	408	5
Fayette	15978	8161	7817	913	6	848	5
Floyd	12458	6365	6093	700	6	615	5
Franklin	8220	4129	4091	486	6	472	6
Fremont	6020	3039	2981	352	6	315	5
Greene	7869	4000	3869	424	5	444	6
Grundy	9164	4616	4548	514	6	482	5
Guthrie	8526	4338	4188	570	7	491	6
Hamilton	11961	6012	5949	672	6	645	5
Hancock	9158	4629	4529	485	5	449	5
Hardin	14047	7156	6891	767	5	790	6
Harrison	11890	5925	5965	609	5	543	5
Henry	14534	7422	7112	627	4	616	4
Howard	7503	3732	3771	384	5	387	5
Humboldt	7878	3996	3882	458	6	475	6
Ida	6047	3062	2985	360	6	341	6
Iowa	11873	6041	5832	617	5	561	5

County	All Ages			65-69		70-74	
	Total	Female	Male	Driver	Percent	Driver	Percent
Jackson	15151	7597	7554	833	5	794	5
Jasper	26865	13703	13162	1423	5	1341	5
Jefferson	12224	6116	6108	487	4	440	4
Johnson	74495	37602	36893	2284	3	1845	2
Jones	14008	7069	6939	764	5	686	5
Keokuk	8449	4293	4156	476	6	468	6
Kossuth	13600	6763	6837	874	6	731	5
Lee	26873	13785	13088	1331	5	1250	5
Linn	142375	72482	69893	6202	4	5080	4
Louisa	8222	4040	4182	403	5	364	4
Lucas	6932	3506	3426	396	6	379	5
Lyon	8830	4422	4408	482	5	467	5
Madison	10355	5209	5146	487	5	418	4
Mahaska	15948	8000	7948	756	5	715	4
Marion	23633	11879	11754	1136	5	996	4
Marshall	28002	14089	13913	1380	5	1316	5
Mills	10680	5321	5359	493	5	381	4
Mitchell	8239	4164	4075	468	6	474	6
Monona	7317	3750	3567	447	6	456	6
Monroe	5941	2981	2960	299	5	312	5
Montgomery	8837	4546	4291	430	5	523	6
Muscatine	29919	14963	14956	1314	4	1108	4
O'Brien	11515	5854	5661	685	6	662	6
Osceola	5335	2707	2628	295	6	300	6
Page	11973	6184	5789	673	6	698	6
Palo Alto	7467	3816	3651	488	7	450	6
Plymouth	18099	9075	9024	851	5	869	5
Pocahontas	6669	3371	3298	403	6	357	5
Polk	277695	142249	135446	10349	4	8863	3
Pottawattamie	63958	32437	31521	3049	5	2715	4
Poweshiek	13654	6937	6717	764	6	668	5
Ringgold	4058	2045	2013	287	7	260	6
Sac	8779	4406	4373	526	6	512	6
Scott	115004	58772	56232	4834	4	3932	3
Shelby	9940	4959	4981	573	6	540	5
Sioux	22286	11235	11051	1053	5	1040	5
Story	54101	26588	27513	1989	4	1736	3
Tama	12971	6603	6368	724	6	661	5
Taylor	5164	2601	2563	304	6	294	6
Union	9321	4775	4546	520	6	479	5
Van Buren	5601	2792	2809	369	7	275	5
Wapello	25127	12866	12261	1397	6	1281	5
Warren	28703	14711	13992	1333	5	1040	4
Washington	14791	7491	7300	732	5	704	5
Wayne	4974	2540	2434	312	6	298	6
Webster	28160	14398	13762	1514	5	1412	5
Winnebago	9045	4542	4503	452	5	461	5
Winneshiek	15075	7465	7610	765	5	690	5

County	All Ages			65-69		70-74	
	Total	Female	Male	Driver	Percent	Driver	Percent
Woodbury	69725	35023	34702	2943	4	2757	4
Worth	5966	2997	2969	331	6	278	5
Wright	10450	5360	5090	580	6	592	6
Total	2118809	1074397	1044412	100330	5	90840	4

Table A.1. (Ages 75+)

County	All Ages			75-79		80-84		85+	
	Total	Female	Male	Driver	Percent	Driver	Percent	Driver	Percent
Adair	6243	3135	3108	310	5	230	4	166	3
Adams	3574	1808	1766	182	5	138	4	101	3
Allamakee	10626	5241	5385	447	4	316	3	174	2
Appanoose	10114	5154	4960	478	5	323	3	218	2
Audubon	5276	2693	2583	292	6	215	4	150	3
Benton	18351	9191	9160	666	4	484	3	309	2
Black Hawk	88676	45356	43320	3172	4	2031	2	1080	1
Boone	18790	9587	9203	714	4	478	3	274	1
Bremer	17411	8925	8486	641	4	553	3	338	2
Buchanan	14639	7433	7206	555	4	368	3	215	1
Buena Vista	14412	7088	7324	677	5	443	3	287	2
Butler	11803	5983	5820	568	5	431	4	260	2
Calhoun	8153	4219	3934	428	5	364	4	227	3
Carroll	16530	8342	8188	738	4	513	3	297	2
Cass	11185	5686	5499	548	5	379	3	207	2
Cedar	13166	6600	6566	510	4	380	3	232	2
Cerro Gordo	33778	17478	16300	1502	4	939	3	538	2
Cherokee	9886	5006	4880	475	5	336	3	189	2
Chickasaw	10114	5009	5105	445	4	294	3	203	2
Clarke	6887	3480	3407	272	4	174	3	112	2
Clay	13268	6821	6447	566	4	416	3	254	2
Clayton	13975	6904	7071	601	4	388	3	255	2
Clinton	36152	18505	17647	1416	4	963	3	494	1
Crawford	12269	6025	6244	519	4	374	3	187	2
Dallas	26854	13538	13316	826	3	542	2	347	1
Davis	5687	2855	2832	242	4	146	3	117	2
Decatur	5714	2889	2825	256	4	159	3	103	2
Delaware	13860	6905	6955	560	4	328	2	194	1
Des Moines	30702	15759	14943	1287	4	841	3	450	1
Dickinson	13012	6610	6402	667	5	407	3	248	2
Dubuque	63926	32323	31603	2161	3	1315	2	612	1
Emmet	8144	4147	3997	417	5	285	3	166	2
Fayette	15978	8161	7817	750	5	513	3	336	2
Floyd	12458	6365	6093	558	4	432	3	274	2
Franklin	8220	4129	4091	433	5	296	4	179	2
Fremont	6020	3039	2981	268	4	201	3	101	2
Greene	7869	4000	3869	440	6	295	4	223	3
Grundy	9164	4616	4548	425	5	364	4	218	2
Guthrie	8526	4338	4188	396	5	270	3	163	2

County	All Ages			75-79		80-84		85+	
	Total	Female	Male	Driver	Percent	Driver	Percent	Driver	Percent
Hamilton	11961	6012	5949	532	4	394	3	250	2
Hancock	9158	4629	4529	424	5	286	3	225	2
Hardin	14047	7156	6891	696	5	540	4	341	2
Harrison	11890	5925	5965	477	4	321	3	204	2
Henry	14534	7422	7112	561	4	378	3	241	2
Howard	7503	3732	3771	357	5	274	4	168	2
Humboldt	7878	3996	3882	391	5	290	4	183	2
Ida	6047	3062	2985	344	6	222	4	124	2
Iowa	11873	6041	5832	458	4	353	3	187	2
Jackson	15151	7597	7554	578	4	397	3	234	2
Jasper	26865	13703	13162	1035	4	709	3	369	1
Jefferson	12224	6116	6108	388	3	258	2	168	1
Johnson	74495	37602	36893	1447	2	871	1	440	1
Jones	14008	7069	6939	566	4	399	3	224	2
Keokuk	8449	4293	4156	409	5	302	4	187	2
Kossuth	13600	6763	6837	663	5	433	3	294	2
Lee	26873	13785	13088	1088	4	732	3	361	1
Linn	142375	72482	69893	4194	3	2667	2	1389	1
Louisa	8222	4040	4182	278	3	192	2	142	2
Lucas	6932	3506	3426	304	4	213	3	154	2
Lyon	8830	4422	4408	386	4	309	3	168	2
Madison	10355	5209	5146	312	3	260	3	157	2
Mahaska	15948	8000	7948	675	4	462	3	271	2
Marion	23633	11879	11754	870	4	591	3	405	2
Marshall	28002	14089	13913	1069	4	764	3	415	1
Mills	10680	5321	5359	321	3	212	2	125	1
Mitchell	8239	4164	4075	445	5	313	4	194	2
Monona	7317	3750	3567	389	5	281	4	183	3
Monroe	5941	2981	2960	290	5	186	3	105	2
Montgomery	8837	4546	4291	382	4	320	4	165	2
Muscatine	29919	14963	14956	947	3	560	2	340	1
O'Brien	11515	5854	5661	556	5	422	4	279	2
Osceola	5335	2707	2628	253	5	182	3	101	2
Page	11973	6184	5789	577	5	446	4	256	2
Palo Alto	7467	3816	3651	380	5	271	4	192	3
Plymouth	18099	9075	9024	697	4	528	3	296	2
Pocahontas	6669	3371	3298	371	6	293	4	167	3
Polk	277695	142249	135446	7029	3	4289	2	2154	1
Pottawattamie	63958	32437	31521	2190	3	1211	2	582	1
Poweshiek	13654	6937	6717	586	4	434	3	259	2
Ringgold	4058	2045	2013	231	6	152	4	109	3
Sac	8779	4406	4373	468	5	364	4	244	3
Scott	115004	58772	56232	3369	3	2005	2	1029	1
Shelby	9940	4959	4981	526	5	368	4	209	2
Sioux	22286	11235	11051	938	4	661	3	377	2
Story	54101	26588	27513	1433	3	984	2	607	1
Tama	12971	6603	6368	587	5	404	3	275	2
Taylor	5164	2601	2563	262	5	202	4	142	3

County	All Ages			75-79		80-84		85+	
	Total	Female	Male	Driver	Percent	Driver	Percent	Driver	Percent
Union	9321	4775	4546	403	4	333	4	180	2
Van Buren	5601	2792	2809	268	5	181	3	139	2
Wapello	25127	12866	12261	1067	4	702	3	413	2
Warren	28703	14711	13992	807	3	530	2	279	1
Washington	14791	7491	7300	605	4	492	3	298	2
Wayne	4974	2540	2434	293	6	199	4	161	3
Webster	28160	14398	13762	1218	4	838	3	448	2
Winnebago	9045	4542	4503	376	4	306	3	196	2
Winneshiek	15075	7465	7610	646	4	399	3	254	2
Woodbury	69725	35023	34702	2322	3	1476	2	763	1
Worth	5966	2997	2969	282	5	203	3	125	2
Wright	10450	5360	5090	561	5	426	4	303	3
Total	2118809	1074397	1044412	76985	4	51715	2	29748	1

Table A.2. Exposure (Million VMT) by County and Age Group in Iowa (Ages 16-24)

County	All Ages	16-19		20-24	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Adair	76.25	4.00	5.24	7.46	9.78
Adams	43.40	2.23	5.15	3.96	9.11
Allamakee	132.37	7.08	5.35	12.44	9.40
Appanoose	125.89	5.53	4.39	11.41	9.07
Audubon	63.13	3.69	5.85	5.38	8.52
Benton	233.56	12.15	5.20	20.63	8.83
Black Hawk	1151.64	46.85	4.07	137.05	11.90
Boone	239.13	10.84	4.53	23.22	9.71
Bremer	217.78	11.16	5.12	22.15	10.17
Buchanan	185.39	9.94	5.36	17.84	9.63
Buena Vista	181.08	9.09	5.02	19.91	10.99
Butler	145.63	7.07	4.85	12.89	8.85
Calhoun	97.97	5.02	5.12	9.10	9.29
Carroll	204.77	13.07	6.38	22.11	10.80
Cass	138.40	6.83	4.94	12.89	9.31
Cedar	167.13	7.65	4.57	14.37	8.60
Cerro Gordo	426.65	18.87	4.42	40.77	9.56
Cherokee	121.22	5.86	4.83	11.37	9.38
Chickasaw	125.38	6.75	5.38	12.73	10.15
Clarke	86.93	4.59	5.28	8.37	9.62
Clay	166.63	8.01	4.81	16.79	10.08
Clayton	174.45	8.99	5.15	16.66	9.55
Clinton	460.77	21.66	4.70	43.70	9.48
Crawford	153.07	8.54	5.58	15.50	10.13
Dallas	349.50	16.98	4.86	29.14	8.34
Davis	71.12	3.48	4.89	6.49	9.13
Decatur	70.78	3.39	4.79	7.03	9.93
Delaware	174.93	10.56	6.03	18.12	10.36
Des Moines	391.02	16.75	4.28	36.83	9.42
Dickinson	161.07	6.65	4.13	14.84	9.21
Dubuque	827.21	38.87	4.70	85.44	10.33
Emmet	100.94	4.83	4.79	10.45	10.35
Fayette	197.72	10.21	5.16	18.81	9.51
Floyd	154.22	7.57	4.91	14.14	9.17
Franklin	100.18	5.17	5.16	9.16	9.14
Fremont	74.98	3.71	4.95	7.02	9.36
Greene	95.27	5.32	5.59	8.95	9.40
Grundy	112.38	5.52	4.91	9.61	8.55
Guthrie	105.03	4.94	4.70	8.85	8.42
Hamilton	149.14	6.86	4.60	12.41	8.32
Hancock	112.97	6.17	5.46	10.97	9.71
Hardin	172.18	8.70	5.05	17.21	10.00
Harrison	150.32	7.72	5.14	13.30	8.85
Henry	185.54	9.25	4.98	17.81	9.60
Howard	92.36	5.10	5.53	9.74	10.55
Humboldt	96.02	5.17	5.38	9.05	9.43

County	All Ages	16-19		20-24	
	Total VMT (million)	VMT	Percent	VMT	Percent
Ida	73.08	4.41	6.04	6.99	9.56
Iowa	150.36	7.16	4.76	13.61	9.05
Jackson	189.97	10.18	5.36	17.46	9.19
Jasper	341.76	15.05	4.40	30.19	8.83
Jefferson	158.62	7.26	4.58	14.30	9.01
Johnson	1021.14	34.79	3.41	132.83	13.01
Jones	176.61	8.37	4.74	15.69	8.88
Keokuk	104.35	5.02	4.81	9.64	9.24
Kossuth	165.04	9.92	6.01	16.54	10.02
Lee	341.79	15.90	4.65	32.33	9.46
Linn	1883.24	73.74	3.92	183.75	9.76
Louisa	105.42	4.65	4.41	9.42	8.94
Lucas	86.05	3.88	4.51	8.10	9.42
Lyon	108.68	6.08	5.59	11.73	10.80
Madison	132.91	6.70	5.04	12.36	9.30
Mahaska	202.54	9.93	4.90	20.58	10.16
Marion	300.40	15.47	5.15	28.52	9.50
Marshall	356.26	15.80	4.43	34.31	9.63
Mills	138.79	6.88	4.96	12.45	8.97
Mitchell	100.02	5.41	5.41	9.19	9.18
Monona	88.95	4.36	4.91	7.63	8.58
Monroe	73.83	3.79	5.14	6.81	9.23
Montgomery	110.06	5.21	4.74	9.39	8.53
Muscatine	391.81	16.39	4.18	37.86	9.66
O'Brien	140.12	8.01	5.71	14.86	10.60
Osceola	65.74	3.64	5.53	6.42	9.76
Page	147.81	6.61	4.47	14.27	9.65
Palo Alto	90.42	5.07	5.60	9.49	10.50
Plymouth	227.92	12.99	5.70	23.31	10.23
Pocahontas	79.79	4.77	5.98	6.89	8.63
Polk	3736.10	135.46	3.63	352.93	9.45
Pottawattamie	834.54	35.17	4.21	82.30	9.86
Poweshiek	170.85	8.01	4.69	15.43	9.03
Ringgold	48.67	2.49	5.12	4.92	10.11
Sac	106.01	5.51	5.20	10.80	10.18
Scott	1520.08	65.50	4.31	151.47	9.96
Shelby	121.94	6.52	5.35	11.21	9.19
Sioux	278.01	16.85	6.06	34.94	12.57
Story	719.94	28.50	3.96	114.14	15.85
Tama	161.53	7.68	4.75	14.28	8.84
Taylor	62.91	3.13	4.97	6.65	10.57
Union	116.67	4.96	4.25	11.40	9.77
Van Buren	68.68	3.49	5.08	6.12	8.92
Wapello	319.02	12.30	3.86	29.53	9.26
Warren	373.14	18.02	4.83	33.68	9.03
Washington	186.70	8.47	4.53	16.66	8.92
Wayne	59.39	3.25	5.47	5.01	8.44
Webster	353.94	17.34	4.90	36.30	10.26

County	All Ages	16-19		20-24	
	Total VMT (million)	VMT	Percent	VMT	Percent
Winnebago	112.21	6.21	5.53	12.07	10.76
Winneshiek	189.71	10.40	5.48	20.41	10.76
Woodbury	912.51	39.98	4.38	98.16	10.76
Worth	74.63	3.42	4.58	7.00	9.38
Wright	127.13	5.98	4.70	11.15	8.77
Total	27271.28	1224.44	4.49	2737.56	10.04

Table A.2. (Ages 25-34)

County	All Ages	25-29		30-34	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Adair	76.25	5.69	7.47	5.76	7.55
Adams	43.40	2.85	6.56	3.30	7.60
Allamakee	132.37	9.87	7.46	11.06	8.35
Appanoose	125.89	10.13	8.05	11.35	9.02
Audubon	63.13	4.26	6.75	4.92	7.79
Benton	233.56	17.28	7.40	23.03	9.86
Black Hawk	1151.64	117.69	10.22	115.65	10.04
Boone	239.13	19.60	8.20	23.33	9.76
Bremer	217.78	16.19	7.43	18.93	8.69
Buchanan	185.39	15.04	8.11	16.57	8.94
Buena Vista	181.08	14.72	8.13	16.73	9.24
Butler	145.63	11.05	7.59	12.52	8.60
Calhoun	97.97	6.31	6.44	7.47	7.63
Carroll	204.77	16.84	8.22	17.70	8.65
Cass	138.40	10.18	7.35	11.39	8.23
Cedar	167.13	12.55	7.51	15.56	9.31
Cerro Gordo	426.65	35.03	8.21	38.36	8.99
Cherokee	121.22	8.00	6.60	9.29	7.66
Chickasaw	125.38	8.73	6.96	10.73	8.55
Clarke	86.93	7.70	8.85	8.18	9.41
Clay	166.63	13.75	8.25	14.69	8.81
Clayton	174.45	11.93	6.84	15.05	8.63
Clinton	460.77	37.14	8.06	43.87	9.52
Crawford	153.07	12.04	7.86	13.55	8.85
Dallas	349.50	28.25	8.08	39.14	11.20
Davis	71.12	4.98	7.00	6.27	8.82
Decatur	70.78	6.03	8.51	5.53	7.81
Delaware	174.93	13.09	7.48	15.66	8.95
Des Moines	391.02	33.09	8.46	36.48	9.33
Dickinson	161.07	11.89	7.38	14.31	8.88
Dubuque	827.21	71.50	8.64	83.47	10.09
Emmet	100.94	8.78	8.69	8.33	8.25
Fayette	197.72	14.68	7.42	16.48	8.34
Floyd	154.22	11.81	7.66	14.27	9.25
Franklin	100.18	7.01	7.00	8.45	8.43
Fremont	74.98	5.31	7.08	6.83	9.11
Greene	95.27	6.11	6.41	7.52	7.90

County	All Ages	25-29		30-34	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Grundy	112.38	7.43	6.61	9.32	8.30
Guthrie	105.03	7.74	7.37	8.89	8.47
Hamilton	149.14	13.72	9.20	13.51	9.06
Hancock	112.97	7.92	7.01	9.34	8.27
Hardin	172.18	13.24	7.69	14.06	8.16
Harrison	150.32	12.45	8.28	14.64	9.74
Henry	185.54	15.20	8.19	19.17	10.33
Howard	92.36	7.03	7.61	8.12	8.79
Humboldt	96.02	6.36	6.62	7.36	7.66
Ida	73.08	5.07	6.94	5.86	8.02
Iowa	150.36	10.86	7.22	14.70	9.78
Jackson	189.97	13.69	7.21	16.91	8.90
Jasper	341.76	27.27	7.98	34.09	9.97
Jefferson	158.62	12.37	7.80	13.50	8.51
Johnson	1021.14	142.67	13.97	131.85	12.91
Jones	176.61	13.86	7.85	16.27	9.21
Keokuk	104.35	7.70	7.37	9.45	9.06
Kossuth	165.04	11.05	6.70	12.24	7.42
Lee	341.79	26.11	7.64	30.61	8.96
Linn	1883.24	194.68	10.34	220.82	11.73
Louisa	105.42	9.62	9.12	11.06	10.49
Lucas	86.05	6.55	7.61	8.33	9.68
Lyon	108.68	9.22	8.49	9.59	8.82
Madison	132.91	9.86	7.42	13.60	10.23
Mahaska	202.54	18.84	9.30	19.29	9.52
Marion	300.40	26.68	8.88	29.07	9.68
Marshall	356.26	28.62	8.03	34.22	9.61
Mills	138.79	10.84	7.81	13.28	9.57
Mitchell	100.02	6.87	6.87	8.09	8.08
Monona	88.95	6.33	7.11	7.28	8.18
Monroe	73.83	5.53	7.49	7.13	9.65
Montgomery	110.06	9.67	8.78	10.82	9.83
Muscatine	391.81	36.92	9.42	40.79	10.41
O'Brien	140.12	11.24	8.02	11.43	8.16
Osceola	65.74	4.40	6.70	5.96	9.06
Page	147.81	12.47	8.43	12.33	8.34
Palo Alto	90.42	7.16	7.91	6.93	7.66
Plymouth	227.92	17.39	7.63	21.32	9.35
Pocahontas	79.79	4.50	5.64	5.49	6.89
Polk	3736.10	412.10	11.03	487.41	13.05
Pottawattamie	834.54	77.89	9.33	83.62	10.02
Poweshiek	170.85	12.72	7.45	15.16	8.88
Ringgold	48.67	3.34	6.86	3.68	7.56
Sac	106.01	7.01	6.61	8.56	8.08
Scott	1520.08	148.92	9.80	166.90	10.98
Shelby	121.94	8.14	6.68	9.98	8.19
Sioux	278.01	23.87	8.58	25.01	9.00
Story	719.94	97.36	13.52	77.35	10.74

County	All Ages	25-29		30-34	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Tama	161.53	11.29	6.99	15.49	9.59
Taylor	62.91	4.74	7.53	5.05	8.03
Union	116.67	9.60	8.23	10.31	8.84
Van Buren	68.68	4.90	7.13	5.91	8.60
Wapello	319.02	26.93	8.44	30.06	9.42
Warren	373.14	29.10	7.80	37.85	10.14
Washington	186.70	15.03	8.05	18.00	9.64
Wayne	59.39	3.77	6.35	4.44	7.47
Webster	353.94	29.13	8.23	32.13	9.08
Winnebago	112.21	8.28	7.38	9.69	8.63
Winneshiek	189.71	14.69	7.74	16.29	8.58
Woodbury	912.51	93.17	10.21	101.10	11.08
Worth	74.63	5.28	7.07	6.91	9.26
Wright	127.13	8.87	6.98	10.73	8.44
Total	27271.28	2502.34	9.18	2800.07	10.27

Table A.2. (Ages 35-44)

County	All Ages	35-39		40-44	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Adair	76.25	7.07	9.27	9.66	12.66
Adams	43.40	4.05	9.33	5.78	13.31
Allamakee	132.37	13.34	10.08	16.25	12.28
Appanoose	125.89	12.43	9.87	14.10	11.20
Audubon	63.13	6.44	10.20	7.38	11.69
Benton	233.56	28.81	12.34	32.26	13.81
Black Hawk	1151.64	109.02	9.47	124.74	10.83
Boone	239.13	23.62	9.88	30.18	12.62
Bremer	217.78	21.21	9.74	25.81	11.85
Buchanan	185.39	19.22	10.37	23.79	12.83
Buena Vista	181.08	18.66	10.31	22.29	12.31
Butler	145.63	13.41	9.21	17.38	11.93
Calhoun	97.97	8.09	8.25	11.32	11.55
Carroll	204.77	20.48	10.00	25.80	12.60
Cass	138.40	13.01	9.40	17.30	12.50
Cedar	167.13	17.89	10.71	22.17	13.26
Cerro Gordo	426.65	41.18	9.65	52.77	12.37
Cherokee	121.22	10.29	8.49	15.50	12.78
Chickasaw	125.38	12.54	10.00	15.94	12.71
Clarke	86.93	8.70	10.01	10.90	12.53
Clay	166.63	15.69	9.42	20.82	12.49
Clayton	174.45	16.60	9.52	22.67	13.00
Clinton	460.77	49.06	10.65	57.60	12.50
Crawford	153.07	14.65	9.57	18.68	12.21
Dallas	349.50	40.93	11.71	48.72	13.94
Davis	71.12	7.22	10.16	8.70	12.23
Decatur	70.78	6.42	9.07	7.94	11.22
Delaware	174.93	19.20	10.98	23.97	13.71

County	All Ages	35-39		40-44	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Des Moines	391.02	39.30	10.05	44.42	11.36
Dickinson	161.07	13.60	8.44	18.37	11.40
Dubuque	827.21	90.12	10.89	100.29	12.12
Emmet	100.94	9.02	8.94	11.18	11.07
Fayette	197.72	19.51	9.87	24.12	12.20
Floyd	154.22	14.95	9.70	17.14	11.12
Franklin	100.18	9.06	9.04	11.01	10.99
Fremont	74.98	6.88	9.18	8.92	11.89
Greene	95.27	9.27	9.73	12.06	12.66
Grundy	112.38	11.33	10.09	13.44	11.96
Guthrie	105.03	10.12	9.63	13.02	12.39
Hamilton	149.14	14.85	9.95	18.70	12.54
Hancock	112.97	10.83	9.58	14.40	12.74
Hardin	172.18	15.54	9.02	20.61	11.97
Harrison	150.32	15.83	10.53	20.08	13.36
Henry	185.54	19.43	10.47	22.58	12.17
Howard	92.36	9.32	10.09	11.54	12.49
Humboldt	96.02	8.93	9.30	12.28	12.79
Ida	73.08	6.27	8.58	9.18	12.57
Iowa	150.36	16.80	11.17	20.94	13.93
Jackson	189.97	20.56	10.82	24.62	12.96
Jasper	341.76	36.17	10.58	42.58	12.46
Jefferson	158.62	12.27	7.74	15.83	9.98
Johnson	1021.14	110.02	10.77	114.11	11.17
Jones	176.61	17.83	10.10	22.56	12.77
Keokuk	104.35	10.26	9.83	13.27	12.71
Kossuth	165.04	14.94	9.05	20.69	12.54
Lee	341.79	33.39	9.77	41.75	12.21
Linn	1883.24	215.91	11.46	229.61	12.19
Louisa	105.42	12.06	11.44	13.28	12.60
Lucas	86.05	8.81	10.24	9.92	11.53
Lyon	108.68	10.83	9.96	12.45	11.46
Madison	132.91	14.45	10.87	16.77	12.62
Mahaska	202.54	19.71	9.73	25.26	12.47
Marion	300.40	32.11	10.69	38.25	12.73
Marshall	356.26	35.76	10.04	41.39	11.62
Mills	138.79	14.23	10.25	18.12	13.05
Mitchell	100.02	10.07	10.07	12.62	12.62
Monona	88.95	7.05	7.93	11.49	12.92
Monroe	73.83	7.21	9.76	8.92	12.08
Montgomery	110.06	10.29	9.35	12.37	11.24
Muscatine	391.81	42.80	10.92	49.72	12.69
O'Brien	140.12	12.21	8.72	16.74	11.94
Osceola	65.74	6.56	9.98	8.60	13.09
Page	147.81	12.57	8.50	16.53	11.18
Palo Alto	90.42	7.81	8.64	10.99	12.15
Plymouth	227.92	22.01	9.66	30.25	13.27
Pocahontas	79.79	7.39	9.26	10.17	12.75

County	All Ages		35-39		40-44	
	Total VMT (Million)		VMT	Percent	VMT	Percent
Polk	3736.10		448.82	12.01	466.29	12.48
Pottawattamie	834.54		88.92	10.65	104.06	12.47
Poweshiek	170.85		17.45	10.21	20.88	12.22
Ringgold	48.67		4.20	8.64	5.42	11.13
Sac	106.01		9.41	8.88	12.51	11.80
Scott	1520.08		164.36	10.81	184.79	12.16
Shelby	121.94		11.95	9.80	15.86	13.00
Sioux	278.01		26.46	9.52	32.88	11.83
Story	719.94		68.08	9.46	76.07	10.57
Tama	161.53		16.86	10.44	19.47	12.05
Taylor	62.91		6.01	9.55	7.22	11.48
Union	116.67		10.83	9.28	14.81	12.69
Van Buren	68.68		6.30	9.17	7.87	11.45
Wapello	319.02		30.66	9.61	38.28	12.00
Warren	373.14		42.64	11.43	48.59	13.02
Washington	186.70		20.31	10.88	23.28	12.47
Wayne	59.39		5.65	9.52	7.27	12.24
Webster	353.94		32.69	9.24	44.27	12.51
Winnebago	112.21		10.07	8.98	13.14	11.71
Winneshiek	189.71		19.39	10.22	24.23	12.77
Woodbury	912.51		98.99	10.85	108.06	11.84
Worth	74.63		7.56	10.13	9.07	12.16
Wright	127.13		11.57	9.10	15.51	12.20
Total	27271.28		2854.65	10.47	3323.33	12.19

Table A.2. (Ages 45-54)

County	All Ages		45-49		50-54	
	Total VMT (Million)		VMT	Percent	VMT	Percent
Adair	76.25		8.95	11.74	7.52	9.86
Adams	43.40		4.93	11.35	4.23	9.75
Allamakee	132.37		15.32	11.57	13.45	10.16
Appanoose	125.89		15.13	12.02	12.33	9.79
Audubon	63.13		7.36	11.66	5.91	9.35
Benton	233.56		26.55	11.37	22.47	9.62
Black Hawk	1151.64		135.47	11.76	122.16	10.61
Boone	239.13		29.24	12.23	24.83	10.39
Bremer	217.78		24.59	11.29	22.98	10.55
Buchanan	185.39		21.50	11.60	19.05	10.27
Buena Vista	181.08		22.46	12.40	18.28	10.09
Butler	145.63		17.30	11.88	15.61	10.72
Calhoun	97.97		12.87	13.13	10.32	10.53
Carroll	204.77		24.45	11.94	19.14	9.35
Cass	138.40		16.17	11.68	14.68	10.61
Cedar	167.13		20.18	12.07	18.41	11.02
Cerro Gordo	426.65		50.81	11.91	46.93	11.00
Cherokee	121.22		15.59	12.86	13.05	10.77
Chickasaw	125.38		14.49	11.56	12.17	9.70

County	All Ages	45-49		50-54	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Clarke	86.93	9.98	11.48	8.72	10.03
Clay	166.63	21.48	12.89	17.21	10.33
Clayton	174.45	21.85	12.52	17.42	9.99
Clinton	460.77	53.63	11.64	46.98	10.19
Crawford	153.07	17.67	11.55	14.93	9.76
Dallas	349.50	42.96	12.29	35.42	10.13
Davis	71.12	8.40	11.81	7.62	10.72
Decatur	70.78	8.11	11.46	7.52	10.62
Delaware	174.93	20.53	11.74	16.16	9.24
Des Moines	391.02	44.98	11.50	43.90	11.23
Dickinson	161.07	18.94	11.76	18.46	11.46
Dubuque	827.21	97.11	11.74	85.99	10.39
Emmet	100.94	12.15	12.03	10.94	10.83
Fayette	197.72	24.02	12.15	19.73	9.98
Floyd	154.22	16.86	10.93	16.90	10.96
Franklin	100.18	12.94	12.92	9.98	9.96
Fremont	74.98	9.00	12.00	8.38	11.17
Greene	95.27	11.00	11.55	9.84	10.33
Grundy	112.38	14.15	12.59	11.48	10.22
Guthrie	105.03	11.98	11.41	10.64	10.13
Hamilton	149.14	17.03	11.42	14.80	9.92
Hancock	112.97	13.59	12.03	12.00	10.62
Hardin	172.18	20.44	11.87	17.24	10.01
Harrison	150.32	16.85	11.21	14.86	9.89
Henry	185.54	20.98	11.31	20.01	10.78
Howard	92.36	10.40	11.26	8.36	9.05
Humboldt	96.02	11.80	12.29	9.71	10.11
Ida	73.08	8.90	12.19	7.34	10.05
Iowa	150.36	18.53	12.32	14.47	9.63
Jackson	189.97	22.14	11.65	18.35	9.66
Jasper	341.76	40.04	11.72	36.19	10.59
Jefferson	158.62	23.26	14.66	26.31	16.59
Johnson	1021.14	110.30	10.80	96.33	9.43
Jones	176.61	20.75	11.75	18.51	10.48
Keokuk	104.35	12.79	12.26	9.74	9.33
Kossuth	165.04	19.94	12.08	16.93	10.26
Lee	341.79	41.25	12.07	37.21	10.89
Linn	1883.24	214.20	11.37	185.92	9.87
Louisa	105.42	12.07	11.45	10.40	9.87
Lucas	86.05	9.39	10.92	8.38	9.74
Lyon	108.68	13.30	12.23	9.87	9.08
Madison	132.91	16.34	12.29	13.73	10.33
Mahaska	202.54	23.16	11.44	21.00	10.37
Marion	300.40	35.05	11.67	29.59	9.85
Marshall	356.26	41.57	11.67	39.78	11.17
Mills	138.79	17.53	12.63	16.00	11.53
Mitchell	100.02	11.77	11.76	9.53	9.53
Monona	88.95	10.27	11.54	8.91	10.02

County	All Ages	45-49		50-54	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Monroe	73.83	8.29	11.23	7.41	10.04
Montgomery	110.06	13.13	11.93	11.81	10.73
Muscatine	391.81	46.33	11.82	40.33	10.29
O'Brien	140.12	17.32	12.36	13.39	9.56
Osceola	65.74	8.19	12.45	5.45	8.28
Page	147.81	18.25	12.35	15.91	10.76
Palo Alto	90.42	10.16	11.24	9.00	9.95
Plymouth	227.92	28.03	12.30	23.09	10.13
Pocahontas	79.79	9.91	12.43	8.38	10.50
Polk	3736.10	417.20	11.17	362.67	9.71
Pottawattamie	834.54	99.48	11.92	86.68	10.39
Poweshiek	170.85	20.13	11.79	17.57	10.28
Ringgold	48.67	5.16	10.59	4.75	9.76
Sac	106.01	12.56	11.85	10.86	10.25
Scott	1520.08	180.86	11.90	158.67	10.44
Shelby	121.94	15.12	12.40	11.91	9.77
Sioux	278.01	32.27	11.61	26.52	9.54
Story	719.94	75.51	10.49	63.42	8.81
Tama	161.53	19.08	11.81	16.09	9.96
Taylor	62.91	6.76	10.75	6.42	10.21
Union	116.67	12.76	10.94	12.58	10.78
Van Buren	68.68	8.12	11.83	7.49	10.90
Wapello	319.02	39.69	12.44	33.79	10.59
Warren	373.14	45.18	12.11	38.98	10.45
Washington	186.70	22.75	12.19	18.75	10.04
Wayne	59.39	7.05	11.88	5.64	9.49
Webster	353.94	42.67	12.06	35.86	10.13
Winnebago	112.21	14.37	12.80	12.02	10.71
Winneshiek	189.71	23.12	12.19	18.57	9.79
Woodbury	912.51	104.24	11.42	92.35	10.12
Worth	74.63	9.55	12.79	7.52	10.07
Wright	127.13	15.74	12.38	13.01	10.23
Total	27271.28	3183.69	11.67	2770.12	10.16

Table A.2. (Ages 55-64)

County	All Ages	55-59		60-64	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Adair	76.25	5.48	7.19	4.59	6.02
Adams	43.40	3.30	7.60	3.08	7.10
Allamakee	132.37	10.10	7.63	8.33	6.29
Appanoose	125.89	10.39	8.25	7.98	6.34
Audubon	63.13	4.93	7.81	3.88	6.15
Benton	233.56	16.17	6.92	11.87	5.08
Black Hawk	1151.64	84.31	7.32	57.34	4.98
Boone	239.13	17.73	7.41	12.67	5.30
Bremer	217.78	18.21	8.36	13.51	6.20
Buchanan	185.39	13.63	7.35	10.49	5.66

County	All Ages	55-59		60-64	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Buena Vista	181.08	11.58	6.39	7.89	4.36
Butler	145.63	12.14	8.34	8.35	5.74
Calhoun	97.97	7.54	7.70	5.69	5.81
Carroll	204.77	12.22	5.97	10.53	5.14
Cass	138.40	10.79	7.79	8.30	5.99
Cedar	167.13	12.48	7.46	8.91	5.33
Cerro Gordo	426.65	31.87	7.47	23.00	5.39
Cherokee	121.22	9.18	7.57	7.04	5.81
Chickasaw	125.38	9.62	7.67	7.34	5.85
Clarke	86.93	6.35	7.31	4.57	5.25
Clay	166.63	11.79	7.08	8.35	5.01
Clayton	174.45	13.23	7.58	9.72	5.57
Clinton	460.77	35.39	7.68	26.15	5.67
Crawford	153.07	12.52	8.18	8.46	5.53
Dallas	349.50	24.48	7.00	16.08	4.60
Davis	71.12	5.27	7.40	4.61	6.49
Decatur	70.78	5.52	7.80	4.47	6.32
Delaware	174.93	11.04	6.31	9.46	5.41
Des Moines	391.02	32.94	8.42	22.87	5.85
Dickinson	161.07	13.27	8.24	9.72	6.04
Dubuque	827.21	58.18	7.03	43.51	5.26
Emmet	100.94	7.10	7.04	5.95	5.89
Fayette	197.72	14.54	7.35	11.71	5.92
Floyd	154.22	12.40	8.04	9.91	6.43
Franklin	100.18	8.19	8.17	5.99	5.98
Fremont	74.98	5.88	7.85	4.17	5.56
Greene	95.27	6.99	7.34	5.51	5.78
Grundy	112.38	9.13	8.12	6.90	6.14
Guthrie	105.03	8.76	8.34	6.40	6.09
Hamilton	149.14	11.34	7.60	8.19	5.49
Hancock	112.97	8.36	7.40	6.25	5.54
Hardin	172.18	12.84	7.46	10.33	6.00
Harrison	150.32	10.80	7.19	8.37	5.57
Henry	185.54	14.49	7.81	9.46	5.10
Howard	92.36	6.66	7.21	5.09	5.51
Humboldt	96.02	6.73	7.01	5.92	6.17
Ida	73.08	5.37	7.35	3.81	5.22
Iowa	150.36	9.72	6.46	7.95	5.29
Jackson	189.97	14.90	7.84	10.57	5.57
Jasper	341.76	26.44	7.74	18.36	5.37
Jefferson	158.62	14.06	8.86	7.01	4.42
Johnson	1021.14	61.72	6.04	35.59	3.49
Jones	176.61	13.72	7.77	10.02	5.67
Keokuk	104.35	7.66	7.35	5.79	5.55
Kossuth	165.04	11.59	7.02	9.71	5.88
Lee	341.79	28.88	8.45	20.10	5.88
Linn	1883.24	133.91	7.11	87.64	4.65
Louisa	105.42	7.46	7.08	5.48	5.19

County	All Ages	55-59		60-64	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Lucas	86.05	6.90	8.02	5.48	6.36
Lyon	108.68	7.36	6.77	5.38	4.95
Madison	132.91	9.93	7.47	7.41	5.58
Mahaska	202.54	14.18	7.00	10.16	5.02
Marion	300.40	21.39	7.12	15.68	5.22
Marshall	356.26	28.66	8.05	20.63	5.79
Mills	138.79	11.18	8.05	7.09	5.11
Mitchell	100.02	7.22	7.22	5.94	5.93
Monona	88.95	7.20	8.09	6.03	6.78
Monroe	73.83	6.03	8.17	4.25	5.75
Montgomery	110.06	8.13	7.39	6.38	5.80
Muscatine	391.81	30.00	7.66	19.58	5.00
O'Brien	140.12	9.35	6.67	7.15	5.10
Osceola	65.74	5.00	7.60	3.48	5.30
Page	147.81	12.18	8.24	7.95	5.38
Palo Alto	90.42	6.24	6.91	4.91	5.43
Plymouth	227.92	15.70	6.89	10.75	4.72
Pocahontas	79.79	6.24	7.83	4.90	6.14
Polk	3736.10	253.47	6.78	159.52	4.27
Pottawattamie	834.54	62.46	7.48	42.15	5.05
Poweshiek	170.85	13.60	7.96	10.54	6.17
Ringgold	48.67	4.18	8.59	3.13	6.43
Sac	106.01	7.77	7.33	6.22	5.87
Scott	1520.08	114.68	7.54	72.63	4.78
Shelby	121.94	8.96	7.35	6.61	5.42
Sioux	278.01	16.76	6.03	13.59	4.89
Story	719.94	42.57	5.91	28.27	3.93
Tama	161.53	12.57	7.78	9.86	6.11
Taylor	62.91	4.82	7.67	3.67	5.83
Union	116.67	9.23	7.91	6.57	5.63
Van Buren	68.68	5.16	7.51	4.53	6.60
Wapello	319.02	24.40	7.65	18.33	5.74
Warren	373.14	29.90	8.01	19.78	5.30
Washington	186.70	13.86	7.42	9.64	5.16
Wayne	59.39	4.60	7.74	3.91	6.58
Webster	353.94	26.14	7.39	18.41	5.20
Winnebago	112.21	7.95	7.08	5.82	5.18
Winneshiek	189.71	12.61	6.65	10.30	5.43
Woodbury	912.51	60.92	6.68	41.28	4.52
Worth	74.63	5.45	7.31	4.24	5.68
Wright	127.13	9.63	7.58	7.85	6.17
Total	27271.28	1975.86	7.25	1380.92	5.06

Table A.2. (Ages 65-74)

County	All Ages	65-69		70-74	
	Total VMT (million)	VMT	Percent	VMT	Percent
Adair	76.25	3.44	4.51	2.63	3.46
Adams	43.40	1.99	4.58	1.33	3.06
Allamakee	132.37	5.69	4.30	4.04	3.05
Appanoose	125.89	5.28	4.19	4.00	3.18
Audubon	63.13	2.89	4.58	2.36	3.74
Benton	233.56	8.07	3.46	5.93	2.54
Black Hawk	1151.64	37.07	3.22	27.82	2.42
Boone	239.13	8.63	3.61	6.76	2.83
Bremer	217.78	8.41	3.86	5.95	2.73
Buchanan	185.39	7.03	3.79	4.73	2.55
Buena Vista	181.08	5.97	3.29	5.40	2.98
Butler	145.63	5.95	4.08	4.75	3.26
Calhoun	97.97	4.86	4.96	3.61	3.68
Carroll	204.77	7.08	3.46	6.45	3.15
Cass	138.40	5.93	4.28	4.39	3.17
Cedar	167.13	6.08	3.64	4.47	2.67
Cerro Gordo	426.65	16.02	3.76	13.78	3.23
Cherokee	121.22	5.61	4.63	4.69	3.87
Chickasaw	125.38	5.03	4.01	3.93	3.13
Clarke	86.93	3.11	3.58	2.56	2.94
Clay	166.63	6.21	3.73	4.75	2.85
Clayton	174.45	7.53	4.32	5.66	3.25
Clinton	460.77	16.68	3.62	12.25	2.66
Crawford	153.07	5.79	3.78	4.49	2.93
Dallas	349.50	10.34	2.96	7.20	2.06
Davis	71.12	3.07	4.32	2.12	2.98
Decatur	70.78	3.34	4.72	2.49	3.52
Delaware	174.93	6.20	3.55	4.64	2.65
Des Moines	391.02	13.85	3.54	10.68	2.73
Dickinson	161.07	7.42	4.61	5.95	3.69
Dubuque	827.21	27.84	3.37	20.95	2.53
Emmet	100.94	4.14	4.10	3.08	3.05
Fayette	197.72	8.35	4.23	6.40	3.24
Floyd	154.22	6.41	4.15	4.64	3.01
Franklin	100.18	4.45	4.44	3.56	3.56
Fremont	74.98	3.22	4.30	2.38	3.17
Greene	95.27	3.88	4.07	3.35	3.52
Grundy	112.38	4.70	4.18	3.64	3.24
Guthrie	105.03	5.22	4.97	3.71	3.53
Hamilton	149.14	6.15	4.12	4.87	3.27
Hancock	112.97	4.44	3.93	3.39	3.00
Hardin	172.18	7.02	4.08	5.96	3.46
Harrison	150.32	5.57	3.71	4.10	2.73
Henry	185.54	5.74	3.09	4.65	2.51
Howard	92.36	3.51	3.80	2.92	3.16
Humboldt	96.02	4.19	4.36	3.59	3.74

County	All Ages	65-69		70-74	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Ida	73.08	3.29	4.51	2.57	3.52
Iowa	150.36	5.65	3.75	4.24	2.82
Jackson	189.97	7.62	4.01	5.99	3.16
Jasper	341.76	13.02	3.81	10.12	2.96
Jefferson	158.62	4.46	2.81	3.32	2.09
Johnson	1021.14	20.90	2.05	13.93	1.36
Jones	176.61	6.99	3.96	5.18	2.93
Keokuk	104.35	4.36	4.17	3.53	3.39
Kossuth	165.04	8.00	4.85	5.52	3.34
Lee	341.79	12.18	3.56	9.44	2.76
Linn	1883.24	56.75	3.01	38.35	2.04
Louisa	105.42	3.69	3.50	2.75	2.61
Lucas	86.05	3.62	4.21	2.86	3.33
Lyon	108.68	4.41	4.06	3.53	3.24
Madison	132.91	4.46	3.35	3.16	2.37
Mahaska	202.54	6.92	3.42	5.40	2.67
Marion	300.40	10.39	3.46	7.52	2.50
Marshall	356.26	12.63	3.54	9.94	2.79
Mills	138.79	4.51	3.25	2.88	2.07
Mitchell	100.02	4.28	4.28	3.58	3.58
Monona	88.95	4.09	4.60	3.44	3.87
Monroe	73.83	2.74	3.71	2.36	3.19
Montgomery	110.06	3.93	3.57	3.95	3.59
Muscatine	391.81	12.02	3.07	8.37	2.14
O'Brien	140.12	6.27	4.47	5.00	3.57
Osceola	65.74	2.70	4.11	2.27	3.45
Page	147.81	6.16	4.17	5.27	3.57
Palo Alto	90.42	4.47	4.94	3.40	3.76
Plymouth	227.92	7.79	3.42	6.56	2.88
Pocahontas	79.79	3.69	4.62	2.70	3.38
Polk	3736.10	94.69	2.53	66.92	1.79
Pottawattamie	834.54	27.90	3.34	20.50	2.46
Poweshiek	170.85	6.99	4.09	5.04	2.95
Ringgold	48.67	2.63	5.40	1.96	4.03
Sac	106.01	4.81	4.54	3.87	3.65
Scott	1520.08	44.23	2.91	29.69	1.95
Shelby	121.94	5.24	4.30	4.08	3.34
Sioux	278.01	9.63	3.47	7.85	2.82
Story	719.94	18.20	2.53	13.11	1.82
Tama	161.53	6.62	4.10	4.99	3.09
Taylor	62.91	2.78	4.42	2.22	3.53
Union	116.67	4.76	4.08	3.62	3.10
Van Buren	68.68	3.38	4.92	2.08	3.02
Wapello	319.02	12.78	4.01	9.67	3.03
Warren	373.14	12.20	3.27	7.85	2.10
Washington	186.70	6.70	3.59	5.32	2.85
Wayne	59.39	2.85	4.81	2.25	3.79
Webster	353.94	13.85	3.91	10.66	3.01

County	All Ages	65-69		70-74	
	Total VMT (Million)	VMT	Percent	VMT	Percent
Winnebago	112.21	4.14	3.69	3.48	3.10
Winneshiek	189.71	7.00	3.69	5.21	2.75
Woodbury	912.51	26.93	2.95	20.82	2.28
Worth	74.63	3.03	4.06	2.10	2.81
Wright	127.13	5.31	4.17	4.47	3.52
Total	27271.28	918.02	3.37	685.84	2.51

Table A.2. (Ages 75+)

County	All Ages	75-79		80-84		85+	
	Total VMT (Million)	VMT	Percent	VMT	Percent	VMT	Percent
Adair	76.25	2.00	2.62	1.28	1.67	0.73	0.96
Adams	43.40	1.17	2.71	0.77	1.76	0.44	1.02
Allamakee	132.37	2.88	2.18	1.75	1.32	0.77	0.58
Appanoose	125.89	3.08	2.45	1.79	1.42	0.96	0.76
Audubon	63.13	1.88	2.98	1.19	1.89	0.66	1.05
Benton	233.56	4.30	1.84	2.69	1.15	1.36	0.58
Black Hawk	1151.64	20.46	1.78	11.27	0.98	4.75	0.41
Boone	239.13	4.61	1.93	2.65	1.11	1.21	0.50
Bremer	217.78	4.13	1.90	3.07	1.41	1.49	0.68
Buchanan	185.39	3.58	1.93	2.04	1.10	0.95	0.51
Buena Vista	181.08	4.37	2.41	2.46	1.36	1.26	0.70
Butler	145.63	3.66	2.52	2.39	1.64	1.14	0.79
Calhoun	97.97	2.76	2.82	2.02	2.06	1.00	1.02
Carroll	204.77	4.76	2.32	2.85	1.39	1.31	0.64
Cass	138.40	3.53	2.55	2.10	1.52	0.91	0.66
Cedar	167.13	3.29	1.97	2.11	1.26	1.02	0.61
Cerro Gordo	426.65	9.69	2.27	5.21	1.22	2.37	0.55
Cherokee	121.22	3.06	2.53	1.86	1.54	0.83	0.69
Chickasaw	125.38	2.87	2.29	1.63	1.30	0.89	0.71
Clarke	86.93	1.75	2.02	0.97	1.11	0.49	0.57
Clay	166.63	3.65	2.19	2.31	1.39	1.12	0.67
Clayton	174.45	3.88	2.22	2.15	1.23	1.12	0.64
Clinton	460.77	9.13	1.98	5.34	1.16	2.17	0.47
Crawford	153.07	3.35	2.19	2.08	1.36	0.82	0.54
Dallas	349.50	5.33	1.52	3.01	0.86	1.53	0.44
Davis	71.12	1.56	2.19	0.81	1.14	0.51	0.72
Decatur	70.78	1.65	2.33	0.88	1.25	0.45	0.64
Delaware	174.93	3.61	2.06	1.82	1.04	0.85	0.49
Des Moines	391.02	8.30	2.12	4.67	1.19	1.98	0.51
Dickinson	161.07	4.30	2.67	2.26	1.40	1.09	0.68
Dubuque	827.21	13.94	1.69	7.30	0.88	2.69	0.33
Emmet	100.94	2.69	2.66	1.58	1.57	0.73	0.72
Fayette	197.72	4.84	2.45	2.85	1.44	1.48	0.75
Floyd	154.22	3.60	2.33	2.40	1.55	1.21	0.78
Franklin	100.18	2.79	2.79	1.64	1.64	0.79	0.79
Fremont	74.98	1.73	2.31	1.12	1.49	0.44	0.59
Greene	95.27	2.84	2.98	1.64	1.72	0.98	1.03

County	All Ages	75-79		80-84		85+	
	Total VMT (Million)	VMT	Percent	VMT	Percent	VMT	Percent
Hamilton	149.14	3.43	2.30	2.19	1.47	1.10	0.74
Hancock	112.97	2.73	2.42	1.59	1.41	0.99	0.88
Grundy	112.38	2.74	2.44	2.02	1.80	0.96	0.85
Guthrie	105.03	2.55	2.43	1.50	1.43	0.72	0.68
Hardin	172.18	4.49	2.61	3.00	1.74	1.50	0.87
Harrison	150.32	3.08	2.05	1.78	1.19	0.90	0.60
Henry	185.54	3.62	1.95	2.10	1.13	1.06	0.57
Howard	92.36	2.30	2.49	1.52	1.65	0.74	0.80
Humboldt	96.02	2.52	2.63	1.61	1.68	0.81	0.84
Ida	73.08	2.22	3.04	1.23	1.69	0.55	0.75
Iowa	150.36	2.95	1.96	1.96	1.30	0.82	0.55
Jackson	189.97	3.73	1.96	2.20	1.16	1.03	0.54
Jasper	341.76	6.68	1.95	3.93	1.15	1.62	0.48
Jefferson	158.62	2.50	1.58	1.43	0.90	0.74	0.47
Johnson	1021.14	9.33	0.91	4.83	0.47	1.94	0.19
Jones	176.61	3.65	2.07	2.21	1.25	0.99	0.56
Keokuk	104.35	2.64	2.53	1.68	1.61	0.82	0.79
Kossuth	165.04	4.28	2.59	2.40	1.46	1.29	0.78
Lee	341.79	7.02	2.05	4.06	1.19	1.59	0.46
Linn	1883.24	27.05	1.44	14.80	0.79	6.11	0.32
Louisa	105.42	1.79	1.70	1.07	1.01	0.62	0.59
Lucas	86.05	1.96	2.28	1.18	1.37	0.68	0.79
Lyon	108.68	2.49	2.29	1.71	1.58	0.74	0.68
Madison	132.91	2.01	1.51	1.44	1.09	0.69	0.52
Mahaska	202.54	4.35	2.15	2.56	1.27	1.19	0.59
Marion	300.40	5.61	1.87	3.28	1.09	1.78	0.59
Marshall	356.26	6.90	1.94	4.24	1.19	1.83	0.51
Mills	138.79	2.07	1.49	1.18	0.85	0.55	0.40
Mitchell	100.02	2.87	2.87	1.74	1.74	0.85	0.85
Monona	88.95	2.51	2.82	1.56	1.75	0.81	0.91
Monroe	73.83	1.87	2.53	1.03	1.40	0.46	0.63
Montgomery	110.06	2.46	2.24	1.78	1.61	0.73	0.66
Muscatine	391.81	6.11	1.56	3.11	0.79	1.50	0.38
O'Brien	140.12	3.59	2.56	2.34	1.67	1.23	0.88
Osceola	65.74	1.63	2.48	1.01	1.54	0.44	0.68
Page	147.81	3.72	2.52	2.48	1.67	1.13	0.76
Palo Alto	90.42	2.45	2.71	1.50	1.66	0.84	0.93
Plymouth	227.92	4.50	1.97	2.93	1.29	1.30	0.57
Pocahontas	79.79	2.39	3.00	1.63	2.04	0.73	0.92
Polk	3736.10	45.34	1.21	23.80	0.64	9.48	0.25
Pottawattamie	834.54	14.13	1.69	6.72	0.81	2.56	0.31
Poweshiek	170.85	3.78	2.21	2.41	1.41	1.14	0.67
Ringgold	48.67	1.49	3.06	0.84	1.73	0.48	0.99
Sac	106.01	3.02	2.85	2.02	1.91	1.07	1.01
Scott	1520.08	21.73	1.43	11.13	0.73	4.53	0.30
Shelby	121.94	3.39	2.78	2.04	1.67	0.92	0.75
Sioux	278.01	6.05	2.18	3.67	1.32	1.66	0.60
Story	719.94	9.24	1.28	5.46	0.76	2.67	0.37

County	All Ages	75-79		80-84		85+	
	Total VMT (Million)	VMT	Percent	VMT	Percent	VMT	Percent
Tama	161.53	3.79	2.34	2.24	1.39	1.21	0.75
Taylor	62.91	1.69	2.69	1.12	1.78	0.62	0.99
Union	116.67	2.60	2.23	1.85	1.58	0.79	0.68
Van Buren	68.68	1.73	2.52	1.00	1.46	0.61	0.89
Wapello	319.02	6.88	2.16	3.90	1.22	1.82	0.57
Warren	373.14	5.21	1.39	2.94	0.79	1.23	0.33
Washington	186.70	3.90	2.09	2.73	1.46	1.31	0.70
Wayne	59.39	1.89	3.18	1.10	1.86	0.71	1.19
Webster	353.94	7.86	2.22	4.65	1.31	1.97	0.56
Winnebago	112.21	2.43	2.16	1.70	1.51	0.86	0.77
Winneshiek	189.71	4.17	2.20	2.21	1.17	1.12	0.59
Woodbury	912.51	14.98	1.64	8.19	0.90	3.36	0.37
Worth	74.63	1.82	2.44	1.13	1.51	0.55	0.74
Wright	127.13	3.62	2.85	2.36	1.86	1.33	1.05
Total	27271.28	496.55	1.82	287.01	1.05	130.89	0.48

Appendix B - Ranking of Iowa Counties

Table B1. Ranking of Iowa Counties Based on the Combinations of Both Older and Younger Drivers

County	Total All Drivers	65 & Over		16 to 19		YO Drivers	
		Total	Percent	Total	Percent	Percent	Total
Ringgold	4,058	1227	30.2	300	7.4	37.6	1,527
Audubon	5,276	1535	29.1	445	8.4	37.5	1,980
Pocahontas	6,669	1925	28.9	575	8.6	37.5	2,500
Wayne	4,974	1472	29.6	391	7.9	37.5	1,863
Ida	6,047	1697	28.1	532	8.8	36.9	2,229
Palo Alto	7,467	2135	28.6	610	8.2	36.8	2,745
Calhoun	8,153	2379	29.2	604	7.4	36.6	2,983
Greene	7,869	2222	28.2	642	8.2	36.4	2,864
Sac	8,779	2516	28.7	664	7.6	36.2	3,180
Kossuth	13,600	3715	27.3	1,195	8.8	36.1	4,910
O'Brien	11,515	3165	27.5	965	8.4	35.9	4,130
Mitchell	8,239	2296	27.9	652	7.9	35.8	2,948
Humboldt	7,878	2180	27.7	622	7.9	35.6	2,802
Monona	7,317	2059	28.1	526	7.2	35.3	2,585
Adair	6,243	1721	27.6	482	7.7	35.3	2,203
Shelby	9,940	2720	27.4	786	7.9	35.3	3,506
Taylor	5,164	1429	27.7	377	7.3	35.0	1,806
Franklin	8,220	2238	27.2	622	7.6	34.8	2,860
Adams	3,574	970	27.1	269	7.5	34.7	1,239
Wright	10,450	2895	27.7	720	6.9	34.6	3,615
Hardin	14,047	3795	27.0	1,048	7.5	34.5	4,843
Carroll	16,530	4106	24.8	1,574	9.5	34.4	5,680
Cherokee	9,886	2688	27.2	706	7.1	34.3	3,394
Van Buren	5,601	1493	26.7	420	7.5	34.2	1,913
Howard	7,503	1933	25.8	615	8.2	34.0	2,548
Grundy	9,164	2442	26.6	665	7.3	33.9	3,107
Lyon	8,830	2261	25.6	732	8.3	33.9	2,993
Osceola	5,335	1370	25.7	438	8.2	33.9	1,808
Hancock	9,158	2316	25.3	743	8.1	33.4	3,059
Guthrie	8,526	2249	26.4	595	7.0	33.4	2,844
Keokuk	8,449	2212	26.2	605	7.2	33.3	2,817
Fayette	15,978	4085	25.6	1,230	7.7	33.3	5,315
Winnebago	9,045	2248	24.9	748	8.3	33.1	2,996
Butler	11,803	3052	25.9	851	7.2	33.1	3,903
Chickasaw	10,114	2510	24.8	813	8.0	32.9	3,323
Cass	11,185	2842	25.4	823	7.4	32.8	3,665
Page	11,973	3121	26.1	796	6.6	32.7	3,917
Emmet	8,144	2079	25.5	582	7.2	32.7	2,661
Sioux	22,286	5244	23.5	2,030	9.1	32.6	7,274
Decatur	5,714	1454	25.4	408	7.1	32.6	1,862
Clayton	13,975	3458	24.7	1,083	7.8	32.5	4,541
Dickinson	13,012	3421	26.3	801	6.2	32.5	4,222
Floyd	12,458	3122	25.1	913	7.3	32.4	4,035
Monroe	5,941	1466	24.7	457	7.7	32.4	1,923
Allamakee	10,626	2578	24.3	853	8.0	32.3	3,431
Crawford	12,269	2925	23.8	1,029	8.4	32.2	3,954

County	Total All Drivers	65 & Over		16 to 19		YO Drivers	
		Total	Percent	Total	Percent	Percent	Total
Hamilton	11,961	3017	25.2	827	6.9	32.1	3,844
Fremont	6,020	1482	24.6	447	7.4	32.0	1,929
Montgomery	8,837	2202	24.9	628	7.1	32.0	2,830
Tama	12,971	3227	24.9	925	7.1	32.0	4,152
Lucas	6,932	1744	25.2	467	6.7	31.9	2,211
Buena Vista	14,412	3482	24.2	1,096	7.6	31.8	4,578
Jackson	15,151	3583	23.6	1,227	8.1	31.7	4,810
Delaware	13,860	3128	22.6	1,272	9.2	31.7	4,400
Worth	5,966	1476	24.7	412	6.9	31.6	1,888
Davis	5,687	1378	24.2	419	7.4	31.6	1,797
Plymouth	18,099	4153	22.9	1,565	8.6	31.6	5,718
Winneshiek	15,075	3502	23.2	1,253	8.3	31.5	4,755
Appanoose	10,114	2519	24.9	666	6.6	31.5	3,185
Poweshiek	13,654	3316	24.3	965	7.1	31.4	4,281
Webster	28,160	6712	23.8	2,089	7.4	31.3	8,801
Union	9,321	2280	24.5	598	6.4	30.9	2,878
Harrison	11,890	2738	23.0	930	7.8	30.8	3,668
Clarke	6,887	1566	22.7	553	8.0	30.8	2,119
Clay	13,268	3115	23.5	966	7.3	30.8	4,081
Bremer	17,411	4004	23.0	1,344	7.7	30.7	5,348
Jones	14,008	3250	23.2	1,009	7.2	30.4	4,259
Cerro Gordo	33,778	7971	23.6	2,273	6.7	30.3	10,244
Buchanan	14,639	3238	22.1	1,197	8.2	30.3	4,435
Mahaska	15,948	3620	22.7	1,196	7.5	30.2	4,816
Washington	14,791	3438	23.2	1,020	6.9	30.1	4,458
Benton	18,351	4016	21.9	1,463	8.0	29.9	5,479
Iowa	11,873	2682	22.6	862	7.3	29.9	3,544
Cedar	13,166	2974	22.6	921	7.0	29.6	3,895
Marion	23,633	5126	21.7	1,864	7.9	29.6	6,990
Lee	26,873	5906	22.0	1,915	7.1	29.1	7,821
Jasper	26,865	6000	22.3	1,813	6.8	29.1	7,813
Clinton	36,152	7877	21.8	2,610	7.2	29.0	10,487
Henry	14,534	3098	21.3	1,114	7.7	29.0	4,212
Wapello	25,127	5794	23.1	1,482	5.9	29.0	7,276
Boone	18,790	4096	21.8	1,306	7.0	28.7	5,402
Marshall	28,002	6126	21.9	1,904	6.8	28.7	8,030
Des Moines	30,702	6723	21.9	2,018	6.6	28.5	8,741
Madison	10,355	2131	20.6	808	7.8	28.4	2,939
Louisa	8,222	1745	21.2	560	6.8	28.0	2,305
Mills	10,680	2089	19.6	829	7.8	27.3	2,918
Dubuque	63,926	12731	19.9	4,683	7.3	27.2	17,414
Dallas	26,854	5070	18.9	2,046	7.6	26.5	7,116
Black Hawk	88,676	17543	19.8	5,645	6.4	26.1	23,188
Warren	28,703	5300	18.5	2,171	7.6	26.0	7,471
Woodbury	69,725	13294	19.1	4,817	6.9	26.0	18,111
Pottawattamie	63,958	12337	19.3	4,237	6.6	25.9	16,574
Jefferson	12,224	2262	18.5	875	7.2	25.7	3,137
Muscatine	29,919	5509	18.4	1,974	6.6	25.0	7,483

County	Total All Drivers	65 & Over		16 to 19		YO Drivers	
		Total	Percent	Total	Percent	Percent	Total
Scott	115,004	19952	17.3	7,892	6.9	24.2	27,844
Linn	142,375	24968	17.5	8,884	6.2	23.8	33,852
Story	54,101	8887	16.4	3,433	6.3	22.8	12,320
Polk	277,695	42965	15.5	16,320	5.9	21.3	59,285
Johnson	74,495	9562	12.8	4,191	5.6	18.5	13,753
Total	**2,118,809**	**439871**	**20.8**	**147,523**	**7.0**	**27.7**	**587,394**

Appendix C - Results of Overrepresentation in 2-Vehicle Crashes in all 99 Iowa Counties for All Age Group Combinations (2000 data)

Over-representation in 2-Vehicle Crashes by County and Age Group (2000)

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Adair	Y-Y	6	0.32	17.82	4.17	0.44
	Y-M	32	9.92	2.23	31.10	0.03
	Y-O	0	1.61	-1.00	4.55	-1.00
	M-M	58	77.12	-0.25	57.97	0.00
	M-O	16	25.01	-0.36	16.97	-0.06
	O-O	4	2.03	0.97	1.24	2.22
	TOTAL	116	116.00		116.00	
Adams	Y-Y	0	0.14	-1.00	0.67	-1.00
	Y-M	10	4.54	1.20	8.67	0.15
	Y-O	2	0.73	1.74	2.00	0.00
	M-M	30	36.06	-0.17	28.17	0.07
	M-O	8	11.59	-0.31	13.00	-0.38
	O-O	4	0.93	3.30	1.50	1.67
	TOTAL	54	54.00		54.00	
Allamakee	Y-Y	10	0.61	15.34	9.46	0.06
	Y-M	60	19.05	2.15	55.09	0.09
	Y-O	10	2.62	2.82	15.98	-0.37
	M-M	78	148.21	-0.47	80.19	-0.03
	M-O	46	40.72	0.13	46.52	-0.01
	O-O	10	2.80	2.58	6.75	0.48
	TOTAL	214	214.00		214.00	
Appanoose	Y-Y	18	0.48	36.31	10.00	0.80
	Y-M	44	18.36	1.40	61.60	-0.29
	Y-O	20	2.64	6.58	18.40	0.09
	M-M	102	174.72	-0.42	94.86	0.08
	M-O	60	50.19	0.20	56.67	0.06
	O-O	6	3.60	0.66	8.46	-0.29
	TOTAL	250	250.00		250.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Audubon	Y-Y	2	0.25	6.90	3.46	-0.42
	Y-M	26	6.92	2.76	21.19	0.23
	Y-O	2	1.23	0.62	3.89	-0.49
	M-M	30	47.25	-0.37	32.45	-0.08
	M-O	12	16.84	-0.29	11.92	0.01
	O-O	2	1.50	0.33	1.09	0.83
	TOTAL	74	74.00		74.00	
Benton	Y-Y	20	0.81	23.82	16.92	0.18
	Y-M	88	26.42	2.33	88.63	-0.01
	Y-O	14	2.96	3.72	19.54	-0.28
	M-M	114	216.50	-0.47	116.09	-0.02
	M-O	56	48.59	0.15	51.18	0.09
	O-O	6	2.73	1.20	5.64	0.06
	TOTAL	298	298.00		298.00	
Black Hawk	Y-Y	142	5.39	25.37	98.80	0.44
	Y-M	764	230.68	2.31	812.69	-0.06
	Y-O	86	23.30	2.69	123.72	-0.30
	M-M	1694	2470.29	-0.31	1671.24	0.01
	M-O	512	499.13	0.03	508.83	0.01
	O-O	56	25.21	1.22	38.73	0.45
	TOTAL	3254	3254.00		3254.00	
Boone	Y-Y	34	1.05	31.45	22.45	0.51
	Y-M	124	39.53	2.14	136.79	-0.09
	Y-O	22	4.61	3.77	32.31	-0.32
	M-M	212	372.74	-0.43	208.38	0.02
	M-O	104	87.00	0.20	98.44	0.06
	O-O	14	5.08	1.76	11.63	0.20
	TOTAL	510	510.00		510.00	
Bremer	Y-Y	26	0.93	26.82	15.80	0.65
	Y-M	88	30.75	1.86	101.54	-0.13
	Y-O	10	3.86	1.59	16.85	-0.41
	M-M	168	252.95	-0.34	163.15	0.03
	M-O	58	63.52	-0.09	54.16	0.07
	O-O	6	3.99	0.50	4.49	0.34
	TOTAL	356	356.00		356.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Buchanan	Y-Y	24	1.02	22.46	17.09	0.40
	Y-M	94	32.35	1.91	106.04	-0.11
	Y-O	14	3.77	2.71	15.78	-0.11
	M-M	168	255.71	-0.34	164.51	0.02
	M-O	54	59.66	-0.09	48.94	0.10
	O-O	2	3.48	-0.43	3.64	-0.45
	TOTAL	356	356.00		356.00	
Buena Vista	Y-Y	10	0.83	11.01	10.91	-0.08
	Y-M	96	27.92	2.44	82.18	0.17
	Y-O	4	3.56	0.12	16.00	-0.75
	M-M	142	234.15	-0.39	154.78	-0.08
	M-O	72	59.72	0.21	60.27	0.19
	O-O	6	3.81	0.58	5.87	0.02
	TOTAL	330	330.00		330.00	
Butler	Y-Y	14	0.37	37.12	6.56	1.13
	Y-M	28	12.54	1.23	40.62	-0.31
	Y-O	8	1.86	3.30	10.26	-0.22
	M-M	66	107.11	-0.38	62.83	0.05
	M-O	38	31.77	0.20	31.73	0.20
	O-O	2	2.36	-0.15	4.01	-0.50
	TOTAL	156	156.00		156.00	
Calhoun	Y-Y	14	0.37	36.61	6.34	1.21
	Y-M	28	11.68	1.40	38.45	-0.27
	Y-O	4	2.11	0.89	8.87	-0.55
	M-M	62	91.65	-0.32	58.32	0.06
	M-O	30	33.18	-0.10	26.92	0.11
	O-O	4	3.00	0.33	3.11	0.29
	TOTAL	142	142.00		142.00	
Carroll	Y-Y	32	1.73	17.45	29.45	0.09
	Y-M	130	44.94	1.89	136.19	-0.05
	Y-O	30	5.96	4.03	28.92	0.04
	M-M	160	291.06	-0.45	157.47	0.02
	M-O	68	77.19	-0.12	66.88	0.02
	O-O	6	5.12	0.17	7.10	-0.16
	TOTAL	426	426.00		426.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Cass	Y-Y	24	0.61	38.05	14.77	0.63
	Y-M	60	20.63	1.91	72.13	-0.17
	Y-O	14	3.03	3.62	20.33	-0.31
	M-M	92	173.09	-0.47	88.10	0.04
	M-O	54	50.90	0.06	49.67	0.09
	O-O	8	3.74	1.14	7.00	0.14
	TOTAL	252	252.00		252.00	
Cedar	Y-Y	8	0.59	12.46	6.21	0.29
	Y-M	56	22.16	1.53	63.00	-0.11
	Y-O	12	2.64	3.55	8.58	0.40
	M-M	168	206.50	-0.19	159.75	0.05
	M-O	34	49.19	-0.31	43.50	-0.22
	O-O	6	2.93	1.05	2.96	1.03
	TOTAL	284	284.00		284.00	
Cerro Gordo	Y-Y	58	2.77	19.92	59.72	-0.03
	Y-M	406	106.03	2.83	386.63	0.05
	Y-O	60	13.83	3.34	75.93	-0.21
	M-M	614	1013.59	-0.39	625.79	-0.02
	M-O	250	264.51	-0.05	245.80	0.02
	O-O	30	17.26	0.74	24.14	0.24
	TOTAL	1418	1418.00		1418.00	
Cherokee	Y-Y	12	0.56	20.42	12.15	-0.01
	Y-M	62	19.00	2.26	68.40	-0.09
	Y-O	22	3.07	6.16	15.30	0.44
	M-M	104	161.07	-0.35	96.27	0.08
	M-O	34	52.09	-0.35	43.07	-0.21
	O-O	6	4.21	0.42	4.82	0.25
	TOTAL	240	240.00		240.00	
Chickasaw	Y-Y	10	0.66	14.13	6.00	0.67
	Y-M	44	20.42	1.15	50.31	-0.13
	Y-O	10	2.81	2.56	11.68	-0.14
	M-M	112	157.70	-0.29	105.37	0.06
	M-O	42	43.42	-0.03	48.95	-0.14
	O-O	10	2.99	2.35	5.68	0.76
	TOTAL	228	228.00		228.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Clarke	Y-Y	10	0.56	16.93	5.78	0.73
	Y-M	44	17.85	1.47	46.24	-0.05
	Y-O	4	2.16	0.85	10.20	-0.61
	M-M	90	142.80	-0.37	92.48	-0.03
	M-O	48	34.54	0.39	40.80	0.18
	O-O	4	2.09	0.92	4.50	-0.11
	TOTAL	200	200.00		200.00	
Clay	Y-Y	26	1.05	23.75	18.64	0.39
	Y-M	120	36.84	2.26	118.34	0.01
	Y-O	12	4.73	1.54	28.37	-0.58
	M-M	180	323.13	-0.44	187.81	-0.04
	M-O	104	82.93	0.25	90.04	0.15
	O-O	12	5.32	1.26	10.79	0.11
	TOTAL	454	454.00		454.00	
Clayton	Y-Y	10	0.47	20.15	6.49	0.54
	Y-M	44	15.26	1.88	43.93	0.00
	Y-O	4	2.14	0.87	11.08	-0.64
	M-M	72	123.17	-0.42	74.30	-0.03
	M-O	42	34.54	0.22	37.47	0.12
	O-O	6	2.42	1.48	4.72	0.27
	TOTAL	178	178.00		178.00	
Clinton	Y-Y	72	3.36	20.40	54.50	0.32
	Y-M	388	122.22	2.17	396.24	-0.02
	Y-O	44	14.16	2.11	70.77	-0.38
	M-M	712	1110.16	-0.36	720.24	-0.01
	M-O	282	257.20	0.10	257.28	0.10
	O-O	24	14.90	0.61	22.98	0.04
	TOTAL	1522	1522.00		1522.00	
Crawford	Y-Y	20	0.91	20.98	12.33	0.62
	Y-M	66	27.26	1.42	77.26	-0.15
	Y-O	14	3.52	2.98	18.08	-0.23
	M-M	128	204.17	-0.37	121.04	0.06
	M-O	54	52.74	0.02	56.66	-0.05
	O-O	10	3.41	1.94	6.63	0.51
	TOTAL	292	292.00		292.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Dallas	Y-Y	34	1.39	23.42	23.20	0.47
	Y-M	144	50.04	1.88	165.78	-0.13
	Y-O	22	4.49	3.90	21.81	0.01
	M-M	304	449.69	-0.32	296.14	0.03
	M-O	84	80.76	0.04	77.93	0.08
	O-O	2	3.63	-0.45	5.13	-0.61
	TOTAL	590	590.00		590.00	
Davis	Y-Y	18	0.25	70.07	7.40	1.43
	Y-M	20	8.68	1.30	34.34	-0.42
	Y-O	0	1.18	-1.00	6.87	-1.00
	M-M	46	74.34	-0.38	39.86	0.15
	M-O	18	20.18	-0.11	15.94	0.13
	O-O	4	1.37	1.92	1.59	1.51
	TOTAL	106	106.00		106.00	
Decatur	Y-Y	14	0.20	69.97	5.13	1.73
	Y-M	12	6.82	0.76	25.88	-0.54
	Y-O	2	1.03	0.95	5.86	-0.66
	M-M	36	58.89	-0.39	32.66	0.10
	M-O	22	17.73	0.24	14.79	0.49
	O-O	0	1.33	-1.00	1.67	-1.00
	TOTAL	86	86.00		86.00	
Delaware	Y-Y	14	0.90	14.63	10.57	0.32
	Y-M	60	24.99	1.40	70.49	-0.15
	Y-O	14	2.91	3.82	10.37	0.35
	M-M	122	174.30	-0.30	117.48	0.04
	M-O	36	40.54	-0.11	34.55	0.04
	O-O	0	2.36	-1.00	2.54	-1.00
	TOTAL	246	246.00		246.00	
Des Moines	Y-Y	66	1.99	32.14	41.38	0.59
	Y-M	238	79.64	1.99	283.06	-0.16
	Y-O	54	9.39	4.75	58.17	-0.07
	M-M	516	796.15	-0.35	484.00	0.07
	M-O	180	187.75	-0.04	198.94	-0.10
	O-O	32	11.07	1.89	20.44	0.57
	TOTAL	1086	1086.00		1086.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Dickinson	Y-Y	28	0.64	42.43	12.96	1.16
	Y-M	70	25.86	1.71	92.22	-0.24
	Y-O	14	4.08	2.44	21.85	-0.36
	M-M	172	259.27	-0.34	164.02	0.05
	M-O	84	81.72	0.03	77.73	0.08
	O-O	10	6.44	0.55	9.21	0.09
	TOTAL	378	378.00		378.00	
Dubuque	Y-Y	122	5.29	22.04	87.86	0.39
	Y-M	610	194.95	2.13	641.60	-0.05
	Y-O	64	19.81	2.23	100.68	-0.36
	M-M	1190	1794.65	-0.34	1171.38	0.02
	M-O	362	364.76	-0.01	367.63	-0.02
	O-O	50	18.53	1.70	28.84	0.73
	TOTAL	2398	2398.00		2398.00	
Emmet	Y-Y	26	0.57	44.71	13.56	0.92
	Y-M	62	19.74	2.14	65.48	-0.05
	Y-O	2	2.88	-0.30	23.39	-0.91
	M-M	90	171.29	-0.47	79.03	0.14
	M-O	38	49.89	-0.24	56.45	-0.33
	O-O	30	3.63	7.26	10.08	1.98
	TOTAL	248	248.00		248.00	
Fayette	Y-Y	18	0.81	21.23	13.47	0.34
	Y-M	80	25.97	2.08	80.42	-0.01
	Y-O	12	3.80	2.16	20.63	-0.42
	M-M	124	208.12	-0.40	120.00	0.03
	M-O	54	60.86	-0.11	61.57	-0.12
	O-O	16	4.45	2.60	7.90	1.03
	TOTAL	304	304.00		304.00	
Floyd	Y-Y	24	0.84	27.59	14.08	0.70
	Y-M	70	28.46	1.46	87.70	-0.20
	Y-O	22	4.05	4.44	24.14	-0.09
	M-M	142	241.21	-0.41	136.56	0.04
	M-O	82	68.57	0.20	75.17	0.09
	O-O	8	4.87	0.64	10.34	-0.23
	TOTAL	348	348.00		348.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Franklin	Y-Y	4	0.50	7.00	5.11	-0.22
	Y-M	44	15.83	1.78	43.53	0.01
	Y-O	10	2.56	2.90	8.24	0.21
	M-M	96	125.28	-0.23	92.68	0.04
	M-O	28	40.55	-0.31	35.11	-0.20
	O-O	6	3.28	0.83	3.32	0.80
	TOTAL	188	188.00		188.00	
Fremont	Y-Y	2	0.21	8.73	1.44	0.39
	Y-M	16	6.91	1.31	15.19	0.05
	Y-O	2	0.99	1.03	3.93	-0.49
	M-M	42	58.15	-0.28	40.05	0.05
	M-O	16	16.57	-0.03	20.71	-0.23
	O-O	6	1.18	4.08	2.68	1.24
	TOTAL	84	84.00		84.00	
Greene	Y-Y	4	0.48	7.31	4.06	-0.01
	Y-M	28	13.96	1.01	33.44	-0.16
	Y-O	14	2.29	5.11	8.44	0.66
	M-M	74	101.27	-0.27	68.89	0.07
	M-O	30	33.26	-0.10	34.78	-0.14
	O-O	4	2.73	0.46	4.39	-0.09
	TOTAL	154	154.00		154.00	
Grundy	Y-Y	6	0.31	18.41	4.88	0.23
	Y-M	34	10.39	2.27	33.98	0.00
	Y-O	4	1.57	1.54	6.25	-0.36
	M-M	60	87.27	-0.31	59.13	0.01
	M-O	20	26.45	-0.24	21.75	-0.08
	O-O	4	2.00	1.00	2.00	1.00
	TOTAL	128	128.00		128.00	
Guthrie	Y-Y	8	0.23	33.16	4.99	0.60
	Y-M	26	8.20	2.17	29.51	-0.12
	Y-O	4	1.30	2.08	6.51	-0.39
	M-M	46	71.73	-0.36	43.62	0.05
	M-O	18	22.74	-0.21	19.25	-0.06
	O-O	4	1.80	1.22	2.12	0.88
	TOTAL	106	106.00		106.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Hamilton	Y-Y	14	0.78	17.06	9.84	0.42
	Y-M	84	28.13	1.99	84.26	0.00
	Y-O	8	4.01	1.00	16.07	-0.50
	M-M	178	255.22	-0.30	180.46	-0.01
	M-O	74	72.69	0.02	68.81	0.08
	O-O	8	5.18	0.55	6.56	0.22
	TOTAL	366	366.00		366.00	
Hancock	Y-Y	8	0.47	15.97	5.70	0.40
	Y-M	36	14.31	1.52	40.63	-0.11
	Y-O	8	2.01	2.98	7.97	0.00
	M-M	78	108.60	-0.28	72.46	0.08
	M-O	22	30.47	-0.28	28.44	-0.23
	O-O	6	2.14	1.81	2.79	1.15
	TOTAL	158	158.00		158.00	
Hardin	Y-Y	12	0.69	16.28	8.47	0.42
	Y-M	60	22.59	1.66	63.18	-0.05
	Y-O	12	3.51	2.42	15.88	-0.24
	M-M	122	183.73	-0.34	117.80	0.04
	M-O	54	57.05	-0.05	59.23	-0.09
	O-O	12	4.43	1.71	7.44	0.61
	TOTAL	272	272.00		272.00	
Harrison	Y-Y	14	0.62	21.49	12.36	0.13
	Y-M	64	20.51	2.12	70.47	-0.09
	Y-O	16	2.49	5.43	12.81	0.25
	M-M	102	168.91	-0.40	100.49	0.02
	M-O	40	40.98	-0.02	36.54	0.09
	O-O	0	2.49	-1.00	3.32	-1.00
	TOTAL	236	236.00		236.00	
Henry	Y-Y	14	1.11	11.64	12.61	0.11
	Y-M	110	38.12	1.89	105.94	0.04
	Y-O	12	4.11	1.92	18.83	-0.36
	M-M	214	328.07	-0.35	222.48	-0.04
	M-O	92	70.77	0.30	79.10	0.16
	O-O	4	3.82	0.05	7.03	-0.43
	TOTAL	446	446.00		446.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Howard	Y-Y	14	0.45	30.40	7.92	0.77
	Y-M	38	13.32	1.85	41.92	-0.09
	Y-O	2	1.92	0.04	10.25	-0.80
	M-M	54	99.53	-0.46	55.48	-0.03
	M-O	34	28.71	0.18	27.12	0.25
	O-O	4	2.07	0.93	3.32	0.21
	TOTAL	146	146.00		146.00	
Humboldt	Y-Y	20	0.56	34.99	12.00	0.67
	Y-M	48	16.81	1.85	60.00	-0.20
	Y-O	8	2.74	1.92	12.00	-0.33
	M-M	76	127.15	-0.40	75.00	0.01
	M-O	40	41.38	-0.03	30.00	0.33
	O-O	0	3.37	-1.00	3.00	-1.00
	TOTAL	192	192.00		192.00	
Ida	Y-Y	8	0.39	19.71	6.38	0.25
	Y-M	30	10.30	1.91	30.91	-0.03
	Y-O	6	1.73	2.47	8.34	-0.28
	M-M	40	68.63	-0.42	37.44	0.07
	M-O	16	23.03	-0.31	20.21	-0.21
	O-O	6	1.93	2.11	2.73	1.20
	TOTAL	106	106.00		106.00	
Iowa	Y-Y	10	0.56	16.94	7.17	0.39
	Y-M	54	19.87	1.72	63.51	-0.15
	Y-O	10	2.43	3.11	6.15	0.63
	M-M	146	177.12	-0.18	140.63	0.04
	M-O	26	43.36	-0.40	27.22	-0.04
	O-O	0	2.65	-1.00	1.32	-1.00
	TOTAL	246	246.00		246.00	
Jackson	Y-Y	12	0.85	13.11	16.55	-0.28
	Y-M	98	26.59	2.69	83.72	0.17
	Y-O	18	3.44	4.24	23.18	-0.22
	M-M	98	207.90	-0.53	105.84	-0.07
	M-O	60	53.74	0.12	58.60	0.02
	O-O	10	3.47	1.88	8.11	0.23
	TOTAL	296	296.00		296.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Jasper	Y-Y	38	1.32	27.81	22.68	0.68
	Y-M	156	49.06	2.09	173.75	-0.10
	Y-O	16	6.20	1.58	28.90	-0.45
	M-M	338	494.12	-0.32	332.78	0.02
	M-O	118	120.01	-0.02	110.69	0.07
	O-O	12	7.29	0.65	9.21	0.30
	TOTAL	678	678.00		678.00	
Jefferson	Y-Y	10	0.72	12.86	10.82	-0.08
	Y-M	94	27.59	2.41	87.60	0.07
	Y-O	8	2.47	2.23	12.77	-0.37
	M-M	174	263.80	-0.34	177.35	-0.02
	M-O	52	47.30	0.10	51.70	0.01
	O-O	6	2.12	1.83	3.77	0.59
	TOTAL	344	344.00		344.00	
Johnson	Y-Y	96	3.56	25.94	71.04	0.35
	Y-M	700	191.62	2.65	731.99	-0.04
	Y-O	42	10.43	3.03	59.93	-0.30
	M-M	1896	2576.20	-0.26	1885.61	0.01
	M-O	320	280.54	0.14	308.78	0.04
	O-O	16	7.64	1.09	12.64	0.27
	TOTAL	3070	3070.00		3070.00	
Jones	Y-Y	8	0.62	11.99	10.64	-0.25
	Y-M	78	21.95	2.55	72.13	0.08
	Y-O	14	2.80	4.00	14.58	-0.04
	M-M	126	195.60	-0.36	122.22	0.03
	M-O	36	49.86	-0.28	49.42	-0.27
	O-O	12	3.18	2.78	5.00	1.40
	TOTAL	274	274.00		274.00	
Keokuk	Y-Y	6	0.17	34.02	7.15	-0.16
	Y-M	32	5.89	4.43	24.86	0.29
	Y-O	2	0.89	1.25	6.84	-0.71
	M-M	20	50.62	-0.60	21.62	-0.08
	M-O	8	15.28	-0.48	11.89	-0.33
	O-O	6	1.15	4.20	1.64	2.67
	TOTAL	74	74.00		74.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Kossuth	Y-Y	20	0.96	19.83	17.38	0.15
	Y-M	74	25.88	1.86	75.16	-0.02
	Y-O	22	4.16	4.29	26.08	-0.16
	M-M	76	174.40	-0.56	81.24	-0.06
	M-O	68	56.09	0.21	56.37	0.21
	O-O	6	4.51	0.33	9.78	-0.39
	TOTAL	266	266.00		266.00	
Lee	Y-Y	24	1.70	13.12	22.84	0.05
	Y-M	184	62.38	1.95	187.53	-0.02
	Y-O	36	7.33	3.91	34.78	0.04
	M-M	386	572.14	-0.33	384.86	0.00
	M-O	144	134.53	0.07	142.75	0.01
	O-O	12	7.91	0.52	13.24	-0.09
	TOTAL	786	786.00		786.00	
Linn	Y-Y	186	8.96	19.76	148.00	0.26
	Y-M	1332	404.95	2.29	1394.68	-0.04
	Y-O	156	34.77	3.49	169.32	-0.08
	M-M	3318	4575.90	-0.27	3285.75	0.01
	M-O	796	785.70	0.01	797.82	0.00
	O-O	56	33.73	0.66	48.43	0.16
	TOTAL	5844	5844.00		5844.00	
Louisa	Y-Y	6	0.22	26.04	5.48	0.09
	Y-M	34	8.67	2.92	32.02	0.06
	Y-O	4	0.95	3.23	7.02	-0.43
	M-M	44	84.67	-0.48	46.75	-0.06
	M-O	24	18.49	0.30	20.49	0.17
	O-O	2	1.01	0.98	2.25	-0.11
	TOTAL	114	114.00		114.00	
Lucas	Y-Y	6	0.24	24.02	3.74	0.61
	Y-M	26	8.89	1.93	28.83	-0.10
	Y-O	4	1.27	2.14	5.69	-0.30
	M-M	54	82.30	-0.34	55.60	-0.03
	M-O	28	23.60	0.19	21.97	0.27
	O-O	0	1.69	-1.00	2.17	-1.00
	TOTAL	118	118.00		118.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Lyon	Y-Y	12	0.48	23.91	10.39	0.16
	Y-M	44	14.22	2.09	49.87	-0.12
	Y-O	12	2.04	4.88	9.35	0.28
	M-M	66	104.96	-0.37	59.84	0.10
	M-O	16	30.13	-0.47	22.44	-0.29
	O-O	4	2.16	0.85	2.10	0.90
	TOTAL	154	154.00		154.00	
Madison	Y-Y	6	0.43	13.04	10.01	-0.40
	Y-M	60	14.59	3.11	50.27	0.19
	Y-O	10	1.50	5.67	11.71	-0.15
	M-M	58	124.57	-0.53	63.15	-0.08
	M-O	30	25.60	0.17	29.43	0.02
	O-O	4	1.31	2.04	3.43	0.17
	TOTAL	168	168.00		168.00	
Mahaska	Y-Y	22	1.33	15.59	21.52	0.02
	Y-M	142	46.00	2.09	142.96	-0.01
	Y-O	32	5.46	4.86	31.99	0.00
	M-M	238	398.95	-0.40	237.40	0.00
	M-O	106	94.65	0.12	106.24	0.00
	O-O	12	5.61	1.14	11.89	0.01
	TOTAL	552	552.00		552.00	
Marion	Y-Y	26	1.49	16.50	24.03	0.08
	Y-M	154	49.23	2.13	148.73	0.04
	Y-O	26	5.49	3.74	35.21	-0.26
	M-M	222	407.77	-0.46	230.14	-0.04
	M-O	120	90.95	0.32	108.98	0.10
	O-O	12	5.07	1.37	12.90	-0.07
	TOTAL	560	560.00		560.00	
Marshall	Y-Y	40	1.93	19.71	34.48	0.16
	Y-M	254	74.55	2.41	248.08	0.02
	Y-O	34	8.69	2.91	50.97	-0.33
	M-M	442	719.44	-0.39	446.28	-0.01
	M-O	186	167.62	0.11	183.36	0.01
	O-O	26	9.76	1.66	18.84	0.38
	TOTAL	982	982.00		982.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Mills	Y-Y	14	0.48	28.07	9.00	0.56
	Y-M	48	16.90	1.84	57.00	-0.16
	Y-O	8	1.57	4.11	9.00	-0.11
	M-M	96	148.30	-0.35	90.25	0.06
	M-O	26	27.48	-0.05	28.50	-0.09
	O-O	4	1.27	2.14	2.25	0.78
	TOTAL	196	196.00		196.00	
Mitchell	Y-Y	10	0.47	20.35	6.01	0.66
	Y-M	32	14.07	1.27	40.69	-0.21
	Y-O	10	2.31	3.34	9.30	0.08
	M-M	72	105.68	-0.32	68.91	0.04
	M-O	34	34.64	-0.02	31.50	0.08
	O-O	2	2.84	-0.30	3.60	-0.44
	TOTAL	160	160.00		160.00	
Monona	Y-Y	18	0.36	49.55	11.92	0.51
	Y-M	34	11.78	1.89	42.57	-0.20
	Y-O	14	2.03	5.91	17.59	-0.20
	M-M	48	97.46	-0.51	38.01	0.26
	M-O	20	33.50	-0.40	31.42	-0.36
	O-O	14	2.88	3.86	6.49	1.16
	TOTAL	148	148.00		148.00	
Monroe	Y-Y	12	0.29	40.32	7.65	0.57
	Y-M	30	9.43	2.18	33.75	-0.11
	Y-O	4	1.29	2.09	8.96	-0.55
	M-M	38	76.53	-0.50	37.24	0.02
	M-O	22	21.02	0.05	19.78	0.11
	O-O	4	1.44	1.77	2.63	0.52
	TOTAL	110	110.00		110.00	
Montgomery	Y-Y	8	0.40	18.80	8.89	-0.10
	Y-M	58	14.26	3.07	47.56	0.22
	Y-O	6	1.99	2.01	14.67	-0.59
	M-M	56	125.76	-0.55	63.61	-0.12
	M-O	44	35.13	0.25	39.23	0.12
	O-O	8	2.45	2.26	6.05	0.32
	TOTAL	180	180.00		180.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Muscatine	Y-Y	30	1.26	22.89	23.90	0.26
	Y-M	184	52.78	2.49	183.91	0.00
	Y-O	18	4.77	2.78	30.29	-0.41
	M-M	350	554.50	-0.37	353.78	-0.01
	M-O	124	100.17	0.24	116.52	0.06
	O-O	12	4.52	1.65	9.59	0.25
	TOTAL	718	718.00		718.00	
O'Brien	Y-Y	16	1.18	12.61	12.84	0.25
	Y-M	86	33.38	1.58	85.00	0.01
	Y-O	18	5.41	2.33	25.31	-0.29
	M-M	138	237.01	-0.42	140.63	-0.02
	M-O	88	76.80	0.15	83.75	0.05
	O-O	14	6.22	1.25	12.47	0.12
	TOTAL	360	360.00		360.00	
Osceola	Y-Y	2	0.24	7.17	2.81	-0.29
	Y-M	14	7.28	0.92	18.75	-0.25
	Y-O	12	1.08	10.07	5.63	1.13
	M-M	38	54.09	-0.30	31.25	0.22
	M-O	10	16.11	-0.38	18.75	-0.47
	O-O	4	1.20	2.33	2.81	0.42
	TOTAL	80	80.00		80.00	
Page	Y-Y	14	0.55	24.40	7.67	0.83
	Y-M	52	20.44	1.54	55.00	-0.05
	Y-O	12	3.13	2.83	21.67	-0.45
	M-M	102	189.43	-0.46	98.64	0.03
	M-O	74	58.01	0.28	77.72	-0.05
	O-O	22	4.44	3.95	15.31	0.44
	TOTAL	276	276.00		276.00	
Palo Alto	Y-Y	20	0.43	45.82	16.24	0.23
	Y-M	48	12.25	2.92	51.15	-0.06
	Y-O	6	2.13	1.81	10.37	-0.42
	M-M	42	87.89	-0.52	40.26	0.04
	M-O	16	30.62	-0.48	16.32	-0.02
	O-O	4	2.67	0.50	1.65	1.42
	TOTAL	136	136.00		136.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Plymouth	Y-Y	18	1.33	12.58	19.85	-0.09
	Y-M	126	39.15	2.22	116.91	0.08
	Y-O	18	4.71	2.82	23.38	-0.23
	M-M	162	289.09	-0.44	172.12	-0.06
	M-O	80	69.54	0.15	68.85	0.16
	O-O	4	4.18	-0.04	6.88	-0.42
	TOTAL	408	408.00		408.00	
Pocahontas	Y-Y	6	0.31	18.48	5.13	0.17
	Y-M	22	8.24	1.67	24.42	-0.10
	Y-O	8	1.44	4.57	7.33	0.09
	M-M	30	55.12	-0.46	29.07	0.03
	M-O	18	19.22	-0.06	17.44	0.03
	O-O	2	1.68	0.19	2.62	-0.24
	TOTAL	86	86.00		86.00	
Polk	Y-Y	392	17.60	21.28	309.37	0.27
	Y-M	3020	873.05	2.46	3142.65	-0.04
	Y-O	266	62.41	3.26	308.61	-0.14
	M-M	8032	10829.29	-0.26	7980.94	0.01
	M-O	1588	1548.31	0.03	1567.46	0.01
	O-O	88	55.34	0.59	76.96	0.14
	TOTAL	13386	13386.00		13386.00	
Pottawattami	Y-Y	78	4.12	17.95	70.41	0.11
	Y-M	590	170.33	2.46	592.58	0.00
	Y-O	62	16.81	2.69	74.60	-0.17
	M-M	1242	1761.83	-0.30	1246.76	0.00
	M-O	326	347.75	-0.06	313.89	0.04
	O-O	20	17.16	0.17	19.76	0.01
	TOTAL	2318	2318.00		2318.00	
Poweshiek	Y-Y	22	0.84	25.07	15.44	0.42
	Y-M	94	30.23	2.11	103.07	-0.09
	Y-O	16	4.08	2.92	20.05	-0.20
	M-M	174	270.82	-0.36	172.00	0.01
	M-O	72	73.09	-0.01	66.93	0.08
	O-O	6	4.93	0.22	6.51	-0.08
	TOTAL	384	384.00		384.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Ringgold	Y-Y	8	0.15	53.60	5.16	0.55
	Y-M	10	4.56	1.19	17.61	-0.43
	Y-O	8	0.87	8.18	6.07	0.32
	M-M	22	35.55	-0.38	15.02	0.46
	M-O	4	13.57	-0.71	10.36	-0.61
	O-O	4	1.30	2.09	1.79	1.24
	TOTAL	56	56.00		56.00	
Sac	Y-Y	6	0.41	13.60	4.11	0.46
	Y-M	30	12.78	1.35	33.88	-0.11
	Y-O	8	2.21	2.63	7.89	0.01
	M-M	74	99.36	-0.26	69.80	0.06
	M-O	28	34.29	-0.18	32.53	-0.14
	O-O	6	2.96	1.03	3.79	0.58
	TOTAL	152	152.00		152.00	
Scott	Y-Y	186	10.18	17.27	136.44	0.36
	Y-M	1228	417.66	1.94	1302.86	-0.06
	Y-O	130	34.61	2.76	154.26	-0.16
	M-M	3138	4282.46	-0.27	3110.30	0.01
	M-O	756	709.69	0.07	736.53	0.03
	O-O	46	29.40	0.56	43.60	0.05
	TOTAL	5484	5484.00		5484.00	
Shelby	Y-Y	12	0.48	23.96	6.10	0.97
	Y-M	38	14.70	1.58	40.00	-0.05
	Y-O	2	2.31	-0.13	11.81	-0.83
	M-M	64	112.40	-0.43	65.63	-0.02
	M-O	44	35.33	0.25	38.75	0.14
	O-O	8	2.78	1.88	5.72	0.40
	TOTAL	168	168.00		168.00	
Sioux	Y-Y	56	1.81	29.98	38.15	0.47
	Y-M	128	49.83	1.57	165.96	-0.23
	Y-O	34	6.19	4.49	31.74	0.07
	M-M	206	343.50	-0.40	180.50	0.14
	M-O	56	85.36	-0.34	69.05	-0.19
	O-O	12	5.30	1.26	6.60	0.82
	TOTAL	492	492.00		492.00	

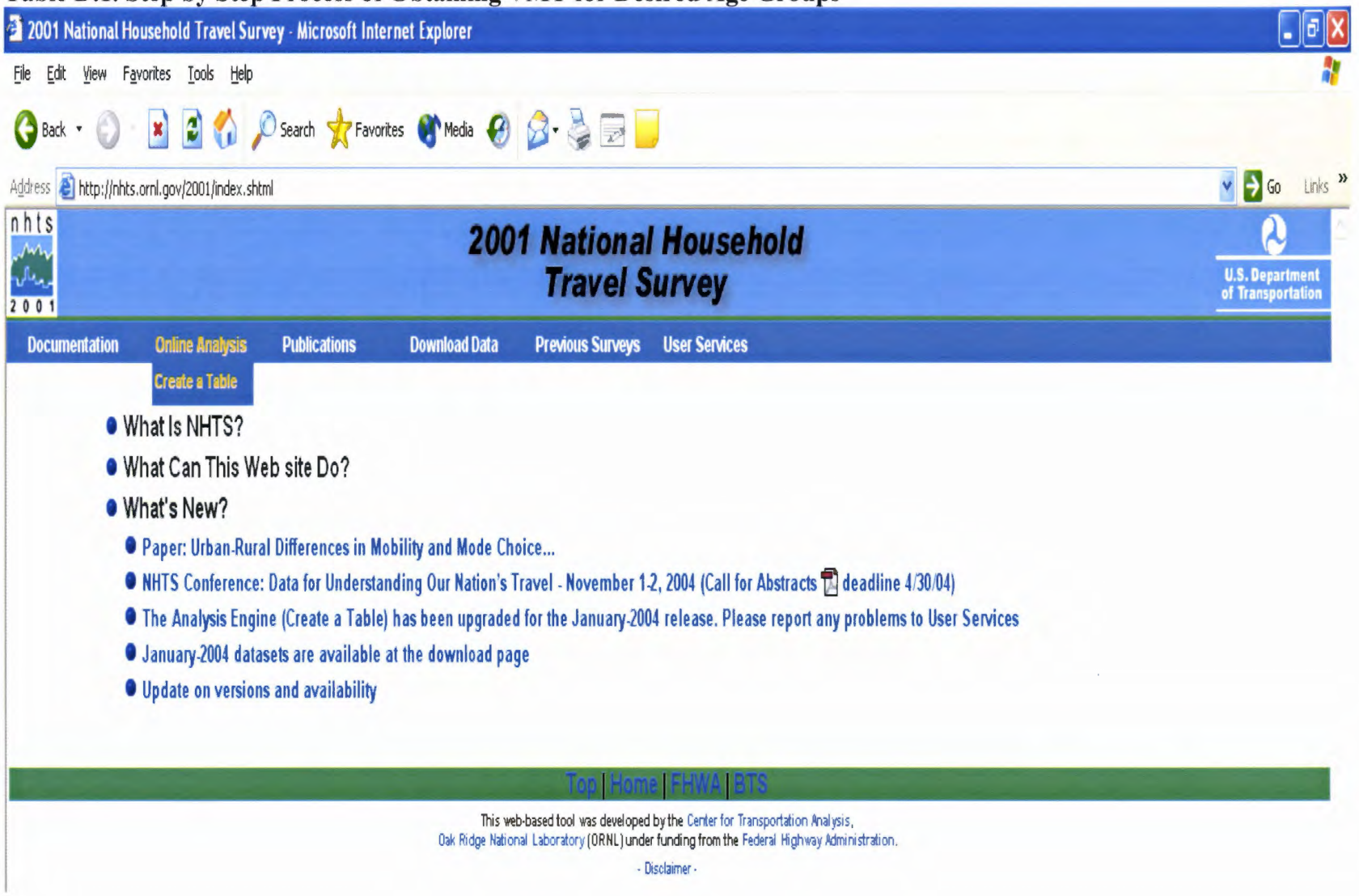
County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Story	Y-Y	78	2.98	25.20	64.11	0.22
	Y-M	486	134.29	2.62	511.74	-0.05
	Y-O	56	10.17	4.51	58.04	-0.04
	M-M	1044	1514.48	-0.31	1021.29	0.02
	M-O	212	229.40	-0.08	231.68	-0.08
	O-O	24	8.69	1.76	13.14	0.83
	TOTAL	1900	1900.00		1900.00	
Tama	Y-Y	6	0.55	9.97	6.29	-0.05
	Y-M	60	19.23	2.12	53.83	0.11
	Y-O	6	2.69	1.23	11.60	-0.48
	M-M	112	169.03	-0.34	115.24	-0.03
	M-O	50	47.21	0.06	49.69	0.01
	O-O	8	3.30	1.43	5.36	0.49
	TOTAL	242	242.00		242.00	
Taylor	Y-Y	8	0.14	56.87	4.02	0.99
	Y-M	6	4.54	0.32	15.54	-0.61
	Y-O	8	0.75	9.72	6.43	0.24
	M-M	22	37.31	-0.41	15.02	0.46
	M-O	8	12.26	-0.35	12.43	-0.36
	O-O	4	1.01	2.97	2.57	0.56
	TOTAL	56	56.00		56.00	
Union	Y-Y	8	0.51	14.56	11.85	-0.32
	Y-M	92	20.32	3.53	78.01	0.18
	Y-O	8	2.82	1.84	14.30	-0.44
	M-M	118	200.76	-0.41	128.45	-0.08
	M-O	54	55.73	-0.03	47.08	0.15
	O-O	4	3.87	0.03	4.31	-0.07
	TOTAL	284	284.00		284.00	
Van Buren	Y-Y	2	0.15	12.38	1.40	0.43
	Y-M	12	4.84	1.48	11.48	0.05
	Y-O	2	0.75	1.65	3.72	-0.46
	M-M	22	39.11	-0.44	23.60	-0.07
	M-O	18	12.20	0.48	15.31	0.18
	O-O	2	0.95	1.10	2.48	-0.19
	TOTAL	58	58.00		58.00	

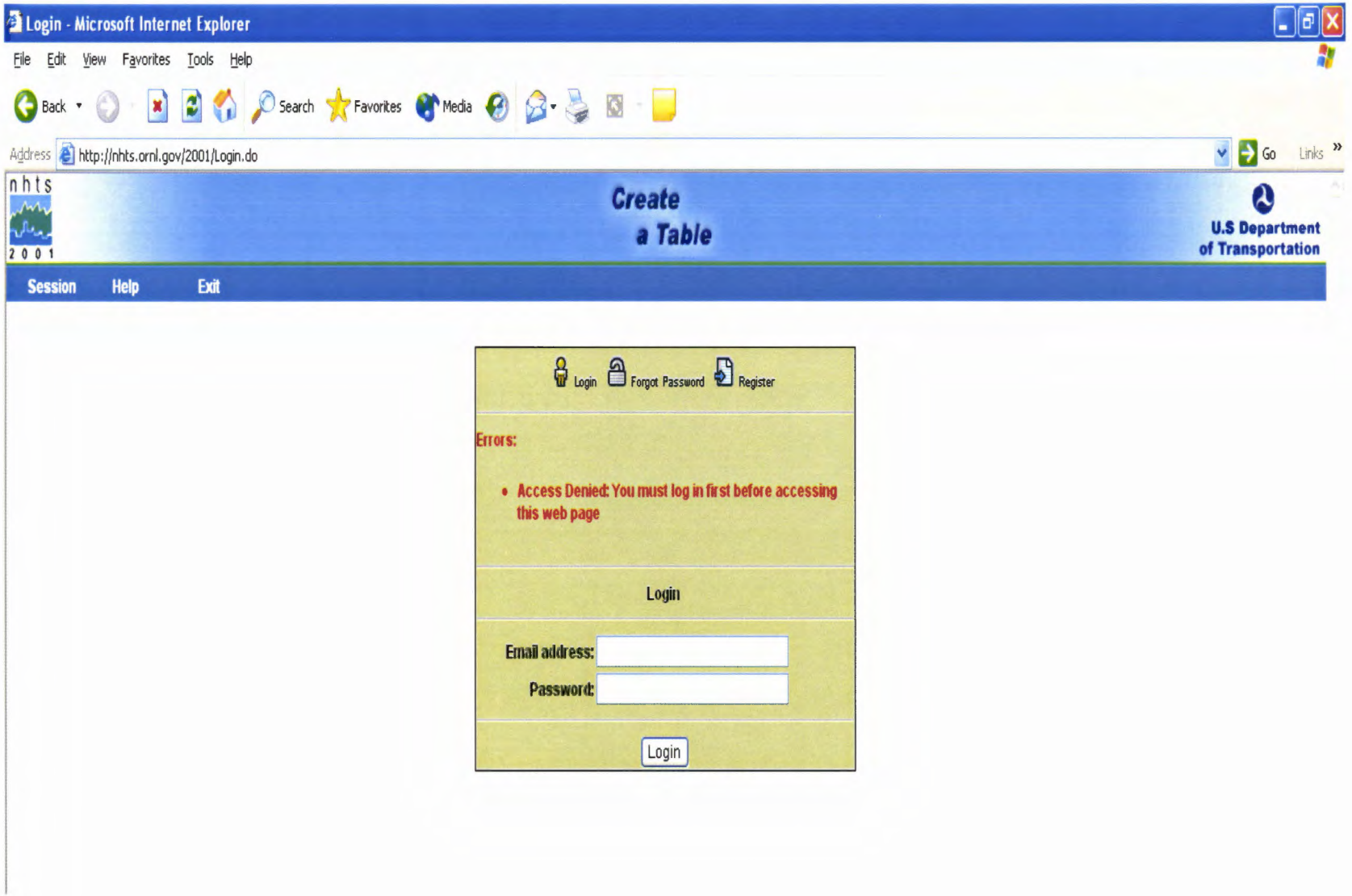
County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Wapello	Y-Y	32	1.22	25.31	27.87	0.15
	Y-M	224	53.72	3.17	211.18	0.06
	Y-O	14	6.93	1.02	35.07	-0.60
	M-M	392	593.20	-0.34	399.98	-0.02
	M-O	136	153.06	-0.11	132.86	0.02
	O-O	20	9.87	1.03	11.03	0.81
	TOTAL	818	818.00		818.00	
Warren	Y-Y	56	1.66	32.82	42.15	0.33
	Y-M	206	59.86	2.44	230.99	-0.11
	Y-O	28	5.41	4.18	30.70	-0.09
	M-M	332	540.93	-0.39	316.45	0.05
	M-O	78	97.73	-0.20	84.12	-0.07
	O-O	10	4.41	1.27	5.59	0.79
	TOTAL	710	710.00		710.00	
Washington	Y-Y	20	0.72	26.63	13.14	0.52
	Y-M	80	27.07	1.96	88.86	-0.10
	Y-O	16	3.41	3.69	20.86	-0.23
	M-M	156	252.98	-0.38	150.28	0.04
	M-O	68	63.80	0.07	70.57	-0.04
	O-O	12	4.02	1.98	8.28	0.45
	TOTAL	352	352.00		352.00	
Wayne	Y-Y	4	0.14	28.06	1.39	1.88
	Y-M	8	4.01	0.99	11.48	-0.30
	Y-O	0	0.75	-1.00	1.74	-1.00
	M-M	26	29.22	-0.11	23.67	0.10
	M-O	6	10.87	-0.45	7.17	-0.16
	O-O	2	1.01	0.98	0.54	2.68
	TOTAL	46	46.00		46.00	
Webster	Y-Y	68	3.14	20.63	58.15	0.17
	Y-M	340	107.93	2.15	367.44	-0.07
	Y-O	76	14.14	4.37	68.26	0.11
	M-M	590	926.19	-0.36	580.45	0.02
	M-O	224	242.69	-0.08	215.67	0.04
	O-O	12	15.90	-0.25	20.03	-0.40
	TOTAL	1310	1310.00		1310.00	

County	Crash Interaction	Actual # of Drivers Involved 2-Veh Crashes	Unadjusted, based on exposure (VMT only)		Adjusted (Interaction Effect)	
			Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation	Expected # of YO Drivers Involved 2-Veh Crashes	% Over-representation
Winnebago	Y-Y	4	0.40	8.90	4.01	0.00
	Y-M	32	12.16	1.63	31.02	0.03
	Y-O	6	1.64	2.66	6.97	-0.14
	M-M	60	91.45	-0.34	60.01	0.00
	M-O	26	24.68	0.05	26.97	-0.04
	O-O	4	1.66	1.40	3.03	0.32
	TOTAL	132	132.00		132.00	
Winneshiek	Y-Y	22	1.12	18.58	20.71	0.06
	Y-M	102	34.50	1.96	106.35	-0.04
	Y-O	30	4.26	6.04	28.24	0.06
	M-M	142	264.71	-0.46	136.57	0.04
	M-O	66	65.37	0.01	72.51	-0.09
	O-O	12	4.04	1.97	9.63	0.25
	TOTAL	374	374.00		374.00	
Woodbury	Y-Y	72	4.17	16.28	52.96	0.36
	Y-M	474	166.35	1.85	505.22	-0.06
	Y-O	60	15.48	2.88	66.86	-0.10
	M-M	1220	1660.63	-0.27	1204.93	0.01
	M-O	320	309.01	0.04	318.93	0.00
	O-O	24	14.37	0.67	21.10	0.14
	TOTAL	2170	2170.00		2170.00	
Worth	Y-Y	6	0.18	32.28	4.20	0.43
	Y-M	20	6.61	2.03	22.09	-0.09
	Y-O	6	0.91	5.59	7.51	-0.20
	M-M	28	60.49	-0.54	29.07	-0.04
	M-O	24	16.67	0.44	19.77	0.21
	O-O	2	1.15	0.74	3.36	-0.40
	TOTAL	86	86.00		86.00	
Wright	Y-Y	10	0.42	22.55	9.19	0.09
	Y-M	52	14.78	2.52	51.19	0.02
	Y-O	12	2.43	3.94	14.44	-0.17
	M-M	74	128.64	-0.42	71.30	0.04
	M-O	34	42.26	-0.20	40.22	-0.15
	O-O	10	3.47	1.88	5.67	0.76
	TOTAL	192	192.00		192.00	

Appendix D - The Process of Obtaining VMT for Desired Age Groups from 2001 National Household Travel Survey (NHTS)

Table D.1. Step by Step Process of Obtaining VMT for Desired Age Groups

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Password:
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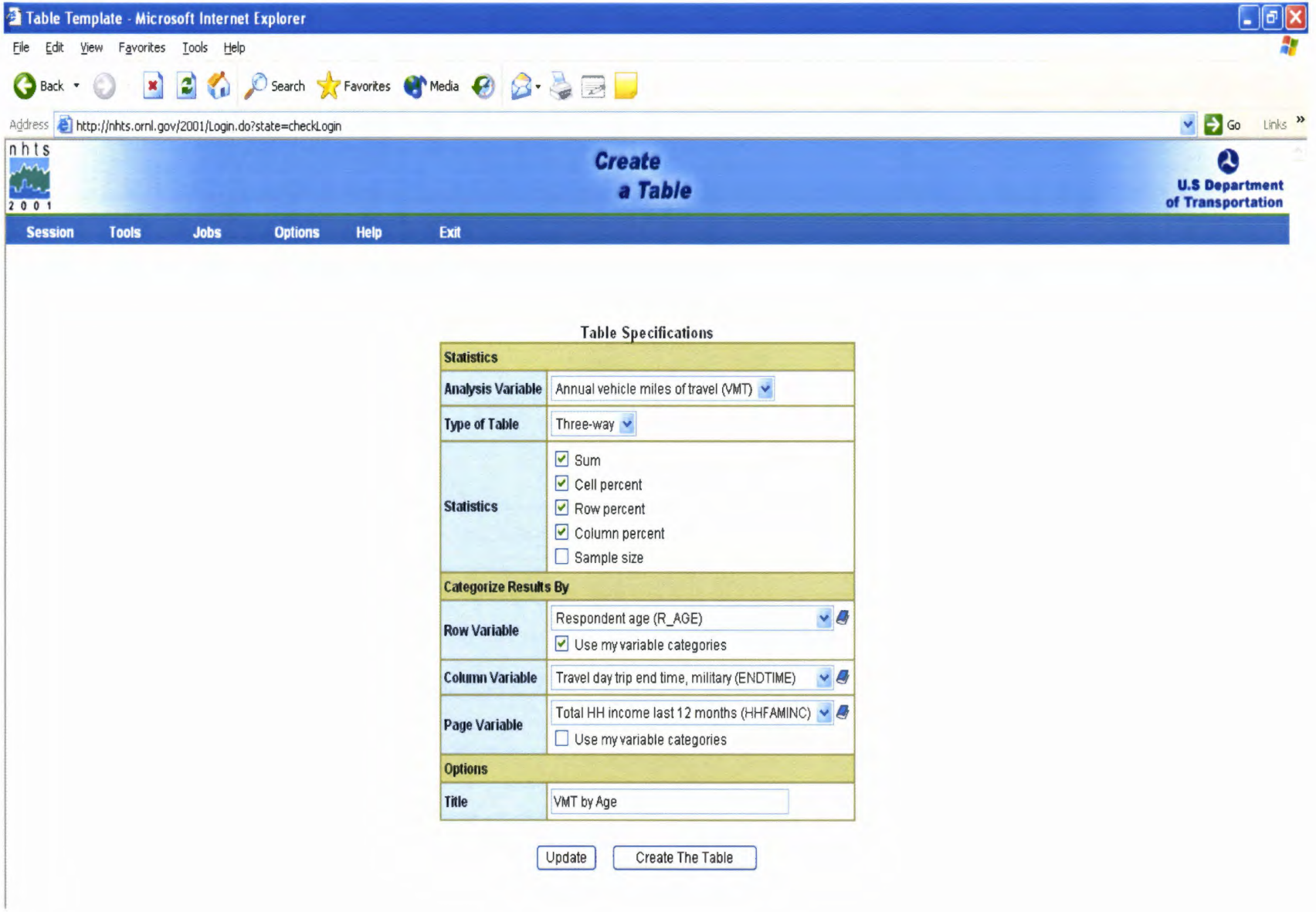
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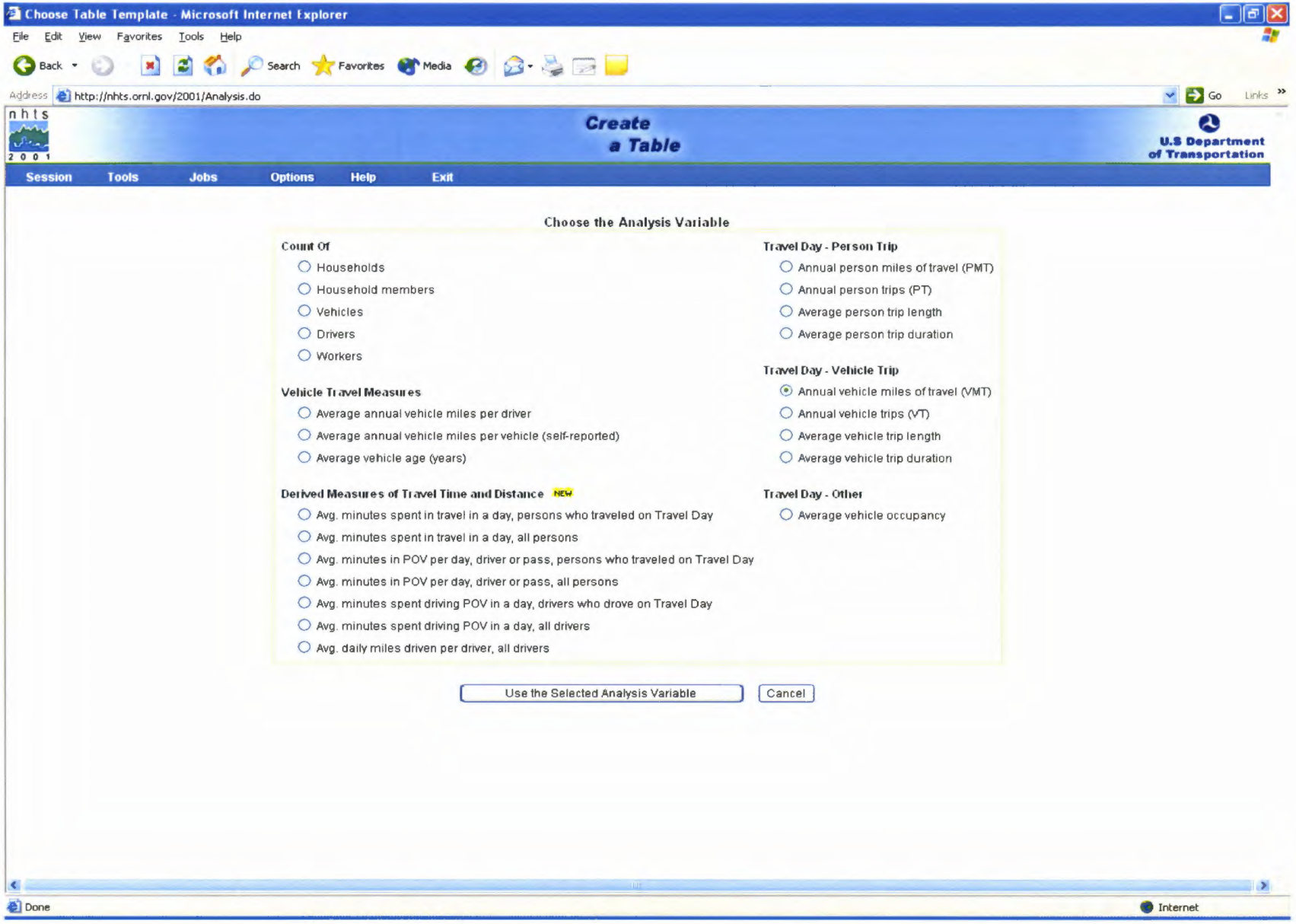
Analysis Variable
Annual vehicle miles of travel (VMT)
Type of Table
Three-way
Statistics
Sum
Cell percent
Row percent
Column percent
Sample size
Categorize Results By
Row Variable
Respondent age (R_AGE)
Use my variable categories
Column Variable
Travel day trip end time, military (ENDTIME)
Page Variable
Total HH income last 12 months (HHFAMINC)
Use my variable categories
Options
Title
VMT by Age
Update
Create The Table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U.S Department of Transportation
Session Tools Jobs Options Help Exit
Choose the Analysis Variable
Count Of
Households
Household members
Vehicles
Drivers
Workers
Vehicle Travel Measures
Average annual vehicle miles per driver
Average annual vehicle miles per vehicle (self-reported)
Average vehicle age (years)
Derived Measures of Travel Time and Distance NEW
Avg. minutes spent in travel in a day, persons who traveled on Travel Day
Avg. minutes spent in travel in a day, all persons
Avg. minutes in POV per day, driver or pass, persons who traveled on Travel Day
Avg. minutes in POV per day, driver or pass, all persons
Avg. minutes spent driving POV in a day, drivers who drove on Travel Day
Avg. minutes spent driving POV in a day, all drivers
Avg. daily miles driven per driver, all drivers
Travel Day - Person Trip
Annual person miles of travel (PMT)
Annual person trips (PT)
Average person trip length
Average person trip duration
Travel Day - Vehicle Trip
Annual vehicle miles of travel (VMT)
Annual vehicle trips (VT)
Average vehicle trip length
Average vehicle trip duration
Travel Day - Other
Average vehicle occupancy
Use the Selected Analysis Variable
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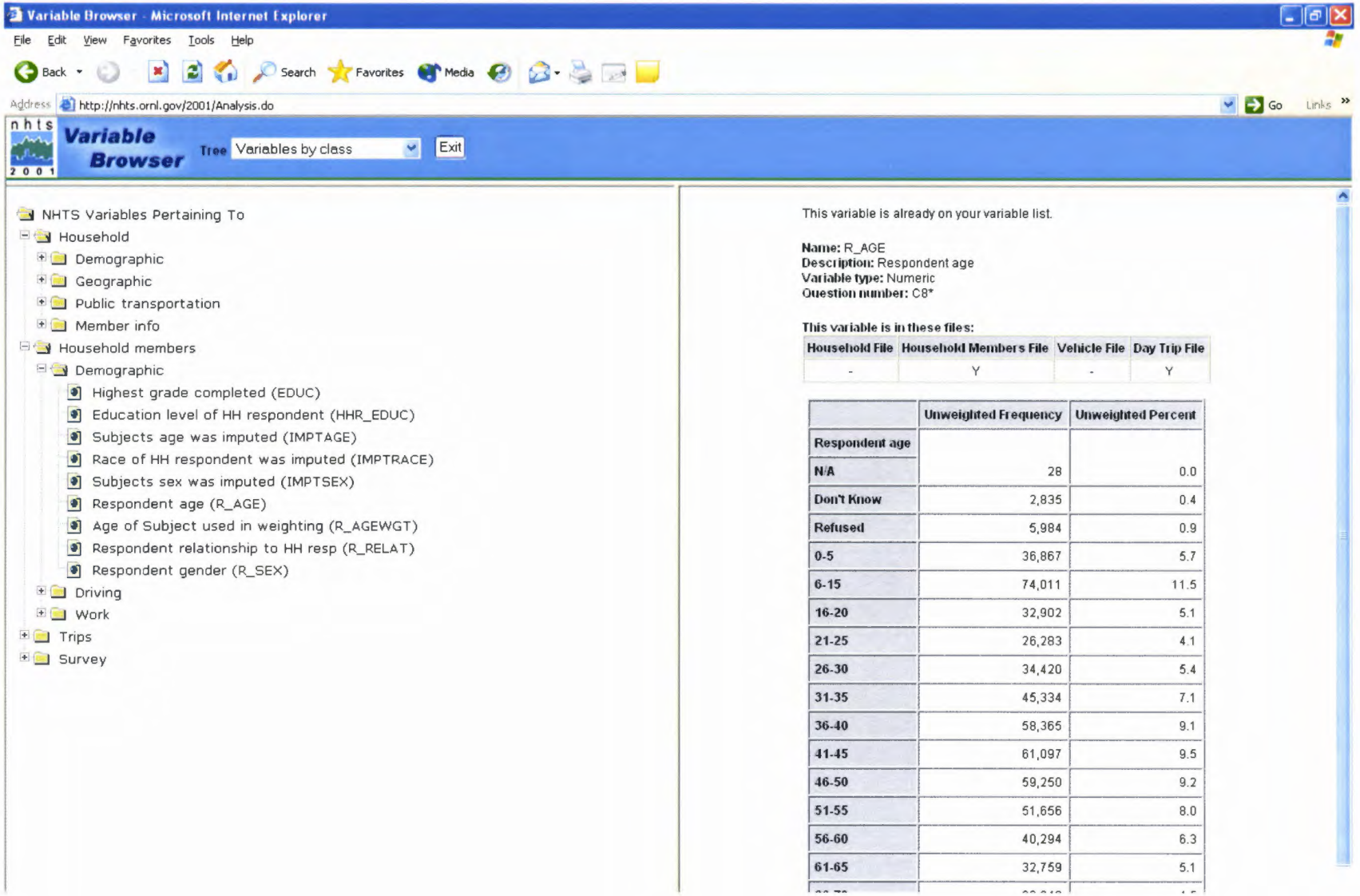
Done
Internet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Variable Browser
Tree Variables by class
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NHTS Variables Pertaining To
Household
Demographic
Geographic
Public transportation
Member info
Household members
Demographic
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Education level of HH respondent (HHR_EDUC)
Subjects age was imputed (IMPTAGE)
Race of HH respondent was imputed (IMPTRACE)
Subjects sex was imputed (IMPTSEX)
Respondent age (R_AGE)
Age of Subject used in weighting (R_AGEWGT)
Respondent relationship to HH resp (R_RELAT)
Respondent gender (R_SEX)
Driving
Work
Trips
Survey
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Name: R_AGE
Description: Respondent age
Variable type: Numeric
Question number: C8*
This variable is in these files:
Household File | Household Members File | Vehicle File | Day Trip File
- | Y | - | Y
Unweighted Frequency | Unweighted Percent
Respondent age
N/A 28 0.0
Don't Know 2,835 0.4
Refused 5,984 0.9
0-5 36,867 5.7
6-15 74,011 11.5
16-20 32,902 5.1
21-25 26,283 4.1
26-30 34,420 5.4
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36-40 58,365 9.1
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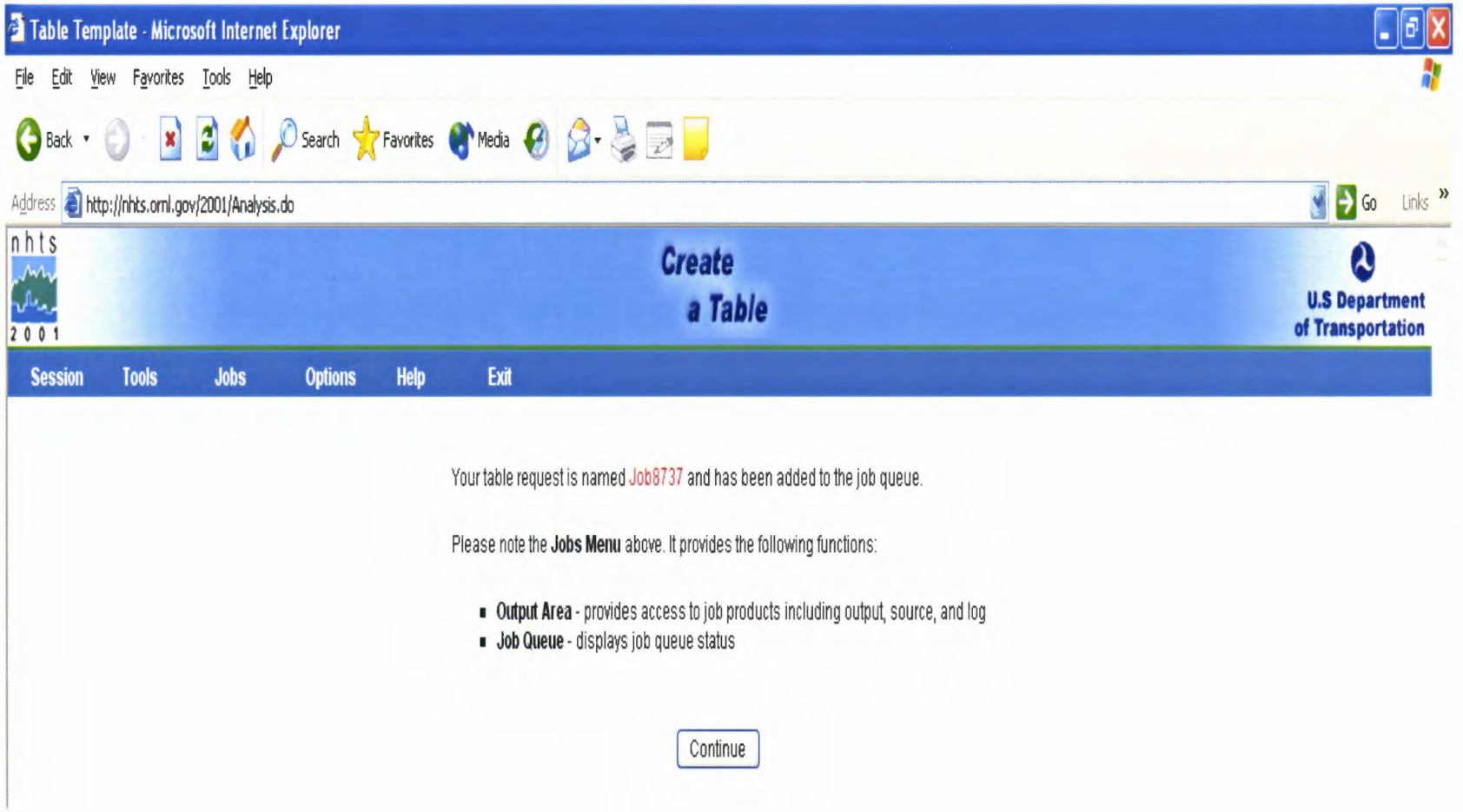
61-65 32,759 5.1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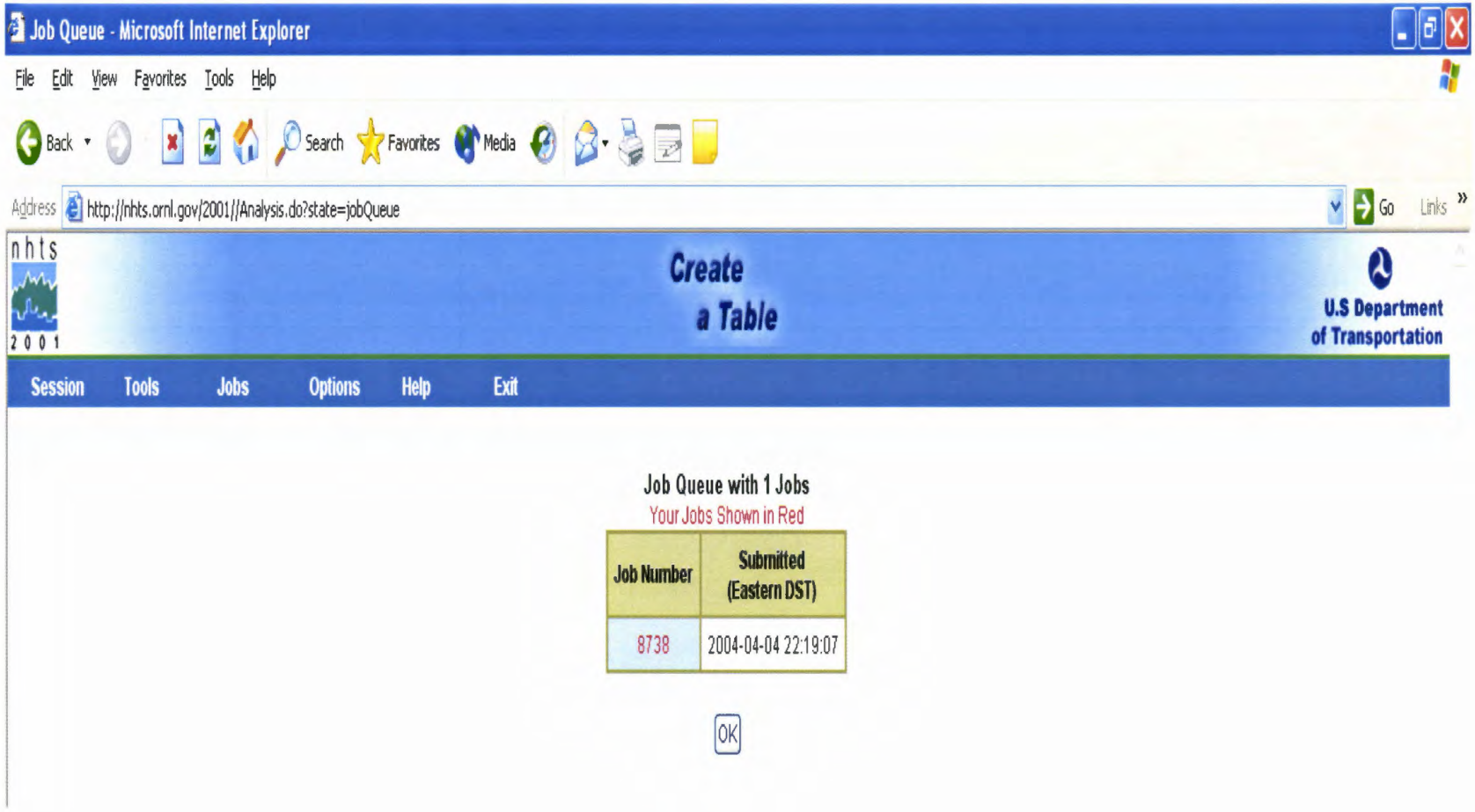
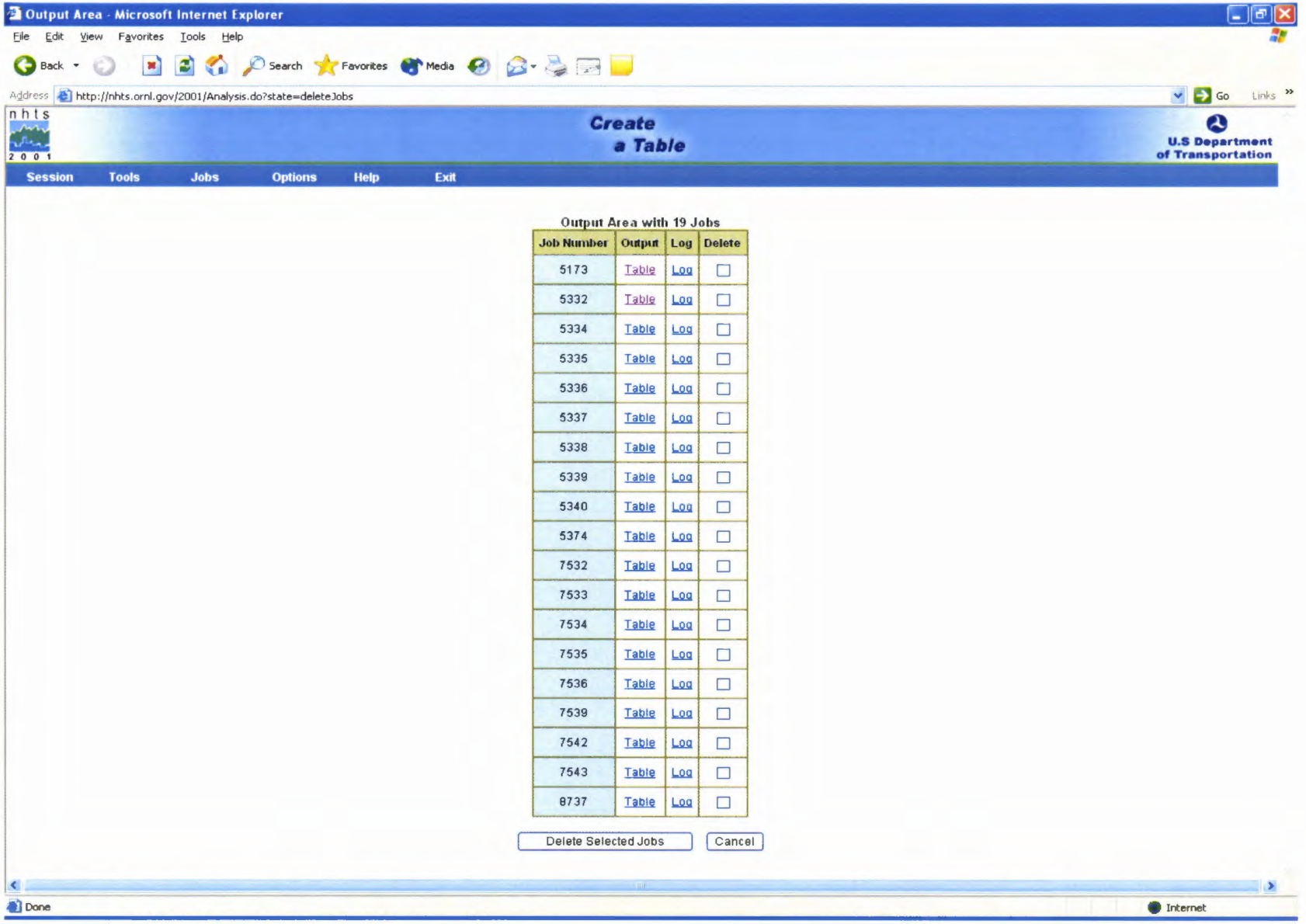
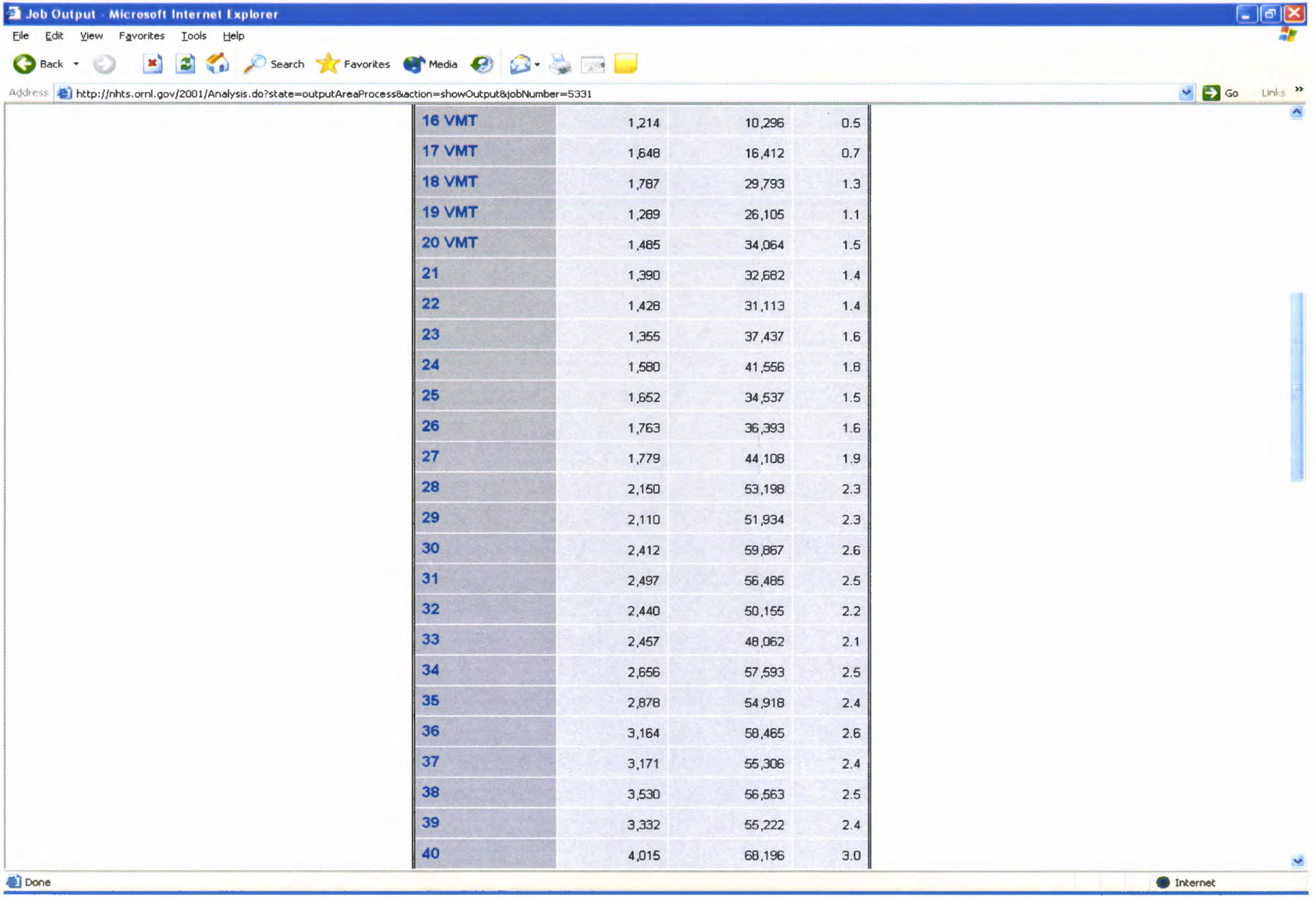
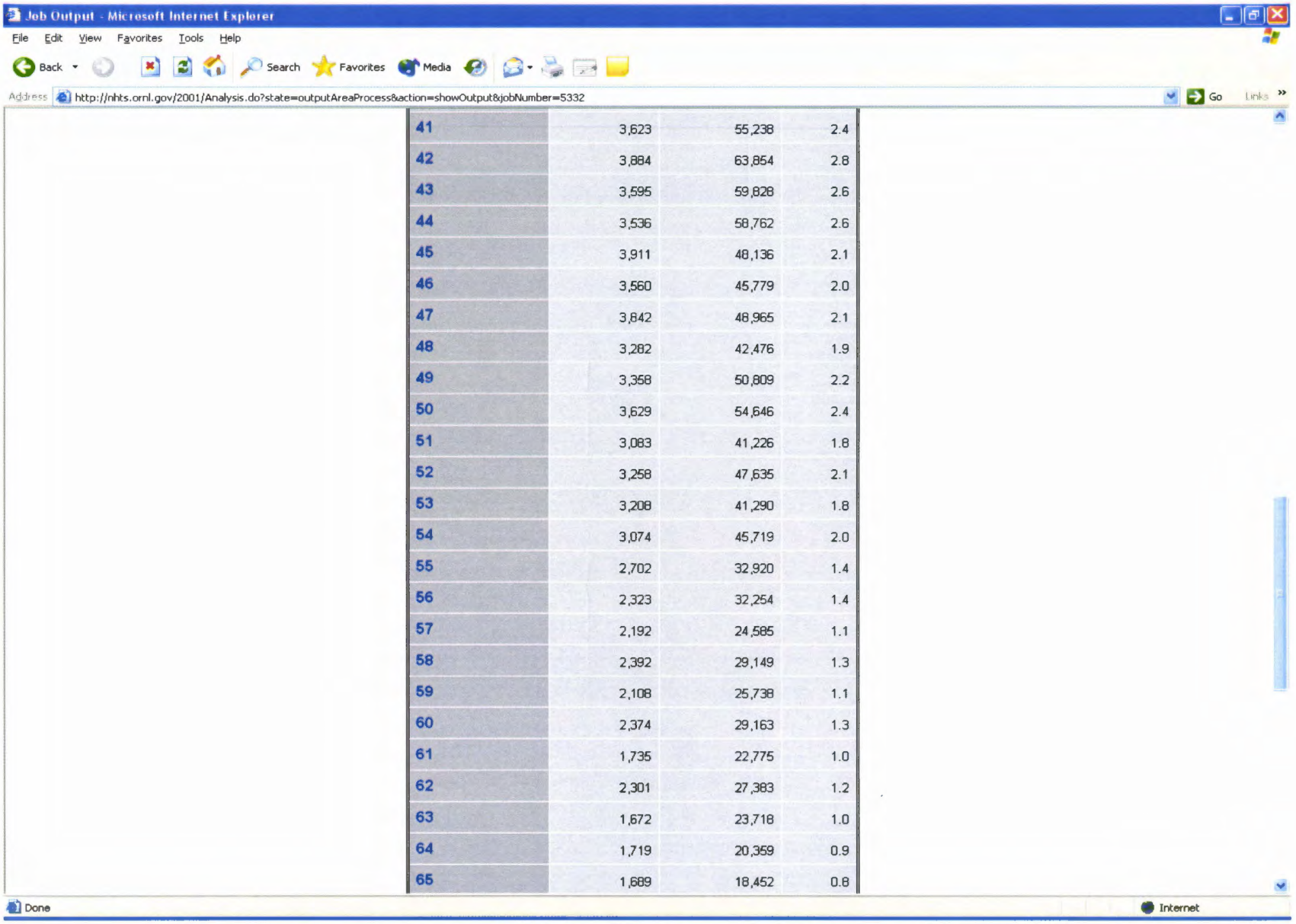
Go Links
nhts 2001
Create a Table
U.S Department of Transportation
Session Tools Jobs Options Help Exit
Your table request is named Job8737 and has been added to the job queue.
Please note the Jobs Menu above. It provides the following functions:
Output Area - provides access to job products including output, source, and log
Job Queue - displays job queue status
Continue


Job Queue - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://nhts.ornl.gov/2001//Analysis.do?state=jobQueue
Go Links
nhts 2001
Create a Table
U.S Department of Transportation
Session Tools Jobs Options Help Exit
Job Queue with 1 Jobs
Your Jobs Shown in Red
Job Number
Submitted (Eastern DST)
8738
2004-04-04 22:19:07
OK


Output Area - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://nhts.ornl.gov/2001/Analysis.do?state=deleteJobs
Go Links
nhts 2001
Create a Table
U.S Department of Transportation
Session Tools Jobs Options Help Exit
Output Area with 19 Jobs
Job Number | Output | Log | Delete
5173 Table Log
5332 Table Log
5334 Table Log
5335 Table Log
5336 Table Log
5337 Table Log
5338 Table Log
5339 Table Log
5340 Table Log
5374 Table Log
7532 Table Log
7533 Table Log
7534 Table Log
7535 Table Log
7536 Table Log
7539 Table Log
7542 Table Log
7543 Table Log
8737 Table Log
Delete Selected Jobs
Cancel
Done
Internet



16 VMT	1,214	10,296	0.5
17 VMT	1,648	16,412	0.7
18 VMT	1,787	29,793	1.3
19 VMT	1,289	26,105	1.1
20 VMT	1,485	34,064	1.5
21	1,390	32,682	1.4
22	1,428	31,113	1.4
23	1,355	37,437	1.6
24	1,580	41,556	1.8
25	1,652	34,537	1.5
26	1,763	36,393	1.6
27	1,779	44,108	1.9
28	2,150	53,198	2.3
29	2,110	51,934	2.3
30	2,412	59,867	2.6
31	2,497	56,485	2.5
32	2,440	50,155	2.2
33	2,457	48,062	2.1
34	2,656	57,593	2.5
35	2,878	54,918	2.4
36	3,164	58,465	2.6
37	3,171	55,306	2.4
38	3,530	56,563	2.5
39	3,332	55,222	2.4
40	4,015	68,196	3.0



41	3,623	55,238	2.4
42	3,884	63,854	2.8
43	3,595	59,828	2.6
44	3,536	58,762	2.6
45	3,911	48,136	2.1
46	3,560	45,779	2.0
47	3,842	48,965	2.1
48	3,282	42,476	1.9
49	3,358	50,809	2.2
50	3,629	54,646	2.4
51	3,083	41,226	1.8
52	3,258	47,635	2.1
53	3,208	41,290	1.8
54	3,074	45,719	2.0
55	2,702	32,920	1.4
56	2,323	32,254	1.4
57	2,192	24,585	1.1
58	2,392	29,149	1.3
59	2,108	25,738	1.1
60	2,374	29,163	1.3
61	1,735	22,775	1.0
62	2,301	27,383	1.2
63	1,672	23,718	1.0
64	1,719	20,359	0.9
65	1,689	18,452	0.8

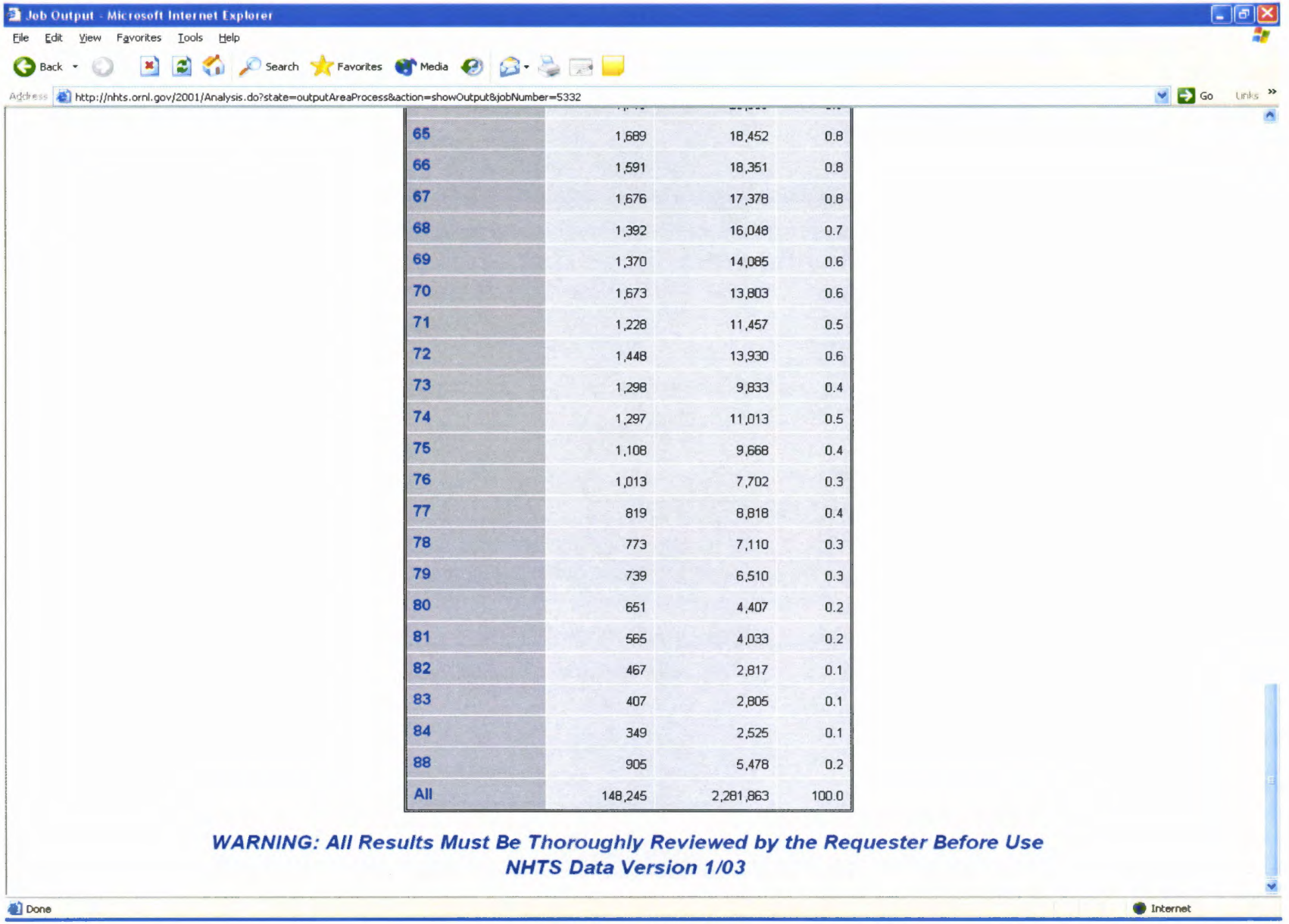

Job Output - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://nhts.ornl.gov/2001/Analysis.do?state=outputAreaProcess&action=showOutput&jobNumber=5332
Go Links
65 1,689 18,452 0.8
66 1,591 18,351 0.8
67 1,676 17,378 0.8
68 1,392 16,048 0.7
69 1,370 14,085 0.6
70 1,673 13,803 0.6
71 1,228 11,457 0.5
72 1,448 13,930 0.6
73 1,298 9,833 0.4
74 1,297 11,013 0.5
75 1,108 9,668 0.4
76 1,013 7,702 0.3
77 819 8,818 0.4
78 773 7,110 0.3
79 739 6,510 0.3
80 651 4,407 0.2
81 565 4,033 0.2
82 467 2,817 0.1
83 407 2,805 0.1
84 349 2,525 0.1
88 905 5,478 0.2
All 148,245 2,281,863 100.0
WARNING: All Results Must Be Thoroughly Reviewed by the Requester Before Use
NHTS Data Version 1/03
Done
Internet

Table D.2. Exposure (Million VMT) by Age and Time of Day

	Travel Day Vehicle Miles (Millions)																										
	Travel day trip start time, military																										
	Refused	Don"t Know	Hour of 00:00	Hour of 01:00	Hour of 02:00	Hour of 03:00	Hour of 04:00	Hour of 05:00	Hour of 06:00	Hour of 07:00	Hour of 08:00	Hour of 09:00	Hour of 10:00	Hour of 11:00	Hour of 12:00	Hour of 13:00	Hour of 14:00	Hour of 15:00	Hour of 16:00	Hour of 17:00	Hour of 18:00	Hour of 19:00	Hour of 20:00	Hour of 21:00	Hour of 22:00	Hour of 23:00	All
Respondent age																											
0																		6									6
1										1						41			15				1				59
2													2	2		49	11	12		42		11					131
3										62	5						1	6	42		90	1					208
4																	0										0
5									22											11	35						68
6									1								5				3						10
7													2	2	34			2	58		32		30				159
8																		3									3
9										16	21		105			19	109	2	19	19		23		15			347
10										13	2				17					5							37
11							13			1							16	1									30
12		36													19					33							88
13																			22								22
14										0							3	20					1				24
15-19	13	8	970	480	282	103	351	810	2,571	5,652	3,090	2,924	3,502	5,082	4,969	5,191	4,844	6,485	7,069	6,326	6,044	4,960	3,584	3,912	2,442	2,525	84,188
20-24		135	1,392	934	1,175	476	1,132	5,345	7,719	11,574	10,800	8,395	7,980	9,979	9,209	10,992	10,026	11,657	15,372	12,568	11,753	7,244	6,346	5,873	5,611	3,165	176,852
25-29		105	1,111	772	966	426	6,003	4,736	9,808	18,442	14,857	8,450	11,733	10,151	13,474	8,896	11,850	16,378	16,400	17,981	15,321	11,935	5,939	7,252	3,734	3,449	220,170
30-34		65	1,391	1,205	675	351	3,964	7,350	16,397	18,244	15,738	10,247	18,596	14,434	15,020	13,090	19,486	19,306	25,354	22,307	18,022	9,904	8,956	5,519	4,023	2,516	272,161
35-39		17	1,282	735	569	458	8,435	6,699	15,614	18,748	15,429	14,330	16,537	14,410	16,550	15,663	17,860	21,725	20,356	24,426	15,929	11,177	9,577	7,397	4,022	2,530	280,474
40-44	253	29	1,396	641	99	721	4,604	9,078	19,141	21,464	16,161	12,293	15,987	17,045	18,331	14,702	21,399	22,944	25,172	24,677	17,994	14,661	11,328	8,391	4,956	2,411	305,878
45	4	43	230		112		1,012	1,719	2,527	3,172	2,722	1,948	2,204	4,874	2,562	2,489	2,675	3,723	4,038	4,284	2,609	1,586	1,650	988	656	311	48,136
46		1	319	162	57	7	254	1,157	2,603	4,971	1,760	1,686	3,355	2,613	2,705	2,522	2,726	3,516	4,572	3,553	2,001	1,964	1,510	995	483	286	45,779
47		5	68	49	38	7	991	1,184	2,376	3,878	2,461	2,998	2,450	2,774	2,713	3,260	3,424	4,292	4,386	3,795	2,713	1,674	1,153	1,534	343	398	48,965
48		13	336	233	18	55	508	1,398	1,857	2,472	2,629	2,274	3,171	1,981	2,537	3,737	1,921	3,400	2,843	2,996	3,412	1,382	1,069	783	747	703	42,476
49		2	132	112	35	26	374	1,395	2,629	3,326	2,387	2,170	3,436	2,028	2,156	5,415	2,602	3,550	3,829	2,901	6,973	1,500	1,328	900	891	712	50,809
50		24	406	51	67	46	724	1,567	4,649	3,711	2,347	2,626	3,247	2,775	2,775	3,694	2,959	3,947	4,712	3,961	3,809	2,156	1,525	1,073	1,145	648	54,646
51		40	261	57	13	10	227	723	1,975	2,469	1,920	2,084	2,284	1,856	2,542	6,714	2,534	2,755	2,749	3,210	2,004	1,467	1,094	1,366	587	286	41,226
52			38	83	11	1,091	408	742	3,361	3,386	2,656	2,415	3,236	3,106	3,759	3,019	2,932	3,576	3,899	3,467	1,841	1,288	1,181	1,050	598	495	47,635
53		90	49	79	69	47	380	851	1,310	2,771	2,620	2,616	2,256	2,304	3,056	2,167	3,113	3,486	3,809	3,210	2,995	1,161	930	918	518	486	41,290
54	7	12	298	40	25	61	439	1,616	2,351	2,837	3,196	2,794	3,385	2,427	2,252	2,442	2,419	2,956	3,725	4,104	2,852	1,963	1,301	1,274	332	612	45,719
55		4	106	225	9	5	266	794	1,931	1,777	1,937	1,947	2,255	2,019	1,408	2,601	1,586	2,213	3,464	2,773	2,101	827	1,106	896	477	193	32,920
56			577	64	24	34	717	789	1,023	1,984	1,713	2,093	2,200	1,859	2,387	1,807	2,008	2,197	2,631	2,568	1,918	1,002	1,177	634	438	411	32,254
57			73	10	133	40	180	711	1,221	1,206	989	1,407	1,474	1,625	1,706	1,841	1,174	2,715	1,581	2,037	1,966	968	621	545	244	120	24,585
58			54	1	3		226	476	1,729	1,944	2,275	1,901	1,786	2,371	1,389	1,938	2,457	2,038	2,336	2,102	1,513	701	898	540	351	118	29,149
59			15	117		16	496	473	1,215	2,481	1,214	1,525	1,348	2,213	1,443	1,279	2,232	2,440	1,868	1,956	1,011	915	882	239	312	48	25,738
60		1	133	46			232	400	1,517	1,708	1,949	1,596	2,077	2,121	1,891	2,155	2,077	2,294	2,711	2,397	1,327	887	340	830	330	147	29,163
61		1	19	4	28	24	84	375	949	1,230	1,565	1,852	1,954	1,048	1,605	1,265	1,351	2,117	2,162	1,313	1,352	850	620	314	225	471	22,775
62		11	45				155	1,167	1,765	1,425	2,235	2,194	2,119	1,577	1,461	2,056	1,421	1,892	2,070	1,551	1,148	1,182	451	371	610	480	27,383
63		52	145	81			1,475	426	924	1,104	2,542	1,296	2,036	1,960	1,659	1,961	1,333	1,420	2,050	1,335	493	551	473	270	56	76	23,718
64			13	25		11	245	772	797	833	969	1,421	1,955	1,727	1,260	1,490	1,622	1,693	1,454	1,646	983	566	365	348	138	27	20,359
65					85		264	144	382	533	1,395	1,319	2,571	1,266	1,467	1,506	1,525	1,835	1,107	926	905	554	387	137	50	93	18,452
66			188				7	64	269	1,726	1,456	1,274	1,341	1,111	1,211	1,263	2,059	1,264	1,343	1,421	909	268	748	297	124	11	18,351
67		743	33	5			5	261	183	509	1,612	1,140	1,569	947	1,433	1,581	1,479	1,687	1,349	762	503	663	483	196	162	73	17,378
68		3	112		39		43	148	681	305	1,330	1,317	1,176	1,364	1,022	1,608	1,058	1,376	683	1,318	482	727	787	375	75	17	16,048
69		28	114					65	423	689	911	750	1,162	1,299	1,704	1,257	834	1,348	864	737	853	477	155	280	115	23	14,085
70		58	2	38			4	45	458	613	690	791	1,398	1,418	862	1,576	903	1,530	925	761	501	369	574	159	54	76	13,803
71		35	5	43	11		10	66	143	236	770	947	947	914	1,275	1,416	1,014	860	533	700	527	251	286	162	139	167	11,457
72		1	1		3		10	163	647	745	529	876	1,970	1,367	762	1,371	1,425	1,066	955	561	558	351	228	286	54	1	13,930
73		1	2				25	470	83	254	457	801	841	811	1,268	948	568	950	721	643	334	264	123	190	66	12	9,833
74			2	14			13	42	266	343	1,250	776	895	1,160	707	742	810	1,205	901	580	353	201	401	146	79	125	11,013
75							2	278	342	609	434	546	1,075	877	661	1,173	719	908	743	239	285	309	251	136	75	3	9,668
76						3		21	171	196	428	940	1,084	1,082	772	473	534	381	219	611	206	310	72	98	102	1	7,702
77		10						125	431	358	717	681	781	803	1,125	748	1,048	591	500	300	195	162	87	90	57	10	8,818
78								3	43	270	544	1,432	762	472	462	543	614	396	454	155	417	245	65	156	73	5	7,110
79								922	110	338	353	407	688	525	488	503	541	604	331	173	71	305	92	13	28	18	6,510
80							170	52	18	37	254	356	398	632	555	393	378	350	255	250	165	70	46	17	10		4,407
81		9						3	12	92	171	436	443	324	794	232	435	273	265	108	64	92	140	29	105	7	4,033
82								4		30	119	177	219	291	233	284	248	294	350	207	133	48	33	33	111	1	2,817
83		15						59	33	23	80	432	239	254	258	258	365	192	173	90	46	70	128	46	45		2,805
84									13	40	110	172	621	258	145	158	314	199	178	75	138	53	28	0	22		2,525
88		11				3		80	21	156	289	343	461	643	514	370	825	478	528	375	153	84	28	40	25	51	5,478
All	277	1,609	11,318	6,307	4,545	4,019	34,447	55,769	114,709	151,005	132,089	113,394	143,307	134,182	138,608	140,896	147,874	172,554	184,142	174,546	138,040	90,384	70,575	57,114	35,837	24,315	2,281,863

Table D.3. Exposure (Million VMT) by Age Group and Time of Day

	Travel Day Vehicle Miles (Millions)																										
	Travel day trip start time, military																										
	Refused	Don"t Know	Hour of 00:00	Hour of 01:00	Hour of 02:00	Hour of 03:00	Hour of 04:00	Hour of 05:00	Hour of 06:00	Hour of 07:00	Hour of 08:00	Hour of 09:00	Hour of 10:00	Hour of 11:00	Hour of 12:00	Hour of 13:00	Hour of 14:00	Hour of 15:00	Hour of 16:00	Hour of 17:00	Hour of 18:00	Hour of 19:00	Hour of 20:00	Hour of 21:00	Hour of 22:00	Hour of 23:00	All
Respondent age																											
0-5									22	63	5		2	2		91	13	24	57	54	125	13		1			472
6-15		36	1				13	6	2	69	59	12	114	43	119	86	307	392	241	236	120	220	193	21	13		2,303
16-20	13	79	1,459	764	507	265	431	1,220	3,979	7,684	5,814	3,904	5,327	7,899	6,788	7,652	6,675	8,046	9,052	8,402	7,923	5,986	4,976	5,155	3,531	3,135	116,669
21-25		87	1,202	822	1,070	404	1,361	5,914	7,504	11,771	9,435	9,050	8,592	8,828	9,758	9,910	10,169	12,043	15,808	13,258	12,368	8,035	5,825	5,807	5,198	3,105	177,325
26-30		118	1,013	823	1,174	407	7,053	5,141	13,903	19,902	17,472	8,178	12,241	12,166	14,434	10,119	13,171	18,442	19,187	19,238	17,723	11,960	6,714	7,604	3,831	3,484	245,500
31-35		31	1,436	999	412	394	4,728	7,409	13,557	17,416	14,644	11,726	18,525	13,891	14,185	12,620	21,376	20,029	23,152	22,587	15,985	11,008	8,203	5,823	4,442	2,633	267,212
36-40	234	17	1,423	775	514	371	7,088	7,021	18,306	20,211	15,948	14,699	16,827	14,272	18,282	17,836	17,183	21,633	21,956	25,458	16,466	12,363	10,554	8,068	3,998	2,248	293,753
41-45	23	72	1,237	583	200	694	4,839	9,025	16,527	20,274	15,448	11,017	15,019	18,878	16,620	12,818	19,392	21,661	24,461	23,445	17,121	11,920	10,943	6,870	4,431	2,303	285,819
46-50		46	1,261	607	215	142	2,851	6,702	14,114	18,359	11,584	11,754	15,659	12,170	12,888	18,628	13,633	18,705	20,343	17,206	18,908	8,676	6,585	5,286	3,609	2,746	242,675
51-55	7	146	753	484	127	1,214	1,720	4,725	10,928	13,240	12,329	11,856	13,415	11,711	13,017	16,941	12,584	14,987	17,645	16,763	11,793	6,706	5,611	5,505	2,511	2,070	208,790
56-60		1	852	238	160	89	1,851	2,850	6,705	9,323	8,141	8,521	8,884	10,188	8,815	9,019	9,947	11,685	11,127	11,060	7,736	4,473	3,919	2,788	1,675	843	140,889
61-65		64	222	110	114	35	2,222	2,884	4,817	5,125	8,706	8,082	10,634	7,578	7,452	8,277	7,251	8,957	8,843	6,770	4,881	3,704	2,294	1,440	1,078	1,146	112,687
66-70		832	449	43	39		58	582	2,013	3,842	5,999	5,272	6,646	6,139	6,231	7,284	6,332	7,204	5,164	4,999	3,248	2,505	2,747	1,307	529	200	79,665
71-75		37	9	57	14		61	1,019	1,482	2,187	3,440	3,946	5,728	5,130	4,673	5,651	4,537	4,989	3,854	2,724	2,057	1,377	1,288	919	414	308	55,900
76-79		10				3		1,071	755	1,162	2,041	3,459	3,315	2,882	2,847	2,268	2,737	1,972	1,503	1,239	888	1,022	316	356	259	34	30,140
80-84		24					170	118	75	221	733	1,573	1,919	1,760	1,984	1,326	1,740	1,308	1,222	731	546	334	375	125	293	8	16,587
85+		11				3		80	21	156	289	343	461	643	514	370	825	478	528	375	153	84	28	40	25	51	5,478
All	277	1,609	11,318	6,307	4,545	4,019	34,447	55,769	114,709	151,005	132,089	113,394	143,307	134,182	138,608	140,896	147,874	172,554	184,142	174,546	138,040	90,384	70,575	57,114	35,837	24,315	2,281,863

Table D.4. Percent Exposure by Age group and Time of Day

	Travel Day Vehicle Miles (Cell %)																										
	Travel day trip start time, military																										
	Refused	Don"t Know	Hour of 00:00	Hour of 01:00	Hour of 02:00	Hour of 03:00	Hour of 04:00	Hour of 05:00	Hour of 06:00	Hour of 07:00	Hour of 08:00	Hour of 09:00	Hour of 10:00	Hour of 11:00	Hour of 12:00	Hour of 13:00	Hour of 14:00	Hour of 15:00	Hour of 16:00	Hour of 17:00	Hour of 18:00	Hour of 19:00	Hour of 20:00	Hour of 21:00	Hour of 22:00	Hour of 23:00	All
Respondent age																											
0-5									0	0	0		0	0		0	0	0	0	0	0	0		0			0
6-15		0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0.1
16-20	0	0	0.1	0	0	0	0	0.1	0.2	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.1	5.1
21-25		0	0.1	0	0	0	0.1	0.3	0.3	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.1	7.8
26-30		0	0	0	0.1	0	0.3	0.2	0.6	0.9	0.8	0.4	0.5	0.5	0.6	0.4	0.6	0.8	0.8	0.8	0.8	0.5	0.3	0.3	0.2	0.2	10.8
31-35		0	0.1	0	0	0	0.2	0.3	0.6	0.8	0.6	0.5	0.8	0.6	0.6	0.6	0.9	0.9	1	1	0.7	0.5	0.4	0.3	0.2	0.1	11.7
36-40	0	0	0.1	0	0	0	0.3	0.3	0.8	0.9	0.7	0.6	0.7	0.6	0.8	0.8	0.8	0.9	1	1.1	0.7	0.5	0.5	0.4	0.2	0.1	12.9
41-45	0	0	0.1	0	0	0	0.2	0.4	0.7	0.9	0.7	0.5	0.7	0.8	0.7	0.6	0.8	0.9	1.1	1	0.8	0.5	0.5	0.3	0.2	0.1	12.5
46-50		0	0.1	0	0	0	0.1	0.3	0.6	0.8	0.5	0.5	0.7	0.5	0.6	0.8	0.6	0.8	0.9	0.8	0.8	0.4	0.3	0.2	0.2	0.1	10.6
51-55	0	0	0	0	0	0.1	0.1	0.2	0.5	0.6	0.5	0.5	0.6	0.5	0.6	0.7	0.6	0.7	0.8	0.7	0.5	0.3	0.2	0.2	0.1	0.1	9.1
56-60		0	0	0	0	0	0.1	0.1	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.3	0.2	0.2	0.1	0.1	0	6.2
61-65		0	0	0	0	0	0.1	0.1	0.2	0.2	0.4	0.4	0.5	0.3	0.3	0.4	0.3	0.4	0.4	0.3	0.2	0.2	0.1	0.1	0	0.1	4.9
66-70		0	0	0	0		0	0	0.1	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0	0	3.5
71-75		0	0	0	0		0	0	0.1	0.1	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0	0	0	2.4
76-79		0				0		0	0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0	0	0	0	1.3
80-84		0					0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0	0	0	0	0	0.7
85+		0				0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
All	0	0.1	0.5	0.3	0.2	0.2	1.5	2.4	5	6.6	5.8	5	6.3	5.9	6.1	6.2	6.5	7.6	8.1	7.6	6	4	3.1	2.5	1.6	1.1	100

Table D.5. Total Percent Exposure by Age Group

	Travel Day Vehicle Miles (Row %)																										
	Travel day trip start time, military																										
	Refused	Don"t Know	Hour of 00:00	Hour of 01:00	Hour of 02:00	Hour of 03:00	Hour of 04:00	Hour of 05:00	Hour of 06:00	Hour of 07:00	Hour of 08:00	Hour of 09:00	Hour of 10:00	Hour of 11:00	Hour of 12:00	Hour of 13:00	Hour of 14:00	Hour of 15:00	Hour of 16:00	Hour of 17:00	Hour of 18:00	Hour of 19:00	Hour of 20:00	Hour of 21:00	Hour of 22:00	Hour of 23:00	All
Respondent age																											
0-5									4.6	13.4	1.1		0.5	0.5		19.2	2.8	5.1	12	11.4	26.5	2.7		0.3			100
6-15		1.5	0				0.6	0.3	0.1	3	2.6	0.5	5	1.9	5.2	3.7	13.3	17	10.5	10.3	5.2	9.5	8.4	0.9	0.6		100
16-20	0	0.1	1.3	0.7	0.4	0.2	0.4	1	3.4	6.6	5	3.3	4.6	6.8	5.8	6.6	5.7	6.9	7.8	7.2	6.8	5.1	4.3	4.4	3	2.7	100
21-25		0	0.7	0.5	0.6	0.2	0.8	3.3	4.2	6.6	5.3	5.1	4.8	5	5.5	5.6	5.7	6.8	8.9	7.5	7	4.5	3.3	3.3	2.9	1.8	100
26-30		0	0.4	0.3	0.5	0.2	2.9	2.1	5.7	8.1	7.1	3.3	5	5	5.9	4.1	5.4	7.5	7.8	7.8	7.2	4.9	2.7	3.1	1.6	1.4	100
31-35		0	0.5	0.4	0.2	0.1	1.8	2.8	5.1	6.5	5.5	4.4	6.9	5.2	5.3	4.7	8	7.5	8.7	8.5	6	4.1	3.1	2.2	1.7	1	100
36-40	0.1	0	0.5	0.3	0.2	0.1	2.4	2.4	6.2	6.9	5.4	5	5.7	4.9	6.2	6.1	5.8	7.4	7.5	8.7	5.6	4.2	3.6	2.7	1.4	0.8	100
41-45	0	0	0.4	0.2	0.1	0.2	1.7	3.2	5.8	7.1	5.4	3.9	5.3	6.6	5.8	4.5	6.8	7.6	8.6	8.2	6	4.2	3.8	2.4	1.6	0.8	100
46-50		0	0.5	0.3	0.1	0.1	1.2	2.8	5.8	7.6	4.8	4.8	6.5	5	5.3	7.7	5.6	7.7	8.4	7.1	7.8	3.6	2.7	2.2	1.5	1.1	100
51-55	0	0.1	0.4	0.2	0.1	0.6	0.8	2.3	5.2	6.3	5.9	5.7	6.4	5.6	6.2	8.1	6	7.2	8.5	8	5.6	3.2	2.7	2.6	1.2	1	100
56-60		0	0.6	0.2	0.1	0.1	1.3	2	4.8	6.6	5.8	6	6.3	7.2	6.3	6.4	7.1	8.3	7.9	7.9	5.5	3.2	2.8	2	1.2	0.6	100
61-65		0.1	0.2	0.1	0.1	0	2	2.6	4.3	4.5	7.7	7.2	9.4	6.7	6.6	7.3	6.4	7.9	7.8	6	4.3	3.3	2	1.3	1	1	100
66-70		1	0.6	0.1	0		0.1	0.7	2.5	4.8	7.5	6.6	8.3	7.7	7.8	9.1	7.9	9	6.5	6.3	4.1	3.1	3.4	1.6	0.7	0.3	100
71-75		0.1	0	0.1	0		0.1	1.8	2.7	3.9	6.2	7.1	10.2	9.2	8.4	10.1	8.1	8.9	6.9	4.9	3.7	2.5	2.3	1.6	0.7	0.6	100
76-79		0				0		3.6	2.5	3.9	6.8	11.5	11	9.6	9.4	7.5	9.1	6.5	5	4.1	2.9	3.4	1	1.2	0.9	0.1	100
80-84		0.1					1	0.7	0.5	1.3	4.4	9.5	11.6	10.6	12	8	10.5	7.9	7.4	4.4	3.3	2	2.3	0.8	1.8	0	100
85+		0.2				0		1.5	0.4	2.9	5.3	6.3	8.4	11.7	9.4	6.8	15.1	8.7	9.6	6.8	2.8	1.5	0.5	0.7	0.5	0.9	100
All	0	0.1	0.5	0.3	0.2	0.2	1.5	2.4	5	6.6	5.8	5	6.3	5.9	6.1	6.2	6.5	7.6	8.1	7.6	6	4	3.1	2.5	1.6	1.1	100

Table D.6. Total Percent Exposure by Time of Day

	Travel Day Vehicle Miles (Column %)																										
	Travel day trip start time, military																										
	Refused	Don"t Know	Hour of 00:00	Hour of 01:00	Hour of 02:00	Hour of 03:00	Hour of 04:00	Hour of 05:00	Hour of 06:00	Hour of 07:00	Hour of 08:00	Hour of 09:00	Hour of 10:00	Hour of 11:00	Hour of 12:00	Hour of 13:00	Hour of 14:00	Hour of 15:00	Hour of 16:00	Hour of 17:00	Hour of 18:00	Hour of 19:00	Hour of 20:00	Hour of 21:00	Hour of 22:00	Hour of 23:00	All
Respondent age																											
0-5									0	0	0		0	0		0.1	0	0	0	0	0.1	0		0			0
6-15		2.2	0				0	0	0	0	0	0	0.1	0	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.3	0	0		0.1
16-20	4.8	4.9	12.9	12.1	11.1	6.6	1.3	2.2	3.5	5.1	4.4	3.4	3.7	5.9	4.9	5.4	4.5	4.7	4.9	4.8	5.7	6.6	7.1	9	9.9	12.9	5.1
21-25		5.4	10.6	13	23.5	10.1	4	10.6	6.5	7.8	7.1	8	6	6.6	7	7	6.9	7	8.6	7.6	9	8.9	8.3	10.2	14.5	12.8	7.8
26-30		7.3	9	13.1	25.8	10.1	20.5	9.2	12.1	13.2	13.2	7.2	8.5	9.1	10.4	7.2	8.9	10.7	10.4	11	12.8	13.2	9.5	13.3	10.7	14.3	10.8
31-35		1.9	12.7	15.8	9.1	9.8	13.7	13.3	11.8	11.5	11.1	10.3	12.9	10.4	10.2	9	14.5	11.6	12.6	12.9	11.6	12.2	11.6	10.2	12.4	10.8	11.7
36-40	84.4	1.1	12.6	12.3	11.3	9.2	20.6	12.6	16	13.4	12.1	13	11.7	10.6	13.2	12.7	11.6	12.5	11.9	14.6	11.9	13.7	15	14.1	11.2	9.2	12.9
41-45	8.4	4.4	10.9	9.3	4.4	17.3	14	16.2	14.4	13.4	11.7	9.7	10.5	14.1	12	9.1	13.1	12.6	13.3	13.4	12.4	13.2	15.5	12	12.4	9.5	12.5
46-50		2.8	11.1	9.6	4.7	3.5	8.3	12	12.3	12.2	8.8	10.4	10.9	9.1	9.3	13.2	9.2	10.8	11	9.9	13.7	9.6	9.3	9.3	10.1	11.3	10.6
51-55	2.4	9.1	6.7	7.7	2.8	30.2	5	8.5	9.5	8.8	9.3	10.5	9.4	8.7	9.4	12	8.5	8.7	9.6	9.6	8.5	7.4	8	9.6	7	8.5	9.1
56-60		0	7.5	3.8	3.5	2.2	5.4	5.1	5.8	6.2	6.2	7.5	6.2	7.6	6.4	6.4	6.7	6.8	6	6.3	5.6	4.9	5.6	4.9	4.7	3.5	6.2
61-65		4	2	1.7	2.5	0.9	6.5	5.2	4.2	3.4	6.6	7.1	7.4	5.6	5.4	5.9	4.9	5.2	4.8	3.9	3.5	4.1	3.3	2.5	3	4.7	4.9
66-70		51.7	4	0.7	0.9		0.2	1	1.8	2.5	4.5	4.6	4.6	4.6	4.5	5.2	4.3	4.2	2.8	2.9	2.4	2.8	3.9	2.3	1.5	0.8	3.5
71-75		2.3	0.1	0.9	0.3		0.2	1.8	1.3	1.4	2.6	3.5	4	3.8	3.4	4	3.1	2.9	2.1	1.6	1.5	1.5	1.8	1.6	1.2	1.3	2.4
76-79		0.6				0.1		1.9	0.7	0.8	1.5	3.1	2.3	2.1	2.1	1.6	1.9	1.1	0.8	0.7	0.6	1.1	0.4	0.6	0.7	0.1	1.3
80-84		1.5					0.5	0.2	0.1	0.1	0.6	1.4	1.3	1.3	1.4	0.9	1.2	0.8	0.7	0.4	0.4	0.4	0.5	0.2	0.8	0	0.7
85+		0.7				0.1		0.1	0	0.1	0.2	0.3	0.3	0.5	0.4	0.3	0.6	0.3	0.3	0.2	0.1	0.1	0	0.1	0.1	0.2	0.2
All	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

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