TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/TX-85/67+396-1		

4. Title and Subtitle	5. Report Date / 6. Performing Organization Code
COSTS OF MOTOR VEHICLE ACCIDENTS IN TEXAS	5. Report Date: May 1985 6. Performing Organization Code:
7. Author(s) John B. Rollins and William F. McFarland	8. Performing Organization Report No. 396-1
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843	10. Work Unit No. 11. Contract or Grant No. 2-8-84-396
12. Sponsoring Agency Name and Address Texas State Department of Highways and Public Transportation Transportation Planning Division P.O. Box 5051, Austin, Texas 78763	13. Type of Report and Period Covered Interim Report September 1983-August 1984 14. Sponsoring Agency Code

15. Supplementary Notes

This study was conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administation.
Study Title: Improved Values of Travel Time and Accident Costs for Highway Project Evaluations

16. Abstract

Accident costs are an important element in quantifying the safety benefits of roadway projects, including new construction and major reconstruction as well as traffic accident countermeasures. Currently used estimates of the costs of traffic accidents, such as the accident costs provided by the National Safety Council or the AASHTO revised Red Book, are out-of-date and do not account for many accident cost differences by accident type, highway type, and other relevant categories.

In order to provide highway project analysts with better means of evaluating roadway projects in Texas, improved and updated accident costs were developed in this study. Based on Texas traffic accident data for 1981-82, these accident costs were developed by several cross-classifications and for different subsets of accidents.

The accident costs developed in this study can be used in the Highway Economic Evaluation Model (HEEM) and in analyzing traffic accident countermeasures. Recommendations for future updating of the costs and for using them in setting project priorities are provided.

17. Key Words	18. Distribution Statement
accident costs, benefit-cost economic evaluation, HEEM, highway safety	No restrictions. This document is available to the public through the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	156	

Form DOT F 1700.7 (8-69)

COSTS OF MOTOR VEHICLE ACCIDENTS IN TEXAS

by

John B. Rollins
Assistant Research Economist

and

William F. McFarland
Research Economist

Research Report 396-1
Research Study Number 2-8-84-396
Improved Values of Travel Time and Accident Costs
for Highway Project Evaluations

Sponsored by

Texas State Department of Highways
and Public Transportation

in cooperation with

U.S. Department of Transportation
Federal Highway Administration

May 1985

Texas Transportation Institute
The Texas A&M University System
College Station, Texas

PREFACE

This study was prepared by the Texas Transportation Institute for the Texas State Department of Highways and Public Transportation. It was prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

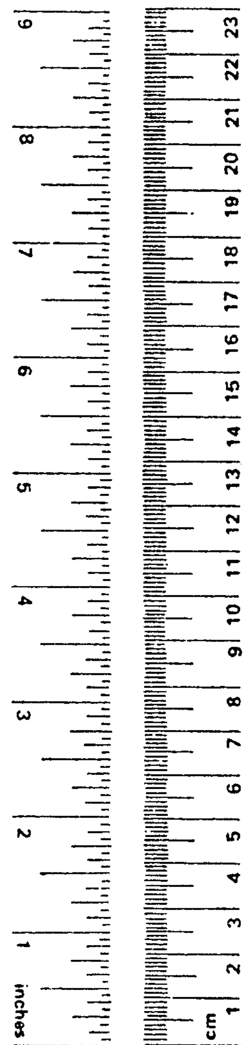
The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

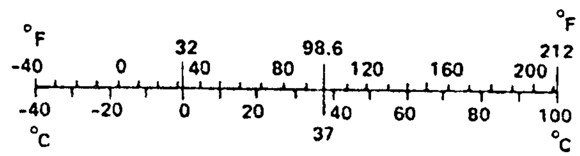
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



SUMMARY OF FINDINGS

Accident costs were developed for use in evaluating accident reduction benefits of roadway projects in Texas. Based on Texas traffic accident and roadway data for 1981-82, these accident costs represent an improvement over such out-of-date accident costs as those provided by the National Safety Council or the AASHTO revised Red Book. The accident costs developed in this study can be either used to evaluate traffic accident countermeasures or used in the Highway Economic Evaluation Model (HEEM) to evaluate major construction or reconstruction projects.

The total cost per accident was calculated from direct and indirect elements. Direct costs were derived on the basis of vehicle involvement costs updated to 1983 and Texas accident data on numbers of involvements per accident. Indirect costs per fatality were based on a market-oriented approach to estimating the value of an accident victim's life to himself and on NHTSA estimates of other indirect costs. Indirect costs per A-B-C injury in fatal and injury accidents were developed using Texas accident data and the NHTSA-based indirect cost per A-B-C injury, derived through a cross-classification of injury severities by the A-B-C scale and the Abbreviated Injury Scale.

Recommendations were made for future updating of the accident costs and for using the costs in setting roadway project priorities. The costs should be updated annually by a simple updating procedure based on two wage and price indices. Periodic updating, every two or three years, should be done using the most recent accident data and several wage and price indices. It was also recommended that using the accident costs in project prioritization, using integer programming and incremental benefit-cost techniques, be considered.

IMPLEMENTATION STATEMENT

This report presents updated and improved accident costs for Texas. These accident costs are presented for several cross-classifications of accidents and for total, wet-weather, and night accidents. The accident costs can be used directly in estimating the accident reduction benefits of roadway projects, primarily either through the Highway Economic Evaluation Model (HEEM) or in accident countermeasure evaluations. Recommendations for future updating of these accident costs and for their use in project prioritization are provided.

The accident costs developed in this report can be implemented immediately to enhance the evaluation of accident reduction benefits of roadway projects, using existing evaluation techniques of the State Department of Highways and Public Transportation. The recommendations for updating the accident costs and using them in project prioritization can be implemented in the future as needed or as appropriate.

TABLE OF CONTENTS

TABLE OF CONTENTS

(continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF FIGURES

CHAPTER I. INTRODUCTION

Benefit-cost analysis of proposed highway projects is a crucial element in the process of allocating highway expenditures. Motorist and pedestrian safety is an important aspect of the benefits of roadway projects, including new construction and major reconstruction as well as traffic accident countermeasures. Accident costs are a proven and accepted approach to quantifying the safety benefits of reductions in accident frequency or severity.

Currently used estimates of the societal costs of traffic accidents, such as the accident costs provided by the National Safety Council [1] or the AASHTO revised Red Book [2], are out-of-date and do not account for many accident cost differences by accident type, highway type, and other relevant categories. Failure to use updated accident cost values and to recognize differences in the costs and proportions of accidents by severity and other categories can lead to less precise estimates of highway project safety benefits and, hence, to less effective allocation of funds, than does taking these differences into account in benefit-cost analyses of projects.

In order to provide highway project analysts in Texas with improved accident cost values, accident costs were developed by several relevant cross-classifications and for different subsets of accidents and were updated to 1983. Accident statistics on vehicles and victims, based on Texas traffic accident data, were used to develop costs per accident and average accident costs weighted across severity. This report presents these improved accident costs for Texas, which can be used to enhance the estimation of the benefits of accident reduction for Texas roadway project evaluations, along with discussions of the use of these improved accident costs in analysis of roadway projects.

CHAPTER II. BACKGROUND

Definitions of Accident Costs

Various attempts have been made to estimate societal losses due to traffic accidents, resulting in the development of four types, or definitions, of accident costs. The first type of accident costs is referred to as direct costs, such as recommended by Winfrey [3]. Direct costs include only those costs directly associated with an accident: property damage, medical expenses, lost worktime from injuries, legal costs, damage awards, and loss of vehicle use.

The second type of accident costs includes both direct accident costs and certain indirect costs. The latter consists, in this case, of the present value of future net production lost as a result of an accident. Net production is the present value of expected future earnings less the accident victim's expected consumption. Net production, or net future earnings, represents the future output of goods and services that society (excluding the accident victim) loses when an individual is killed or rendered permanently and totally disabled by an accident. By excluding the accident victim's expected future consumption, this valuation excludes the value of an accident victim's life to himself and, therefore, understates the total cost. Examples of this type of accident cost estimate are values recommended by the National Safety Council [1] and the revised Red Book [2].

The third type of accident costs differs from the second in that indirect costs include the gross, or total, future production of the accident victim. By including the victim's expected future consumption, this estimate more accurately measures total loss. The National Highway Traffic Safety Administration (NHTSA) has developed cost estimates of this type [4].

The fourth type of accident costs is based on willingness to pay to avoid a fatal accident, estimated through an evaluation of motorists' choices involving varying degrees of risk. In this sense, this is a market-oriented approach to estimating accident costs. This type of accident costs includes indirect cost factors not reflected in any of the other three types of costs, since it reflects the value of a person's life to himself and to others. Studies estimating the value of one's life to himself suggest that the other three types of accident cost values understate total losses. For example, a study of motorists' seat belt use [18] estimated this value of life to be $377,790 (in 1980 dollars), compared with the National Safety Council's estimate of $160,000 (in 1979 dollars) for the total cost per fatality [1], or the NHTSA value of $311,375 (in 1980 dollars) for the value of one's life to himself [4]. The market approach to accident cost estimation was used in recent research for the Federal Highway Administration to develop accident costs for several states [5].

Sources of Direct Costs

Notable attempts to estimate direct costs per traffic accident include studies by Wilbur Smith and Associates, Inc. [6] and the U.S. Department of Transportation [4]. The Wilbur Smith study developed direct accident costs as part of a study of primarily urban and suburban accidents in the Washington, D.C. area. This study was apparently used by the California Department of Transportation in developing accident costs for California [7]. The California accident costs were later updated and included in the revised Red Book by the Stanford Research Institute [2]. The Wilbur Smith costs, however, were not developed by the types of cross-classifications needed for detailed benefit-cost analyses of highway projects.

The U.S. Department of Transportation study developed what are commonly referred to as NHTSA accident costs. These cost estimates were developed by severity only and, from the standpoint of highway safety cost-effectiveness analysis, are therefore lacking in that no cross-classifications were used. The NHTSA costs were developed per fatality, per injury (five severities), and per property-damage-only (PDO) accident. Thus, no NHTSA estimate is available of the cost per fatal or injury accident or per fatal or injury vehicle involvement, and such costs cannot be derived from the NHTSA data. Further, some cost items (e.g., property damage) per fatality appear to actually be per vehicle involvement. In addition, property damage estimates are based on insurance claims for damage to relatively new cars only and so are not representative of all damaged vehicles.

The only available source of direct costs per vehicle involvement, by the cross-classifications needed in detailed cost-effectiveness studies of highway projects, is a group of state accident cost studies that were performed in Illinois [8], Massachusetts [9,10], New Mexico [11], Ohio [12], and Utah [13], based on guidelines from the U.S. Bureau of Public Roads [14]. The costs for Illinois, Massachusetts, New Mexico, and Utah were later shown to be statistically comparable and were consolidated by Burke [15] into estimates of direct involvement costs per passenger car, single-unit truck, and combination truck by the following cross-classifications: (1) accident severity, (2) type of area (rural, urban), (3) type of vehicle (passenger car, truck), and (4) type of accident. Because of the comprehensive nature of this data base, with the types of cross-classifications needed for detailed benefit-cost studies, direct accident costs were developed in the present study on the basis of these vehicle involvement costs [5].

Sources of Indirect Costs

Indirect costs used in this study were obtained from two sources. The indirect cost per fatality, discussed previously, was taken from [5] and updated to 1983. This market-oriented approach to estimating the indirect cost per fatality was, in turn, based on two sources. The element for the value of a victim's life to himself was derived from Blomquist's estimate of this value, developed from a study of motorists' seat belt use [18]. Other indirect costs per fatality, including the value of the victim's life to others, costs of insurance administration, and accident investigation costs, were taken from NHTSA [4].

The indirect cost per injury, by A-B-C severity, was obtained from [5] and updated to 1983. The elements of the indirect costs of A-B-C injuries were developed in [5] by relating data on frequencies of injuries cross-classified by the Abbreviated Injury Scale (AIS) and the A-B-C scale. These data were from the National Crash Severity Study and the National Accident Sampling System. The results from relating injuries by these two scales permitted the NHTSA indirect cost elements, reported by AIS severities, to be applied to Texas injuries classified by A-B-C severities [5].

CHAPTER III. ACCIDENT COST CALCULATIONS

Accident costs were developed on the basis of Texas traffic accident data, using updated unit costs and estimation procedures developed by TTI for the Federal Highway Administration [5]. This chapter describes the data and procedures used in this study and presents tables of accident costs and statistics for use in roadway project evaluations in Texas.

The accident cost estimates developed in this study consist of direct and indirect costs, as defined in the previous chapter. Tables of accident proportions and direct, indirect, and total accident costs are contained in Tables 1-72. Accident proportions by severity are presented in Tables 1-18. Direct accident costs are given in Tables 19-36. Indirect accident costs are shown in Tables 37-54, and total accident costs are presented in Tables 55-72.

Accident Data

Accident statistics used in developing accident costs were calculated from Texas traffic accident data and roadway inventory records for 1981 and 1982. These statistics were developed by several cross-classifications previously determined to be meaningful in benefit-cost evaluations of highway projects [5]:

- Area (rural, urban)
- Severity (fatal, injury, PDO)
- Multiple-vehicle, single-vehicle
- Intersection, non-intersection
- Accident type
- Road type (controlled access, other divided, undivided)

Table 1. Accident proportions for rural accidents in Texas.*

Accident Type	Severity		
	Fatal	Injury	PDO
Multi-vehicle			
Controlled access	.0186	.3143	.6671
Divided	.0210	.3372	.6418
Undivided	.0229	.3308	.6463
All	.0223	.3296	.6481
Single-vehicle			
Controlled access	.0416	.3965	.5619
Divided	.0372	.4045	.5583
Undivided	.0306	.4207	.5487
All	.0324	.4166	.5510
All accidents			
Controlled access	.0303	.3560	.6137
Divided	.0283	.3673	.6044
Undivided	.0267	.3752	.5981
All rural	.0273	.3723	.6004

*Based on Texas accident data for 1981-82.

Table 2. Accident proportions for urban accidents in Texas.

Accident Type	Severity		
	Fatal	Injury	PDO
Multi-vehicle			
Controlled access	.0036	.2758	.7206
Divided	.0041	.3083	.6876
Undivided	.0026	.2576	.7398
All	.0029	.2654	.7317
Single-vehicle			
Controlled access	.0277	.4191	.5532
Divided	.0263	.4445	.5292
Undivided	.0105	.3365	.6530
All	.0136	.3532	.6332
All accidents			
Controlled access	.0088	.3066	.6846
Divided	.0072	.3277	.6651
Undivided	.0046	.2781	.7173
All urban	.0055	.2867	.7078

Table 3. Accident proportions for rural, multiple-vehicle accidents in Texas, all roadway types combined.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	.0186	.3563	.6251
Head-on	.0387	.3752	.5861
Rear-end	.0049	.3285	.6666
Other	.0097	.2974	.6929
All	.0137	.3348	.6515
Non-intersection			
Angle	.0062	.2640	.7298
Head-on	.0795	.3800	.5405
Rear-end	.0131	.3591	.6278
Other	.0121	.2783	.7096
All	.0281	.3261	.6458
All			
Angle	.0151	.3302	.6547
Head-on	.0774	.3798	.5428
Rear-end	.0105	.3494	.6401
Other	.0113	.2853	.7034
All rural	.0223	.3296	.6481

Table 4. Accident proportions for rural, multiple-vehicle accidents in Texas, controlled access roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	.0107	.3248	.6645
Head-on	.0487	.3752	.5861
Rear-end	.0026	.2489	.7485
Other	.0048	.2023	.7929
All	.0075	.2698	.7227
Non-intersection			
Angle	.0078	.2500	.7422
Head-on	.1257	.3716	.5027
Rear-end	.0188	.3943	.5869
Other	.0120	.2441	.7439
All	.0240	.3360	.6400
All			
Angle	.0104	.3172	.6724
Head-on	.1226	.3603	.5171
Rear-end	.0162	.3706	.6132
Other	.0099	.2318	.7583
All rural	.0186	.3143	.6671

Table 5. Accident proportions for rural, multiple-vehicle accidents in Texas, divided roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	.0255	.4144	.5601
Head-on	.0387	.3752	.5861
Rear-end	.0049	.3245	.6666
Other	.0116	.2886	.6998
All	.0174	.3612	.6214
Non-intersection			
Angle	.0109	.3050	.6841
Head-on	.1376	.4358	.4266
Rear-end	.0272	.3675	.6053
Other	.0081	.2596	.7323
All	.0239	.3186	.6575
All			
Angle	.0223	.3901	.5876
Head-on	.1255	.4268	.4477
Rear-end	.0197	.3444	.6359
Other	.0091	.2680	.7229
All rural	.0210	.3372	.6418

Table 6. Accident proportions for rural, multiple-vehicle accidents in Texas, undivided roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	.0182	.3511	.6307
Head-on	.0417	.3854	.5729
Rear-end	.0059	.3423	.6518
Other	.0101	.3097	.6802
All	.0139	.3386	.6475
Non-intersection			
Angle	.0057	.2604	.7339
Head-on	.0763	.3790	.5447
Rear-end	.0088	.3463	.6449
Other	.0128	.2875	.6997
All	.0292	.3255	.6453
All			
Angle	.0144	.3234	.6622
Head-on	.0746	.3793	.5461
Rear-end	.0078	.3449	.6473
Other	.0117	.2961	.6922
All rural	.0229	.3308	.6463

Table 7. Accident proportions for urban, multiple-vehicle accidents in Texas, all roadway types combined.

Accident Type	Severity		
	Fatal	Injury	PDO
<u>Intersection</u>			
Angle	.0032	.2965	.7003
Head-on	.0078	.2910	.7012
Rear-end	.0007	.2999	.6994
Other	.0022	.2406	.7572
All	.0024	.2822	.7154
<u>Non-intersection</u>			
Angle	.0013	.1792	.8195
Head-on	.0219	.3497	.6284
Rear-end	.0020	.3079	.6901
Other	.0023	.1780	.8197
All	.0036	.2396	.7568
<u>All</u>			
Angle	.0028	.2743	.7229
Head-on	.0195	.3397	.6408
Rear-end	.0014	.3041	.6945
Other	.0023	.2108	.7869
All urban	.0029	.2654	.7317

Table 8. Accident proportions for urban, multiple-vehicle accidents in Texas, controlled access roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
<u>Intersection</u>			
Angle	.0038	.2954	.7008
Head-on	.0078	.2910	.7012
Rear-end	.0004	.2980	.7016
Other	.0013	.1626	.8361
All	.0020	.2584	.7396
<u>Non-intersection</u>			
Angle	.0045	.1696	.8259
Head-on	.0782	.3945	.5273
Rear-end	.0029	.3365	.6606
Other	.0043	.2136	.7821
All	.0050	.2917	.7033
<u>All</u>			
Angle	.0038	.2856	.7106
Head-on	.0657	.3642	.5701
Rear-end	.0021	.3245	.6734
Other	.0030	.1912	.8058
All urban	.0036	.2758	.7206

Table 9. Accident proportions for urban, multiple-vehicle accidents in Texas, divided roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	.0067	.3476	.6457
Head-on	.0078	.2910	.7012
Rear-end	.0012	.3307	.6681
Other	.0034	.2991	.6975
All	.0041	.3286	.6673
Non-intersection			
Angle	.0037	.2368	.7595
Head-on	.0414	.4431	.5155
Rear-end	.0025	.3373	.6602
Other	.0028	.1936	.8036
All	.0040	.2672	.7288
All			
Angle	.0062	.3290	.6648
Head-on	.0300	.3930	.5770
Rear-end	.0017	.3334	.6649
Other	.0032	.2557	.7411
All urban	.0041	.3083	.6876

Table 10. Accident proportions for urban, multiple-vehicle accidents in Texas, undivided roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	.0027	.2909	.7064
Head-on	.0088	.2983	.6929
Rear-end	.0007	.2938	.7055
Other	.0022	.2458	.7520
All	.0023	.2797	.7180
Non-intersection			
Angle	.0010	.1746	.8244
Head-on	.0175	.3435	.6390
Rear-end	.0014	.2852	.7134
Other	.0018	.1671	.8311
All	.0031	.2208	.7761
All			
Angle	.0024	.2672	.7304
Head-on	.0161	.3359	.6480
Rear-end	.0010	.2897	.7093
Other	.0020	.2090	.7890
All urban	.0026	.2576	.7398

Table 11. Accident proportions for single-vehicle accidents in Texas, all roadway types combined.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	.0026	.1317	.8657
Fixed or other object	.0280	.4349	.5371
Parked car	.0212	.2503	.7285
Pedalcycle	.0775	.9131	.0094
Pedestrian	.2804	.7196	.0000
RR train	.1144	.4063	.4793
Overturn	.0351	.5292	.4357
Other non-collision	.0298	.2376	.7326
All rural	.0324	.4166	.5510
Urban			
Animal	.0031	.1935	.8034
Fixed or other object	.0107	.3692	.6201
Parked car	.0018	.1330	.8652
Pedalcycle	.0175	.9695	.0130
Pedestrian	.0927	.9073	.0000
RR train	.0565	.3774	.5661
Overturn	.0206	.6366	.3428
Other non-collision	.0236	.5351	.4413
All urban	.0136	.3532	.6332

Table 12. Accident proportions for single-vehicle accidents in Texas, controlled access roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	.0026	.1317	.8657
Fixed or other object	.0320	.3820	.5860
Parked car	.0715	.3943	.5342
Pedalcycle	.0775	.9131	.0094
Pedestrian	.4688	.5312	.0000
RR train	.1144	.4063	.4793
Overturn	.0340	.5227	.4433
Other non-collision	.0079	.1552	.8369
All rural	.0416	.3965	.5619
Urban			
Animal	.0053	.1968	.7979
Fixed or other object	.0154	.3780	.6066
Parked car	.0266	.4053	.5681
Pedalcycle	.0258	.9548	.0194
Pedestrian	.3179	.6821	.0000
RR train	.0565	.3774	.5661
Overturn	.0249	.6466	.3285
Other non-collision	.0266	.2909	.6825
All urban	.0277	.4191	.5532

Table 13. Accident proportions for single-vehicle accidents in Texas, divided roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	.0024	.1442	.8534
Fixed or other object	.0297	.3952	.5751
Parked car	.0243	.4375	.5382
Pedalcycle	.0775	.9131	.0094
Pedestrian	.3735	.6265	.0000
RR train	.1144	.4063	.4793
Overturn	.0485	.5137	.4378
Other non-collision	.0033	.2124	.7843
All rural	.0372	.4045	.5583
Urban			
Animal	.0031	.1935	.8034
Fixed or other object	.0162	.3939	.5899
Parked car	.0063	.2774	.7163
Pedalcycle	.0544	.9205	.0251
Pedestrian	.1863	.8137	.0000
RR train	.1364	.3864	.4772
Overturn	.0187	.6327	.3486
Other non-collision	.0041	.4545	.5414
All urban	.0263	.4445	.5292

Table 14. Accident proportions for single-vehicle accidents in Texas, undivided roadways.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	.0028	.1300	.8672
Fixed or other object	.0273	.4460	.5267
Parked car	.0112	.2052	.7836
Pedalcycle	.0697	.9204	.0099
Pedestrian	.2434	.7566	.0000
RR train	.1136	.4015	.4849
Overturn	.0338	.5320	.4342
Other non-collision	.0460	.2790	.6750
All rural	.0306	.4207	.5487
Urban			
Animal	.0031	.1959	.8010
Fixed or other object	.0089	.3643	.6268
Parked car	.0009	.1211	.8780
Pedalcycle	.0154	.9724	.0122
Pedestrian	.0661	.9339	.0000
RR train	.0552	.3747	.5701
Overturn	.0193	.6335	.3472
Other non-collision	.0252	.6096	.3652
All urban	.0105	.3365	.6530

Table 15. Accident proportions for wet-weather, rural accidents in Texas.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	.0107	.2683	.7210
Divided	.0083	.3627	.6290
Undivided	.0105	.3454	.6441
All	.0101	.3407	.6492
Non-intersection			
Controlled access	.0186	.3214	.6600
Divided	.0225	.2978	.6797
Undivided	.0281	.3429	.6290
All	.0265	.3362	.6373
All			
Controlled access	.0164	.3066	.6770
Divided	.0172	.3222	.6606
Undivided	.0214	.3438	.6348
All multi	.0205	.3379	.6416
Single-vehicle			
Controlled access	.0187	.3273	.6540
Divided	.0142	.3457	.6401
Undivided	.0187	.3752	.6061
All single	.0182	.3657	.6161
All			
Controlled access	.0177	.3187	.6636
Divided	.0155	.3351	.6494
Undivided	.0200	.3599	.6201
All rural	.0193	.3525	.6282

Table 16. Accident proportions for wet-weather, urban accidents in Texas.

Accident Type	Severity		
	Fatal	Injury	PDO
<u>Multiple-vehicle</u>			
Intersection			
Controlled access	.0010	.2468	.7522
Divided	.0024	.3207	.6769
Undivided	.0013	.2645	.7342
All	.0014	.2681	.7305
Non-intersection			
Controlled access	.0028	.2848	.7124
Divided	.0029	.2757	.7214
Undivided	.0032	.2297	.7671
All	.0031	.2459	.7510
All			
Controlled access	.0020	.2693	.7287
Divided	.0026	.3057	.6917
Undivided	.0020	.2513	.7467
All multi	.0021	.2590	.7389
<u>Single-vehicle</u>			
Controlled access	.0116	.3193	.6691
Divided	.0108	.3629	.6263
Undivided	.0068	.2974	.6958
All single	.0080	.3056	.6864
<u>All</u>			
Controlled access	.0048	.2839	.7113
Divided	.0041	.3160	.6799
Undivided	.0032	.2627	.7341
All urban	.0035	.2707	.7258

Table 17. Accident proportions for night, rural accidents in Texas.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	.0160	.3244	.6596
Divided	.0296	.4453	.5251
Undivided	.0182	.3913	.5905
All	.0193	.3911	.5896
Non-intersection			
Controlled access	.0309	.3951	.5740
Divided	.0408	.4110	.5482
Undivided	.0563	.3897	.5540
All	.0506	.3927	.5567
All			
Controlled access	.0275	.3788	.5937
Divided	.0367	.4236	.5397
Undivided	.0425	.3903	.5672
All multi	.0398	.3922	.5680
Single-vehicle			
Controlled access	.0524	.4032	.5444
Divided	.0471	.4135	.5394
Undivided	.0350	.4076	.5574
All single	.0377	.4076	.5547
All			
Controlled access	.0430	.3940	.5630
Divided	.0430	.4175	.5395
Undivided	.0372	.4024	.5604
All rural	.0384	.4026	.5590

Table 18. Accident proportions for night, urban accidents in Texas.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	.0038	.3165	.6797
Divided	.0068	.3795	.6137
Undivided	.0045	.3365	.6590
All	.0047	.3397	.6556
Non-intersection			
Controlled access	.0109	.3630	.6261
Divided	.0087	.3191	.6722
Undivided	.0077	.2949	.6974
All	.0086	.3144	.6770
All			
Controlled access	.0079	.3431	.6490
Divided	.0075	.3582	.6343
Undivided	.0058	.3200	.6742
All multi	.0064	.3290	.6646
Single-vehicle			
Controlled access	.0386	.4435	.5179
Divided	.0347	.4632	.5021
Undivided	.0129	.3264	.6607
All single	.0176	.3496	.6328
All			
Controlled access	.0190	.3793	.6017
Divided	.0143	.3845	.6012
Undivided	.0092	.3230	.6678
All urban	.0112	.3380	.6508

Table 19. Direct accident costs for rural accidents in Texas, 1983 dollars.*

Accident Type	Severity		
	Fatal	Injury	PDO
Multi-vehicle			
Controlled access	$48,300	$ 9,500	$1,650
Divided	45,400	9,200	1,550
Undivided	51,300	10,300	1,550
All	50,500	10,100	1,550
Single-vehicle			
Controlled access	16,100	6,400	2,850
Divided	13,900	6,500	2,750
Undivided	12,700	5,600	1,650
All	13,300	5,800	1,850
All accidents			
Controlled access	25,900	7,800	2,200
Divided	26,900	7,900	2,050
Undivided	29,500	7,700	1,600
All rural	28,800	7,700	1,700

*Texas accident costs are based on 1981-82 Texas accident data. Costs are rounded to the nearest $100 for fatal and injury accidents and to the nearest $50 for property-damage-only accidents.

Table 20. Direct accident costs for urban accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
<u>Multi-vehicle</u>			
Controlled access	$31,600	$5,100	$850
Divided	33,000	5,000	900
Undivided	33,800	5,000	950
All	33,300	5,000	950
<u>Single-vehicle</u>			
Controlled access	15,900	5,000	850
Divided	16,300	4,900	850
Undivided	15,900	4,600	600
All	16,000	4,700	650
<u>All accidents</u>			
Controlled access	21,000	5,100	850
Divided	24,400	5,000	900
Undivided	23,300	4,900	850
All urban	22,800	4,900	850

Table 21. Direct accident costs for rural, multiple-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$42,400	$ 8,400	$1,200
Head-on	59,400	16,400	1,950
Rear-end	45,300	9,900	1,700
Other	39,300	7,900	1,500
All	42,900	8,800	1,400
Non-intersection			
Angle	41,300	8,600	1,200
Head-on	58,000	16,500	2,100
Rear-end	44,400	9,600	1,750
Other	39,000	7,800	1,500
All	53,000	11,000	1,650
All			
Angle	42,300	8,500	1,200
Head-on	58,100	16,500	2,100
Rear-end	44,500	9,700	1,700
Other	39,100	7,900	1,500
All rural	50,500	10,100	1,550

Table 22. Direct accident costs for rural, multiple-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$45,500	$ 8,800	$1,350
Head-on	60,700	16,600	2,200
Rear-end	44,000	9,700	1,700
Other	36,300	7,800	1,450
All	48,300	8,800	1,500
Non-intersection			
Angle	45,800	9,000	1,450
Head-on	60,700	18,100	3,100
Rear-end	43,900	9,500	1,800
Other	35,800	7,800	1,450
All	49,000	9,800	1,700
All			
Angle	45,500	8,800	1,350
Head-on	60,700	18,000	3,000
Rear-end	44,000	9,500	1,750
Other	36,300	7,800	1,450
All rural	48,300	9,500	1,650

Table 23. Direct accident costs for rural, multiple-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$41,200	$ 8,600	$1,300
Head-on	58,700	16,600	2,050
Rear-end	42,600	9,900	1,700
Other	39,600	7,800	1,500
All	41,000	8,700	1,450
Non-intersection			
Angle	44,500	9,700	1,300
Head-on	58,700	16,800	2,450
Rear-end	42,600	9,400	1,750
Other	38,700	7,800	1,500
All	47,900	9,500	1,600
All			
Angle	41,500	8,800	1,300
Head-on	58,700	16,700	2,450
Rear-end	42,600	9,600	1,750
Other	39,600	7,800	1,500
All rural	45,400	9,200	1,550

Table 24. Direct accident costs for rural, multiple-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$42,500	$ 8,400	$1,200
Head-on	59,400	16,400	1,950
Rear-end	45,300	9,900	1,700
Other	39,200	7,900	1,500
All	43,200	8,800	1,400
Non-intersection			
Angle	41,000	8,400	1,200
Head-on	57,800	16,500	2,050
Rear-end	45,700	9,700	1,700
Other	39,600	7,900	1,500
All	54,000	11,300	1,650
All			
Angle	42,300	8,400	1,200
Head-on	57,900	16,500	2,050
Rear-end	45,600	9,800	1,700
Other	39,400	7,900	1,500
All rural	51,300	10,300	1,550

Table 25. Direct accident costs for urban, multiple-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$39,200	$5,300	$1,200
Head-on	37,400	5,700	1,250
Rear-end	31,000	5,100	800
Other	22,300	4,200	750
All	34,400	5,000	1,000
Non-intersection			
Angle	37,500	5,300	1,200
Head-on	37,400	5,800	1,250
Rear-end	29,000	5,200	800
Other	22,800	4,300	750
All	32,100	5,000	900
All			
Angle	39,000	5,300	1,200
Head-on	37,400	5,800	1,250
Rear-end	29,500	5,200	800
Other	22,500	4,200	750
All urban	33,300	5,000	950

Table 26. Direct accident costs for urban, multiple-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$37,700	$5,300	$1,200
Head-on	38,900	5,800	1,400
Rear-end	28,200	5,100	800
Other	22,500	4,300	750
All	34,400	5,100	950
Non-intersection			
Angle	38,800	5,300	1,200
Head-on	38,900	7,600	1,450
Rear-end	28,100	5,200	800
Other	22,400	4,600	700
All	30,400	5,100	800
All			
Angle	37,800	5,300	1,200
Head-on	38,900	7,400	1,450
Rear-end	28,200	5,200	800
Other	22,500	4,500	700
All urban	31,600	5,100	850

Table 27. Direct accident costs for urban, multiple-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$38,100	$5,300	$1,200
Head-on	36,000	5,700	1,350
Rear-end	30,300	5,100	800
Other	22,400	4,200	750
All	33,800	5,000	950
Non-intersection			
Angle	37,700	5,300	1,200
Head-on	39,700	6,200	1,300
Rear-end	30,300	5,100	800
Other	21,600	4,300	750
All	32,100	5,000	850
All			
Angle	37,700	5,300	1,200
Head-on	39,700	6,100	1,300
Rear-end	30,300	5,100	800
Other	22,100	4,200	750
All urban	33,000	5,000	900

Table 28. Direct accident costs for urban, multiple-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$39,700	$5,300	$1,200
Head-on	37,400	5,700	1,250
Rear-end	30,600	5,200	800
Other	22,200	4,200	750
All	34,500	5,000	1,000
Non-intersection			
Angle	38,400	5,300	1,200
Head-on	36,800	5,700	1,250
Rear-end	30,100	5,200	800
Other	23,200	4,200	750
All	33,000	5,000	900
All			
Angle	39,600	5,300	1,200
Head-on	36,900	5,700	1,250
Rear-end	30,300	5,200	800
Other	22,600	4,200	750
All urban	33,800	5,000	950

Table 29. Direct accident costs for single-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	$ 6,900	$7,100	$1,250
Fixed or other object	11,100	5,100	1,950
Parked car	22,400	4,700	850
Pedalcycle	12,300	1,600	150
Pedestrian	13,100	4,000	50
RR train	25,500	7,300	1,650
Overturn	14,800	6,900	1,900
Other non-collision	14,400	10,800	5,500
All rural	13,300	5,800	1,850
Urban			
Animal	11,100	4,600	750
Fixed or other object	13,100	5,900	750
Parked car	16,000	2,500	400
Pedacycle	16,500	3,000	200
Pedestrian	18,700	4,200	100
RR train	23,700	6,300	2,350
Overturn	14,300	3,500	1,150
Other non-collision	13,500	3,500	2,100
All urban	16,000	4,700	650

Table 30. Direct accident costs for single-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	$ 7,000	$ 9,100	$1,750
Fixed or other object	15,600	5,100	2,850
Parked car	22,300	4,700	900
Pedalcycle	11,900	2,200	150
Pedestrian	13,900	3,800	50
RR train	28,100	7,100	1,800
Overturn	15,700	8,100	2,600
Other non-collision	16,400	14,600	5,850
All rural	16,100	6,400	2,850
Urban			
Animal	11,100	4,600	750
Fixed or other object	13,800	5,900	800
Parked car	16,100	2,500	400
Pedalcycle	16,400	2,900	150
Pedestrian	18,400	4,200	100
RR train	23,300	6,100	2,300
Overturn	14,800	3,500	1,400
Other non-collision	14,900	3,500	2,650
All urban	15,900	5,000	850

Table 31. Direct accident costs for single-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	$ 6,900	$ 8,200	$1,550
Fixed or other object	12,200	5,100	2,800
Parked car	22,400	4,700	900
Pedalcycle	12,000	2,100	150
Pedestrian	12,900	4,000	50
RR train	25,500	6,900	1,700
Overturn	15,500	8,000	2,400
Other non-collision	14,900	15,300	6,700
All rural	13,900	6,500	2,750
Urban			
Animal	11,100	4,600	750
Fixed or other object	12,900	5,900	800
Parked car	16,100	2,500	400
Pedalcycle	16,700	3,000	150
Pedestrian	18,800	4,200	100
RR train	23,000	5,800	2,750
Overturn	18,400	3,500	1,250
Other non-collision	13,400	3,500	3,050
All urban	16,300	4,900	850

Table 32. Direct accident costs for single-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	$ 6,900	$6,900	$1,200
Fixed or other object	10,300	5,100	1,700
Parked car	22,500	4,800	850
Pedalcycle	12,300	1,600	150
Pedestrian	12,900	4,000	50
RR train	25,700	7,300	1,600
Overturn	14,600	6,600	1,750
Other non-collision	14,100	9,000	4,900
All rural	12,700	5,600	1,650
Urban			
Animal	11,000	4,600	800
Fixed or other object	12,800	5,900	750
Parked car	15,900	2,500	400
Pedalcycle	16,500	3,000	200
Pedestrian	18,800	4,200	100
RR train	23,700	6,300	2,350
Overturn	13,500	3,500	1,000
Other non-collision	12,400	3,500	1,750
All urban	15,900	4,600	600

Table 33. Direct accident costs for wet-weather, rural accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	$44,900	$ 8,900	$1,450
Divided	44,900	9,100	1,450
Undivided	45,600	9,100	1,400
All	44,900	9,100	1,450
Non-intersection			
Controlled access	54,600	10,600	1,700
Divided	54,600	9,900	1,650
Undivided	55,100	12,500	1,650
All	54,600	12,000	1,650
All			
Controlled access	49,700	10,100	1,650
Divided	52,900	9,600	1,600
Undivided	53,500	11,200	1,550
All multi	52,900	10,900	1,550
Single-vehicle			
Controlled access	13,500	7,500	3,550
Divided	13,500	8,000	3,950
Undivided	12,100	5,900	2,050
All single	13,500	6,300	2,450
All			
Controlled access	27,300	8,500	2,750
Divided	33,200	8,700	2,850
Undivided	33,700	8,300	1,800
All rural	33,100	8,400	2,050

Table 34. Direct accident costs for wet-weather, urban accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	$33,500	$5,100	950
Divided	33,500	5,100	950
Undivided	34,500	5,100	1,000
All	33,500	5,100	1,000
Non-intersection			
Controlled access	30,700	5,200	800
Divided	34,300	5,000	850
Undivided	35,100	5,100	950
All	34,300	5,100	900
All			
Controlled access	30,900	5,100	850
Divided	33,800	5,100	900
Undivided	34,900	5,100	950
All multi	33,700	5,100	950
Single-vehicle			
Controlled access	16,000	5,200	850
Divided	15,900	5,200	900
Undivided	15,800	5,000	600
All single	15,900	5,000	700
All			
Controlled access	20,500	5,200	850
Divided	22,900	5,100	900
Undivided	24,800	5,100	900
All urban	23,600	5,100	900

Table 35. Direct accident costs for night, rural accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	$42,300	$8,900	$1,500
Divided	42,400	9,100	1,450
Undivided	42,500	8,800	1,400
All	42,400	8,800	1,450
Non-intersection			
Controlled access	48,500	9,800	1,750
Divided	49,400	10,100	1,650
Undivided	54,000	11,800	1,650
All	53,000	11,300	1,700
All			
Controlled access	48,000	9,600	1,700
Divided	46,100	9,700	1,550
Undivided	52,200	10,700	1,550
All multi	51,300	10,500	1,600
Single-vehicle			
Controlled access	16,700	6,300	2,550
Divided	13,600	6,200	2,300
Undivided	12,400	5,500	1,350
All single	13,100	5,600	1,550
All			
Controlled access	24,200	7,500	2,200
Divided	24,500	7,600	2,000
Undivided	26,200	7,000	1,400
All rural	25,800	7,100	1,550

Table 36. Direct accident costs for night, urban accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	$34,300	$5,100	$ 950
Divided	32,600	5,000	950
Undivided	34,500	5,000	1,000
All	34,100	5,000	950
Non-intersection			
Controlled access	31,000	5,100	800
Divided	32,600	5,000	850
Undivided	33,200	5,000	900
All	32,400	5,000	900
All			
Controlled access	31,700	5,100	850
Divided	32,600	5,000	900
Undivided	33,800	5,000	950
All multi	33,100	5,000	950
Single-vehicle			
Controlled access	23,800	5,100	700
Divided	16,300	5,100	700
Undivided	15,800	4,800	550
All single	15,800	4,900	600
All			
Controlled access	25,900	5,100	800
Divided	22,400	5,000	850
Undivided	21,700	4,900	750
All urban	22,200	5,000	800

Table 37. Indirect accident costs for rural accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multi-vehicle			
Controlled access	$857,000	$10,100	$50
Divided	770,000	10,600	50
Undivided	823,800	11,000	50
All	822,100	10,900	50
Single-vehicle			
Controlled access	677,500	11,900	50
Divided	625,900	11,100	50
Undivided	642,700	10,900	50
All	646,400	11,000	50
All accidents			
Controlled access	731,800	11,100	50
Divided	685,200	10,800	50
Undivided	721,400	10,900	50
All rural	719,500	10,900	50

Table 38. Indirect accident costs for urban accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multi-vehicle			
Controlled access	$722,400	$5,700	$50
Divided	739,400	6,200	50
Undivided	698,000	6,200	50
All	708,600	6,100	50
Single-vehicle			
Controlled access	631,600	8,500	50
Divided	637,500	8,500	50
Undivided	625,800	8,100	50
All	628,500	8,200	50
All accidents			
Controlled access	660,900	6,500	50
Divided	686,600	6,700	50
Undivided	655,400	6,800	50
All urban	660,300	6,700	50

Table 39. Indirect accident costs for rural, multiple-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
<u>Intersection</u>			
Angle	$793,500	$11,300	$50
Head-on	877,700	14,300	50
Rear-end	758,500	5,900	50
Other	799,000	10,100	50
All	796,500	9.900	50
<u>Non-intersection</u>			
Angle	680,500	9,000	50
Head-on	868,700	17,600	50
Rear-end	707,100	8,000	50
Other	798,500	10,300	50
All	830,500	11,500	50
<u>All</u>			
Angle	783,400	10,700	50
Head-on	868,900	17,500	50
Rear-end	714,600	7,400	50
Other	798,700	10,200	50
All rural	822,100	10,900	50

Table 40. Indirect accident costs for rural, multiple-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
<u>Intersection</u>			
Angle	$856,900	$10,400	$50
Head-on	931,800	8,600	50
Rear-end	791,500	3,300	50
Other	918,600	9,000	50
All	856,900	8,600	50
<u>Non-intersection</u>			
Angle	882,400	12,900	50
Head-on	931,800	20,300	50
Rear-end	791,500	9,600	50
Other	981,400	10,000	50
All	882,400	10,700	50
<u>All</u>			
Angle	856,900	10,600	50
Head-on	931,800	20,100	50
Rear-end	791,500	8,900	50
Other	918,600	9,700	50
All rural	857,000	10,100	50

Table 41. Indirect accident costs for rural, multiple-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$782,400	$12,500	$50
Head-on	947,300	11,400	50
Rear-end	661,700	5,700	50
Other	667,400	11,800	50
All	757,000	11,400	50
Non-intersection			
Angle	785,700	11,100	50
Head-on	947,300	22,200	50
Rear-end	661,700	8,600	50
Other	777,100	8,000	50
All	777,100	9,900	50
All			
Angle	785,700	12,300	50
Head-on	947,300	21,500	50
Rear-end	661,700	8,000	50
Other	667,400	9,000	50
All rural	770,000	10,600	50

Table 42. Indirect accident costs for rural, multiple-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$801,200	$11,100	$50
Head-on	877,700	14,500	50
Rear-end	758,500	6,100	50
Other	834,600	10,000	50
All	808,900	9,900	50
Non-intersection			
Angle	638,000	8,600	50
Head-on	861,200	17,400	50
Rear-end	672,100	7,300	50
Other	776,600	10,700	50
All	828,700	11,800	50
All			
Angle	781,600	10,500	50
Head-on	861,700	17,300	50
Rear-end	695,800	6,900	50
Other	795,900	10,400	50
All rural	823,800	11,000	50

Table 43. Indirect accident costs for urban, multiple-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$686,100	$ 6,700	$50
Head-on	724,100	10,300	50
Rear-end	684,500	3,500	50
Other	667,800	6,700	50
All	682,700	6,000	50
Non-intersection			
Angle	691,900	6,000	50
Head-on	804,200	12,300	50
Rear-end	667,700	4,800	50
Other	672,000	6,500	50
All	735,700	6,300	50
All			
Angle	686,600	6,600	50
Head-on	798,700	12,000	50
Rear-end	671,700	4,200	50
Other	669,800	6,600	50
All urban	708,600	6,100	50

Table 44. Indirect accident costs for urban, multiple-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$685,100	$ 6,800	$50
Head-on	849,400	13,400	50
Rear-end	675,200	3,200	50
Other	676,000	5,600	50
All	691,300	5,300	50
Non-intersection			
Angle	734,000	6,100	50
Head-on	849,400	16,100	50
Rear-end	674,100	5,500	50
Other	666,100	6,300	50
All	734,000	6,000	50
All			
Angle	694,500	6,700	50
Head-on	849,400	15,900	50
Rear-end	675,200	4,800	50
Other	676,000	6,000	50
All urban	722,400	5,700	50

Table 45. Indirect accident costs for urban, multiple-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$700,900	$ 7,400	$50
Head-on	695,000	12,200	50
Rear-end	695,000	3,700	50
Other	685,000	7,300	50
All	695,000	6,300	50
Non-intersection			
Angle	831,200	6,800	50
Head-on	1,062,000	14,200	50
Rear-end	831,200	4,900	50
Other	748,000	6,400	50
All	831,200	6,100	50
All			
Angle	703,900	7,400	50
Head-on	1,062,000	13,800	50
Rear-end	686,100	4,200	50
Other	708,500	7,000	50
All urban	739,400	6,200	50

Table 46. Indirect accident costs for urban, multiple-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Intersection			
Angle	$682,300	$ 6,600	$50
Head-on	724,100	10,100	50
Rear-end	687,400	3,600	50
Other	658,700	6,700	50
All	678,300	6,000	50
Non-intersection			
Angle	661,100	5,900	50
Head-on	769,700	11,900	50
Rear-end	651,100	4,400	50
Other	661,400	6,500	50
All	722,200	6,400	50
All			
Angle	680,400	6,500	50
Head-on	765,500	11,600	50
Rear-end	663,800	3,900	50
Other	659,800	6,600	50
All urban	698,000	6,200	50

Table 47. Indirect accident costs for single-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	$646,400	$ 6,800	$50
Fixed or other object	661,600	10,800	50
Parked car	655,700	11,600	50
Pedalcycle	627,300	10,400	50
Pedestrian	593,700	13,900	50
RR train	736,400	11,700	50
Overturn	650,200	11,400	50
Other non-collision	627,000	9,000	50
All rural	646,400	11,000	50
Urban			
Animal	628,500	6,600	50
Fixed or other object	647,200	8,200	50
Parked car	651,200	6,300	50
Pedalcycle	610,100	7,200	50
Pedestrian	601,200	9,900	50
RR train	706,200	9,300	50
Overturn	631,600	9,100	50
Other non-collision	600,500	8,000	50
All urban	628,500	8,200	50

Table 48. Indirect accident costs for single-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	$677,500	$ 8,500	$50
Fixed or other object	708,500	11,300	50
Parked car	698,400	13,100	50
Pedalcycle	677,500	11,900	50
Pedestrian	614,100	16,300	50
RR train	677,500	11,900	50
Overturn	688,900	12,500	50
Other non-collision	677,500	6,600	50
All rural	677,500	11,900	50
Urban			
Animal	631,600	7,100	50
Fixed or other object	651,300	7,900	50
Parked car	675,000	9,000	50
Pedalcycle	631,600	7,500	50
Pedestrian	606,200	14,100	50
RR train	631,600	8,500	50
Overturn	628,300	9,300	50
Other non-collision	631,600	8,400	50
All urban	631,600	8,500	50

Table 49. Indirect accident costs for single-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	$625,900	$ 6,000	$50
Fixed or other object	649,500	11,200	50
Parked car	625,900	13,700	50
Pedalcycle	625,900	11,100	50
Pedestrian	580,500	16,000	50
RR train	625,900	11,100	50
Overturn	619,200	11,000	50
Other non-collision	625,900	7,500	50
All rural	625,900	11,100	50
Urban			
Animal	637,500	6,600	50
Fixed or other object	645,200	8,300	50
Parked car	637,500	6,900	50
Pedalcycle	637,500	7,500	50
Pedestrian	597,600	11,200	50
RR train	637,500	8,500	50
Overturn	662,900	8,800	50
Other non-collision	637,500	8,200	50
All urban	637,500	8,500	50

Table 50. Indirect accident costs for single-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Rural			
Animal	$642,700	$ 6,700	$50
Fixed or other object	655,200	10,800	50
Parked car	599,000	10,700	50
Pedalcycle	622,000	10,300	50
Pedestrian	589,100	13,500	50
RR train	742,100	11,600	50
Overturn	648,800	11,300	50
Other non-collision	623,400	9,900	50
All rural	642,700	10,900	50
Urban			
Animal	625,800	6,800	50
Fixed or other object	645,600	8,300	50
Parked car	634,700	5,900	50
Pedalcycle	604,000	7,200	50
Pedestrian	599,500	9,500	50
RR train	711,400	9,400	50
Overturn	628,800	9,100	50
Other non-collision	591,000	7,900	50
All urban	625,800	8,100	50

Table 51. Indirect accident costs for wet-weather, rural accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	$776,900	$ 9,400	$50
Divided	776,900	11,900	50
Undivided	803,000	8,800	50
All	776,900	9,200	50
Non-intersection			
Controlled access	846,900	10,900	50
Divided	846,900	9,700	50
Undivided	847,800	11,400	50
All	846,900	11,200	50
All			
Controlled access	843,600	10,600	50
Divided	834,100	10,600	50
Undivided	839,400	10,400	50
All multi	834,100	10,500	50
Single-vehicle			
Controlled access	609,900	9,400	50
Divided	648,600	9,200	50
Undivided	635,200	9,600	50
All single	632,600	9,500	50
All			
Controlled access	699,100	9,800	50
Divided	741,400	9,800	50
Undivided	741,500	10,000	50
All rural	734,000	9,900	50

Table 52. Indirect accident costs for wet-weather, urban accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	$677,400	$4,800	$50
Divided	677,400	5,800	50
Undivided	668,200	5,200	50
All	677,400	5,300	50
Non-intersection			
Controlled access	659,800	6,000	50
Divided	754,800	5,500	50
Undivided	788,000	6,100	50
All	754,800	6,100	50
All			
Controlled access	664,700	5,600	50
Divided	706,400	5,700	50
Undivided	740,500	5,500	50
All multi	724,600	5,600	50
Single-vehicle			
Controlled access	616,100	7,000	50
Divided	661,800	7,600	50
Undivided	630,100	7,500	50
All single	628,500	7,400	50
All			
Controlled access	630,700	6,000	50
Divided	685,100	6,100	50
Undivided	682,200	6,100	50
All urban	670,400	6,100	50

Table 53. Indirect accident costs for night, rural accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	$811,900	$10,000	$50
Divided	811,900	13,500	50
Undivided	849,300	11,100	50
All	811,900	11,300	50
Non-intersection			
Controlled access	908,000	12,000	50
Divided	792,000	12,300	50
Undivided	850,300	14,200	50
All	851,300	13,700	50
All			
Controlled access	869,500	11,600	50
Divided	773,800	12,800	50
Undivided	850,200	13,100	50
All multi	844,700	12,900	50
Single-vehicle			
Controlled access	653,400	11,900	50
Divided	628,700	11,300	50
Undivided	637,600	11,000	50
All single	639,100	11,100	50
All			
Controlled access	705,700	11,800	50
Divided	677,300	11,900	50
Undivided	711,500	11,600	50
All rural	707,500	11,700	50

Table 54. Indirect accident costs for night, urban accidents in Texas, 1983 dollars.

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Intersection			
Controlled access	$683,400	$6,200	$50
Divided	671,800	7,100	50
Undivided	706,100	7,200	50
All	696,800	7,000	50
Non-intersection			
Controlled access	724,700	7,700	50
Divided	891,200	7,500	50
Undivided	725,200	8,300	50
All	742,300	8,100	50
All			
Controlled access	716,100	7,100	50
Divided	762,000	7,200	50
Undivided	716,200	7,600	50
All multi	722,800	7,400	50
Single-vehicle			
Controlled access	631,200	9,100	50
Divided	645,200	8,900	50
Undivided	632,500	8,500	50
All single	633,500	8,600	50
All			
Controlled access	653,800	7,900	50
Divided	691,100	7,700	50
Undivided	660,200	8,000	50
All urban	662,100	8,000	50

Table 55. Total accident costs for rural accidents in Texas, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Multi-vehicle				
Controlled access	$905,300	$19,600	$1,700	$24,100
Divided	815,400	19,800	1,600	24,800
Undivided	875,100	21,300	1,600	28,100
All	872,600	21,000	1,600	27,400
Single-vehicle				
Controlled access	693,600	17,300	2,900	37,700
Divided	639,800	17,600	2,800	32,500
Undivided	655,400	16,500	1,700	27,900
All	659,700	16,800	1,900	29,400
All accidents				
Controlled access	757,700	18,900	2,250	31,100
Divided	712.100	18,700	2,100	28,300
Undivided	750,900	18,600	1,650	28,000
All rural	748,300	18,600	1,750	28,400

Table 56. Total accident costs for urban accidents in Texas, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Multi-vehicle				
Controlled access	$754,000	$10,800	$ 900	$ 6,300
Divided	772,400	11,200	950	7,300
Undivided	731,800	11,200	1,000	5,500
All	741,900	11,100	1,000	5,800
Single-vehicle				
Controlled access	647,500	13,500	900	24,100
Divided	653,800	13,400	900	23,600
Undivided	641,700	12,700	650	11,400
All	644,500	12,900	700	13,800
All accidents				
Controlled access	681,900	11,600	900	10,200
Divided	711,000	11,700	950	9,600
Undivided	678,700	11,700	900	7,000
All urban	683,100	11,600	900	7,700

Table 57. Total accident costs for rural, multiple-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Intersection				
Angle	$878,300	$19,700	$1,250	$24,100
Head-on	937,100	30,700	2,000	50,100
Rear-end	803,800	15,800	1,750	10,300
Other	838,300	18,000	1,550	14,600
All	839,400	18,700	1,450	18,700
Non-intersection				
Angle	721,800	17,600	1,250	10,000
Head-on	926,700	34,100	2,150	87,800
Rear-end	751,500	17,600	1,800	17,300
Other	837,500	18,100	1,550	16,300
All	883,500	22,500	1,700	33,300
All				
Angle	825,700	19,200	1,250	19,600
Head-on	927,000	34,000	2,150	85,800
Rear-end	759,100	17,100	1,750	15,100
Other	837,800	18,100	1,550	15,700
All rural	872,600	21,000	1,600	27,400

Table 58. Total accident costs for rural, multiple-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Intersection				
Angle	$ 902,400	$19,200	$1,400	$ 16,800
Head-on	992,500	25,200	2,250	49,100
Rear-end	835,500	13,000	1,750	6,700
Other	954,900	16,800	1,500	9,200
All	905,200	17,400	1,550	12,600
Non-intersection				
Angle	928,200	21,900	1,500	13,800
Head-on	992,500	38,400	3,150	140,600
Rear-end	835,400	19,100	1,850	24,300
Other	1,017,200	17,800	1,500	17,700
All	931,400	20,500	1,750	30,400
All				
Angle	902,400	19,400	1,400	16,500
Head-on	992,500	38,100	3,050	137,000
Rear-end	835,500	18,400	1,800	21,500
Other	954,900	17,500	1,500	14,600
All rural	905,300	19,600	1,700	24,100

Table 59. Total accident costs for rural, multiple-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Intersection				
Angle	$ 823,600	$21,100	$1,350	$ 30,500
Head-on	1,006,000	28,000	2,100	50,700
Rear-end	704,300	15,600	1,750	9,700
Other	707,000	19,600	1,550	14,900
All	798,000	20,100	1,500	22,100
Non-intersection				
Angle	830,200	20,800	1,350	16,300
Head-on	1,006,000	39,000	2,500	156,500
Rear-end	704,300	18,000	1,800	26,900
Other	815,800	15,800	1,550	11,800
All	825,000	19,400	1,650	27,000
All				
Angle	827,200	21,100	1,350	27,500
Head-on	1,006,000	38,200	2,500	143,700
Rear-end	704,300	17,600	1,800	21,100
Other	707,000	16,800	1,550	12,100
All rural	815,400	19,800	1,600	24,800

Table 60. Total accident costs for rural, multiple-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Intersection				
Angle	$843,700	$19,500	$1,250	$23,300
Head-on	937,100	30,900	2,000	52,100
Rear-end	803,800	16,000	1,750	11,400
Other	873,800	17,900	1,550	15,400
All	852,100	18,700	1,450	19,100
Non-intersection				
Angle	679,000	17,000	1,250	9,200
Head-on	919,000	33,900	2,100	84,100
Rear-end	717,800	17,000	1,750	13,300
Other	816,200	18,600	1,550	16,900
All	882,700	23,100	1,700	34,400
All				
Angle	823,900	18,900	1,250	18,800
Head-on	919,600	33,800	2,100	82,600
Rear-end	741,400	16,700	1,750	12,700
Other	835,300	18,300	1,550	16,300
All rural	875,100	21,300	1,600	28,100

Table 61. Total accident costs for urban, multiple-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Intersection				
Angle	$725,300	$12,000	$1,250	$ 6,800
Head-on	761,500	16,000	1,300	11,900
Rear-end	715,500	8,600	850	3,700
Other	690,100	10,900	800	4,700
All	751,500	11,000	1,050	5,700
Non-intersection				
Angle	729,400	11,300	1,250	4,000
Head-on	841,600	18,100	1,300	25,600
Rear-end	696,700	10,000	850	5,100
Other	694,800	10,800	800	4,200
All	767,800	11,300	950	6,200
All				
Angle	725,600	11,900	1,250	6,200
Head-on	836,100	17,800	1,300	23,200
Rear-end	701,200	9,400	850	4,400
Other	692,300	10,800	800	4,500
All urban	741,900	11,100	1,000	5,800

Table 62. Total accident costs for urban, multiple-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Intersection				
Angle	$722,800	$12,100	$1,250	$ 7,200
Head-on	888,300	19,200	1,450	13,500
Rear-end	703,400	8,300	850	3,400
Other	698,500	9,900	800	3,200
All	725,700	10,400	1,000	4,900
Non-intersection				
Angle	772,800	11,400	1,250	6,400
Head-on	888,300	23,700	1,500	79,600
Rear-end	702,200	10,700	850	6,200
Other	688,500	10,900	750	5,900
All	764,400	11,100	850	7,700
All				
Angle	732,300	12,000	1,250	7,100
Head-on	888,300	23,300	1,500	67,700
Rear-end	703,400	10,000	850	5,300
Other	698,500	10,500	750	4,700
All urban	754,000	10,800	900	6,300

Table 63. Total accident costs for urban, multiple-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Intersection				
Angle	$ 739,000	$12,700	$1,250	$10,200
Head-on	731,000	17,900	1,400	11,900
Rear-end	725,300	8,800	850	4,300
Other	707,400	11,500	800	6,400
All	728,800	11,300	1,000	7,400
Non-intersection				
Angle	868,900	12,100	1,250	7,000
Head-on	1,101,700	20,400	1,350	55,300
Rear-end	861,500	10,000	850	6,100
Other	769,600	10,700	800	4,900
All	863,300	11,100	900	7,100
All				
Angle	741,600	12,700	1,250	9,600
Head-on	1,101,700	19,900	1,350	41,700
Rear-end	716,400	9,300	850	4,900
Other	730,600	11,200	800	5,800
All urban	772,400	11,200	950	7,300

Table 64. Total accident costs for urban, multiple-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Intersection				
Angle	$722,000	$11,900	$1,250	$ 6,300
Head-on	761,500	15,800	1,300	12,300
Rear-end	718,000	8,800	850	3,700
Other	680,900	10,900	800	4,800
All	712,800	11,000	1,050	5,500
Non-intersection				
Angle	699,500	11,200	1,250	3,700
Head-on	806,500	17,600	1,300	21,000
Rear-end	681,200	9,600	850	4,300
Other	684,600	10,700	800	3,700
All	755,200	11,400	950	5,600
All				
Angle	720,000	11,800	1,250	5,800
Head-on	802,400	17,300	1,300	19,600
Rear-end	694,100	9,100	850	3,900
Other	682,400	10,800	800	4,300
All urban	731,800	11,200	1,000	5,500

Table 65. Total accident costs for single-vehicle accidents in Texas, all roadway types combined, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Rural				
Animal	$653,300	$13,900	$1,300	$ 4,700
Fixed or other object	672,700	15,900	2,000	26,800
Parked car	678,100	16,300	900	19,100
Pedalcycle	639,600	12,000	200	60,500
Pedestrian	606,800	17,900	100	183,000
RR train	761,900	19,000	1,700	95,700
Overturn	665,000	18,300	1,950	33,900
Other non-collision	641,400	19,800	5,550	27,900
All rural	659,700	16,800	1,900	29,400
Urban				
Animal	639,600	11,200	800	4,800
Fixed or other object	660,300	14,100	800	12,800
Parked car	667,200	8,800	450	2,800
Pedalcycle	626,600	10,200	250	20,900
Pedestrian	619,900	14,100	150	70,300
RR train	729,900	15,600	2,400	48,500
Overturn	645,900	12,600	1,200	21,700
Other non-collision	614,000	11,500	2,150	21,600
All urban	644,500	12,900	700	13,800

Table 66. Total accident costs for single-vehicle accidents in Texas, controlled access roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Rural				
Animal	$684,500	$17,600	$1,800	$ 5,700
Fixed or other object	724,100	16,400	2,900	31,100
Parked car	720,700	17,800	950	59,100
Pedalcycle	689,400	14,100	200	66,300
Pedestrian	628,000	20,100	100	305,100
RR train	705,600	19,000	1,850	89,300
Overturn	704,600	20,600	2,650	35,900
Other non-collision	693,900	21,200	5,900	13,700
All rural	693,600	18,300	2,900	37,700
Urban				
Animal	642,700	11,700	800	6,300
Fixed or other object	665,100	13,800	850	16,000
Parked car	691,100	11,500	450	23,300
Pedalcycle	648,000	10,400	200	26,700
Pedestrian	624,600	18,300	150	211,000
RR train	654,900	14,600	2,350	43,800
Overturn	643,100	12,800	1,450	24,800
Other non-collision	646,500	11,900	2,700	22,500
All urban	647,500	13,500	900	24,100

Table 67. Total accident costs for single-vehicle accidents in Texas, divided roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Rural				
Animal	$632,800	$14,200	$1,600	$ 4,900
Fixed or other object	661,700	16,200	2,850	27,700
Parked car	648,300	18,400	950	24,300
Pedalcycle	637,900	13,200	200	61,500
Pedestrian	593,400	20,000	100	234,200
RR train	651,400	18,000	1,750	82,700
Overturn	634,700	19,000	2,450	41,600
Other non-collision	640,800	22,800	6,750	12,300
All rural	639,800	17,600	2,800	32,500
Urban				
Animal	648,600	11,200	800	4,800
Fixed or other object	658,100	14,200	850	16,800
Parked car	653,600	9,400	450	7,000
Pedalcycle	654,200	10,500	200	45,300
Pedestrian	616,400	15,400	150	127,400
RR train	660,500	14,300	2,800	97,000
Overturn	681,300	12,300	1,300	21,000
Other non-collision	650,900	11,700	3,100	9,700
All urban	653,800	13,400	900	23,600

Table 68. Total accident costs for single-vehicle accidents in Texas, undivided roadways, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Rural				
Animal	$649,600	$13,600	$1,250	$ 4,700
Fixed or other object	665,500	15,900	1,750	26,200
Parked car	621,500	15,500	900	10,800
Pedalcycle	634,300	11,900	200	55,200
Pedestrian	602,000	17,500	100	159,800
RR train	767,800	18,900	1,650	95,700
Overturn	663,400	17,900	1,800	32,700
Other non-collision	637,500	18,900	4,950	37,900
All rural	655,400	16,500	1,700	27,900
Urban				
Animal	636,800	11,400	850	4,900
Fixed or other object	658,400	14,200	800	11,500
Parked car	650,600	8,400	450	2,000
Pedalcycle	620,500	10,200	250	19,500
Pedestrian	618,300	13,700	150	53,700
RR train	735,100	15,700	2,400	47,800
Overturn	642,300	12,600	1,050	20,700
Other non-collision	603,400	11,400	1,800	22,800
All urban	641,700	12,700	650	11,400

Table 69. Total accident costs for wet-weather, rural accidents in Texas, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Multiple-vehicle				
Intersection				
Controlled access	$821,800	$18,300	$1,500	$14,800
Divided	821,800	21,000	1,500	15,400
Undivided	848,600	17,900	1,450	16,000
All	821,800	18,300	1,500	15,500
Non-intersection				
Controlled access	901,500	21,500	1,750	24,800
Divided	901,500	19,600	1,700	27,300
Undivided	902,900	23,900	1,700	34,600
All	901,500	23,200	1,700	32,800
All				
Controlled access	893,300	20,700	1,700	22,100
Divided	887,000	20,200	1,650	22,900
Undivided	892,900	21,600	1,600	27,600
All multi	887,000	21,400	1,600	26,400
Single-vehicle				
Controlled access	623,400	16,900	3,600	19,500
Divided	662,100	17,200	4,000	17,900
Undivided	647,300	15,500	2,100	19,200
All single	646,100	15,800	2,500	19,100
All				
Controlled access	726,400	18,300	2,800	20,500
Divided	774,600	18,500	2,900	20,100
Undivided	775,200	18,300	1,850	23,200
All rural	767,100	18,300	2,100	22,600

Table 70. Total accident costs for wet-weather, urban accidents in Texas, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Multiple-vehicle				
Intersection				
Controlled access	$710,900	$ 9,900	$1,000	$ 3,900
Divided	710,900	10,900	1,000	5,900
Undivided	702,700	10,300	1,050	4,400
All	710,900	10,400	1,050	4,600
Non-intersection				
Controlled access	690,500	11,200	850	5,700
Divided	789,100	10,500	900	5,800
Undivided	823,100	11,200	1,000	6,000
All	789,100	11,200	950	5,900
All				
Controlled access	695,600	11,700	900	5,200
Divided	740,200	10,800	950	5,900
Undivided	775,400	10,600	1,000	5,000
All multi	758,300	10,700	1,000	5,100
Single-vehicle				
Controlled access	632,100	12,200	900	11,800
Divided	677,700	12,800	950	12,600
Undivided	645,900	12,500	650	8,600
All single	644,400	12,400	750	9,500
All				
Controlled access	651,200	11,200	900	6,900
Divided	708,000	11,200	950	7,100
Undivided	707,000	11,200	950	5,900
All urban	707,000	11,200	950	6,200

Table 71. Total accident costs for night, rural accidents in Texas, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Multiple-vehicle				
Intersection				
Controlled access	$854,200	$18,900	$1,550	$20,800
Divided	858,300	22,600	1,500	36,100
Undivided	891,800	19,900	1,450	24,900
All	854,300	20,100	1,500	25,200
Non-intersection				
Controlled access	956,500	21,800	1,800	39,200
Divided	841,400	22,400	1,700	44,500
Undivided	904,300	26,000	1,700	62,000
All	904,300	25,000	1,750	56,600
All				
Controlled access	917,500	21,200	1,750	34,300
Divided	819,900	22,500	1,600	40,500
Undivided	902,400	23,800	1,600	48,500
All multi	896,000	23,400	1,650	45,800
Single-vehicle				
Controlled access	670,100	18,200	2,600	43,900
Divided	642,300	17,500	2,350	38,800
Undivided	650,000	16,500	1,400	30,300
All single	652,200	16,700	1,600	32,300
All				
Controlled access	729,900	19,300	2,250	40,300
Divided	701,800	19,500	2,050	39,400
Undivided	737,700	18,600	1,450	35,700
All rural	733,300	18,600	1,600	36,500

Table 72. Total accident costs for night, urban accidents in Texas, 1983 dollars.

Accident Type	Severity			
	Fatal	Injury	PDO	Average
Multiple-vehicle				
Intersection				
Controlled access	$717,700	$11,300	$1,000	$ 7,000
Divided	704,400	12,100	1,000	10,000
Undivided	740,600	12,200	1,050	8,100
All	730,900	12,000	1,000	8,200
Non-intersection				
Controlled access	755,700	12,800	850	13,400
Divided	923,800	12,500	900	12,600
Undivided	758,400	13,300	950	10,400
All	774,700	13,100	950	11,400
All				
Controlled access	747,800	12,200	900	10,700
Divided	794,600	12,200	950	10,900
Undivided	750,000	12,600	1,000	9,100
All multi	755,900	12,400	1,000	9,600
Single-vehicle				
Controlled access	655,000	14,200	750	32,000
Divided	661,500	14,000	750	29,800
Undivided	648,300	13,300	600	13,100
All single	649,300	13,500	650	16,600
All				
Controlled access	679,700	13,000	850	18,400
Divided	713,500	12,700	900	15,600
Undivided	681,900	12,900	800	11,000
All urban	684,300	13,000	850	12,600

Statistics were calculated by these cross-classifications for night accidents and wet-weather accidents, in addition to all accidents, in order to allow more precise evaluation of countermeasures specifically directed at either of these two subsets of accidents.

The following accident statistics were calculated for the indicated sets of accidents and by the indicated cross-classifications:

- Accident frequencies and proportions by severity
- Numbers of passenger cars, single-unit trucks, and combination trucks per accident
- Numbers of fatalities and injuries (by A-B-C severities) per fatal accident and per injury accident

Accident proportions by severity, presented in Tables 1-18, were used in calculating average accident costs, weighted across severities, as explained below.

Direct Accident Costs

Direct accident costs were calculated using numbers of vehicle involvements per accident and vehicle involvement costs. Involvement costs were obtained by updating the 1980 involvement costs in [5], which were derived from Burke's values [15], to 1983 (fourth quarter). The following cost elements were updated:

- Costs of damage to vehicle and other property
- Medical costs
- Cost of loss of vehicle use
- Value of time lost
- Legal and court costs
- Miscellaneous direct costs

The following wage and price indices [16,17] were used to update the different elements of the involvement costs:

- Vehicle damage - "automobile maintenance and repair" component of the consumer price index (CPI)
- Doctor and dentist fees - "medical care, professional services" component of CPI
- Other medical costs - "medical care" component of CPI
- Value of time lost - index of average hourly earnings on private nonagricultural payrolls
- All other cost items - CPI for all items, all urban consumers

The elements of the 1980 involvement costs were expressed as weights that sum to 100 percent, with each weight specifying a proportion of the total involvement cost for a particular case (e.g., passenger car, fatal). Applying the wage and price indices to the 1980 weights for each case produced a set of 1983 weights, the sum of which was used to update the 1980 involvement costs to 1983. Table 73 presents the 1980 weights for elements of passenger car and truck involvements, and Table 74 shows these weights updated to 1983.[1] The 1983 vehicle involvement costs are presented in Tables 75-80. Since involvement costs were unavailable by some cross-classifications such as road type, the costs were applied without differentiation across such categories. For example, the 1983 direct involvement costs for passenger cars in fatal

---

[1]No distinction could be made between single-unit and combination trucks for updating purposes, since the original state studies [8-13] did not make this distinction. Hence, the same set of updating weights was used for both types of truck involvements.

Table 73. 1980 weights of direct cost elements of vehicle involvements.

Vehicle Type and Cost Element	Accident Severity		
	Fatal	Injury	PDO
Passenger Car Involvements			
Vehicle damage	28.45%	49.22%	90.27%
Other property damage	0.83	1.07	5.72
Doctor and dentist fees	12.86	12.14	-
Other medical costs	19.22	11.28	-
Loss of vehicle use	0.15	0.39	0.71
Value of time lost	13.70	13.97	1.67
Legal and court costs	24.30	10.14	0.62
Miscellaneous costs	0.49	1.79	1.01
Total	100.00	100.00	100.00
Truck Involvements			
Vehicle damage	47.08%	43.02%	78.61%
Other property damage	3.62	3.52	7.65
Doctor and dentist fees	7.73	10.35	-
Other medical costs	13.66	9.36	-
Loss of vehicle use	6.05	6.45	10.43
Value of time lost	6.93	21.13	2.20
Legal and court costs	14.20	5.56	0.37
Miscellaneous costs	0.73	0.61	0.74
Total	100.00	100.00	100.00

Table 74. 1983 weights of direct cost elements of vehicle involvements.

Vehicle Type and Cost Element	Accident Severity		
	Fatal	Injury	PDO
Passenger Car Involvements			
Vehicle damage	35.08%	60.69%	111.31%
Other property damage	1.01	1.30	6.95
Doctor and dentist fees	16.70	15.76	-
Other medical costs	26.10	15.32	-
Loss of vehicle use	0.18	0.47	0.86
Value of time lost	16.74	17.07	2.04
Legal and court costs	29.51	12.31	0.75
Miscellaneous costs	0.60	2.17	1.23
Total	125.92	125.09	123.14
Truck Involvements			
Vehicle damage	58.05%	53.05%	96.93%
Other property damage	4.40	4.27	9.29
Doctor and dentist fees	10.04	13.44	-
Other medical costs	18.55	12.71	-
Loss of vehicle use	7.35	7.83	12.67
Value of time lost	8.47	25.81	2.69
Legal and court costs	17.24	6.75	0.45
Miscellaneous costs	0.89	0.74	0.90
Total	124.99	124.60	122.93

Table 75. Direct cost per rural passenger car involvement, 1983 dollars.*

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Angle	$18,300	$3,900	$550
Head-on	28,200	8,000	800
Rear-end	21,100	4,800	850
Other	19,600	4,000	750
Single-vehicle			
Animal	5,200	6,400	900
Fixed or other object	7,500	5,000	1,050
Parked car	21,100	4,800	850
Pedalcycle	10,600	1,500	200
Pedestrian	11,300	4,200	50
RR train	19,600	5,600	500
Overturn**	11,700	5,400	650
Other non-collision**	11,700	5,400	650

*Based on Burke [15] and McFarland and Rollins [5]. Rounded to nearest $100 for fatal and injury costs and to nearest $50 for property-damage-only (PDO) costs.

**Involvement costs for overturn and other non-collision accidents are identical because these two accident types were not differentiated in the original state studies used in developing involvement costs.

Table 76. Direct cost per urban, passenger car involvement, 1983 dollars.*

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Angle	$19,700	$2,700	$ 600
Head-on	17,800	2,600	600
Rear-end	14,800	2,500	400
Other	10,600	2,100	400
Single-vehicle			
Animal	9,300	4,600	800
Fixed or other object	10,500	6,000	650
Parked car	14,800	2,500	400
Pedalcycle	15,100	3,100	200
Pedestrian	17,300	4,200	100
RR train	20,800	5,400	2,100
Overturn**	10,800	3,500	600
Other non-collision**	10,800	3,500	600

*Based on Burke [15] and McFarland and Rollins [5].

**Involvement costs for overturn and other non-collision accidents are identical because these two accident types were not differentiated in the original state studies used in developing involvement costs.

Table 77. Direct cost per rural, single-unit truck involvement, 1983 dollars.*

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Angle	$25,400	$ 3,300	$ 550
Head-on	18,500	5,300	1,650
Rear-end	14,500	3,400	600
Other	17,100	3,400	600
Single-vehicle			
Animal	5,1000	5,900	1,100
Fixed or other object	18,700	6,100	1,800
Parked car	14,500	3,400	600
Pedalcycle	8,300	5,200	100
Pedestrian	6,200	2,400	50
RR train	50,000	113,300	5,300
Overturn**	9,800	7,400	2,750
Other non-collision**	9,800	7,400	2,750

*Based on Burke [15] and McFarland and Rollins [5].

**Involvement costs for overturn and other non-collision accidents are identical because these two accident types were not differentiated in the original state studies used in developing involement costs.

Table 78. Direct cost per urban, single-unit truck involvement, 1983 dollars.*

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Angle	$14,900	$1,900	$ 450
Head-on	6,000	2,800	550
Rear-end	6,800	1,200	250
Other	3,100	1,500	250
Single-vehicle			
Animal	9,300	4,500	550
Fixed or other object	32,300	4,100	1,250
Parked car	6,800	1,200	250
Pedalcycle	15,800	1,900	100
Pedestrian	16,300	4,100	100
RR train	29,000	4,300	1,750
Overturn**	9,300	3,000	1,350
Other non-collision**	9,300	3,000	1,350

*Based on Burke [15] and McFarland and Rollins [5].

**Involvement costs for overturn and other non-collision accidents are identical because these two accident types were not differentiated in the original state studies used in developing involvement costs.

Table 79. Direct cost per rural, combination truck involvement, 1983 dollars.*

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Angle	$25,800	$12,200	$ 2,850
Head-on	21,700	13,800	4,400
Rear-end	20,100	3,900	1,200
Other	11,600	3,600	700
Single-vehicle			
Animal	5,100	20,100	4,500
Fixed or other object	46,300	5,500	12,750
Parked car	20,100	3,900	1,200
Pedalcycle	8,300	5,200	100
Pedestrian	16,200	2,400	50
RR train	50,000	13,300	5,300
Overturn**	30,000	20,600	9,400
Other non-collision**	30,000	20,600	9,400

*Based on Burke [15] and McFarland and Rollins [5].

**Involvement costs for overturn and other non-collision accidents are identical because these two accident types were not differentiated in the original state studies used in developing involvement costs.

Table 80. Direct cost per urban, combination truck involvement, 1983 dollars.*

Accident Type	Severity		
	Fatal	Injury	PDO
Multiple-vehicle			
Angle	$ 4,400	$ 1,400	$ 550
Head-on	10,300	17,300	1,950
Rear-end	6,800	1,400	250
Other	8,100	3,800	150
Single-vehicle			
Animal	9,300	4,500	550
Fixed or other object	32,300	4,600	2,750
Parked car	6,800	1,400	250
Pedalcycle	8,800	900	100
Pedestrian	11,400	4,300	100
RR train	29,000	23,500	4,900
Overturn**	49,700	3,700	4,850
Other non-collision**	49,700	3,700	4,850

*Based on Burke [15] and McFarland and Rollins [5].

**Involvement costs for overturn and other non-collision accidents are identical because these two accident types were not differentiated in the original state studies used in developing involvement costs.

accidents (Table 75) were calculated by multiplying 1980 involvement costs [5] by a factor of 1.2592 from Table 74.

Direct costs per accident (excluding funeral costs), in 1983 dollars, were calculated as the sum of the involvements per accident times the corresponding 1983 involvement costs. For example, the direct cost (DC) per fatal, rural, multiple-vehicle, head-on accident was calculated as follows:

$$DC = (C_{PC} \times PC) + (C_{ST} \times ST) + (C_{CT} \times CT)$$

$$= (\$28,200 \times 1.74) + (\$18,500 \times 0.09) + (\$21,700 \times 0.24)$$

$$= \$55,900 \text{ (excluding funeral costs)}$$

where C_{pc}, C_{st}, and C_{ct}, respectively, represent the involvement costs per passenger car, single-unit truck, and combination truck, and where PC, ST, and CT, respectively, represent the numbers of passenger cars, single-unit trucks, and combination trucks per accident.

Funeral costs per accident were calculated as the number of fatalities per accident times the difference between the average cost of a funeral in the present year and the present value of that same cost incurred in the future (discounted at four percent[2]) had the victim lived to the current average life expectancy. According to NHTSA [4], the average number of years remaining in the life expectancy of the median-aged traffic fatality is 44.8 years.

---

[2]A four percent discount rate is consistent with recommendations in the AASHTO revised Red Book [2] and elsewhere [5]. Although real interest rates (market rates less inflation) are currently higher than four percent, it is the authors' view that financial market forces will eventually bring the current historically-high real interest rates back to the four percent level, thereby reflecting the historical real cost of capital. Hence, a discount rate of four percent was used in present worth calculations in this study.

Given a 1983 average funeral cost of $1,951 [5] (which can be updated to later years using the CPI for all items, all urban consumers), the funeral cost per fatality in an accident is $1,951 - 337 = $1,614 (1983 dollars).

In this example, the funeral cost for this type of accident is $1,614 times 1.38 fatalities per accident, or $2,227. Adding this value to the other direct costs produces a direct cost as follows:

DC = $55,900 + ($1,614 x 1.38)

$58,100 (including funeral costs)

Direct costs per accident are presented in Tables 19-36; the cost of $58,100 in this example is taken from Table 21.

Although it might be argued that additional funeral costs should be included in direct costs to reflect shortened life spans of nonfatally injured accident victims, such funeral costs were not included in the direct accident costs. The authors were unaware of any estimates of the proportion of seriously injured individuals whose expected life spans were shortened due to their injuries, or of the extent to which their life spans may have been shortened. Further, the difference in the present values of funeral costs incurred at the end of the expected remaining years of life (44.8 years) of the median-aged traffic fatality and at the end of the remaining years of a shortened life span due to injuries may not be great, if such a value could be accurately estimated. For example, the present value of a funeral occurring 44.8 years in the future is $337, as described above. If an injured individual's life span is shortened by, say, 20 years, then the present value of funeral costs is $738, giving a difference in direct costs of $738 - $337 = $401. If his life span is shortened by 10 years, then this difference is equal to only \$498 - \$337 = \$161. For these reasons, then, no attempt was made to include any present value of funeral costs, incurred before the expected remaining 44.8 years of life, to reflect shortened life spans due to nonfatal injuries.

Indirect Accident Costs

Indirect accident costs were developed from accident records on numbers of fatalities and A-B-C injuries per accident and from unit indirect costs per fatality and per injury. Procedures developed in [5] were used to develop the unit indirect costs.

Indirect Cost Per Injury

Indirect costs of nonfatal injuries were defined in this study to include: (1) production and consumption losses for the injured person, (2) other losses to the injured person's home and family and to the community at large, (3) costs of accident investigation, and (4) insurance administration costs. The source for estimates of these losses is NHTSA [4], which reports these cost elements according to the Abbreviated Injury Scale (AIS) for fatalities (AIS code 6), PDO accidents (code 0), and five severities of injuries: (1) minor (AIS code 1), (2) moderate (code 2), (3) severe, not life-threatening (code 3), (4) severe, life-threatening (code 4), and (5) critical, survival uncertain (code 5). The NHTSA costs were updated to 1983 using wage and price indices [16,17] and are given in Table 81.

Since Texas accident records use the A-B-C injury classification system (incapacitating, nonincapacitating, and possible injury, respectively), it was necessary to relate the indirect cost by AIS severities to A-B-C injury

Table 81. NHTSA indirect costs per injury by AIS injury severity and per PDO accident, 1983 dollars.

Cost Component	Injury Severity (AIS)						PDO
	6 (fatal)	5	4	3	2	1	
Production/ consumption:							
Market	$461,506*	$227,431	$ 99,755	$2,954	$1,554	$117	$ 0
Home, family, community	114,111	68,230	29,917	764	557	35	0
Insurance administration	554	554	536	451	413	97	56
Accident investigation	151	151	132	86	66	53	11
Total	$576,322	$296,366	$130,340	$4,255	$2,590	$302	$67

* This market value of $461,506 per fatality is substituted for the NHTSA value for a fatality.

Source: [5]. McFarland and Rollins' 1980 III values (based on NHTSA [4]) were updated to 1983 IV using the Consumer Price Index for all urban consumers, all items [16] for insurance administration and the index of average hourly earnings on private nonagricultural payrolls [17] for the other values.

frequencies. A method for doing this was developed in [5], whereby data on distributions of injuries by AIS severities versus A-B-C severities were used to weight the AIS indirect costs across A-B-C injuries in fatal accidents and in injury accidents. This procedure was used in this study to develop the unit indirect costs for A-B-C injuries in fatal and injury accidents.

Injuries by AIS severities were related to the distribution of injuries by A-B-C severities using data obtained from the National Crash Severity Study (NCSS) for 1977-78 and the National Accident Sampling System (NASS) for 1979-80. Each of these samples contains a large number of accidents cross-classified by the AIS and A-B-C scales. The NCSS sample was used for fatal accidents, since it covered a larger sample of injuries in fatal accidents than did the NASS sample. For an analogous reason, the NASS sample was used for injuries in injury accidents. Tables 82 and 83 show the cross-classification of AIS and A-B-C injury severities for fatal and injury accidents, respectively, in percentage terms.

To derive unit indirect costs, the following procedure from [5] was followed. First, the percentage distributions of injuries from Tables 82 and 83 were plotted in Figures 1 and 2, which have a logarithmic scale on the vertical axis. In each figure, the cumulative percent of injuries for each AIS severity class was plotted versus the cumulative percent of injuries for all AIS classes at points along the horizontal axis represented by: (1) the origin, (2) percent of C injuries, (3) percent of C+B injuries, and (4) percent of C+B+A injuries (100 percent). For each AIS severity class, a curve was fitted through these four points in such a way that the vertical sum of the points on the curve at any point on the horizontal axis equals the corresponding

Table 82. Injuries in fatal accidents, percentages by A-B-C scale and AIS scale.*

AIS Scale	A-B-C Scale			
	C	B	A	Total
0	0.30%	0.30%	0.00%	0.60%
1	5.86	17.90	14.99	38.75
2	0.75	5.86	13.51	20.12
3	0.60	3.90	19.21	23.71
4	0.30	1.05	9.16	10.51
5	0.00	0.15	5.86	6.01
6	0.00	0.00	0.30	0.30
Total	7.81%	29.16%	63.03%	100.00%

*Based on NCSS data, 1977-78.

Table 83. Injuries in injury accidents, percentages by A-B-C scale and AIS scale.*

AIS Scale	A-B-C Scale			
	C	B	A	Total
0	2.84%	0.46%	0.07%	3.37%
1	32.45	30.38	6.08	68.91
2	2.97	7.36	6.67	17.00
3	0.82	2.94	4.70	8.46
4	0.04	0.36	1.25	1.65
5	0.00	0.16	0.42	0.58
6	0.00	0.00	0.03	0.03
Total	39.12%	41.66%	19.22%	100.00%

*Based on NASS data, 1979-80.

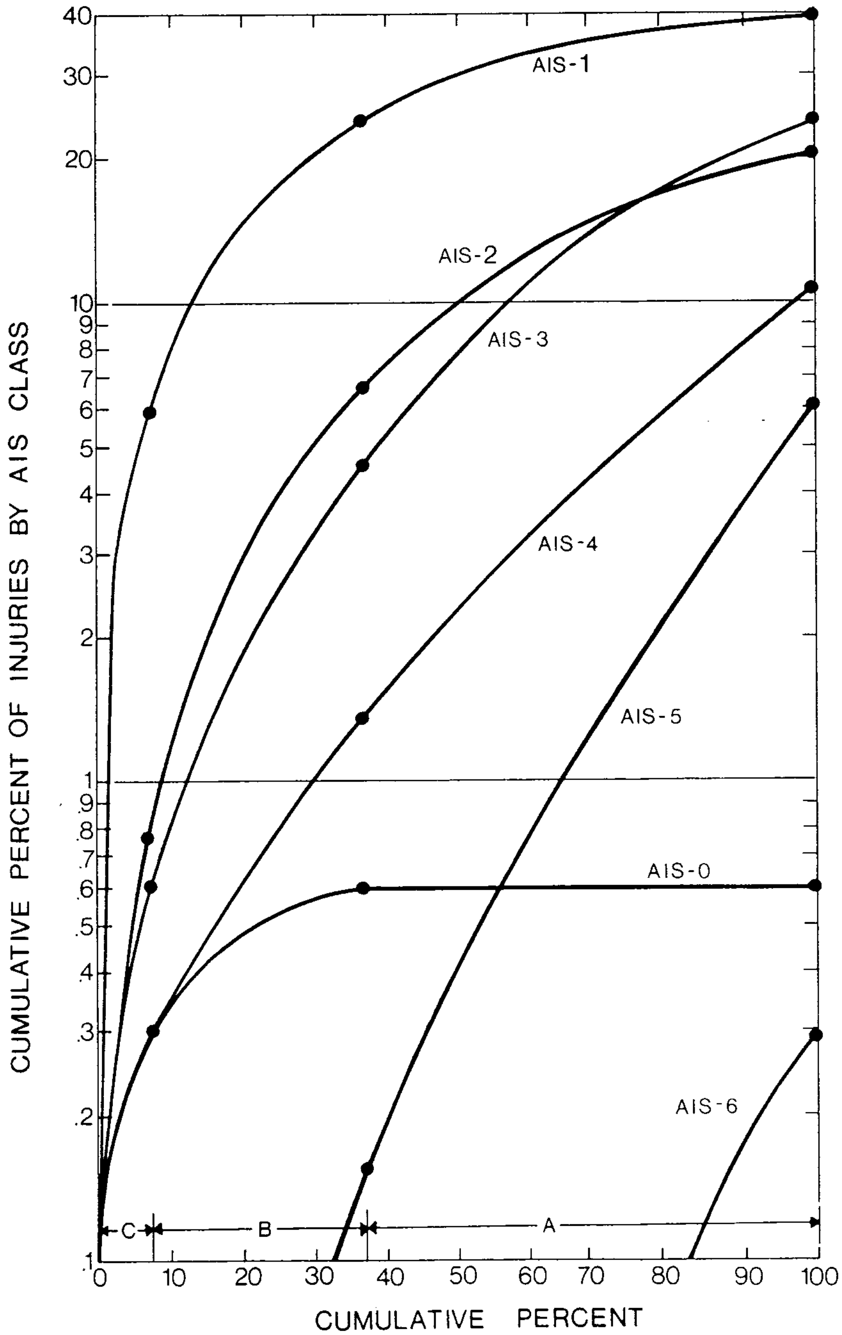


Figure 1. Cumulative percent of injuries by AIS class versus cumulative percent by A-B-C scale, for injuries in fatal accidents, NCSS sample (logarithmic scale on vertical axis).

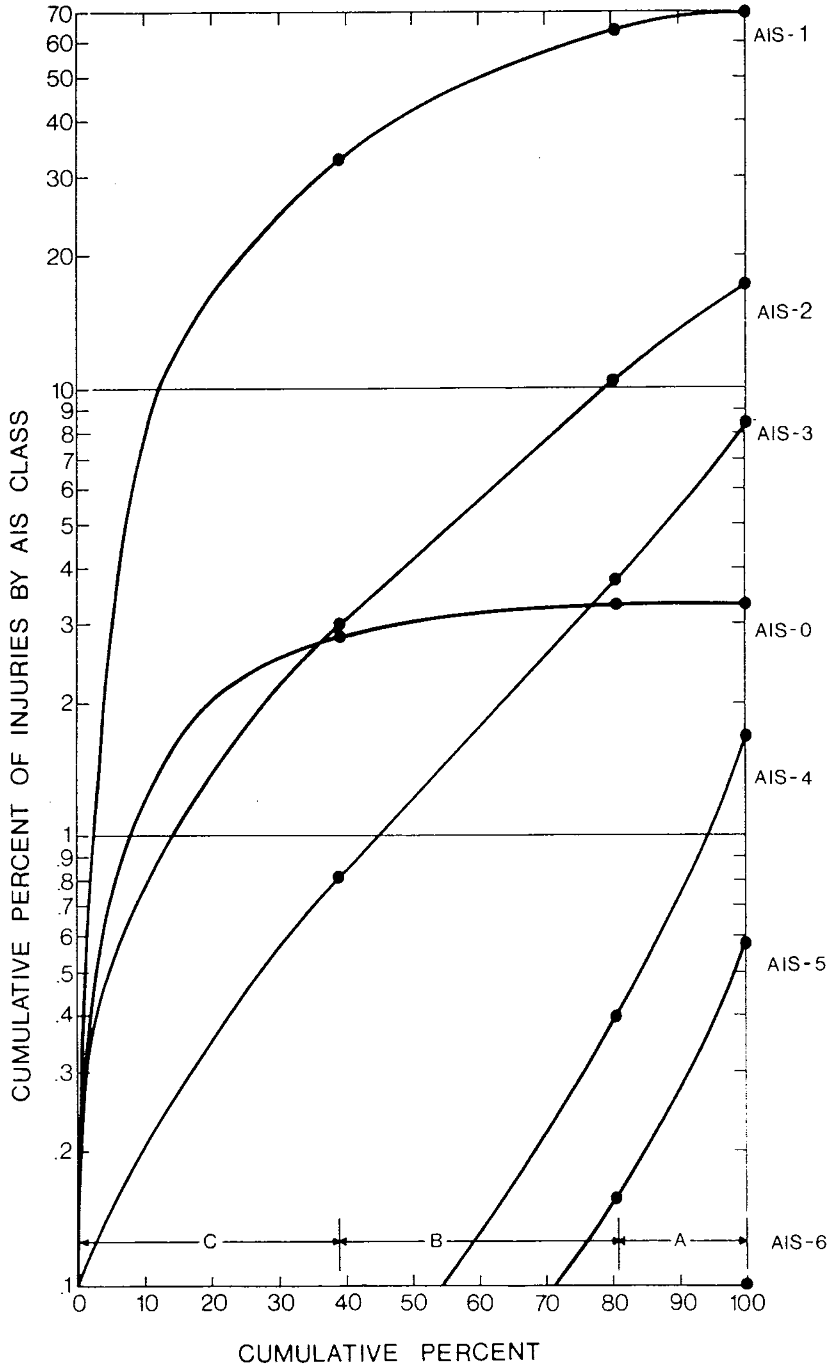


Figure 2. Cumulative percent of injuries by AIS class versus cumulative percent by A-B-C scale, for injuries in injury accidents, NASS sample (logarithmic scale on vertical axis).

cumulative percentage. Since the logarithmic scale in Figures 1 and 2 may be difficult to read, Figures 3 and 4 with arithmetic scales on the vertical axis were developed to facilitate reading the scales [5].

Two assumptions are implied by using Figures 1 and 2 (or 3 and 4) to estimate the percent distribution of A-B-C severities across AIS severities. First, it is assumed that the distribution of injuries across severities in Texas in 1981-82 is the same as in the nationwide NCSS and NASS samples. Second, it is assumed that the cumulative distribution of injuries by AIS scale follows the curves in Figures 1 and 2 (or 3 and 4) in such a way that the C injuries fall within the lowest part of the distribution, the B injuries fall within the midrange, and the A injuries fall within the upper range of the distribution.

Given these assumptions, the second step in developing unit indirect costs was to compile percentages, of weights, of AIS injuries relative to the A-B-C distribution of injuries in the Texas accident sample. Tables 84 and 85 show how this was done for injuries in fatal accidents and injuries in injury accidents, respectively, using Figure 1 (or 3) for fatal accidents and Figure 2 (or 4) for injury accidents.

The distribution of injuries in fatal accidents in Texas for 1981-82 was C = 15.06 percent, B = 38.21 percent, and A = 46.73 percent, as shown in Table 84. The points on the AIS curves (codes 0-6), corresponding to the cumulative A-B-C points (C = 15.06 percent, C+B = 53.27 percent, and C+B+A = 100.00 percent) along the horizontal axis, were read from Figure 1 (or 3). These values are shown in the first row of Table 84 for C injuries (0.42, 11.06, 1.84, ..., 0.00). The next three rows of Table 84 show how the values for B injuries

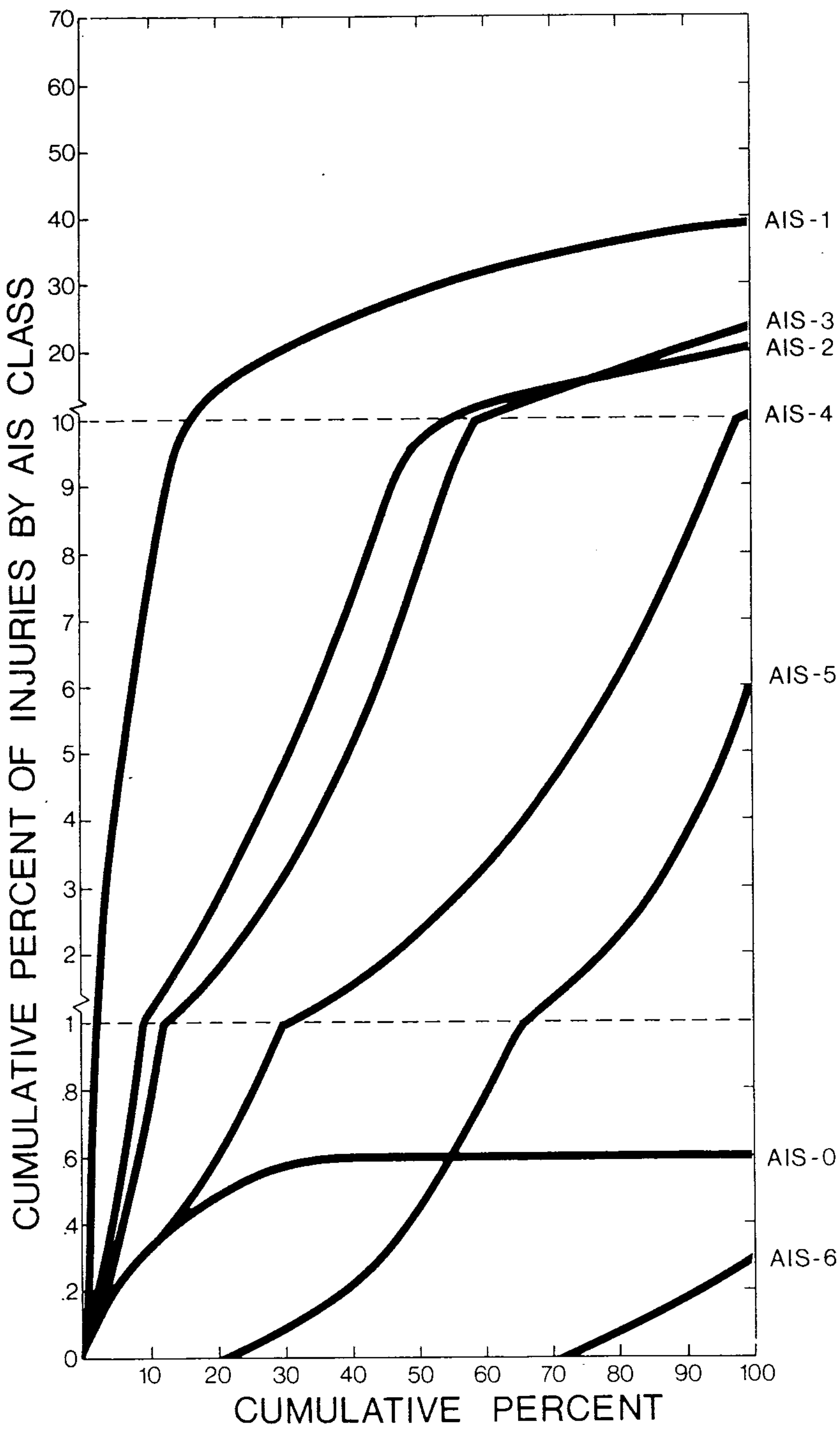


Figure 3. Cumulative percent of injuries by AIS class versus cumulative percent by A-B-C scale, for injuries in fatal accidents, NCSS sample (three-tiered arithmetic scale on vertical axis).

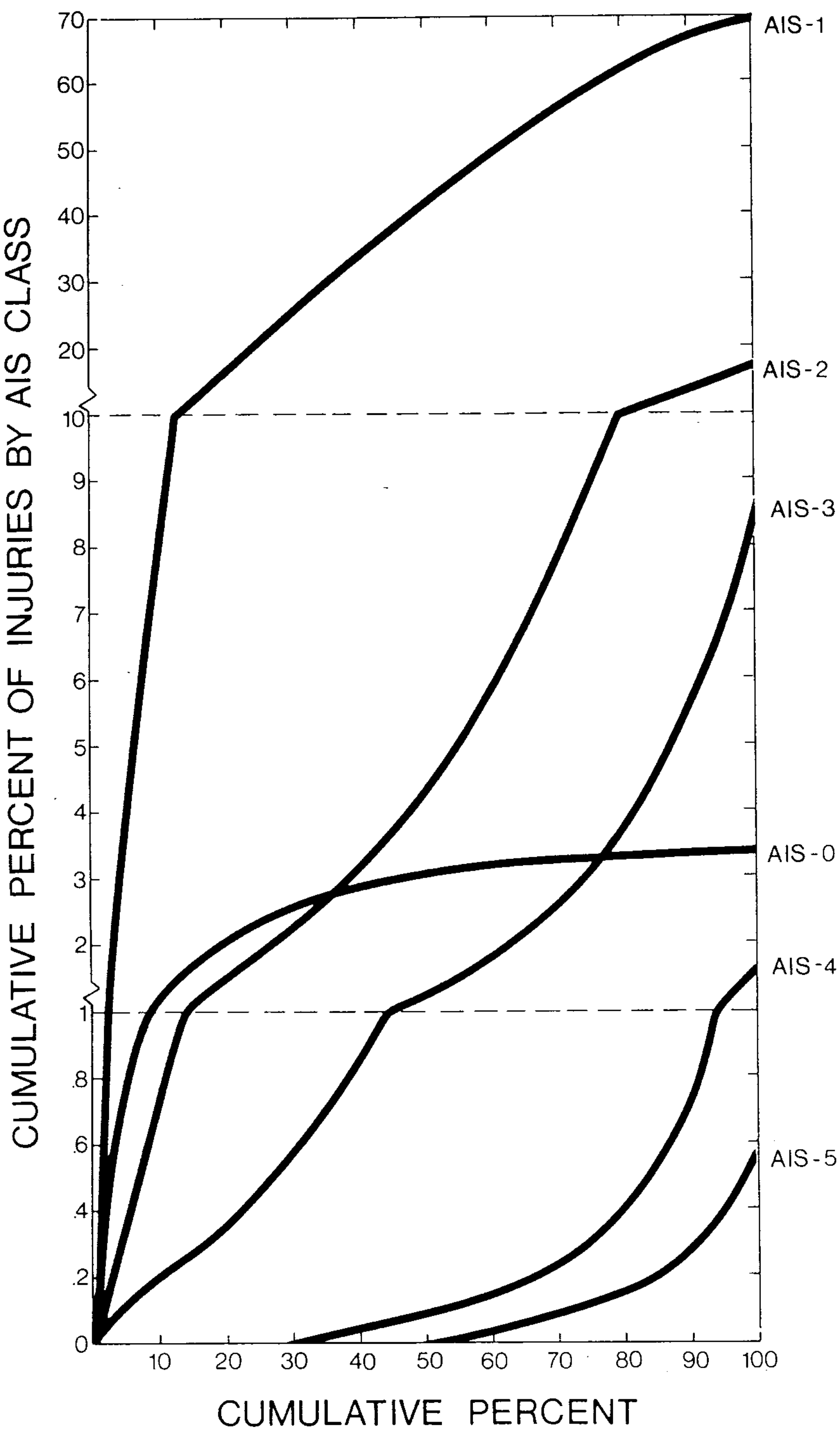


Figure 4. Cumulative percent of injuries by AIS class versus cumulative percent by A-B-C scale, for injuries in injury accidents, NASS sample (three-tiered arithmetic scale on vertical axis).

Table 84. Estimation of the percent of injuries in each AIS severity class for each A-B-C injury category for injuries in fatal accidents in Texas.*

Percentage Point on Horizontal Axis	Percentage Point on AIS Curves Corresponding to Percentage Point on Horizontal Axis by AIS Class							
	0	1	2	3	4	5	6	Total
C Percent (15.06%)	0.42	11.06	1.84	1.26	0.48	0.00	0.00	15.06
C+B Percent (53.27%)	0.60	30.17	10.77	8.64	2.57	0.52	0.00	
Less C	0.42	11.06	1.84	1.26	0.48	0.00	0.00	
Equals B	0.18	19.11	8.93	7.38	2.09	0.52	0.00	38.21
C+B+A Percent (100%)	0.60	38.75	20.12	23.71	10.51	6.01	0.30	
Less C+B	0.60	30.17	10.77	8.64	2.57	0.52	0.00	
Equals A	0.00	8.58	9.35	15.07	7.94	5.49	0.30	46.73

*Based on Texas accident data, 1981-82.

Table 85. Estimation of the percent of injuries in each AIS severity class for each A-B-C injury category for injuries in injury accidents in Texas.*

Percentage Point on Horizontal Axis	Percentage Point on AIS Curves Corresponding to Percentage Point on Horizontal Axis by AIS Class							
	0	1	2	3	4	5	6	Total
C Percent (43.03%)	2.92	35.77	3.35	0.42	0.05	0.00	0.00	43.03
C+B Percent (87.99%)	3.34	65.96	12.67	5.11	0.67	0.24	0.00	
Less C	2.92	35.77	3.35	0.94	0.05	0.00	0.00	
Equals B (100%)	0.42	30.19	9.32	4.17	0.62	0.24	0.00	44.96
C+B+A Percent	3.37	68.91	17.00	8.46	1.65	0.58	0.03	
Less C+B	3.34	65.96	12.67	5.11	0.67	0.24	0.00	
Equals A	0.03	2.95	4.33	3.357	0.98	0.34	0.03	12.01

*Based on Texas accident data, 1981-82.

(0.18, 19.11, 8.93, ..., 0.00) were calculated as the difference between the points on the AIS curves for cumulative C+B (0.60, 30.17, 10.77, ..., 0.00) injuries and the points for C injuries alone. The last three rows of Table 84 demonstrate the calculation of the values for A injuries (0.00, 8.58, 9.35, ..., 0.30), calculated as the difference between the values for C+B+A injuries (0.60, 38.75, 20.12, ..., 0.30) and those for C+B injuries.

The distribution of injuries in injury accidents in Texas for 1981-82 was C = 43.03 percent, B = 44.96 percent, and A = 12.01 percent, as shown in Table 85. The procedure for calculating the percentages, or weights, for injuries in injury accidents is the same as for injuries in fatal accidents (Table 84), using Figure 2 (or 4) [5].

The third step in developing unit indirect costs was to use the percentages in Tables 84 and 85 to weight the NHTSA costs in Table 81, to produce indirect costs for A, B, and C injuries for both fatal and injury accidents. This calculation procedure is illustrated in Table 86, which shows the calculation of the indirect cost of $62,610 (1983 dollars) per A injury in fatal accidents. The indirect costs of A, B, and C injuries in fatal and injury accidents are shown in Table 87. The difference in these unit costs by accident severity indicates that injuries of a given A-B-C severity are more severe in fatal accidents than in injury accidents.

Indirect Cost Per Fatality

In Chapter II, three definitions of, or approaches to calculating, indirect costs per fatality were identified. The approach taken by the National Safety Council [1] and the revised Red Book [2] includes costs of a fatality

Table 86. Illustration of calculation of indirect cost per injury for A injuries in fatal accidents in Texas, 1983 dollars.

(1) AIS Class	(2) Percent by AIS Class*	(3) Proportion by AIS Class**	(4) Indirect Cost per Injury***	(5) Column (3) X Column (4)
0	0.00%	.0000	$ 67	$ 0
1	8.58	.1836	302	56
2	9.35	.2001	2,590	518
3	15.07	.3225	4,255	1,372
4	7.94	.1699	130,340	22,146
5	5.49	.1175	296,366	34,818
6	0.30	.0064	576,322	3,700
Total	46.73	1.0000	--	$62,610

* From Table 84.

** Percent in Column (2) divided by total for Column (2).

*** From Table 81.

Table 87. Indirect cost per injury for A-B-C injuries in fatal and injury accidents in Texas, 1983 dollars.*

Injury Severity	Indirect Cost per Injury**	
	Fatal Accidents	Injury Accidents
A	$ 62,600	$ 22,700
B	12,700	4,500
C	5,100	700

* Derived from Tables 81, 84, and 85.

** Rounded to nearest $100.

to others but includes no such cost for the value of a person's life to himself. Hence, this approach was not used in developing indirect costs of fatalities in this study. The second approach, that used by NHTSA [4] does not exclude the victim's own consumption from his total future production and so can be considered to include a value for the victim's life to himself. The third approach [5], based on motorists' willingness to incur small costs in order to reduce slightly the risk of being killed, is considered to be the most appropriate method of estimating the indirect cost per fatality for use in benefit-cost evaluations of traffic accident countermeasures and, thus, was used in this study.

The indirect cost per fatality was calculated as shown in Table 81. The "production/consumption" value of $461,506 represents the value of a person's life to himself, as estimated by Blomquist [18] and updated to 1983. To this value was added three other values, developed by NHTSA: (1) the value to others of $114,111, (2) insurance administration costs of $554 per fatality, and (3) accident investigation costs of $151 per fatality. The sum of these four costs gave the indirect cost per fatality of $576,322 in 1983 dollars.

This indirect cost should not be interpreted as implying that an average individual would be willing and able to pay $576,322 to avoid a certain death. Rather, the amount that an average individual would pay to avoid one chance in a million of being killed, plus 1/1,000,000 of the cost of his death to others, is about 57 cents (equal to $576,322 divided by one million).

Indirect Cost Per Accident

The indirect cost per accident was calculated as the sum of the numbers of fatalities and A-B-C injuries per accident, calculated from accident records, times their respective unit indirect costs. For fatal accidents, the indirect cost per accident (IC) of a particular type (e.g., rural, multiple-vehicle, non-intersection, undivided roadway, head-on) was calculated as:

$$IC = (IC_F \times F) + (IC_A \times A) + (IC_B \times B) + (IC_C \times C)$$
$$= (\$576,322 \times F) + (\$62,610 \times A) + (\$12,741 \times B) + (\$5,050 \times C)$$

where IC_F, IC_A, IC_B, and I_C, respectively, represent the indirect costs per fatality and per A, B, and C injury in fatal accidents, and where F, A, B, and C, respectively, represent the numbers of fatalities and A, B, and C injuries per fatal accident. For nonfatal injury accidents, the indirect cost per accident of a particular type was calculated as:

$$IC = (IC_A \times A) + (IC_B \times B) + (IC_C \times C)$$
$$= (\$22,660 \times A) + (\$4,514 \times B) + (\$702 \times C)$$

where IC_A, IC_B, and IC_C, respectively, represent the indirect costs per A, B, and C injury in injury accidents, and where A, B, and C, respectively, represent the numbers of A, B, and C injuries per injury accident. Indirect accident costs for Texas are presented in Tables 37-54.

Total Accident Costs

The total cost of an accident is simply the sum of the direct and indirect costs per accident. Total accident costs for Texas, based on 1981-82 accident data and expressed in 1983 dollars, are presented in Tables 55-72.

The total costs presented in Tables 55-72 are the accident costs that should be used in benefit-cost analyses of roadway projects. Costs are available in these tables for situations frequently addressed by project implementation. In many cases of traffic accident countermeasures, countermeasures affect all severities of accidents proportionately (or there is insufficient information to determine whether a countermeasure differentially affects accidents of different severities). Hence, average accident costs, weighted across severities, are provided. It is anticipated that these average costs, rather than costs by severity, will commonly be used for evaluating roadway projects.

Interesting comparisons can be made among various types of accidents by noting the averge accident costs. Particularly noteworthy are the relatively high average costs of head-on accidents (Tables 57-64) and accidents involving pedestrians or trains (Tables 65-68). Although the cost per pedestrian accident for any severity is not noticeably different from the costs of other types of accidents, the proportion of fatal accidents is much higher for pedestrian accidents than for other accident types, as shown in Tables 1-18. To a lesser extent, the same is true for head-on accidents and traffic accidents involving trains.

CHAPTER IV. APPLICATIONS OF ACCIDENT COSTS

The preceeding chapters have detailed the methodology used to develop Texas accident costs, based on Texas traffic accident data for 1981-82. Complete tables of accident costs were compiled by cross-classifications useful in benefit-cost analyses of roadway projects. The accident cost values presented in Tables 55-72 are recommended for use in estimating accident reduction benefits of roadway projects.

There are two primary ways in which these accident costs can be applied in benefit-cost evaluations of roadway projects. First, the values can be used in the Highway Economic Evaluation Model (HEEM) to estimate accident reduction benefits associated with major construction or reconstruction projects. Second, they can be used in evaluating accident reduction benefits of traffic accident countermeasures. This chapter discusses these applications of the recommended accident costs.

Use of Accident Costs in HEEM

The accident costs developed in this study can be used in HEEM for calculating the accident cost reduction benefits of major highway projects. Table 88 shows the highway type codes used in HEEM [19,20]. Table 89 presents the 1975 accident costs used in the original version of HEEM [19]. These values were based on California accident costs [7,21] that, in turn, were based on values developed by Wilbur Smith and Associates [6]. The average costs shown in Table 89 were calculated by weighting costs across severities, using accident data from Houston [19,22]. The 1982 accident costs currently used in HEEM, as revised by Memmott and Buffington [20], were developed by updating 1980 Texas accident cost values [5] based on Texas accident data for 1978-79.

Table 88. HEEM highway types.

Highway Type Code	Speed Limit (MPH)	Highway Type Description
-	**	Urban diverted***
U2C	25	Urban 2-lane conventional highway
U2C	35	Urban 2-lane conventional highway
U3C*	25	Urban 3-lane conventional highway
U3C*	35	Urban 3-lane conventional highway
U4C	25	Urban 4-lane conventional highway
U4C	35	Urban 4-lane conventional highway
U5C*	25	Urban 5-lane conventional highway
U5C*	35	Urban 5-lane conventional highway
U6C	25	Urban 6-lane conventional highway
U6C	35	Urban 6-lane conventional highway
U2E	-	Urban 2-lane expressway
U3E*	-	Urban 3-lane expressway
U4E	-	Urban 4-lane expressway
U5E*	-	Urban 5-lane expressway
U6E	-	Urban 6-lane expressway
U3F*	-	Urban 3-lane freeway
U4F	-	Urban 4-lane freeway
U5F*	-	Urban 5-lane freeway
U6F	-	Urban 6-lane freeway
U7F*	-	Urban 7-lane freeway
U8F	-	Urban 8-lane freeway
U9F*	-	Urban 9-lane freeway
U10F	-	Urban 10-lane freeway
U11F*	-	Urban 11-lane freeway
U12F	-	Urban 12-lane freeway
U13F*	-	Urban 13-lane freeway
U14F	-	Urban 14-lane freeway
U15F*	-	Urban 15-lane freeway
U16F	-	Urban 16-lane freeway
U3M*	-	Urban 3-lane metered freeway
U4M	-	Urban 4-lane metered freeway
U5M*	-	Urban 5-lane metered freeway
U6M	-	Urban 6-lane metered freeway
U7M*	-	Urban 7-lane metered freeway
U8M	-	Urban 8-lane metered freeway
U9M*	-	Urban 9-lane metered freeway
U10M	-	Urban 10-lane metered freeway
U11M*	-	Urban 11-lane metered freeway

(continued)

Table 88. HEEM highway types. (continued)

Highway Type Code	Speed Limit (MPH)	Highway Type Description
U12M	-	Urban 12-lane metered freeway
U13M*	-	Urban 13-lane metered freeway
U14M	-	Urban 14-lane metered freeway
U15M*	-	Urban 15-lane metered freeway
U16M	-	Urban 16-lane metered freeway
U1AT*	25	Urban 1-lane arterial contraflow
U1AT*	35	Urban 1-lane arterial contraflow
U1AN*	25	Urban 1-lane arterial concurrent flow
U1AN*	35	Urban 1-lane arterial concurrent flow
U1T*	-	Urban 1-lane freeway contraflow
U1N*	-	Urban 1-lane freeway concurrent flow
U2N*	-	Urban 2-lane freeway concurrent flow
U1S*	-	Urban 1-lane freeway busway
U2S*	-	Urban 2-lane freeway busway
-	**	Rural diverted***
R2C	40	Rural 2-lane conventional highway
R2C	55	Rural 2-lane conventional highway
R4C	40	Rural 4-lane conventional highway
R4C	55	Rural 4-lane conventional highway
R6C	40	Rural 6-lane conventional highway
R6C	55	Rural 6-lane conventional highway
R4D	-	Rural 4-lane divided highway
R6D	-	Rural 6-lane divided highway
R2E	-	Rural 2-lane expressway
R4E	-	Rural 4-lane expressway
R6E	-	Rural 6-lane expressway
R4F	-	Rural 4-lane freeway
R6F	-	Rural 6-lane freeway
R8F	-	Rural 8-lane freeway
R10F	-	Rural 10-lane freeway
R12F	-	Rural 12-lane freeway

* Not included in original HEEM [19] but included in revised HEEM [20].

** Unspecified in original HEEM [19]. Set to 25 mph for urban diversion routes and to 15 mph for rural diversion routes in revised HEEM [20].

*** An unspecified circuitous route to handle any overflow traffic from a specified corridor route.

Table 89. 1975 HEEM accident costs.*

Highway Type Code**	Speed Limit (MPH)	Accident Cost*** (1975 dollars)
Urban diverted	-	$ 1,700
U2C	25	1,700
U2C	35	1,700
U4C	25	1,700
U4C	35	1,700
U6C	25	1,700
U6C	35	1,700
U2E	-	1,800
U4E	-	1,800
U6E	-	1,800
U4F	-	1,800
U6F	-	1,800
U8F	-	1,800
U10F	-	1,800
U12F	-	1,800
U14F	-	1,800
U16F	-	1,800
U4M	-	1,800
U6M	-	1,800
U8M	-	1,800
U10M	-	1,800
U12M	-	1,800
U14M	-	1,800
U16M	-	1,800
Rural Diverted	-	1,800
R2C	40	1,800
R2C	55	1,800
R4C	40	1,800
R4C	55	1,800
R6C	40	1,800
R6C	55	1,800
R4D	-	2,300
R6D	-	2,300
R2E	-	2,300
R4E	-	2,300
R6E	-	2,300
R4F	-	2,300
R6F	-	2,300
R8F	-	2,300
R10F	-	2,300
R12F	-	2,300

* Original HEEM [19].

** See Table 88 for a description of highway type codes.

*** Based on California accident costs [7,21] derived from values developed by Wilbur Smith and Associates [6]. Weighted across accident severities using accident data from Houston, Texas.

Table 90 presents the 1983 accident costs that were developed in this study for the revised HEEM and that will soon be incorporated into the revised HEEM. Following procedures in [20] for assigning accident costs to roadway types in the revised HEEM, costs for controlled access and undivided roadways from Table 56 were used for the urban types, while costs for controlled access, other divided, and undivided roadways from Table 55 were used for the rural types.

Use of Accident Costs in Highway Safety Analysis

The accident costs developed in this study are also appropriate for use in quantifying the benefits of traffic accident countermeasures. Accident costs were developed for specific cases of accidents, e.g., intersections, railroad grade crossing, pedestrians, or fixed objects (roadside accidents), thereby providing detailed values for evaluating particular types of countermeasures. Further, these accident costs can be used with either percentage reduction factors or roadside obstacle severity indices.

Percentage Reduction Factors

In most cases, the effectiveness of an accident countermeasure in reducing accident costs at a particular accident location is measured using percentage reduction factors. The annual accident cost reduction produced by the countermeasure is calculated by multiplying the percentage reduction factor by the appropriate accident cost value and then multiplying the result by the average number of accidents per year at the location.

For example, suppose that it is proposed to install left-turn lanes at a particular urban intersection on a city street, at which primarily rear-end accidents have occurred at an average rate of 10 accidents per year. Suppose

Table 90. Recommended 1983 accident costs for HEEM.*

Highway Type Code**	Speed Limit (MPH)	Cost Per Accident*** (1983 Dollars)
Urban diverted	25	$ 7,000
U2C	25	7,000
U2C	35	7,000
U3C	25	7,000
U3C	35	7,000
U4C	25	7,000
U4C	35	7,000
U5C	25	7,000
U5C	35	7,000
U6C	25	7,000
U6C	35	7,000
U2E	-	10,200
U3E	-	10,200
U4E	-	10,200
U5E	-	10,200
U6E	-	10,200
U3F	-	10,200
U4F	-	10,200
U5F	-	10,200
U6F	-	10,200
U7F	-	10,200
U8F	-	10,200
U9F	-	10,200
U10F	-	10,200
U11F	-	10,200
U12F	-	10,200
U13F	-	10,200
U14F	-	10,200
U15F	-	10,200
U16F	-	10,200
U3M	-	10,200
U4M	-	10,200
U5M	-	10,200
U6M	-	10,200
U7M	-	10,200
U8M	-	10,200
U9M	-	10,200
U10M	-	10,200
U11M	-	10,200

(continued)

Table 90. Recommended 1983 accident costs for HEEM.* (continued)

Highway Type Code**	Speed Limit (MPH)	Cost Per Accident*** (1983 Dollars)
U12M	-	$ 10,200
U13M	-	10,200
U14M	-	10,200
U15M	-	10,200
U16M	-	10,200
U1AT	25	7,000
U1AT	35	7,000
U1AN	25	7,000
U1AN	35	7,000
U1T	-	10,200
U1N	-	10,200
U2N	-	10,200
U1S	-	10,200
U2S	-	10,200
Rural Diverted	15	28,000
R2C	40	28,000
R2C	55	28,000
R4C	40	28,000
R4C	55	28,000
R6C	40	28,000
R6C	55	28,000
R4D	-	28,300
R6D	-	28,300
R2E	-	31,100
R4E	-	31,100
R6E	-	31,100
R4F	-	31,100
R6F	-	31,100
R8F	-	31,100
R10F	-	31,100
R12F	-	31,100

* These accident cost values will soon be incorporated into the revised HEEM.

** See Table 88 for a description of highway type codes.

*** Based on Texas accident data for 1981-82.

further that the expected percentage reduction factor (PRF) for this countermeasure is 50 percent. The average accident cost corresponding to this situation is $3,700 per accident, from Table 64. The annual expected accident cost reduction (ACR) for this countermeasure, then, is calculated (in 1983 dollars) as:

ACR = PRF x Cost/accident x Accidents/year

= .50 x $3,700 x 10

= $18,500 benefits per year

It should be noted that estimates of percentage reduction factors vary widely for many countermeasures. The literature on highway accident countermeasure effectiveness is limited, and percentage reduction factors used by various states are often only rough estimates of countermeasure effectiveness. This is due, at least in part, to small accident data samples used in developing percentage reduction factors. Appropriate experimental design, encompassing both sample size and analytical technique, is very important in developing valid estimates of countermeasure effectiveness.

At the present time, the Texas State Department of Highways and Public Transportation (SDHPT) is engaged in an ongoing effort to develop and improve its estimates of percentage reduction factors for accident countermeasures used in Texas. As additional data become available, over time, on accident experiences at various safety-treated locations throughout the state, SDHPT revises its percentage reduction factors to reflect the additional information on the effectiveness of different countermeasures.

Accident Costs and Severity Indices

Accident countermeasures for treating roadside hazards are difficult to evaluate using percentage reduction factors, for two reasons. First, the number of accidents with a particular roadside obstacle often is too small during a short time period (e.g., three years) to accurately indicate the expected number of accidents with the obstacle. Secondly, many roadside accident countermeasures may change accident severity in ways that are difficult to estimate using percentage reduction factors.

Therefore, severity indices for roadside obstacles are an appropriate method for estimating accident reduction benefits of roadside accident countermeasures. In previous research [5], McFarland and Rollins related accident costs to severity indices for roadside obstacles. These severity indices, based on Texas accident data for 1978-79, are a modified version of the severity indices presented in AASHTO's Guide for Selecting, Locating, and Designing Traffic Barriers [23], referred to here as the AASHTO Barrier Guide. The modified severity indices, related to accident costs for specific types of roadside obstacles, are provided in this report for use in estimating accident reduction benefits of roadside accident countermeasures.

The revised severity indices and the associated accident costs are summarized in Tables 91-93, taken from [5]. Table 91 presents roadside obstacle inventory codes for various types of roadside obstacles. Based on the AASHTO Barrier Guide, this table reflects the revised severity indices developed in [5]. Table 92 relates the obstacle inventory codes in Table 91 to the revised severity indices for urban and rural areas. The rural severity indices in this

Table 91. Roadside obstacle inventory codes.

Identification Code	Descriptor Code
01. Utility Poles	(00) average
02. Trees	(00) average
03. Signposts	(01) pole-mounted, breakaway base, safety treated
	(02) single-pole-mounted, rigid
	(03) double-pole-mounted, rigid
	(04) triple-pole-mounted, rigid
	(05) cantilever support, rigid
	(06) overhead sign bridge, rigid
04. Luminaire Poles	(01) aluminum pole, aluminum transformer or slip base, safety treated
	(02) aluminum pole, aluminum shoe base
	(03) steel pole, aluminum transformer or slip base, safety treated
	(04) steel pole, steel transformer base
	(05) steel pole, steel shoe base
05. Traffic Signal Poles	(01) breakaway base, safety treated
	(02) rigid base
06. Railroad Signal Poles	(01) breakaway base, safety treated
	(02) rigid base
07. Railroad Crossing Gate	(00) average
08. Mailbox	(01) average, safety treated
	(02) average, non-safety treated
09. Fence	(00) average
10. Curbs	(01) mountable design
	(02) non-mountable design less than 10 inches (.254 m) high
	(03) barrier design greater than 10 inches (.254 m) high

(continued)

Table 91. Roadside obstacle inventory codes. (continued)

Identification Code	Descriptor Code
11. Guardrail or Median Barrier	(01) w-section with standard post spacing (6 ft-3 in) (02) w-section with other than standard post spacing (03) approach guardrail to bridge--decreased post spacing (3 ft-1 1/2 in) (.95 m) adjacent to bridge (04) approach guardrail to bridge--post spacing not decreased adjacent to bridge (05) post and cable (06) metal beam guardrail fence barrier (in median) (07) median barrier (CMB design or equivalent
12. Roadside Slope	(01) sod slope (positive) (02) sod slope (negative) (03) concrete-faced slope (positive) (04) concrete-faced slope (negative) (05) rubble rip-rap slope (positive) (06) rubble rip-rap slope (negative)
13. Ditch (includes erosion, rip-rap runoff ditches, etc.--does not include ditches formed by front and back slopes)	(00) average
14. Culverts	(01) headwall (or exposed end of pipe culvert) (02) gap between culverts on parallel roadways (03) sloped culvert with grate (04) sloped culvert without grate ($\leq$ 3 ft diameter) (05) sloped culvert without grate (> 3 ft diameter)
15. Inlets	(01) raised drop inlet (tabletop) (02) depressed drop inlet (03) sloped inlet
16. Roadway under Bridge Structure	(01) bridge piers (02) bridge abutment, vertical face (03) bridge abutment, sloped face

(continued)

Table 91. Roadside obstacle inventory codes. (continued)

Identification Code	Descriptor Code		
17. Roadway over Bridge Structure	(01) open gap between parallel bridges		
	(02) closed gap between parallel bridges		
	(03) rigid bridgerail--smooth and continuous construction		
	(04) semi-rigid bridgerail--smooth and continuous contsruction		
	(05) other bridgerail--probable penetration, severe snagging and/or pocketing, or vaulting		
	(06) elevated gore abutment		
18. Retaining Wall	(01) retaining wall (face)		
	(02) retaining wall (exposed end)		
19. Ditches		Front Slope	Back Slope
	(01)	6:1	6:1
	(02)	6:1	5:1
	(03)	6:1	3.5:1
	(04)	5:1	6:1
	(05)	5:1	5:1
	(06)	5:1	3.5:1
	(07)	4:1	6:1
	(08)	4:1	5:1
	(09)	4:1	3.5:1
	(10)	3.6:1	6:1
	(11)	3.6:1	5:1
	(12)	3.6:1	3.5:1
	(13)	3:1	6:1
	(14)	3:1	5:1
	(15)	3:1	3.5:1
20. Construction Material	(00) average		
21. Commercial Signs	(00) average		
22. Crash Cushions	(00) average		

(continued)

Table 91. Roadside obstacle inventory codes. (continued)

Longitudinal Barrier End Treatment Codes

Beginning Treatment Codes
1. Not Beginning at Structure - Safety Treated
2. Not Beginning at Structure - Not Safety Treated
3. Beginning at Structure - Full-Beam Connection
4. Beginning at Structure - Not Full-Beam Connection

Ending Treatment Codes
1. Not Ending at Structure - Safety Treated
2. Not Ending at Structure - Not Safety Treated
3. Ending at Structure - Full-Beam Connection
4. Ending at Structure - Not Full-Beam Connection

Obstacles that are not of the longitudinal class have been designated code 0 for each end treatment.

Source: From [5], Volume II, Appendix C, Table 21.

Table 92. Severity indices.

Identification Code	Descriptor Code	End Treatment Code		Severity Index*	
		Beginning	Ending	Urban	Rural
1	0	0	0	3.2	4.8
2	0	0	0	7.6	8.0
3	1	0	0	0.0	0.0
3	2	0	0	4.7	4.7
3	3	0	0	7.2	7.2
3	4	0	0	7.2	7.2
3	5	0	0	7.2	7.2
3	6	0	0	8.1	8.1
4	1	0	0	0.0	0.0
4	2	0	0	8.4	8.4
4	3	0	0	3.5	3.5
4	4	0	0	8.5	8.5
4	5	0	0	8.6	8.6
5	1	0	0	0.0	0.0
5	2	0	0	1.6	8.5
6	1	0	0	0.0	0.0
6	2	0	0	4.5	3.3
7	0	0	0	0.0	0.0
8	1	0	0	0.0	0.0
8	2	0	0	1.9	2.5
9	0	0	0	1.0	2.4
10	1	0	0	2.4	2.4
10	2	0	0	4.1	4.1
10	3	0	0	3.7	3.7
11	1	1	1	4.0	4.9
11	1	1	2	4.3	5.2
11	1	1	3	3.9	4.8
11	1	1	4	4.8	5.7
11	1	2	1	5.9	6.8
11	1	2	2	6.0	6.7
11	1	2	3	5.6	6.5
11	1	2	4	6.0	6.9
11	1	3	1	3.6	4.5
11	1	3	2	3.6	4.5
11	1	3	3	3.6	4.5
11	1	3	4	4.9	5.8

(continued)

Table 92. Severity indices. (continued)

Identification Code	Descriptor Code	End Treatment Code Beginning	End Treatment Code Ending	Severity Index* Urban	Severity Index* Rural
11	1	4	1	4.8	5.7
11	1	4	2	5.0	6.2
11	1	4	3	4.8	6.0
11	1	4	4	5.3	6.5
11	2	1	1	4.2	5.4
11	2	1	2	4.5	5.7
11	2	1	3	4.1	5.3
11	2	1	4	5.0	6.2
11	2	2	1	6.1	7.3
11	2	2	2	6.2	7.4
11	2	2	3	5.8	7.0
11	2	2	4	6.2	7.4
11	2	3	1	3.8	5.0
11	2	3	2	3.8	5.0
11	2	3	3	3.8	5.0
11	2	3	4	5.1	6.3
11	2	4	1	5.0	5.9
11	2	4	2	5.2	6.1
11	2	4	3	5.0	5.9
11	2	4	4	5.3	6.2
11	3	1	1	4.0	4.9
11	3	1	2	4.3	5.2
11	3	1	3	3.6	4.5
11	3	1	4	4.8	5.7
11	3	2	1	5.9	6.8
11	3	2	2	5.3	6.2
11	3	2	3	4.2	5.1
11	3	2	4	5.3	6.2
11	3	3	1	4.5	4.4
11	3	3	2	4.5	4.4
11	3	3	3	4.5	4.4
11	3	3	4	4.7	5.6
11	3	4	1	4.3	5.2
11	3	4	2	4.8	5.7
11	3	4	3	4.2	5.1
11	3	4	4	5.0	5.9
11	4	1	1	4.0	4.9
11	4	1	2	4.3	5.2
11	4	1	3	3.9	4.8
11	4	1	4	4.8	5.7
11	4	2	1	5.9	6.8
11	4	2	2	6.0	6.9

(continued)

Table 92. Severity indices. (continued)

Identification Code	Descriptor Code	End Treatment Code		Severity Index*	
		Beginning	Ending	Urban	Rural
11	4	2	3	5.6	6.5
11	4	2	4	6.0	6.9
11	4	3	1	3.6	4.5
11	4	3	2	3.6	4.5
11	4	3	3	3.6	4.5
11	4	3	4	4.9	5.8
11	4	4	1	4.8	5.7
11	4	4	2	5.0	5.9
11	4	4	3	4.8	5.7
11	4	4	4	5.3	6.2
11	5	1	1	4.2	5.1
11	5	1	2	4.2	5.1
11	5	1	3	4.2	5.1
11	5	1	4	4.2	5.1
11	5	2	1	4.2	5.1
11	5	2	2	4.2	5.1
11	5	2	3	4.2	5.1
11	5	2	4	4.2	5.1
11	5	3	1	4.2	5.1
11	5	3	2	4.2	5.1
11	5	3	3	4.2	5.1
11	5	3	4	4.2	5.1
11	5	4	1	4.2	5.1
11	5	4	2	4.2	5.1
11	5	4	3	4.2	5.1
11	5	4	4	4.2	5.1
11	6	1	1	4.7	5.6
11	6	1	2	4.7	5.6
11	6	1	3	4.7	5.6
11	6	1	4	5.3	6.2
11	6	2	1	5.9	6.8
11	6	2	2	6.0	6.9
11	6	2	3	5.6	6.5
11	6	2	4	6.0	6.9
11	6	3	1	4.3	5.2
11	6	3	2	4.7	5.6
11	6	3	3	4.3	5.2
11	6	3	4	4.9	5.8
11	6	4	1	4.8	5.7
11	6	4	2	5.0	5.9
11	6	4	3	4.8	5.7
11	6	4	4	5.3	6.2

(continued)

Table 92. Severity indices. (continued)

Identification Code	Descriptor Code	End Treatment Code		Severity Index*	
		Beginning	Ending	Urban	Rural
11	7	1	1	4.5	5.4
11	7	1	2	4.5	5.4
11	7	1	3	4.5	5.4
11	7	1	4	4.5	5.4
11	7	2	1	4.5	5.4
11	7	2	2	4.5	5.4
11	7	2	3	4.5	5.4
11	7	2	4	4.5	5.4
11	7	3	1	4.5	5.4
11	7	3	2	4.5	5.4
11	7	3	3	4.5	5.4
11	7	3	4	4.5	5.4
11	7	4	1	4.5	5.4
11	7	4	2	4.5	5.4
11	7	4	3	4.5	5.4
11	7	4	4	4.5	5.4
12	1	0	0	3.0	3.0
12	2	0	0	3.0	3.0
12	3	0	0	2.5	2.5
12	4	0	0	2.5	2.5
12	5	0	0	5.1	5.1
12	6	0	0	5.1	5.1
13	0	0	0	0.0	0.0
14	1	0	0	7.9	7.9
14	2	0	0	5.5	5.5
14	3	0	0	3.3	3.3
14	4	0	0	5.5	5.5
14	5	0	0	7.7	7.7
15	1	0	0	5.7	5.7
15	2	0	0	3.1	3.1
15	3	0	0	3.3	3.3
16	1	0	0	9.3	9.3
16	2	0	0	9.3	9.3
16	3	0	0	5.5	5.5

(continued)

Table 92. Severity indices. (continued)

Identification Code	Descriptor Code	End Treatment Code		Severity Index*	
		Beginning	Ending	Urban	Rural
17	1	0	0	7.2	7.2
17	2	0	0	5.5	5.5
17	3	0	0	6.3	6.3
17	4	0	0	6.0	6.0
17	5	0	0	9.3	9.3
17	6	0	0	9.4	9.3
18	1	0	0	5.5	5.5
18	2	0	0	9.3	9.3
19	1	0	0	2.2	2.2
19	2	0	0	2.4	2.4
19	3	0	0	3.0	3.0
19	4	0	0	2.3	2.3
19	5	0	0	2.5	2.5
19	6	0	0	3.0	3.0
19	7	0	0	2.6	2.6
19	8	0	0	3.0	3.0
19	9	0	0	4.0	4.0
19	10	0	0	3.5	3.5
19	11	0	0	3.8	3.8
19	12	0	0	4.5	4.5
19	13	0	0	3.6	3.6
19	14	0	0	4.2	4.2
19	15	0	0	4.8	4.8
20	0	0	0	7.2	1.9
21	0	0	0	8.9	5.1
22	0	0	0	0.0	0.0

*For high-speed urban roadways, use the severity index for rural roadways.

Source: From [5], Volume II, Appendix C, Table 22.

Table 93. Average accident cost related to severity index, by type of roadway, 1983 dollars.

Severity Index	Average Urban	High-Speed Urban	Average Rural
0.0	$ 3,300	$ 3,670	$ 3,910
0.1	3,590	4,070	4,470
0.2	3,890	4,490	5,040
0.3	4,180	4,890	5,600
0.4	4,470	5,300	6,160
0.5	4,770	5,710	6,720
0.6	5,060	6,110	7,280
0.7	5,350	6,530	7,850
0.8	5,650	6,930	8,410
0.9	5,940	7,340	8,970
1.0	6,230	7,750	9,530
1.1	6,530	8,150	10,090
1.2	6,820	8,570	10,660
1.3	7,110	8,970	11,220
1.4	7,410	9,390	11,780
1.5	7,700	9,790	12,340
1.6	7,990	10,190	12,900
1.7	8,290	10,610	13,470
1.8	8,580	11,010	14,030
1.9	8,870	11,430	14,590
2.0	9,170	11,830	15,150
2.1	9,340	12,050	15,400
2.2	9,480	12,230	15,640
2.3	9,640	12,440	15,890
2.4	9,800	12,650	16,140
2.5	9,950	12,830	16,390
2.6	10,110	13,040	16,630
2.7	10,270	13,250	16,880
2.8	10,410	13,430	17,120
2.9	10,570	13,640	17,370
3.0	10,730	13,850	17,620
3.1	10,880	14,030	17,870
3.2	11,040	14,240	18,110
3.3	11,190	14,440	18,350
3.4	11,340	14,630	18,600
3.5	11,500	14,840	18,840
3.6	11,660	15,040	19,100
3.7	11,810	15,230	19,330
3.8	11,960	15,430	19,590

(continued)

Table 93. Average accident cost related to severity index, by type of roadway, 1983 dollars. (continued)

Severity Index	Average Urban	High-Speed Urban	Average Rural
3.9	$12,120	$15,640	$19,830
4.0	12,130	15,650	19,930
4.1	12,170	15,700	20,050
4.2	12,210	15,750	20,180
4.3	12,240	15,800	20,310
4.4	12,290	15,860	20,440
4.5	12,330	15,910	20,590
4.6	12,380	15,970	20,750
4.7	12,430	16,030	20,910
4.8	12,490	16,110	21,080
4.9	12,550	16,190	21,280
5.0	12,610	16,270	21,470
5.1	12,680	16,360	21,680
5.2	12,760	16,460	21,900
5.3	12,830	16,560	22,130
5.4	12,920	16,670	22,380
5.5	13,010	16,790	22,640
5.6	13,110	16,910	22,930
5.7	13,210	17,040	23,220
5.8	13,320	17,180	23,540
5.9	13,440	17,340	23,880
6.0	13,580	17,510	24,240
6.1	13,710	17,680	24,620
6.2	13,860	17,880	25,040
6.3	14,020	18,090	25,470
6.4	14,190	18,310	25,940
6.5	14,370	18,540	26,440
6.6	14,570	18,790	26,980
6.7	14,790	19,080	27,560
6.8	15,010	19,360	28,180
6.9	15,250	19,670	28,850
7.0	15,520	20,020	29,570
7.1	15,810	20,400	30,350
7.2	16,120	20,800	31,210
7.3	16,460	21,240	32,140
7.4	16,830	21,700	33,140
7.5	17,230	22,230	34,250
7.6	17,670	22,790	35,480
7.7	18,150	23,410	36,820

(continued)

Table 93. Average accident cost related to severity index, by type of roadway, 1983 dollars. (continued)

Severity Index	Average Urban	High-Speed Urban	Average Rural
7.8	$18,680	$ 24,100	$ 38,300
7.9	19,260	24,840	39,960
8.0	19,910	25,670	41,820
8.1	20,630	26,620	43,910
8.2	21,420	27,630	46,280
8.3	22,330	28,800	48,990
8.4	23,340	30,110	52,120
8.5	24,500	31,600	55,770
8.6	25,820	33,310	60,070
8.7	27,350	35,280	65,220
8.8	29,150	37,600	71,500
8.9	31,260	40,330	79,300
9.0	33,790	43,590	89,270
9.1	36,880	47,570	102,430
9.2	40,740	52,560	120,600
9.3	45,670	58,910	147,320
9.4	50,590	65,270	174,050
9.5	55,520	71,610	200,780
9.6	60,440	77,960	227,500
9.7	65,370	84,320	254,230
9.8	70,290	90,670	280,950
9.9	75,210	97,030	307,680
10.0	80,140	103,380	334,400

Source: From [5], Volume II, Appendix C, Table 16. Updated to 1983 using wage and price indices [16,17] for components of accident costs. Based on Texas accident data for 1979-80.

table also apply to high-speed urban facilities. Table 93 presents the revised severity indices and the corresponding accident costs for urban, high-speed urban, and rural roadways. These three tables are used in calculating accident reduction benefits for a roadside accident countermeasure.

The accident cost reduction per accident for a countermeasure at a particular roadside accident location is calculated by a four-step procedure. First, the obstacle inventory codes for the obstacle, prior to treatment and after implementation of the countermeasure, are taken from Table 91. Second, the severity indices for the two obstacle inventory codes are obtained from Table 92. Third, the basic accident costs for the two severity indices are taken from Table 93. Fourth, the basic (unadjusted for roadway curvature) accident costs from Table 93 are adjusted for roadway curvature, if appropriate, using one of the adjustment factors from Table 94, developed by McFarland and Rollins in previous research [5].

Annual accident reduction benefits produced by the countermeasure can then be calculated. The accident cost reduction per year is equal to the difference between the accident costs per year (i.e., cost per accident times the expected number of accidents per year at the location) before and after treatment. The expected number of accidents per year with the obstacle before and after safety treatment can be estimated using some method such as encroachment-probability models [23,5]. McFarland and Rollins have developed equations for predicting the expected annual number of accidents for various types of roadside obstacles (rectangular object, circular object, median barrier, and longitudinal object) [5].

Table 94. Recommended adjustments to accident costs for horizontal curvature.

Degree of Horizontal Curvature	Recommended Adjustments*	
	Urban	Rural
0.0 degrees	Use 0.75 x ACU	Use 0.62 x ACR
0.001-3.0 degrees	Use 1.37 x ACU	Use 1.13 x ACR
3.001-6.0 degrees	Use 2.35 x ACU	Use 1.94 x ACR
>6.0 degrees	Use 2.98 x ACU	Use 2.46 x ACR

*ACU = average accident cost for roadside obstacle in urban areas;
ACR = average accident cost for roadside obstacle in rural areas.

For example, suppose that it is proposed to safety-treat a culvert headwall at a rural location where the roadway has a four-degree curvature, by installing a sloped culvert with a grate. From Table 91, it is seen that the pre-treatment code is 14-1, and the post-treatment code is 14-3. From Table 92, the corresponding severity indices for this situation are 7.9 and 3.3, respectively. From Table 93, the basic (unadjusted for roadway curvature) accident costs for severity indices of 7.9 and 3.3 are, respectively, $39,960 and $18,350 for this rural location. However, because this culvert is located on a four-degree curve, the basic accident costs are multiplied by 1.94, giving estimated costs before and after the safety treatment of $77,520 and $35,600, respectively. If the expected number of collisions with the culvert is 0.2 per year both before and after treatment, then the annual benefit of this countermeasure is calculated as:

ACR = (Cost/accident x Expected accidents/year, pre-treatment) -

(Cost/accident x Expected accidents/year, post-treatment)

= ($77,520)(0.2) - ($35,600)(0.2)

= $8,380 benefits per year

In some cases, the expected number of collisions at a location may be greater after treatment than before treatment. For example, installing a longitudinal barrier such as a guardrail around a nonlongitudinal obstacle, such as the culvert in the example above, may lead to as much a tenfold increase in collisions, due to the size of the barrier relative to that of the obstacle [5].

CHAPTER V. CONCLUSIONS AND RECOMMENDATIONS

The preceeding chapters have presented accident costs for Texas and have discussed the application of these costs in benefit-cost analyses of roadway projects, in both HEEM and traffic safety analysis. This chapter presents recommendations for future updating of Texas accident costs and for the use of these costs in establishing project priorities.

Updating Accident Costs

To maintain consistency of accident cost values with other benefits and costs of projects, it is recommended that the accident costs be updated periodically. This should be done both annually and once every two or three years, the latter involving a more comprehensive effort than the former.

Annual Updating

The accident costs recommended in this report, presented in Tables 55-72, can be easily updated on an annual basis using wage and price indices for elements of accident costs [16,17]. An updating factor to be applied to the accident cost value in Tables 55-72 can be calculated as follows.

First, an updating factor for the direct cost component of each total accident cost value is calculated using the CPI for all items, all urban consumers [16] for 1983-IV (i.e., fourth quarter) and for the desired year t. The CPI for 1983-IV is 303.1 (1967=100). The updating factor for direct costs, DIRFAC, is calculated as:

$$\text{DIRFAC} = (\text{CPI}_t) \;/\; (\text{CPI}_{83})$$

$$= (\text{CPI}_t) \;/\; 303.1$$

Second, an updating factor for the indirect cost component of each total accident cost value is calculated using the index of average hourly earnings (IAHE) on private nonagricultural payrolls [17] for 1983-IV and for the desired year t. The IAHE for 1983-IV is 157.1 (1977=100). The updating factor for indirect costs, INDFAC, is calculated as:

$$\text{INDFAC} = (\text{IAHE}_t) / (\text{IAHE}_{83})$$
$$= (\text{IDHE}_t) / 157.1$$

Third, weights for averaging DIRFAC and INDFAC are calculated. These weights are the proportions of direct and indirect costs relative to total accident cost, by rural and urban. The weights are calculated using average direct and indirect costs for all accidents, by rural and urban, from Tables 19-20 (direct) and 37-38 (indirect), averaged across accident severities using accident proportions from Tables 1-2. The weight (by rural or urban) for direct cost, WD, is equal to the average direct cost divided by the average total cost from Tables 55-72. The weight (by rural or urban) for indirect cost, WI, is equal to the average indirect cost divided by the average total cost. The values of WD and WI, by rural and urban, are as follows:

Weight	Rural	Urban
WD	0.1646	0.2762
WI	0.8354	0.7238

Fourth, an updating factor (by rural or urban) for total accident cost, TOTFAC, is calculated. TOTFAC is calculated (for rural or urban) by weighting DIRFAC and INDFAC by WD and WI, as follows:

$$\text{TOTFAC} = (\text{DIRFAC} \times \text{WD}) + (\text{INDFAC} \times \text{WI})$$

For example, suppose that the 1983 accident costs are to be updated to 1984. Assuming that the 1984 CPI is 320.0 and that the 1984 IAHE is 167.0, TOTFAC is calculated by the following steps:

1. Calculate DIRFAC = $(CPI_{84}) / (CPI_{83})$

   = 320.0 / 303.1

   = 1.0558

2. Calculate INDFAC = $(IAHE_{84}) / (IAHE_{83})$

   = 167.0 / 157.1

   = 1.0630

3. Calculate TOTFAC = (DIRFAC x WD) + (INDFAC x WI)

   = (1.0558 x 0.1646) + (1.0630 x .8354)

   = 1.0618 (rural)

   TOTFAC = (DIRFAC x WD) + (INDFAC x WI)

   = (1.0558 x 0.2762) + (1.0630 x .7238)

   = 1.0610 (urban)

The values of TOTFAC are then applied to the 1983 total accident cost values in Tables 55-72 to update the costs to 1984, by rural and urban. For example, the average cost per rural, multiple-vehicle accident on a controlled access roadway (Table 55) is updated from 1983 to 1984 as $24,100 x 1.0618 = $25,600. The average cost per urban, single-vehicle accident (Table 56) is updated as $13,800 x 1.0610 = $14,600.

Annual updating of accident costs can be done over a short time period of two or three years. During this length of time, accident experience by cross-classifications will not change, due to such factors as improved highway safety technology or changes in the mix of large and small cars, to the extent that the annually updated costs would be rendered unsatisfactory. Further, the degree of imprecision in calculating the updating factors using only the CPI and index of average hourly earnings will not cause the updated costs to differ significantly from what they would have been, had the factors been updated using all relevant cost indices.

Periodic Updating

Over periods of time longer than two or three years, it is recommended that accident costs be updated using the most recently available accident data and all relevant cost indices. This form of updating would involve following the procedures used in this report to develop accident costs on the basis of two years of Texas accident data and updated vehicle involvement costs. While this updating procedure requires considerably more effort than the annual updating procedure described above, it is necessary in order to maintain the most accurate and useful accident costs possible for use in roadway project evaluations in Texas.

Use of Accident Costs in Setting Project Priorities

The accident costs developed in this study can also be used, in addition to HEEM and traffic accident countermeasure evaluation, in establishing priorities for roadway projects. Techniques for optimally allocating a fixed budget among a set of alternative roadway projects have been developed by TTI for FHWA [5]. On the basis of samples of highway safety projects in Texas and Alabama, it has been shown that 35 to 40 percent more benefits can be obtained using these techniques for project prioritization than can be realized from simple benefit-cost analysis.

These techniques, called integer programming and incremental benefit-cost analysis, can select a benefit-maximizing set of projects from a set of alternatives, for a given budget of initial project costs. The key feature of these techniques is that multiple, mutually exclusive project alternatives, rather than a single project, are considered at each location under evaluation. The present worth of benefits and the costs of each project alternative over its service life are specified as input data. At most, one of the alternatives at each location will be selected for implementation. These optimization methods are operational, and full details on the procedures and calculations for the techniques, along with FORTRAN computer programs and documentation, are available from TTI or FHWA [5].

Accident costs are used in calculating the benefits of each project alternative. The following equation from [5] illustrates how the present worth of project benefits, net of annual maintenance, operating, and repair costs, is calculated for each alternative:

$$B = \sum_{t=1}^{SL} \left(\frac{AC_t}{(1+r)^t} + \frac{OUB_t}{(1+r)^t} - \frac{MC_t}{(1+r)^t} - \frac{RC_t}{(1+r)^t} \right) + \frac{SV}{(1+r)^{SL}}$$

where:

B = present worth of net benefits over the service life of the accident countermeasure alternative (project)

SL = service life of the alternative, in years

AC_t = expected reduction in accident costs from employing the alternative, in year t

OUB_t = other expected user benefits from employing the alternative, in year t

MC_t = change in annual maintenance and operating costs from employing the alternative (excluding repair costs), in year t

RC_t = change in annual repair costs from employing the alternative, in year t

SV = salvage value of the alternative at the end of its service life

r = discount rate

These optimization techniques can be used to assist decision makers in allocating any fixed budget defined in accordance with any guidelines, restrictions, or definitions regarding categories of roadway expenditures. Given a set of candidate projects of any type - accident countermeasures, roadside hazard countermeasures, pavement rehabilitation, etc. - the techniques can be used in selecting projects from the set of alternatives, in such a way that maximum user benefits are obtained for the available budget. It is recommended that these optimization techniques be considered for incorporation into the roadway budget allocation process in Texas.

Recommendation for Future Research

Future refinements of motor vehicle accident costs should take into account the findings of two recent reports, which were not available in time to be considered in this study. NHTSA updated and revised their accident costs [24], reducing their estimates of productivity losses for fatalities and various severities of injuries, relative to their previous estimates [4]. A second report [25] evaluated various approaches to estimating accident costs, recommending a willingness-to-pay approach and a four percent discount rate (as used in this study). Like the NHTSA study [24], the second study [25] recommended lower production/consumption (i.e., human capital) costs for fatalities and injuries than were used in this study. A thorough review of the methodology and findings of these two studies should be undertaken as part of future efforts to refine accident cost estimates.

However, the results of neither of the two studies can be used directly with state accident data to develop accident costs. Both studies provided accident cost estimates by AIS classifications, although state accident records use the A-B-C scale for injury severity classification. Before the findings of the two studies can be used in developing accident costs based on state accident data, the AIS costs must be related to the A-B-C scale by some method such as that presented in this study.

REFERENCES

1. National Safety Council, "Estimating the Cost of Accidents," Chicago, Illinois: National Safety Council, 1979.

2. A Manual on User-Benefit Analysis of Highway and Bus-Transit Improvements, 1977, Washington, D.C.: American Association of State Highway and Transportation Officials, 1978.

3. Winfrey, Robley, Economic Analysis for Highways, Scranton, Pennsylvania: International Textbook Co., 1968.

4. Faigin, Barbara, Societal Costs of Motor Vehicle Accidents-1975, Washington, D.C.: U.S. Department of Transportation, National Highway Traffic Safety Administration, December 1976.

5. McFarland, W.F. and Rollins, J.B., Cost-Effectiveness Techniques for Highway Safety, eight volumes, prepared for Federal Highway Administration under Contract DTFH61-80-C-00080, College Station, Texas: Texas Transportation Institute, December 1983.

6. Wilbur Smith and Associates, Motor Vehicle Accident Costs, Washington Metropolitan Area, New Haven, Connecticut: Wilbur Smith and Associates, Inc., 1966.

7. Smith, R. and Tamburri, T., Direct Costs of California State Highway Accidents, Sacramento, California: California Division of Highways, 1967.

8. Illinois Department of Public Works and Buildings, Division of Highways, Cost of Motor Vehicle Accidents to Illinois Motorists, 1958, Springfield, Illinois: Illinois Division of Highways, December 1962.

9. Dunman, Robie, "Economic Costs of Motor Vehicle Accidents," Traffic Accidents Studies, 1958, Bulletin 208, Washington, D.C.: Highway Research Board, 1960.

10. Dunman, Robie, "Economic Cost of Traffic Accidents in Relation to the Human Element," Economic Costs of Traffic Accidents, Bulletin 263, Washington, D.C.: Highway Research Board, 1960.

11. New Mexico State Highway Department, Planning Division, The Economic Costs of Motor-Vehicle Accidents, three volumes (passenger cars-1955, trucks-1956), Santa Fe, New Mexico: New Mexico State Highway Department, no date.

12. Ohio Department of Highways, The Analysis of Motor Vehicle Accident Costs in the State of Ohio, Columbus, Ohio: Ohio State University, 1970.

13. Utah State Department of Highways, Planning Division, Economic Cost of Motor-Vehicle Accidents, four volumes (passenger cars-1955, trucks-1957), Salt Lake City, Utah: Utah State Department of Highways, 1959, 1960.

14. U.S. Department of Commerce, A Proposal Study for the Determination of the Cost of Motor Vehicle Accidents, Washington, D.C.: Bureau of Public Roads, 1949.

15. Burke, Dock, Highway Accident Costs and Rates in Texas, Research Report 114-1F, College Station, Texas: Texas Transportation Institute, December 1970.

16. U.S. Department of Labor, Bureau of Labor Statistics, CPI Detailed Report, monthly issues.

17. U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, monthly issues.

18. Blomquist, G., "Value of Life: Implications of Automobile Seat Belt Use," unpublished dissertation, University of Chicago, 1977.

19. Guide to the Highway Economic Evaluation Model, Austin, Texas: Texas State Department of Highways and Public Transportation, February 1976.

20. Memmott, J.L. and Buffington, J.L., Revised Highway Economic Evaluation Model (HEEM-II), Research Report 225-28F, College Station, Texas: Texas Transportation Institute, November 1983.

21. California Department of Transportation, "Accident Costs," memo to district directors from J.E. Peddy, Chief, Office of System and Program Development, Division of Highways, Sacramento, California: California Department of Transportation, October 18, 1974.

22. Deriving HEEM's Assumptions for Texas State Department of Highways and Public Transportation, Austin, Texas: Texas State Department of Highways and Public Transportation, February 1976.

23. Guide for Selecting, Locating, and Designing Traffic Barriers, Washington, D.C.: American Association of State Highway and Transportation Officials, 1977.

24. National Highway Traffic Safety Administration, The Economic Cost to Society of Motor Vehicle Accidents, draft report, Washington, D.C.: U.S. Department of Transportation, National Highway Traffic Safety Administration, January 1983.

25. Miller, T.R., Reinert, K.A., and Whiting, B.E., Alternative Approaches to Accident Cost Concepts: State of the Art, Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration, January 1984.