

The Likelihood of Human Casualty in Highway Crashes

6th Briefing: Vehicle Based ACN Algorithms

**Based on an Investigation Conducted for
the FHWA/NHTSA Crash Analysis Center
at George Washington University, Virginia**

**June 24, 1996
DeBlois Associates
Washington, D.C.**

"The Likelihood of Casualty in Highway Crashes"

Introduction

This is the sixth briefing concerning the cited subject. Work reported here addresses and evaluates car based ACN algorithms, as an alternative to the car occupant based ACN algorithms, addressed in the 4th briefing.

Specifically in this briefing, the algorithms estimate the probability of a car in a towaway crash involving at least one occupant at a stipulated outcome. Four threshold severities are addressed: MAIS 1+, MAIS 2+, MAIS 3+, and Fatality.

Probabilities are estimated for three classes of predictors:

- (a) Total Delta V and Direction of Force in Planar Crashes;
- (b) Rollover, yes or no; and
- (c) Rollover Occurrence plus Pre-Rollover Travel Speed

Raw Data & Processing

The data compiled in the eight years, 1988-1995, of NASS/CDS are the basic data used. The NASS weights are used as weighing factors in any data processing procedure. A further description of data processing, pre-processing, and post-processing may be found in the 4th Briefing, dated May 10 1996, including the nominal procedure for processing the raw data, as well as the estimation of standard errors and confidence bounds. The presentation of detailed algorithms follows.

Presentation of Programmable Algorithms

Fully detailed algorithms are presented below as follows:

Planar Crashes: on Pages 2 to 4
 Rollover: on Pages 4 and 5
 Rollover & Travel Speed: on Pages 5 and 6

Results from Application of the Algorithms

Detailed results are tabulated as follows:

Planar Crashes: Tables XX to XXIII
 Rollover: Table XIV
 Rollover & Travel Speed: Tables XV to XVIII

Illustrative results are shown in Figs 56 to 66.

Programmable Algorithm for Planar Car Crashes

Probability of Car with at Least One Occupant at MAIS=1+

$$P = 1 / [1 + \exp(-w)]$$

Model:

$$w = A_0 + A_1 \cdot DVTOTAL + A_2 \cdot DOFF + A_3 \cdot DOFL + A_4 \cdot DOFR$$

DVTOTAL = Total Delta V in mph Continuously;
 DOFF=1 if Direction of Force is 11 to 1 O'Clock; else DOFF=0;
 DOFL=1 if Direction of Force is 8 to 10; else DOFL=0;
 DOFR=1 if Direction of Force is 2 to 4; else DOFR=0;
 DOFF=0 & DOFL=0 & DOFR=0 if Direction of Force is 5 to 7.

For Cars with at Least One Occupant @ MAIS=1+

Logistic Regression Coefficients

Predictor	A	Std Err	Probabil. of A=0
Intercept	-0.96	0.14	0.0000
DVTOTAL	0.10	0.01	0.0000
DOFF	0.20	0.11	0.0789
DOFL	0.78	0.14	0.0000
DOFR	0.47	0.14	0.0010

Covariance Matrix (5x5)

```

-----
1.736395E-002 -4.973353E-004 -1.005513E-002 -1.076249E-002 -1.052255E-002
-4.973353E-004 3.293553E-005 1.163290E-005 6.138844E-005 4.514988E-005
-1.005513E-002 1.163290E-005 1.155317E-002 9.883544E-003 9.881662E-003
-1.076249E-002 6.138844E-005 9.883544E-003 1.799655E-002 9.862948E-003
-1.052255E-002 4.514988E-005 9.881662E-003 9.862948E-003 1.757757E-002

```

For Cars with at Least One Occupant at MAIS=2+

Logistic Regression Coefficients

```

-----
Predictor          A          Std Err          Probabil.
                   of A=0
-----
Intercept          -1.74          0.13            0.0000
DVTOTAL            0.09           0.01            0.0000
DOFF                0.30           0.10            0.0044
DOFL                0.65           0.13            0.0000
DOFR                0.40           0.13            0.0018
-----

```

Covariance Matrix (5x5)

```

-----
1.373087E-002 -3.384959E-004 -8.386425E-003 -9.087584E-003 -8.741663E-003
-3.384959E-004 2.119497E-005 2.067470E-006 4.795755E-005 2.628480E-005
-8.386425E-003 2.067470E-006 9.632978E-003 8.347014E-003 8.345762E-003
-9.087584E-003 4.795755E-005 8.347014E-003 1.390941E-002 8.362187E-003
-8.741663E-003 2.628480E-005 8.345762E-003 8.362187E-003 1.417767E-002

```

For Cars with at Least One Occupant at MAIS=3+

Logistic Regression Coefficients

```

-----
Predictor          A          Std Err          Probabil.
                   of A=0
-----
Intercept          -1.95          0.12            0.0000
DVTOTAL            0.09           0.00            0.0000
DOFF                0.32           0.10            0.0016
DOFL                0.63           0.12            0.0000
DOFR                0.46           0.12            0.0002
-----

```

Covariance Matrix (5x5)

```

-----
1.298844E-002 -3.065980E-004 -8.050088E-003 -8.735739E-003 -8.467898E-003
-3.065980E-004 1.870882E-005 3.527612E-006 4.691647E-005 3.049707E-005
-8.050088E-003 3.527612E-006 9.213949E-003 7.996364E-003 7.994426E-003
-8.735739E-003 4.691647E-005 7.996364E-003 1.329263E-002 8.036727E-003
-8.467898E-003 3.049707E-005 7.994426E-003 8.036727E-003 1.347383E-002

```

For Cars with at Least One Fatality

Logistic Regression Coefficients

```

-----
Predictor          A          Std Err          Probabil.
                    of A=0
-----
Intercept          -9.55          0.48            0.0000
DVTOTAL            0.12           0.01            0.0000
DOFF                1.94           0.45            0.0000
DOFL                3.11           0.48            0.0000
DOFR                2.93           0.49            0.0000
-----

```

Covariance Matrix (5x5)

```

-----
1.911464E-001 -8.682873E-004 -1.667222E-001 -1.744044E-001 -1.747885E-001
-8.682873E-004 2.453529E-005 1.589261E-004 3.845261E-004 3.808504E-004
-1.667222E-001 1.589261E-004 1.712782E-001 1.636323E-001 1.636899E-001
-1.744044E-001 3.845261E-004 1.636323E-001 1.919154E-001 1.672060E-001
-1.747885E-001 3.808504E-004 1.636899E-001 1.672060E-001 1.989618E-001

```

Programmable Algorithms for Shown Outcomes v. Rollover

$$P = 1 / [1 + \exp(-w)]$$

Model:

$$w = A_0 + A_1 \cdot RO$$

RO=1 if Rollover Occurs; else RO=0

Logistic Regression Coefficients

Predictor	A	Std Err	Probabil. of A=0
For Cars with at Least One Occupant at MAIS=1+			
Intercept	0.54	0.02	0.0000
RO	0.95	0.11	0.0000
For Cars with at Least One Occupant at MAIS=2+			
Intercept	-0.14	0.02	0.0000
RO	0.75	0.08	0.0000
For Cars with at Least One Occupant at MAIS=3+			
Intercept	-0.34	0.02	0.0000
RO	0.78	0.08	0.0000
For Cars with at Least One Occupant Fatality			
Intercept	-4.59	0.04	0.0000
RO	1.49	0.10	0.0000

Covariance Matrices

For Cars with at Least One Occupant at MAIS=1+	
3.418308E-004	-3.492986E-004
-3.492986E-004	6.667907E-003
For Cars with at Least One Occupant at MAIS=2+	
2.791770E-004	-2.885163E-004
-2.885163E-004	4.020461E-003
For Cars with at Least One Occupant at MAIS=3+	
2.705822E-004	-2.793272E-004
-2.793272E-004	3.651717E-003
For Cars with at Least One Occupant Fatality	
1.900903E-003	-1.912418E-003
-1.912418E-003	6.414193E-003

Algorithms for Shown Outcomes v. Rollover and Travel Speed

$$P = 1 / [1 + \exp(-w)]$$

Model:

$$w = A_0 + A_1 \cdot RO + A_2 \cdot (\text{Travel Speed})$$

RO=1 if Rollover Occurs; else RO=0

Logistic Regression Coefficients

Predictor	A	Std Err	Probabil. of A=0

For Cars with at Least One Occupant at MAIS=1+			
Intercept	0.55	0.06	0.0000
RO	0.95	0.21	0.0000
TRAVEL SPEED	0.01	0.00	0.0003
For Cars with at Least One Occupant at MAIS=2+			
Intercept	-0.16	0.06	0.0044
RO	0.57	0.15	0.0001
TRAVEL SPEED	0.01	0.00	0.0000
For Cars with at Least One Occupant at MAIS=3+			
Intercept	-0.43	0.05	0.0000
RO	0.62	0.14	0.0000
TRAVEL SPEED	0.01	0.00	0.0000
For Cars with at Least One Occupant Fatality			
Intercept	-5.38	0.18	0.0000
RO	0.76	0.19	0.0001
TRAVEL SPEED	0.03	0.00	0.0000

Covariance Matrices

For Cars with at Least One Occupant at MAIS=1+			
2.955227E-003	4.032630E-004	-5.910636E-005	
4.032630E-004	2.175205E-002	-5.269377E-005	
-5.910636E-005	-5.269377E-005	1.952426E-006	
For Cars with at Least One Occupant at MAIS=2+			
2.481267E-003	2.818556E-004	-4.968334E-005	
2.818556E-004	1.250228E-002	-3.968876E-005	
-4.968334E-005	-3.968876E-005	1.589315E-006	
For Cars with at Least One Occupant at MAIS=3+			
2.443478E-003	2.327198E-004	-4.897118E-005	
2.327198E-004	1.089715E-002	-3.593734E-005	
-4.897118E-005	-3.593734E-005	1.537752E-006	
For Cars with at Least One Fatality			
2.541481E-002	7.105984E-004	-4.237499E-004	
7.105984E-004	1.898576E-002	-1.327578E-004	
-4.237499E-004	-1.327578E-004	9.017561E-006	

Table XX.

Probability of a Car with at Least One Occupant @ MAIS 1+;
Results from Application of Algorithm for Planar Car Crashes

Direction of Force	DeltaV	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Lower	Upper
11-1	5	43.5	1.7	40.2	46.8
11-1	10	56.0	1.2	53.6	58.4
11-1	15	67.7	0.9	65.9	69.5
11-1	20	77.6	0.9	75.8	79.4
11-1	25	85.1	0.9	83.3	86.9
11-1	30	90.4	0.8	88.8	92.0
11-1	35	93.9	0.7	92.5	95.3
11-1	40	96.2	0.5	95.2	97.2
11-1	45	97.7	0.4	96.9	98.5
11-1	50	98.6	0.3	98.0	99.2
11-1	55	99.1	0.2	98.7	99.5
11-1	60	99.5	0.1	99.3	99.7
11-1	65	99.7	0.1	99.5	99.9
11-1	70	99.8	0.1	99.6	100.0
11-1	75	99.9	0.0	99.9	99.9
11-1	80	99.9	0.0	99.9	99.9
11-1	85	100.0	0.0	100.0	100.0
11-1	90	100.0	0.0	100.0	100.0
2-4	5	50.2	2.5	45.3	55.1
2-4	10	62.5	2.1	58.4	66.6
2-4	15	73.3	1.7	70.0	76.6
2-4	20	81.9	1.4	79.2	84.6
2-4	25	88.2	1.1	86.0	90.4
2-4	30	92.5	0.9	90.7	94.3
2-4	35	95.3	0.7	93.9	96.7
2-4	40	97.1	0.5	96.1	98.1
2-4	45	98.2	0.3	97.6	98.8
2-4	50	98.9	0.2	98.5	99.3
2-4	55	99.3	0.2	98.9	99.7
2-4	60	99.6	0.1	99.4	99.8
2-4	65	99.8	0.1	99.6	100.0
2-4	70	99.9	0.0	99.9	99.9
2-4	75	99.9	0.0	99.9	99.9
2-4	80	99.9	0.0	99.9	99.9
2-4	85	100.0	0.0	100.0	100.0
2-4	90	100.0	0.0	100.0	100.0
8-10	5	57.9	2.5	53.0	62.8
8-10	10	69.4	1.9	65.7	73.1
8-10	15	78.9	1.5	76.0	81.8

Table XX. Cont'd

8-10	20	86.1	1.2	83.7	88.5
8-10	25	91.1	0.9	89.3	92.9
8-10	30	94.4	0.7	93.0	95.8
8-10	35	96.5	0.5	95.5	97.5
8-10	40	97.9	0.4	97.1	98.7
8-10	45	98.7	0.3	98.1	99.3
8-10	50	99.2	0.2	98.8	99.6
8-10	55	99.5	0.1	99.3	99.7
8-10	60	99.7	0.1	99.5	99.9
8-10	65	99.8	0.1	99.6	100.0
8-10	70	99.9	0.0	99.9	99.9
8-10	75	99.9	0.0	99.9	99.9
8-10	80	100.0	0.0	100.0	100.0
8-10	85	100.0	0.0	100.0	100.0
8-10	90	100.0	0.0	100.0	100.0
5-7	5	38.7	2.7	33.4	44.0
5-7	10	51.0	2.6	45.9	56.1
5-7	15	63.2	2.3	58.7	67.7
5-7	20	73.9	2.0	70.0	77.8
5-7	25	82.3	1.7	79.0	85.6
5-7	30	88.5	1.3	86.0	91.0
5-7	35	92.7	1.0	90.7	94.7
5-7	40	95.4	0.8	93.8	97.0
5-7	45	97.2	0.5	96.2	98.2
5-7	50	98.3	0.4	97.5	99.1
5-7	55	98.9	0.3	98.3	99.5
5-7	60	99.4	0.2	99.0	99.8
5-7	65	99.6	0.1	99.4	99.8
5-7	70	99.8	0.1	99.6	100.0
5-7	75	99.9	0.1	99.7	100.1
5-7	80	99.9	0.0	99.9	99.9
5-7	85	99.9	0.0	99.9	99.9
5-7	90	100.0	0.0	100.0	100.0

Table XXI.

Probability of a Car with at Least One Occupant @ MAIS 2+;
Results from Application of Algorithm for Planar Car Crashes

Direction of Force	DeltaV	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Lower	Upper
11-1	5	27.1	1.2	24.7	29.5
11-1	10	36.8	1.0	34.8	38.8
11-1	15	47.8	0.9	46.0	49.6
11-1	20	58.9	1.0	56.9	60.9
11-1	25	69.2	1.2	66.8	71.6
11-1	30	77.9	1.3	75.4	80.4
11-1	35	84.7	1.2	82.3	87.1
11-1	40	89.7	1.1	87.5	91.9
11-1	45	93.2	0.9	91.4	95.0
11-1	50	95.5	0.7	94.1	96.9
11-1	55	97.1	0.5	96.1	98.1
11-1	60	98.1	0.4	97.3	98.9
11-1	65	98.8	0.3	98.2	99.4
11-1	70	99.2	0.2	98.8	99.6
11-1	75	99.5	0.1	99.3	99.7
11-1	80	99.7	0.1	99.5	99.9
11-1	85	99.8	0.1	99.6	100.0
11-1	90	99.9	0.0	99.9	99.9
2-4	5	29.1	1.8	25.6	32.6
2-4	10	39.2	1.9	35.5	42.9
2-4	15	50.2	1.9	46.5	53.9
2-4	20	61.3	1.9	57.6	65.0
2-4	25	71.3	1.8	67.8	74.8
2-4	30	79.6	1.7	76.3	82.9
2-4	35	85.9	1.5	83.0	88.8
2-4	40	90.6	1.2	88.2	93.0
2-4	45	93.8	0.9	92.0	95.6
2-4	50	95.9	0.7	94.5	97.3
2-4	55	97.4	0.5	96.4	98.4
2-4	60	98.3	0.4	97.5	99.1
2-4	65	98.9	0.3	98.3	99.5
2-4	70	99.3	0.2	98.9	99.7
2-4	75	99.5	0.1	99.4	99.8
2-4	80	99.7	0.1	99.5	99.9
2-4	85	99.8	0.1	99.6	100.0
2-4	90	99.9	0.0	99.9	99.9
8-10	5	34.5	1.9	30.8	38.2
8-10	10	45.3	1.9	41.6	49.0
8-10	15	56.5	1.8	53.0	60.0

Table XXI. Cont'd

8-10	20	67.0	1.8	63.5	70.5
8-10	25	76.1	1.6	73.0	79.2
8-10	30	83.3	1.5	80.4	86.2
8-10	35	88.7	1.2	86.3	91.1
8-10	40	92.5	1.0	90.5	94.5
8-10	45	95.1	0.8	93.5	96.7
8-10	50	96.8	0.6	95.6	98.0
8-10	55	97.9	0.4	97.1	98.7
8-10	60	98.7	0.3	98.1	99.3
8-10	65	99.2	0.2	98.8	99.6
8-10	70	99.5	0.1	99.3	99.7
8-10	75	99.7	0.1	99.5	99.9
8-10	80	99.8	0.1	99.6	100.0
8-10	85	99.9	0.0	99.9	99.9
8-10	90	99.9	0.0	99.9	99.9
5-7	5	21.6	1.8	18.1	25.1
5-7	10	30.2	2.0	26.3	34.1
5-7	15	40.4	2.2	36.1	44.7
5-7	20	51.5	2.3	47.0	56.0
5-7	25	62.5	2.4	57.8	67.2
5-7	30	72.3	2.2	68.0	76.6
5-7	35	80.4	2.0	76.5	84.3
5-7	40	86.5	1.7	83.2	89.8
5-7	45	91.0	1.3	88.5	93.5
5-7	50	94.0	1.0	92.0	96.0
5-7	55	96.1	0.8	94.5	97.7
5-7	60	97.5	0.5	96.5	98.5
5-7	65	98.4	0.4	97.6	99.2
5-7	70	99.0	0.3	98.4	99.6
5-7	75	99.3	0.2	98.9	99.7
5-7	80	99.6	0.1	99.4	99.8
5-7	85	99.7	0.1	99.5	99.9
5-7	90	99.8	0.1	99.6	100.0

Table XXII.

Probability of a Car with at Least One Occupant @ MAIS 3+;
Results from Application of Algorithm for Planar Car Crashes

Direction of Force	DeltaV	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Lower	Upper
11-1	5	23.5	1.1	21.3	25.7
11-1	10	32.5	1.0	30.5	34.5
11-1	15	43.0	0.9	41.2	44.8
11-1	20	54.2	0.9	52.4	56.0
11-1	25	65.0	1.2	62.6	67.4
11-1	30	74.5	1.3	72.0	77.0
11-1	35	82.1	1.3	79.6	84.6
11-1	40	87.8	1.2	85.4	90.2
11-1	45	91.8	1.0	89.8	93.8
11-1	50	94.6	0.8	93.0	96.2
11-1	55	96.5	0.6	95.3	97.7
11-1	60	97.7	0.4	96.9	98.5
11-1	65	98.6	0.3	98.0	99.2
11-1	70	99.1	0.2	98.7	99.5
11-1	75	99.4	0.2	99.0	99.8
11-1	80	99.6	0.1	99.4	99.8
11-1	85	99.8	0.1	99.6	100.0
11-1	90	99.8	0.0	99.8	99.8
2-4	5	26.1	1.6	23.0	29.2
2-4	10	35.7	1.8	32.2	39.2
2-4	15	46.5	1.8	43.0	50.0
2-4	20	57.7	1.9	54.0	61.4
2-4	25	68.1	1.9	64.4	71.8
2-4	30	77.0	1.8	73.5	80.5
2-4	35	84.0	1.5	81.1	86.9
2-4	40	89.2	1.3	86.7	91.7
2-4	45	92.8	1.0	90.8	94.8
2-4	50	95.3	0.8	93.7	96.9
2-4	55	97.0	0.6	95.8	98.2
2-4	60	98.0	0.4	97.2	98.8
2-4	65	98.7	0.3	98.1	99.3
2-4	70	99.2	0.2	98.8	99.6
2-4	75	99.5	0.1	99.3	99.7
2-4	80	99.7	0.1	99.5	99.9
2-4	85	99.8	0.1	99.6	100.0
2-4	90	99.9	0.0	99.9	99.9
8-10	5	29.5	1.7	26.2	32.8
8-10	10	39.7	1.8	36.2	43.2
8-10	15	50.7	1.8	47.2	54.2

Table XXII. Cont'd

8-10	20	61.8	1.8	58.3	65.3
8-10	25	71.7	1.8	68.2	75.2
8-10	30	79.9	1.6	76.8	83.0
8-10	35	86.2	1.4	83.5	88.9
8-10	40	90.7	1.1	88.5	92.9
8-10	45	93.9	0.9	92.1	95.7
8-10	50	96.0	0.7	94.6	97.4
8-10	55	97.4	0.5	96.4	98.4
8-10	60	98.3	0.3	97.7	98.9
8-10	65	98.9	0.2	98.5	99.3
8-10	70	99.3	0.2	98.9	99.7
8-10	75	99.6	0.1	99.4	99.8
8-10	80	99.7	0.1	99.5	99.9
8-10	85	99.8	0.1	99.6	99.9
8-10	90	99.9	0.0	99.9	99.9
5-7	5	18.2	1.5	15.3	21.1
5-7	10	25.9	1.8	22.4	29.4
5-7	15	35.4	2.0	31.5	39.3
5-7	20	46.3	2.3	41.8	50.8
5-7	25	57.4	2.4	52.7	62.1
5-7	30	67.9	2.3	63.4	72.4
5-7	35	76.9	2.1	72.8	81.0
5-7	40	83.9	1.8	80.4	87.4
5-7	45	89.1	1.5	86.2	92.0
5-7	50	92.8	1.1	90.6	95.0
5-7	55	95.3	0.9	93.5	97.1
5-7	60	96.9	0.6	95.7	98.1
5-7	65	98.0	0.4	97.2	98.8
5-7	70	98.7	0.3	98.1	99.3
5-7	75	99.2	0.2	98.8	99.6
5-7	80	99.5	0.2	99.1	99.9
5-7	85	99.7	0.1	99.5	99.9
5-7	90	99.8	0.1	99.6	100.0

Table XXIII.

Probability of a Car with at Least One Fatality;
Results from Application of Algorithm for Planar Car Crashes

Direction of Force	DeltaV	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Lower	Upper
11-1	5	0.1	0.0	0.1	0.1
11-1	10	0.2	0.0	0.2	0.2
11-1	15	0.3	0.0	0.3	0.3
11-1	20	0.5	0.1	0.3	0.7
11-1	25	1.0	0.1	0.8	1.2
11-1	30	1.8	0.2	1.4	2.2
11-1	35	3.2	0.3	2.6	3.8
11-1	40	5.7	0.6	4.5	6.9
11-1	45	9.9	1.1	7.7	12.1
11-1	50	16.7	1.9	13.0	20.4
11-1	55	26.7	3.1	20.6	32.8
11-1	60	39.9	4.3	31.5	48.3
11-1	65	54.7	5.0	44.9	64.5
11-1	70	68.8	4.8	59.4	78.2
11-1	75	80.1	3.9	72.5	87.7
11-1	80	88.0	2.8	82.5	93.5
11-1	85	93.0	1.9	89.3	96.7
11-1	90	96.0	1.2	93.6	98.4
2-4	5	0.2	0.0	0.2	0.2
2-4	10	0.4	0.1	0.2	0.6
2-4	15	0.8	0.1	0.6	1.0
2-4	20	1.4	0.3	0.8	2.0
2-4	25	2.6	0.5	1.6	3.6
2-4	30	4.7	0.8	3.1	6.3
2-4	35	8.2	1.4	5.5	10.9
2-4	40	13.9	2.4	9.2	18.6
2-4	45	22.8	3.8	15.4	30.2
2-4	50	35.0	5.2	24.8	45.2
2-4	55	49.5	6.2	37.3	61.7
2-4	60	64.1	6.1	52.1	76.1
2-4	65	76.5	5.1	66.5	86.5
2-4	70	85.6	3.8	78.2	93.0
2-4	75	91.5	2.5	86.6	96.4
2-4	80	95.2	1.6	92.1	98.3
2-4	85	97.3	1.0	95.3	99.3
2-4	90	98.5	0.6	97.3	99.7
8-10	5	0.3	0.1	0.1	0.5
8-10	10	0.5	0.1	0.3	0.7
8-10	15	1.0	0.2	0.6	1.4

Table XXIII. Cont'd

8-10	20	1.7	0.3	1.1	2.3
8-10	25	3.1	0.5	2.1	4.1
8-10	30	5.5	0.9	3.7	7.3
8-10	35	9.6	1.5	6.7	12.5
8-10	40	16.2	2.5	11.3	21.1
8-10	45	26.1	3.9	18.5	33.7
8-10	50	39.2	5.2	29.0	49.4
8-10	55	54.0	5.8	42.6	65.4
8-10	60	68.1	5.5	57.3	78.9
8-10	65	79.6	4.5	70.8	88.4
8-10	70	87.7	3.2	81.4	94.0
8-10	75	92.8	2.1	88.7	96.9
8-10	80	95.9	1.3	93.4	98.4
8-10	85	97.7	0.8	96.1	99.3
8-10	90	98.7	0.5	97.7	99.7
5-7	5	0.0	0.0	0.0	0.0
5-7	10	0.0	0.0	0.0	0.0
5-7	15	0.0	0.0	0.0	0.0
5-7	20	0.1	0.0	0.1	0.1
5-7	25	0.1	0.1	0.0	0.3
5-7	30	0.3	0.1	0.1	0.5
5-7	35	0.5	0.2	0.1	0.9
5-7	40	0.9	0.3	0.3	1.5
5-7	45	1.6	0.6	0.4	2.8
5-7	50	2.8	1.1	0.6	5.0
5-7	55	5.0	1.9	1.3	8.7
5-7	60	8.7	3.3	2.2	15.2
5-7	65	14.8	5.4	4.2	25.4
5-7	70	24.0	8.0	8.3	39.7
5-7	75	36.6	10.3	16.4	56.8
5-7	80	51.2	11.4	28.9	73.5
5-7	85	65.7	10.6	44.9	86.5
5-7	90	77.7	8.4	61.2	94.2

Table XXIV.

Probability of a Car with at Least One Occupant @ Shown Outcome Severity; Results from Application of Algorithm versus Rollover

Rollover	Max Outcome Severity	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Lower	Upper
No	MAIS 1+	63.2	0.4	64.0	62.4
Yes	MAIS 1+	81.6	1.2	84.0	79.2
No	MAIS 2+	46.5	0.4	47.3	45.7
Yes	MAIS 2+	64.8	1.4	67.5	62.1
No	MAIS 3+	41.6	0.4	42.4	40.8
Yes	MAIS 3+	60.8	1.4	63.5	58.1
No	Fatality	1.0	0.0	1.0	1.0
Yes	Fatality	4.3	0.3	4.9	3.7

Table XXV.

Probability of a Car with at Least One Occupant @ MAIS 1+ Outcome Severity; Results from Application of Algorithm of MAIS 1+ versus Rollover and Travel Speed

Rollover	Travel Speed mph	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Upper	Lower
No	10	65.7	1.0	67.7	63.7
No	20	67.9	0.8	69.5	66.3
No	30	70.1	0.7	71.5	68.7
No	40	72.1	0.7	73.5	70.7
No	50	74.1	0.8	75.7	72.5
No	60	76.0	1.0	78.0	74.0
No	70	77.7	1.1	79.9	75.5
No	80	79.4	1.3	81.9	76.9
No	90	81.0	1.4	83.7	78.3
Yes	10	83.2	2.1	87.3	79.1
Yes	20	84.6	1.9	88.3	80.9
Yes	30	85.8	1.7	89.1	82.5
Yes	40	87.0	1.6	90.1	83.9
Yes	50	88.1	1.5	91.0	85.2
Yes	60	89.1	1.3	91.6	86.6
Yes	70	90.0	1.3	92.5	87.5
Yes	80	90.9	1.2	93.3	88.5
Yes	90	91.7	1.1	93.9	89.5

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Table XXVI.

Probability of a Car with at Least One Occupant @ MAIS 2+ Outcome Severity; Results from Application of Algorithm of MAIS 2+ versus Rollover and Travel Speed

Rollover	Travel Speed mph	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Upper	Lower
No	10	48.5	1.0	50.5	46.5
No	20	51.0	0.8	52.6	49.4
No	30	53.5	0.8	55.1	51.9
No	40	56.0	0.8	57.6	54.4
No	50	58.4	0.9	60.2	56.6
No	60	60.8	1.1	63.0	58.6
No	70	63.2	1.3	65.7	60.7
No	80	65.5	1.6	68.6	62.4
No	90	67.7	1.8	71.2	64.2
Yes	10	62.5	2.8	68.0	57.0
Yes	20	64.8	2.6	69.9	59.7
Yes	30	67.0	2.4	71.7	62.3
Yes	40	69.2	2.2	73.5	64.9
Yes	50	71.3	2.1	75.4	67.2
Yes	60	73.3	2.0	77.2	69.4
Yes	70	75.2	1.9	78.9	71.5
Yes	80	77.0	1.9	80.7	73.3
Yes	90	78.8	1.9	82.5	75.1

Table XXVII.

Probability of a Car with at Least One Occupant @ MAIS 3+ Outcome Severity; Results from Application of Algorithm of MAIS 3+ versus Rollover and Travel Speed

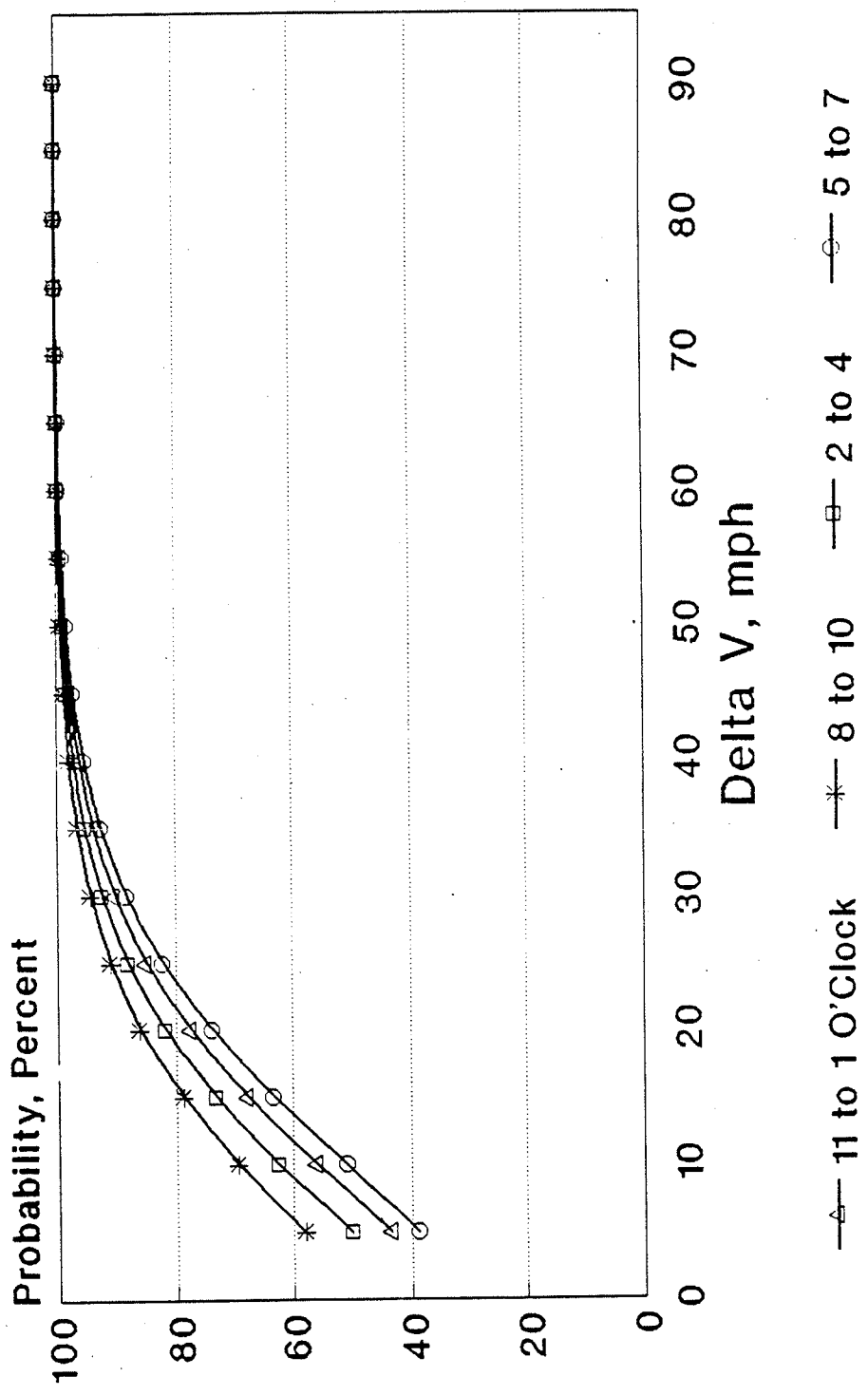
Rollover	Travel Speed mph	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Upper	Lower
No	10	41.8	1.0	43.8	39.8
No	20	44.3	0.8	45.9	42.7
No	30	46.8	0.7	48.2	45.4
No	40	49.3	0.8	50.9	47.7
No	50	51.7	0.9	53.5	49.9
No	60	54.2	1.1	56.4	52.0
No	70	56.7	1.4	59.4	54.0
No	80	59.1	1.6	62.2	56.0
No	90	61.5	1.8	65.0	58.0
Yes	10	57.2	2.7	62.5	51.9
Yes	20	59.6	2.5	64.5	54.7
Yes	30	62.0	2.4	66.7	57.3
Yes	40	64.3	2.2	68.6	60.0
Yes	50	66.6	2.1	70.7	62.5
Yes	60	68.8	2.1	72.9	64.7
Yes	70	70.9	2.0	74.8	67.0
Yes	80	72.9	2.0	76.8	69.0
Yes	90	74.8	2.0	78.7	70.9

Table XXVIII.

Probability of a Car with at Least One Occupant @ Fatal Outcome Severity; Results from Application of Algorithm of Fatality versus Rollover and Travel Speed

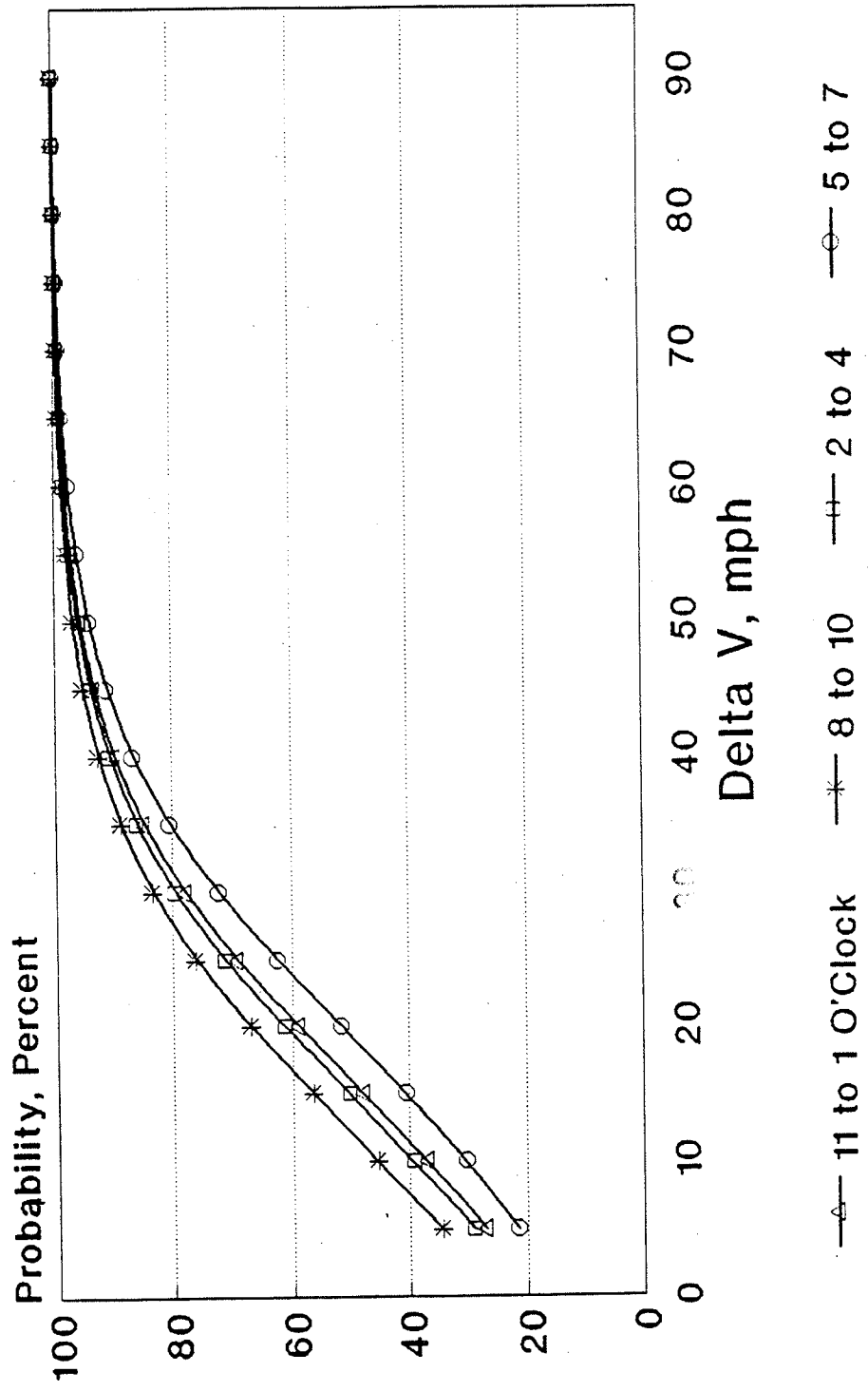
Rollover	Travel Speed mph	Probab. & Std Err		95% Confid. Bounds	
		P	seP	Upper	Lower
No	10	0.6	0.1	0.8	0.4
No	20	0.8	0.1	1.0	0.6
No	30	1.1	0.1	1.3	0.9
No	40	1.5	0.1	1.7	1.3
No	50	2.0	0.1	2.2	1.8
No	60	2.7	0.2	3.1	2.3
No	70	3.6	0.4	4.4	2.8
No	80	4.8	0.6	6.0	3.6
No	90	6.4	0.9	8.2	4.6
Yes	10	1.3	0.2	1.7	0.9
Yes	20	1.8	0.3	2.4	1.2
Yes	30	2.4	0.3	3.0	1.8
Yes	40	3.2	0.4	4.0	2.4
Yes	50	4.2	0.5	5.2	3.2
Yes	60	5.6	0.6	6.8	4.4
Yes	70	7.4	0.8	9.0	5.8
Yes	80	9.8	1.1	12.0	7.6
Yes	90	12.8	1.5	15.7	9.9

Fig. 56. Probability of a Towaway Car with at Least One Occupant Incurring an Injury @ MAIS 1+ in Shown Planar Crashes



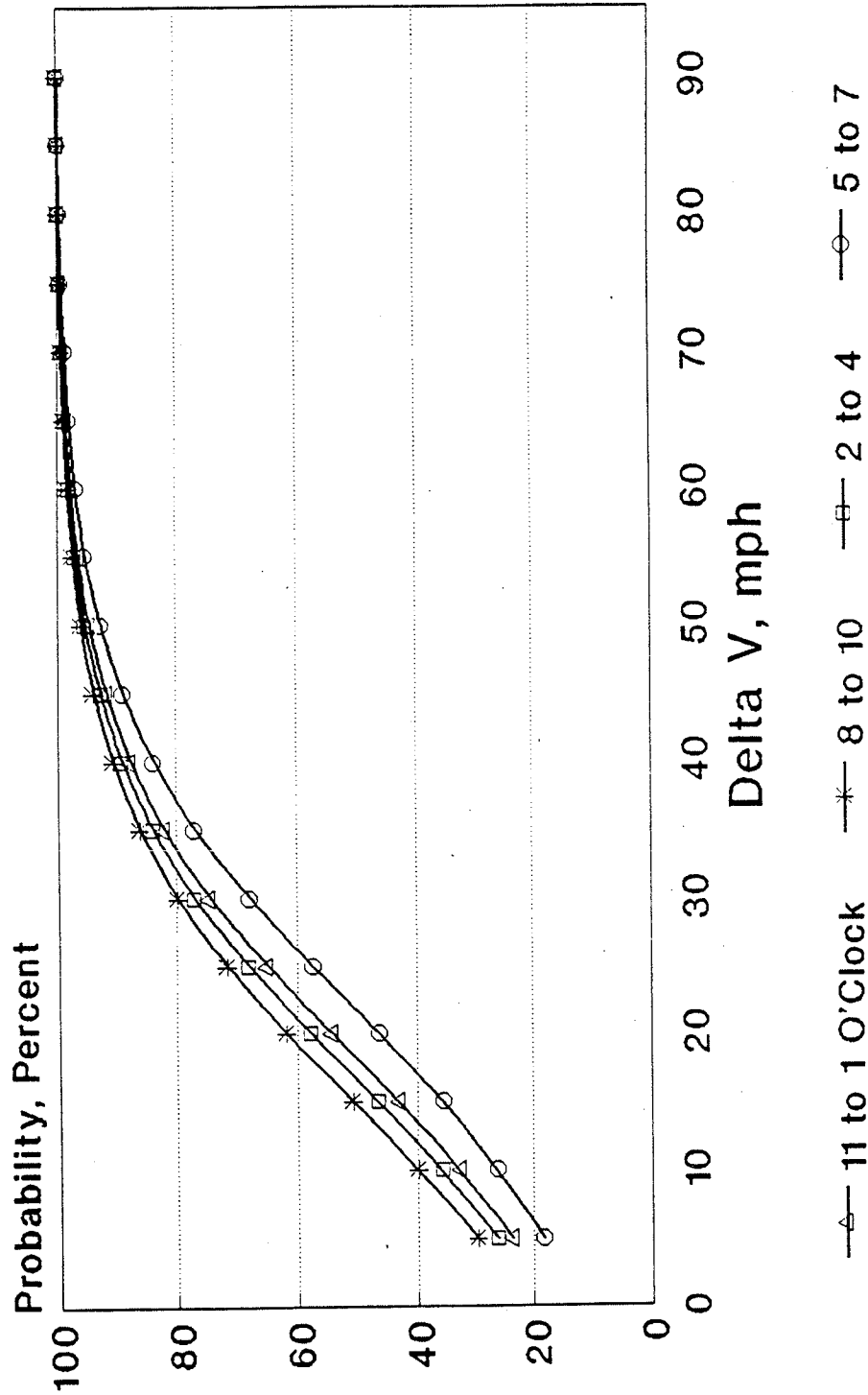
The NASS/CDS 1988-1995

Fig. 57. Probability of a Towaway Car
with at Least One Occupant Incurring an
Injury @ MAIS 2+ in Shown Planar Crashes



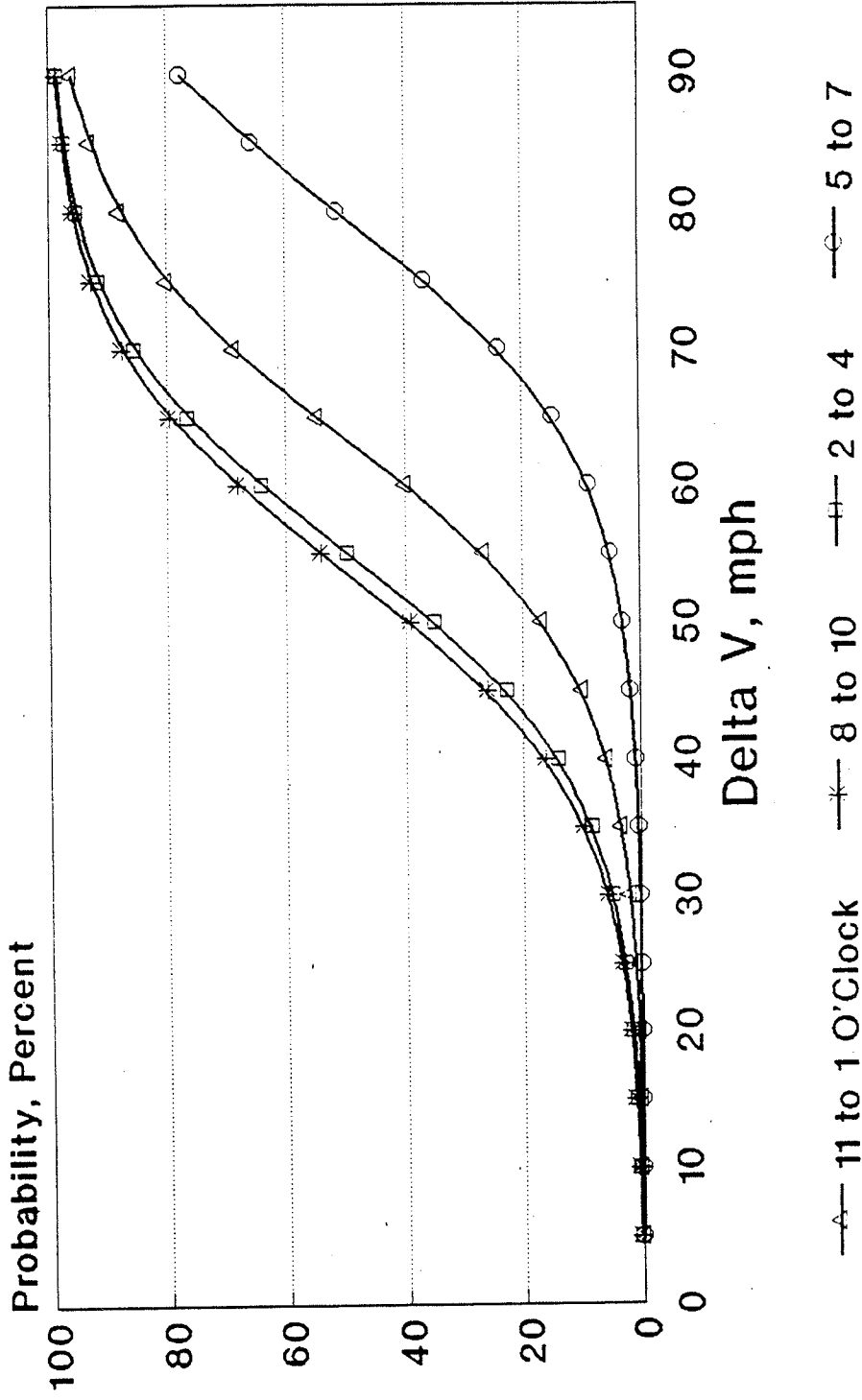
The NASS/CDS 1988-1995

Fig. 58. Probability of a Towaway Car
with at Least One Occupant Incurring an
Injury @ MAIS 3+ in Shown Planar Crashes



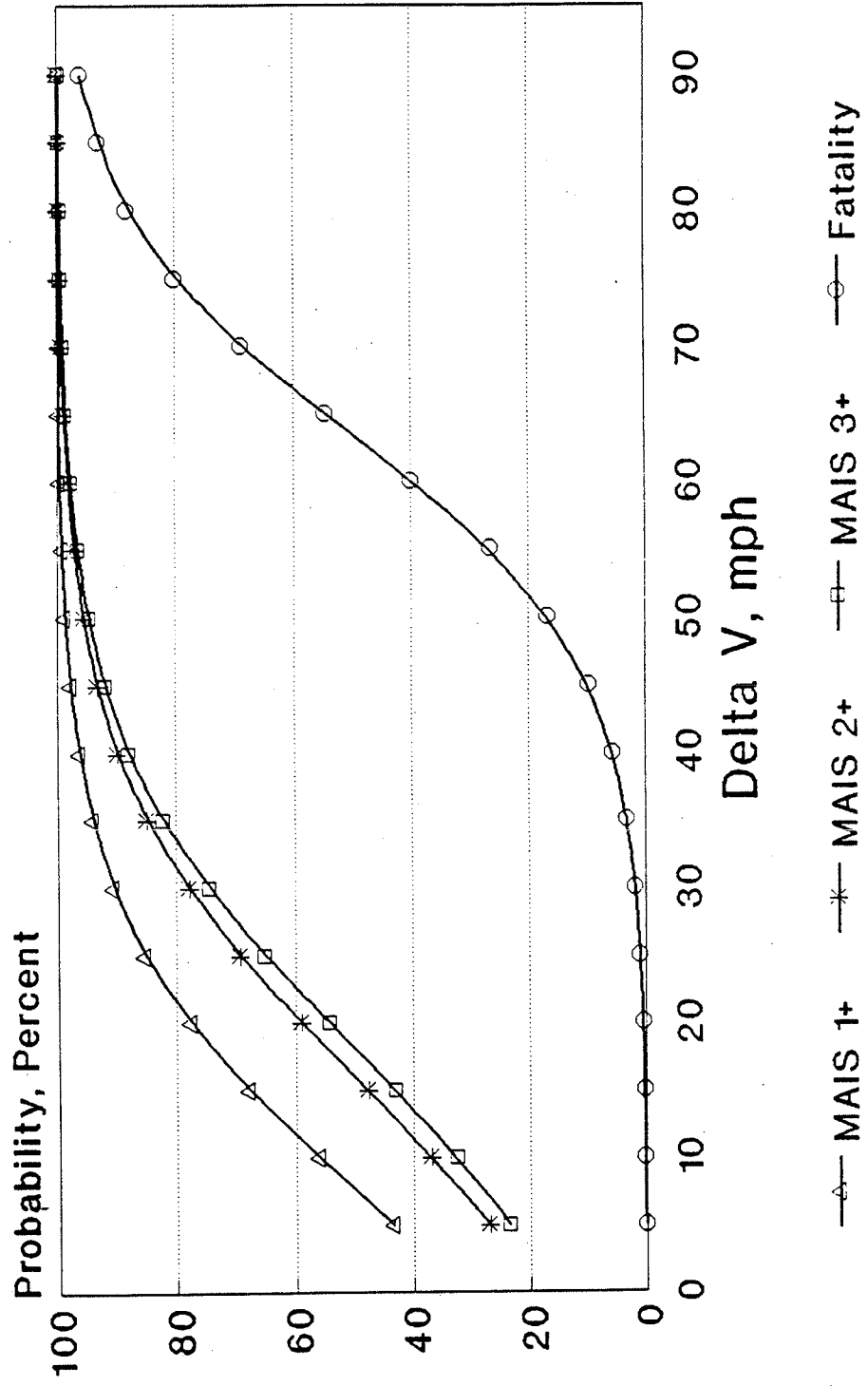
The NASS/CDS 1988-1995

Fig. 59. Probability of a Towaway Car with at Least One Occupant Fatality in Shown Planar Crashes



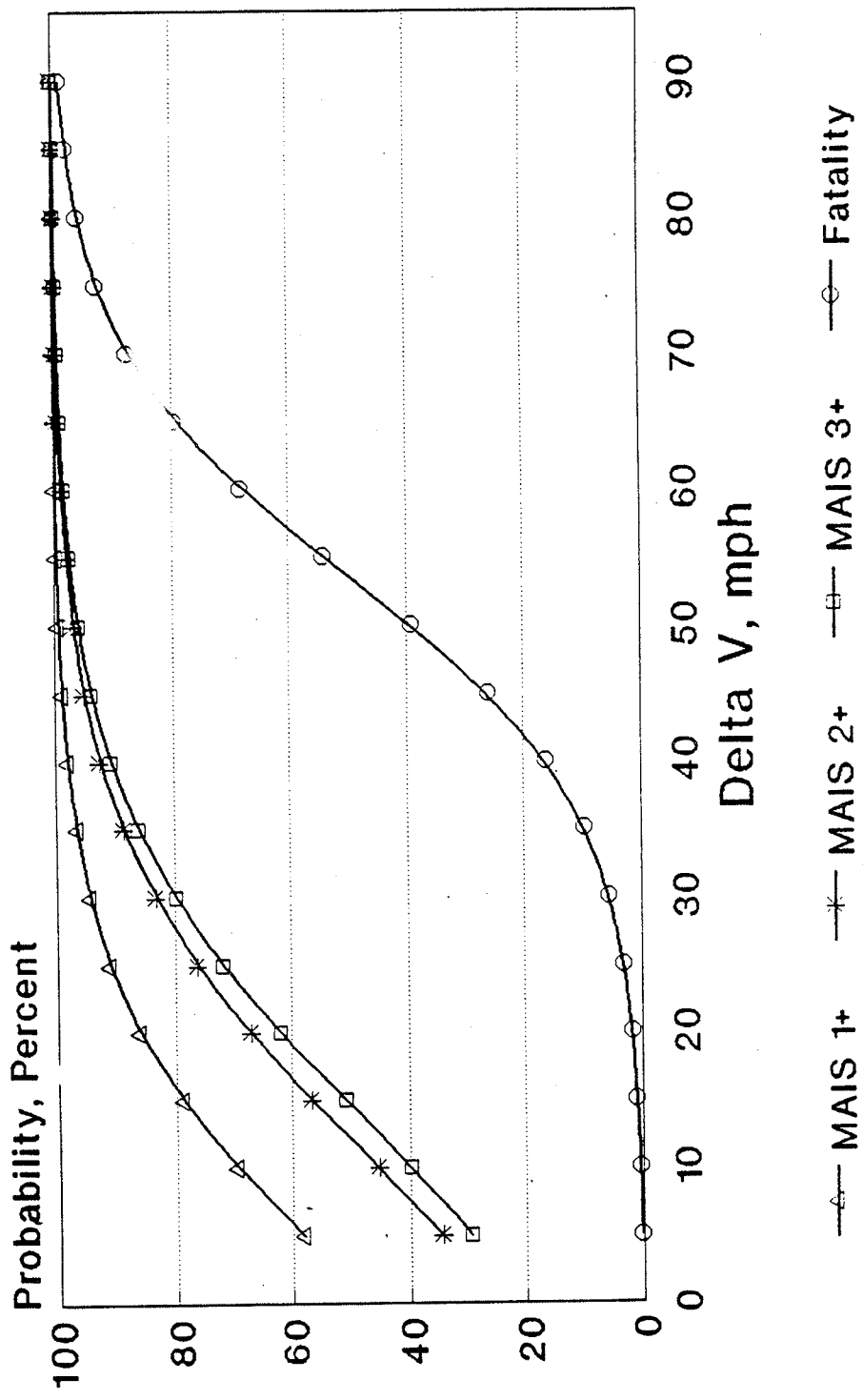
The NASS/CDS 1988-1995

Fig. 60. Probability of a Towaway Car with at Least One Occupant at Shown Max Outcome Severity, in 11-1 Planar Crashes



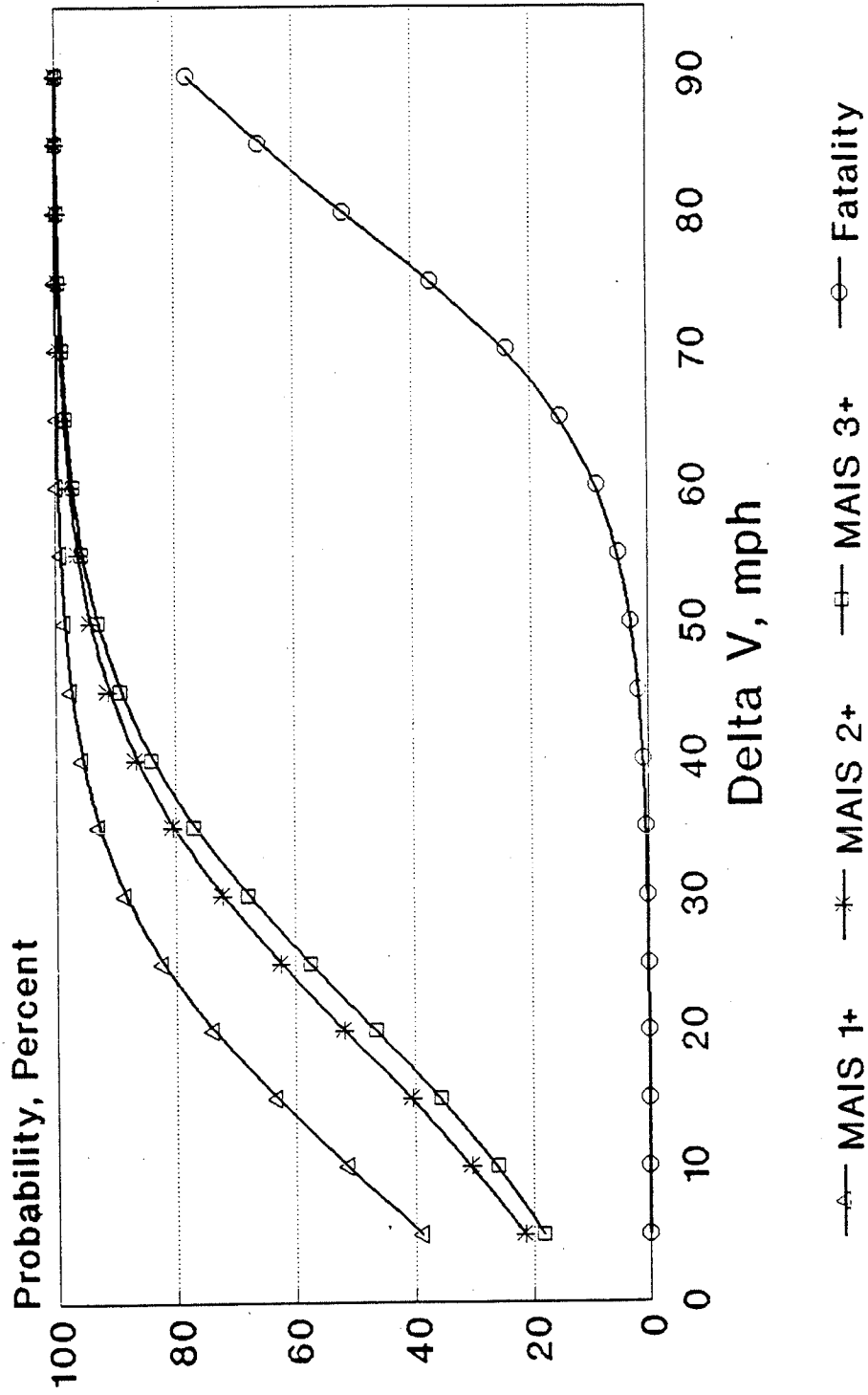
The NASS/CDS 1988-1995

Fig. 61. Probability of a Towaway Car with at Least One Occupant at Shown Max Outcome Severity, in 8-10 Planar Crashes



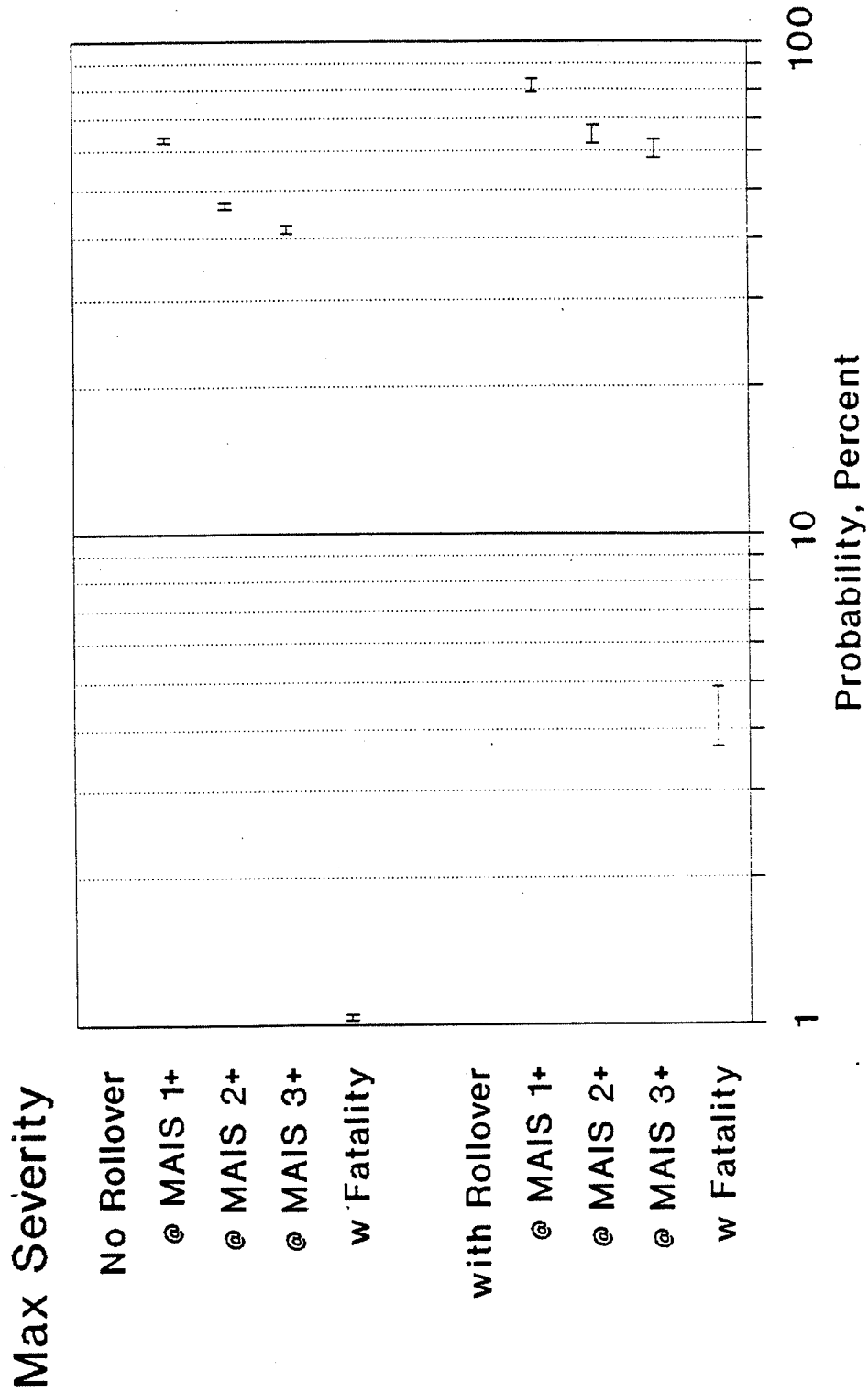
The NASS/CDS 1988-1995

Fig. 62. Probability of a Towaway Car with at Least One Occupant at Shown Max Outcome Severity, in 5-7 Planar Crashes



The NASS/CDS 1988-1995

Fig. 63. 95% Confidence Bounds of Probability for a Car with at Least One Occupant @ Shown Max Outcome Severity



The NASS/CDS 1988-1995

Fig. 64. Probability of a Towaway Car with at Least One Occupant at Shown Max Outcome Severity, v. R/O & Travel Speed

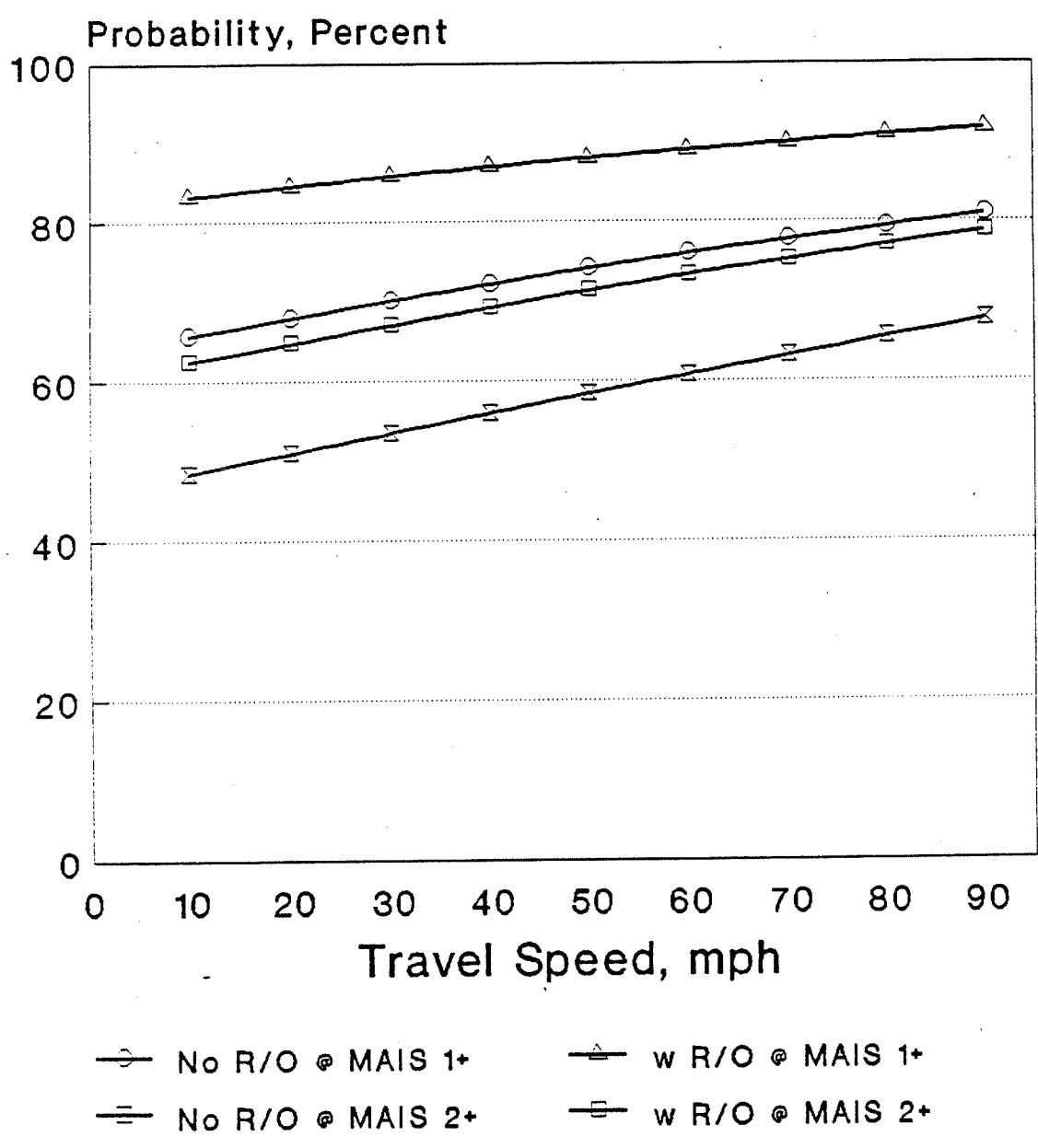


Fig. 65. Probability of a Towaway Car with at Least One Occupant at Shown Max Outcome Severity, v. R/O & Travel Speed

